ANNUAL REPORT

of the Plant Sciences Branch, Royal Botanic Gardens and Domain Trust

2002–2003

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

PLANTS = LIFE

Royal Botanic Gardens & Domain Trust

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Plant Sciences Branch

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

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

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

www.rbgsyd.nsw.gov.au

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Contents

Highlights of the Year

- Second 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 55 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 $1.4 million is just under last year's record level ($1.5 million), and with a greater proportion of the funding directed to the Trust.
- Maintenance of diverse and high quality research programs, with nearly 70 publications for scientific audiences. Significant projects initiated during the year include: an evolutionary study of the families Elaeocarpaceae (predominantly rainforest trees) and Tremandraceae (dry-adapted shrubs) in Australia, relationships in the liverwort family Lepidoziaceae, propagation of high-altitude orchids from New Guinea, diagnosis and control of diseases of cloves and vanilla in Indonesia, and interactive keys to rainforest trees in New Guinea and freshwater algae in NSW.
- Continued leadership role in the NSW Biodiversity Strategy, including key committee contributions and significant funded projects
- Series of workshops organised by Centre for Plant Conservation in collaboration with Australian Network for Plant Conservation and Australian Association of Bush Regenerators.
- Establishment of an exhibition series in the Atrium area of the Brown Building, including The Forgotten Flora and Fascinating Fungi.
- Recognition and celebration of our role in biodiversity research through the sponsorship of our second Eureka Prize (awarded to Dr Bob Pressey, NSW National Parks & Wildlife Service).
- Successful negotiations with Royal Botanic Gardens Kew (UK) to establish a partnership with the Millenium Seed Bank, resulting in expansion of the NSW Seedbank and associated research.
- Introduction of a new library management system, 'Horizons'.
- Only one (single-day) Lost-Time Injury for the Branch, and Safe Work Statements prepared for laboratory facilities and field work.

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 will be 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

Program Reviews and Planning

The rolling review of programs continued in 2002/03 with a presentation on the **Conservation Horticulture of Australian Plants Theme** to the Scientific Committee of the Trust. This long-standing Trust program seeks to assist biodiversity conservation and the horticultural industry through investigating the biology of Australian plants. Current strengths are: strategies for reproduction in the wild and in cultivation, cultivation generally, and seed storage.

New directions identified include:

- Strengthening the seed biology sub-program, with a focus on understanding threatened species regeneration strategies *in situ* as well as *ex situ* especially with regard to conservation of endangered ecological communities.
  This will be achieved by:
  - forging better links with *in situ* conservation and restoration efforts with the National Parks and Wildlife Service, Greening Australia and other restoration groups;
  - supporting the NSW Seedbank and Trust *ex situ* conservation objectives, particularly by forging stronger links with other seed biology research groups, especially through the Millennium Seedbank germplasm conservation program and associated research and,
  - exploring the potential of the program to incorporate research on environmental problems such as salinity and fire management.
- Greater emphasis on conservation outcomes for the 'mainstream' horticulture programs within the theme, for example:
  - exploring the potential of non-weedy *Swainsona* species for horticulture;
  - collaborating with NSW Agriculture and the University of Sydney to further increase the horticultural use of Flannel Flowers as a cut flower crop; and,
  - ensuring the scientific integrity of the worldwide Wollemi Pine release in 2005/6 by providing horticultural information generated through scientific research e.g. nutritional requirements of potted plants.

Two whole-day seminar days, in July and August, allowed staff to share ideas and inform each other about programs and projects within the Branch. In 2003/04, students and honorary research associates will be invited to deliver similar presentations in 2–3 seminar days. These are in addition to our regular lunch-time seminar series.

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 on 13 August, in Sydney. Nearly 700 scientists, science journalists, politicians and 'celebrities' were present when Director Frank Howarth awarded our second Eureka Prize, sponsored by the Friends of the Gardens, to Dr Bob Pressey from the National Parks and Wildlife Service, for innovative research that has revolutionised the planning of new reserves for biodiversity conservation. 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). The other three finalists were: Australian Biological Resources Study & Bruce Maslin, Western Australian Herbarium; Professor Roger Kitching, Australian School of Environmental Studies, Griffith University; and Threatened Mammal Research Team, CSIRO Sustainable Ecosystems, Wembley WA.

Science Week

This year's contribution from the Plant Sciences Branch was limited due to resourcing constraints, however, our 'mini' Open Day focusing on the Volunteer Herbarium Mounting Program was well received. It also included Banks and Solander specimens displayed alongside matching *Florilegium* plates; the bryophyte exhibition; botanical collecting techniques; the NSW Collections database; and various science publications.

Conference Hosting

No conferences were hosted during 2002/03, a welcome break after a heavy conference program in the previous financial year. 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', to be held at our Sydney site in July 2003.

Teaching

The number of students supervised continues to increase – 55 compared with 48 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. Preparations were made for the first residential school in Sydney to be held at the Trust and the Australian Museum in July 2003.

Honorary research associates

Leading fungal specialist, Professor John Leslie, was appointed as a new Honorary Research Associate in February 2003. The following Honorary Research Associates' terms were renewed during 2002/03: Dr Alan Archer, Dr Helen Ramsay, Joy Thompson, Professor John Thomson (July 2002), Professor Peter Bernhardt, Don Blaxell, Michael Dingley and Dr Peter Michael (October 2002), Dr Barbara Briggs, Professor David Mabberley, Dr Bettye Rees and Geoff Sainty (February 2003), Professor Carrick Chambers (June 2003). The 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 2002–03, the Trust hosted Kate Hughes, its second Cosh Summer Student. 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. The project is reported on under the Flora of Australia Theme below.

Scientific Committee of the Trust

Dr Patricia Selkirk (Macquarie University) resigned from the Scientific Committee of the Trust and is to be replaced (in July 2003) by Professor Daniella Tilbury (Macquarie University). The other 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 (National Parks and Wildlife Service).

The committee met three times during 2002/03, having decided to reduce the frequency of meetings from four to three times a year to coincide better with the Trust meetings. Through the provision of general advice and feedback, and the review of scientific projects and programs, the committee continued to have an important role in the management of the Plant Science Program.

Part 3: Conservation and Horticultural Section

Research Section

This section brings together broad expertise in ecology, 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. 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 has two driving forces. Firstly, the need to provide horticultural solutions to conservation problems. Secondly, a desire to increase the number and variety of species available in horticulture.

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. The Plant Disease Diagnostic Unit complements services provided by the NSW Department of Agriculture by focussing on pests and diseases of ornamental plants. It also plays an important role in the Trust's integrated pest management programs.

New South Wales Vegetation Theme

Aquatic vascular plants

Dr Surrey Jacobs continued his study on macrophytes as a tool to assess wetland 'health', with further sampling of the Snowy River and the continuation of student Joanne Ling, who is comparing different assessment techniques and examining the effects of errors in sampling and identification. Joanne Ling completed most of her field work and analysis, and is now preparing her thesis.

Classification and status assessment of the vegetation of NSW

Ecologist John Benson continues to develop the NSW Vegetation Classification and Assessment database, an authoritative account of the vegetation of the State. The database now has 80 fields covering 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, photographs and a general description. Over 200 plant communities, mostly from the western half of NSW, are recorded in the database. Two publications are in preparation: a paper describing the project, the fields in the database and the threat categories and criteria, and a second (c. 500 pages in hard copy) with detailed descriptions of the plant communities in the Western Plains of NSW. This year additional communities were added, existing records enhanced, and photographs taken.

Following is an edited example ['…[etc.]' indicates omitted texts] of an output from this database:

ID Number	**71 Carbeen Woodland (Draft August 2003 – edited to reduce size)**
Original Data Entry	John Benson
Data Entry Date	30/12/2003
Formations	Eucalyptus Communities of the Tropics (including Carbeen, and Inland Bloodwood alliances)
State Vegetation Map (Keith 2003)	107. Northwest alluvial sands woodlands
State Landscapes (Mitchell 2003)	
NVIS Map Code	NA
Forest Type (RN 17)	190 — White Cypress Pine-Brown Bloodwood (P) ;
Scientific Name	*Corymbia tessellaris — Corymbia dolichocarpa — Callitris glaucophylla / Geijera parviflora* — Alstonia constricta type form — *Acacia ligulata* — …[etc.]
Common Name	Carbeen woodland on sandy rises of the Darling Riverine Plains Bioregion
Characteristic Trees	*Corymbia tessellaris; Corymbia dolichocarpa; Callitris glaucophylla; Eucalyptus populnea* subsp. *bimbil*; *Eucalyptus chloroclada*; *Casuarina cristata; Allocasuarina luehmannii; Atalaya hemiglauca*
Characteristic Shrubs/ Vines/Epiphytes	*Geijera parviflora; Alstonia constricta Type form; Acacia ligulata; Acacia salicina; Eremophila mitchellii; Petalstigama pubescens* ;…[etc.]
Characteristic Groundcover	*Einadia nutans subsp. linifolia; Sclerolaena birchii; Aristida calycina; Austrostipa scabra* subsp *scabra; Abutilon oxycarpum;* …[etc.]
Characteristic Weed Species	*Cenchrus longispinus; Lycium ferocissimum; Rapistrum rugosum; Opuntia stricta* var. *stricta; Medicago polymorpha*
Threatened Plants	Not assessed
Threatened Fauna	Not assessed
Mean Native Species Richness	Not assessed
Characteristic Qualifiers	Quantitative Data
Authority(s)	Equivalent to map unit R8 in Sivertsen and Metcalfe (2001). Described for west of the Gwydir Watercourse in McCosker and Duggin (1993). Mapped at 1:100000 scale by Sawtell and Miller (2001)…[etc.]
Authority Qualifiers	Quantitative Data
Interstate Equivalents	Probably allied to regional ecosystem 11.3.19 in Sattler and Williams (1999) in Queensland.
Class. Confidence Level	High
Level of Classification	Association
Rainforest Structure (Webb)	Not applicable
Structure (WH)	Woodland; Open Forest
Height Class (WH)	Tall; Mid-High;
Vegetation Description	Mid-high to tall woodland or open forest composed of Carbeen (*Corymbia tessellaris*) often with Long-fruited Bloodwood (*Eucalyptus dolichocarpa*) and White Cypress Pine (*Callitris glaucophylla*)…[etc.]
Mapped/Modeled	Current extent mapped
Mapping Info	Mapped as map unit R8 by Sivertsen and Metcalfe (2001). More detailed mapping is by Peasely (2001), Sawtell (2000) and Sawtell and Miller (2001). Some small areas may not have been mapped. Not adequately plot-sampled in its western occurrences as of 2002.
Adeq Of Plot Sampling	Inadequately Sampled
Climate Zone	Dry subtropical: moderately dry winter; Semi-arid: hot;
IBRA	Darling Riverine Plains (>70%) ; Brigalow Belt South (1–30%) ;
IBRA Sub-Region	Castlereagh-Barwon (30–70%) ; Collarenabri Interfluve (1–30%) ; Warrambool-Moonie (1–30%) ; Northern Outwash (1–30%) ;

Botanical Division	North Western Plains (NWP) (>70%) ;
Local Govt. Area	Walgett (30 –70%) ; Moree Plains (30–70%) ; Brewarrina (1–30%) ;
Catchment Management Authority	Border Rivers (30–70%) ; Gwydir (1– 30%) ;
Reg Veg. Man. Plans	Walgett (30–70%) ; Moree (30 – 70%) ; Brewarrina (1– 30%) ;
Substrate Mass	Eolian sand; Eolian sediment;
Lithology	Aeolian sand or loam; Alluvial sand;
Great Soil Group	Earthy sand;
Soil Texture	Clay loam, sandy; Loamy sand; Sand;
Landform Patterns	Alluvial plain;
Landform Elements	Plain; Prior stream;
Land Use	Cropping and Horticulture; Grazing; Nature Conservation;
Impacts Euro settlement	Major alteration of species composition; Major reduction (>70%) in extent and /or range;
Pre-European Extent (ha)	18500
Pre-European Accuracy	+/- 10% accuracy
Pre-European Qualifiers	Estimated from extant vegetation maps: full range
Pre-European Comments	This community occurs on sand lenses that are restricted in extent so in NSW it would always have been a restricted in extent. White (2002a) map 15473 ha as the pre-European extent of this community for the Moree Plains Shire…[etc.]
Current Extent (ha)	4496
Current Extent Accuracy	+/- 10% accuracy
Current Extent Qualifiers	Measured from map of extant vegetation
Current Extent Comments	Peasley (2001) maps 1360 ha of Carbeen communities in the Moree Plains Shire in the NSW Central Division indicating that most of it has been cleared in this region (reduced from an estimated 15473 ha, White 2002a)…[etc.]
Percent Remaining	24
Percent Remaining Accuracy	+/- 10% accuracy
Degree of Fragmentation	Human induced highly fragmented small stands with <30% extent remaining and high edge to area ratio
Recoverability	Moderate health as structure and/or composition altered. Likely to recover considerably if causal factors and secondary impacts removed.
Weediness	Medium (5-15%) with < 10% cover
Threatening Processes	Clearing for grazing or marginal cropping, grazing by stock (sheep have been seen grazing nature reserves), timber extraction. Weeds including…[etc.]
Threatening Process Lookup	Clearing for agriculture; Unsustainable grazing and trampling by stock; Unsustainable grazing by feral animals; Weed (exotic) invasion;
Disturbance and Successional Stages	Cypress pine regrowth may be occurring where logging has occurred in the past.
Adjoining Communities	Grades into River Red Gum, Dirty Gum (ID 206), White Cypress Pine and Poplar Box plant communities on different soils adjoining the sand lenses.
Fire Regime	Unknown - isolated patches now preclude extensive wildfires. Some understorey species may be susceptible to too frequent fire.
Conservation Reserves	Boomi NR 49 (M) ; Boomi West NR 30 (M) ; Boronga NR 40 (M) ;
Total Area Reserved	119
No of Reps in Reserves	3
Explanation of Reserved Areas	Boomi NR, Boomi West NR and Buronga NR measured from Peasely (2001) and cross checked with earlier NPWS site estimates. including Auld (1981) and Porter (1971). Sivertsen et al. (2000) mapped…[etc.]
PA or VCA's	
Total Area in PA and VCA's	0
No of Reps in PA/VCA	0
Total Area Protected	119

Area Protected Accuracy	+/- 10% accuracy
Protected Current Extent %	2.64
Total Reps in Protected Area	3
Protected Pre Euro Extent	0.64
Common (>10000 ha in 1750)	5-15% conserved (moderately conserved)
Common Qualifiers	Inadequately across distribution
Restricted (>1000<10000 ha in 1750)	
Restricted Qualifiers	
Rare (<1000 ha in 1750)	
Rare Qualifiers	
Key Sites for Protection	Small stands protected in nature reserves. Areas are mapped in the wheatbelt and Western Division. Some of these areas should be protected under property agreements or in reserves.
Threat Category	Endangered
Threat/Protection Area Code	E/5a
Threat Criteria	4; 5; 1;
Planning Controls	Other
Planning and Management	Requires protection from clearing and overgrazing in Moree Plains, Walgett and Brewarrina regional vegetation management plans. Property agreements and/or nature reserves should be persued to protect more areas.
Listed Under Legislation	Listed TSCA (*NSW Threatened Species Conservation Act*);
Recovery Plan No	-1
Recovery Plan Yes	0
Recovery Plan	Required
Photos 1-3 & Captions	
References	Sivertsen, D. & Metcalfe, L. (2001) Northern NSW wheatbelt vegetation mapping. Unpublished vegetation maps and descriptions (NSW NPWS: Hurstville); Sattler, P.S. & Williams, R.D. (eds)(1999) The Conservation Status of Queensland's Bioregional Ecosystems (Environmental Protection Agency: Brisbane)…[etc.]

Conservation committees

Staff continued to serve on key State committees relating to environmental legislation or issues about the conservation of species or habitats. Two important statutory committees that include Trust representation are the NSW Scientific Committee (Doug Benson) and the NSW Fisheries Scientific Committee (Dr Alan Millar). The Trust also contributed to two major implementation groups, the Biodiversity Strategy Implementation Group (Dr Tim Entwisle) and the Native Vegetation Implementation Group (Bob Makinson). Dr Entwisle continued as chair of the NSW Biological Diversity Advisory Council, and changes to the *Threatened Species Conservation Act* (TSC Act) allow for an ongoing representative of the Trust on the Council.

Towards the end of the financial year, ecologist John Benson spent considerable time advising the NSW Government on matters pertaining to the Wentworth Group of Scientists' report to the Premier on vegetation reforms. This included providing advice and writing a report to the Native Vegetation Reform Implementation Group chaired by the Hon. Ian Sinclair. Dr Surrey Jacobs continued to his representation on the NSW State Wetland Advisory Committee.

Ecology of Sydney plant species

Part 9 of the popular series documenting the ecology of plants in the Sydney region was published in the fourth issue of *Cunninghamia* volume 7, covering monocotyledon families Agavaceae to Juncaginaceae (with 260 native species, 101 exotic species). Though this issue includes the large and widespread families Cyperaceae and Juncaceae, very little ecological research has targeted these families in Australia.

Ecological monitoring

The Trust 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 monitoring of Cumberland Plain Woodland vegetation started in 1990. A paper discussing the likely makeup of the original Cumberland Plain flora based on interpretations and implications of the work of Robert Brown and other early collectors presented at the Robert Brown 200 Conference (in May 2002) was published. 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 also being studied. This is providing insights into plant species distributions and recruitment issues that are relevant to management of the Endangered Ecological Communities of Western Sydney.

Freshwater macroalgal ecology

Lucy Nairn continued her PhD project on the ecology of macroalgal communities in the Kangaroo River catchment, 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. The focus of her work in 2002/03 was a series of experiments to test the impact of light and substrate texture on algal community composition. Floods and drought had a major impact on the success of these experiments, and the completion of the project has been delayed.

Masters student Jennie Nelson continued her part-time study on desmid communities in western Sydney, and how these compare to the collections of George Playfair made over 100 years ago. We hope to gain insight into historical changes to the aquatic environment around Sydney as well as a better knowledge of what influences the distribution of these microalgae. The project is cosupervised by Dr Tim Entwisle and Associate Professor Shelley Burgin at the University of Western Sydney.

Liverpool Plains native grassland survey

In the previous year, John Benson and Dr Chris Allen initiated 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 5% 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, and will provide insights into the effects of drought and 'normal' conditions on 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 was placed across the remnant and derived grasslands.

Proteaceae genetics and ecology

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 determine 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 reported as being eaten by birds. An experiment to test whether animals disperse *Persoonia* seeds found that the majority of fruits were removed (probably by wallabies rather than birds) while some were destroyed (probably by rats). A seed burial trial was set up for all of the taxa, to examine the role of the soil-stored seed bank as a stage in their overall life history. It was found that seed viability decayed slowly with time, with 50–70% of seeds remaining viable after two years.

An especially interesting insight into *Persoonia* seed biology was provided by two intense bushfires within five years at one of the study sites for *Persoonia mollis* subsp. *nectens*. The second fire (January 2002) killed all of the cohort of seedlings that had germinated after the first fire and it was expected that few, if any seedlings would appear following the second fire. Contrary to this expectation, the population of seedlings that has germinated since January 2002 is only 25% smaller than the total number that germinated between 1997 and 2002. This has potentially major implications for fire management: fires occurring in quick succession may be less catastrophic than was previously feared, at least for this species.

Pollinator observations and hand pollinations were used to determine the preferred mating systems of the study taxa. All were found to be self-incompatible but rare species were found to have fewer native pollinators than the common species and showed lower ratios of seed set. A manuscript describing these results was submitted for publication. The demographic data collected for these species are 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.

Rainforest fragmentation

Having been significantly affected by clearing and degradation, Australian rainforests provide an excellent opportunity for investigating the genetic consequences of habitat fragmentation. Rainforest remnants differ in size, isolation, species composition and control populations, for good experimental design, are still available. Evolutionary and ecological factors play a significant role on how habitat fragmentation influences population dynamics and it is important to differentiate between the effects of fragmentation dating back to geological events and the consequences of current, human-induced disturbance.

Dr Maurizio Rossetto is investigating the consequences of rainforest fragmentation in northern New South Wales, using three related but evolutionary and ecological distinct tree species belonging to the genus *Elaeocarpus*. DNA-based results suggest that *E. williamsianus*, a small rare tree capable of vegetative growth, is currently reduced to single-clone populations having lost most of its capacity for sexual reproduction as a result of fragmentation. Microsatellite-based data suggests that fragmentation during ancient glaciation events is the main cause for low within- and high between-population diversity in *Elaeocarpus* sp. 'Rocky Creek', a narrow endemic species restricted to the sites of ancient rainforest refugia. In the more widespread *E. grandis*, a species highly affected by clearing, population size and isolation from core rainforest areas appear to be the main factors influencing gene diversity and population dynamics. A fast growing tree with easily dispersed fruits, *E. grandis* appears to be capable of successive colonisation waves following disturbance events and is therefore less affected by habitat fragmentation. Understanding the factors that affect population dynamics across different taxa will help us better predict the long-term viability of plant communities within our increasingly fragmented landscape.

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.

Wollemi Pine

Ecologist John Benson gathered detailed ecological data from trees in all known populations of the rare Wollemi Pine. Two papers are proposed: one on the population structure, and a second covering seedlings at one of the sites that has been monitored now for six years.

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-storey 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 80 species have been studied so far and the results will be summarised in a publication.

Orchid research

Over the past year, using funding provided by the Hermon Slade Orchid Fund, an orchid seed germination and storage research project was established at Mount Annan Botanic Garden. This project focuses on the *ex situ* conservation of a number of threatened NSW orchids, including the mycorrhizae required for their germination and growth. Seed storage protocols have been developed for a range of taxa and basic research and seed storage facilities have been established in association with the NSW Seedbank. Staff and students are receiving training in orchid collection, propagation and long-term storage.

Proteaceae development

The waratah (*Telopea speciosissima*) is an Australian Proteaceae species grown as a cut flower crop. Waratah flower quality is severely reduced by browning of the floral bracts prior to harvest. PhD student Amelia Martyn is working at Mount Annan Botanic Garden and with local growers investigating the causes of bract browning. Her work has suggested that it may be 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.

Seed biology of threatened species

A report was submitted to the Biodiversity Strategy Implementation Group summarising the findings of an extensive study of seedbanking procedures and requirements for threatened NSW species (funded through the NSW Biodiversity Strategy). As a result of this study, seedbanking procedures have been refined and other issues are being addressed. In particular, priorities have been defined for future seed biology research at Mount Annan. The experimental component of this report is being prepared as an article for a peer-reviewed journal. A paper on seedbanking of *Hakea dohertyi* will be published in a forthcoming issue of *Cunninghamia.*

Wollemi Pine

A number of collaborative research projects have yielded significant findings about the life and times of the Wollemi Pine. A paper by Dr Rod Peakall (Australian National University), working with Mount Annan scientists and others, is due to be published in *Molecular Ecology*. It describes the very low genetic variability found in several members of the family Araucariaceae, and in the Wollemi Pine in particular, and poses some questions about the consequences of low diversity in such species. Another paper has been accepted 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 (University of New England), funded by the Hermon 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 well attended symposium sponsored by ANZAAS and the Trust, and organised by Patricia Meaghers and others, was held at the Conservatorium of Music in August 2002. It brought together researchers, field officers and journalists, with members of the public, to share information about this fascinating species. A video of the day's proceedings was produced by the Trust and National Parks and Wildlife Service. The paper delivered by Patricia Meagher and Dr Cathy Offord, summarising the results of horticultural research on the Wollemi Pine, was published in *Australasian Parks and Leisure.*

Fungi and Plants Theme

***Armillaria* root rot**

Armillaria luteobubalina is a fungus that causes root disease in many trees. A molecular study by PhD student Jillian Smith-White using AFLPs was carried out to investigate the population dynamics and genetic structure of *Armillaria* populations in both natural and cultivated ecosystems. This study found that the populations were genetically complex and that infection via sexual propagules (basidiospores) was far more common than expected. In a separate study it was shown that the fungus was capable of colonising trees to a height of five metres under certain conditions. This has major implications for the disposal and chipping of infected trees as it potentially means that the pathogen could be spread in mulch.

Fungal diseases in Sulawesi, Indonesia

The Australian Centre for International Agricultural Research (ACIAR) provided funding to the Trust 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 (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.

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 wordwide has been 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 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 has commenced studies on the biology of *Phyllosticta telopeae*, a fungus that causes a leaf spot of the waratah.

Fusarium

Three major meetings on *Fusarium* involved staff from the Trust during 2002/2003. In July 2002 a *Fusarium* Laboratory Workshop was held at The University of Sydney and was organised by Dr Brett Summerell and staff from plant pathology. This workshop, part of a program of annual workshops held since 2000, had 42 participants, mainly from Australia but also with a significant representation from the Asia/Pacific region. In January 2003, Dr Summerell was convenor of the Ninth International *Fusarium* Meeting, held at The University of Sydney. Dr Summerell was also a guest lecturer at a laboratory workshop on *Fusarium* identification held at Kansas State University in June 2003.

***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 on Sydney Harbour foreshores. It is causing significant damage to certain ecosystems with potential detrimental effects to several threatened plant and animal species. Collaborative research, with Dr Keith McDougall, NSW National Parks and Wildlife Service, has focused on the identification of the presence of the pathogen in national parks. Detailed studies of the impact of the pathogen were conducted at Barrington Tops and Werrikimbe National Parks. PhD student Ratiya Pongpisutta is studying the extent of morphological, genetic and pathogenic variation in the organism throughout NSW, while PhD student Chris Howard has recently commenced 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 in national parks.

Communication and Services

Cunninghamia: a journal of plant ecology for eastern Australia

Cunninghamia is the flagship publication for the ecology program at the Trust. 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, the 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. Highlights of issues 3 and 4 of volume 7 include:

- Papers presented at the *Robert Brown 200 Conference* including contributions on the Cumberland Plain Woodland and an overview paper discussing rarity, rare plants and the NSW *Threatened Species Conservation Act.*
- Vegetation surveys of Inverell and Yallaroi Shires, Burnt Down Scrub Nature Reserve and the Nangar Plain in Kosciuszko National Park.
- Vegetation survey of Mt Canobolas State Recreation Area and a detailed study of its mosses, liverworts and hornworts.
- Floristic descriptions of *Sphagnum* communities in NSW.
- Comparative population studies in two *Cissus* species, and an assessment of the introduced shrub *Euphorbia paralias* along the mainland coast.
- Effect of time since fire, topography and resprouting eucalypts on ephemeral understorey species composition in semi-arid mallee.
- Part 9 of the Ecology of the Sydney plant species series (see above).

Plant disease diagnosis

The Plant Disease Diagnostic Unit offers a commercial service for the detection, diagnosis and control of plant diseases. It is utilised by both external clients and the Trust's 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 209 samples, 163 from external clients (an increase of 30% over last year) and 43 from within the Trust. The majority of enquiries originated from private gardeners in the Sydney region (42%) and professional horticultural advisors and companies (34%). Local Councils and Government organisations made up the rest. A number of trends emerged from the results of these analyses:

- Tests for soil borne diseases, (*Phytophthora* spp., *Armillaria* spp. and *Rhizoctonia* spp.) were the most requested (47%), with *Phytophthora* tests predominating (38%). The Unit also carried out large-scale soil testing of parts of Sydney Harbour

foreshores where widespread decline of native trees, especially *Angophora* spp., has occurred. In some cases the dieback fungus *Phytophthora cinnamomi* and other *Phytophthora* species have been detected, but a combination of drought and environmental pollutants has also played a large role. We expect that this increased incidence of root disease, both pathogen and environmentally induced, will continue to increase.

- Within the Trust, *Phytophthora* testing was also the most frequent assay (50%). *P cinnamomi* was however only detected at Mount Tomah Garden. Other species of *Phytophthora* and in other cases *Pythium* were the usual result from soil assays, an indication that plant pathogens were not the primary cause of decline but were more often associated with plants already stressed by external factors (i.e. the drought has caused havoc everywhere).
- The level of infection with *Armillaria*, as shown by the appearance of the distinctive honey-coloured mushrooms in early winter, was much less this year. The milder weather conditions may have contributed to this as a period of cold temperature is required prior to fruiting. The Unit used the recently developed molecular test on suspect root and wood samples instead to accurately diagnose this disease.
- Fusarium Wilt of the Canary Island Date Palm, caused by *Fusarium oxysporum* f. sp. *canariensis,* was detected at two new Sydney sites, Balgowlah and Five Dock. Suspect palms in the Sydney Gardens were also tested and found to be clean. Using a specific DNA probe, the Unit diagnosed the first records of this disease in Victoria, at Geelong and a separate infection at Albert Park. Fusarium Wilt is now present in three states; however, the mechanism of long distance transmission of this disease remains a mystery.
- The remainder of disease problems processed by the Unit include stem and leaf fungal infections (12%), insect infestation (6%), secondary saprophytes (5%), nutrient imbalance (7%) and identification of wood decay organisms in standing trees (10%).

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. 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 user-friendly 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 around Australia 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 and wattles, but also a wide range of expertise in other groups well represented in New South Wales.

Through the study of plant relationships, the Origins and Evolution Theme is 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. Over coming years we will consolidate our research in this area to focus 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 Theme 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 is where the State holds its reference library of a 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). This vital part of our scientific heritage requires expert scientific and technical curation. A key objective over the next few years is to unlock the rich store of information in the herbarium through databasing the collection information as part of Australia's Virtual Herbarium.

The Plant Diversity Section also supports 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 plant systematics journal *Telopea* is published by the Plant Diversity Section.

Flora of Australia Theme

Aquatic vascular plants

Dr Surrey Jacobs continued his molecular studies in several groups including Zosteraceae, Vallisneria and Aponogeton. Dr Jacobs is collaborating with Dr Don Les of the University of Connecticut, with the first publication on Zosteraceae now published. Further material was collected for DNA analysis.

Bryophytes

Dr Elizabeth Brown attended a bryophyte workshop in Wanaka, New Zealand, in November 2002 and then collected Lepidoziaceae in Westland with Dr John Braggins. Fieldwork was undertaken in New South Wales (including Lord Howe Island) by Dr Brown to collect specimens of Fossombronia and Lepidoziaceae. A project investigating relationships of Australian and New Zealand Lepidoziaceae was awarded funding by the Hermon Slade Foundation. Margaret Heslewood will use nuclear and chloroplast DNA markers to investigate molecular relationships within this family.

Research in the Fossombroniaceae continued with funding through the New South Wales Biodiversity Research Strategy. Will Cuddy (with initial help from Hannah McPherson) maintained the living collection of *Fossombronia* gathered in last year's fieldwork. This enables the collection of data at all stages of the life cycle. Pure cultures of several collections have been generated from capsules sent to Dr Christine Cargill (Centre for Plant Biodiversity Research, Canberra). These cultures provide the most reliable source of material for DNA work. A general analysis of leaf and stem characters was used to group all collections into nine morphotypes, one of which seems to be a clonal female population. The molecular technique 'ISSR' has been optimised for six primers, and an initial screen of representatives of all nine morphotypes has revealed considerable variation between collections. Scanning electron microscopy was used to investigate spore and elater morphology in the collections. The combination of morphogical and molecular data will be used to identify and formally describe species of *Fossombronia* in NSW.

Honorary Research Associate Helen Ramsay together with W.B. Schofield (University of British Colombia) and B.C. Tan (University of Singapore) have completed the revision of the moss family Sematophyllaceae in Australia. Part 1 was published and Part 2 is in press. Collaborative work for the *Flora of Australia* on the family Bryaceae with J.R. Spence (Glen Canyon Nature Reserve, Page, USA) and A.J. Shaw (Duke University, USA) continued with the checking the Flora manuscripts of the family Bryaceae prior to publication in volume 52. Other work, in collaboration with Andi Cairns (James Cook University) on Mosses of Wet Tropics Bioregion of northeast Queensland, is nearing completion.

Cyperaceae

Karen Wilson continued studies of various genera in the family Cyperaceae, largely in collaboration with Associate Professor Jeremy Bruhl (University of New England) and jointly supervised students. The large widespread genus *Fimbristylis* and its allies is being studied morphologically and anatomically by PhD student Kerri Clarke, and is also being studied from a molecular and palynological standpoint by Kioumars Ghamkhar, another PhD student, with Dr Adam Marchant as a co-supervisor. PhD Student Xiufu Zhang submitted her thesis on the delimitation of the genus *Carpha* using morphological, anatomical and molecular characters. Her work reversed conventional thinking on the structure of spikelets in that group. Honours student Linda McLaughlin investigated sectional relationships within the genus Schoenus using morphological and anatomical characters.

Economically important plants

Not strictly concerned with the *Flora of Australia*, but consistent with the fundamental nomenclatural and taxonomic focus for this Theme, is the work of Honorary Research Associate Professor David Mabberley. Professor Mabberley continued his series of investigations into the taxonomy and nomenclature of economically important plants as precursors to a new edition of his *The Plant-book*.

Elaeocarpaceae and Tremandraceae

A new project initiated by recent appointments Drs Darren Crayn and Maurizio Rossetto is investigating aspects of the evolution of the families Elaeocarpaceae (comprising predominantly of rainforest trees) and Tremandraceae (composed predominantly of dry-adapted shrubs) in Australia. The origins and relationships of the Australian taxa are sought by phylogenetic studies using molecular data, the results of which will provide a basis for systematic, historical biogeographic and population genetic studies. Results to date indicate that Tremandraceae are nested phylogenetically within Elaeocarpaceae, being more closely related to *Elaeocarpus* and *Aceratium* than these two genera are to the other two genera of Elaeocarpaceae that have Australian representatives, *Aristotelia* and *Sloanea*.

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 southeastern NSW. Each genus is shown to be a specialised lineage that is placed within the much larger and more widespread genus *Epacris*.

Drs Brown, Crayn and Jocelyn Powell submitted a paper revising the genus *Lissanthe*. One new species is described, two are transferred from the genus *Leucopogon*, and the genus description amended. Dr Crayn also commenced an assessment of pollen morphology of species in the genus *Lissanthe* s. lat..

Eucalypts

Ken Hill continued systematic studies on the eucalypts, in collaboration with Honorary Research Associate Don Blaxell. Work continued on new taxa from New South Wales and on the Sydney Blue Gum group.

Fabaceae: Faboideae

Dr Peter Wilson continued work on the genus *Indigofera*, in the family Fabaceae. The *Indigofera pratensis* species complex, distributed along the Queensland coast and west to Mt Isa and the Northern Territory, was the subject of morphological and molecular studies by Aniuska Kazandjian, a PhD student from James Cook University, Townsville jointly supervised by Professor Betsy Jackes and Dr Wilson. Aniuska Kazandjian submitted in July 2002. A number of new taxa are likely to be recognised as a result of this study. Already a small nomenclatural paper has been accepted for publication in *Taxon*, and the first part of a revision has been submitted to *Telopea*. Work is progressing on coding all Australian species of the genus for a CD-ROM identification tool.

Fabaceae: Faboideae

Postgraduate student Peter Jobson and his co-supervisor Dr Peter Weston continued their systematics study of the genus *Dillwynia*.

Fabaceae: Mimosoideae

Drs Mary Tindale and Phillip Kodela continued taxonomic and curatorial work on the genus *Acacia*.

Freshwater algae

Dr Tim Entwisle, Hannah McPherson and Dr Morgan Vis (Ohio University, USA) prepared a paper on a taxonomically obscure group of freshwater red algae from Australia and New Zealand (Stewart Island). This paper will be submitted for publication to *Australian Systematic Botany*. New and existing collections of *Batrachospermum pseudogelatinosum* Entwisle & Vis, and related taxa, from Australia and New Zealand were analysed to determine whether this morphologically diverse taxon should be further subdivided. In particular, the value of the taxonomic character

'dioecy/monoecy' was assessed with molecular, morphometric and diagnostic morphology datasets, and its applicability more widely considered in light of these results. While the molecular data supported the intuitive feel that there is great variability within this taxon, there was no practical way to subdivide *B. pseudogelatinosum*. Acceptance of a broadly circumscribed paraphyletic species (paraspecies), *B. pseudogelatinosum*, which includes both dioecious and monoecious populations is recommended. It was concluded that the value of monoecy/dioecy as a character must be determined on a taxon-by-taxon basis — it is no better or worse than any other taxonomic character.

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 18 months to include the remaining genera in the family Oedogoniaceae (i.e. *Bulbochaete* and *Oedocladium*). *Oedogonium* is a vegetatively simple but species-rich genus widespread throughout the world, in almost all freshwater habitats. There have been numerous, mostly unvouchered, literature records from Australia, including 80 species, but no national revision. So far, there seem to be 8–10 species new to science and 20 or more new records, in a total flora of at least 100 species. *Bulbochaete* currently includes about 30 Australian representatives. For both genera, most older records have been confirmed or brought up to date, and the ranges of many cosmopolitan species extended across the continent. The distinctness of three undulate-celled species in Australian waters has been demonstrated, and curiously our flora shows clear floristic links to those known for China and the Indian subcontinent.

Dr Skinner and Dr Entwisle have completed a review of the 'macroscopic' members of the freshwater green algal family Chaetophoraceae in Australia, demonstrating the distribution of *Stigeoclonium* (3 species), *Draparnaldia* (1 species), *Draparnaldiopsis* (1 species, new to Australia), *Chaetophora* (3 species) *Uronema* (1 species). Dr Skinner has contributed a list of freshwater macroalgae to the floral survey of the Mitchell Plateau in the Kimberley region of Western Australia.

With funding from Community Access to Natural Resource Information, Nick Yee and Dr Entwisle prepared an interactive key to freshwater algal genera in New South Wales (ALGKEY). Over 200 of the most commonly encountered genera were scored for relatively simple characters, and all character states and genera were fully illustrated. In addition to this INTKEY (DELTA) product, a quick pictorial guide to the same genera was included in a new website, AFA – Australian Freshwater Algae, to go live July 2003.

Honorary Research Associate Mike Dingley continued his taxonomic studies of the freshwater green microalgal group, the desmids.

Lamiaceae

Dr Barry Conn, PhD student Nikola Streiber and Dr Rogier de Kok (Centre for Plant Biodiversity Research, Canberra) have continued their research into the phylogeny of

the Australian endemic subfamily Chloanthoideae. Preliminary results from molecular data support the monophyly of the subfamily and of the two tribes *Chloantheae* and *Westringieae*. The inclusion of the *Eichlerago tysonii* as a species of *Prostanthera* is supported and preliminary results suggest that *Wrixonia* should also be reduced to the synonymy of *Prostanthera*.

Lichens

Dr Alan Archer continued his studies on the Graphidaceae from Australia, and further afield, such as Christmas Island, the Philippines and the Solomon Islands. A number of species, first described from Australia, have been found in these islands. Additional new species from Australia and the Solomon Islands have been reported. For example, the lichen genus *Sclerophyton* has been reported from Australia for the first time, and one new Australian species and three new Solomon Islands species have been described.

During 2003, Sureporn Jariangprasert (Pia), a postgraduate student from Majeo University, Chiang Mai, who is studying the lichen genus *Pertusaria* in Thailand, visited the Trust. A collaborative study of her recent collections revealed several new taxa that are to be published later.

An interesting discovery this year was that *Graphina hartmanniana*, an endemic species known only from the holotype, is the same as *Dictyographa cinerea*, a New Zealand species recently reported from Australia.

Marine algae

Dr Alan Millar and Dr George Wilson (Australian Museum) began a long-term collaborative study of marine algae and their associated invertebrates. This Hermon Slade Foundation funded project will involve surveying the marine algae from Brush Island to Broulee Island including the Tollgate Islands off Batemans Bay region of southern NSW, to test the theory that there is a large degree of host specificity and thus co-evolution between the two life forms.

The French Government sponsored Dr Millar to survey the marine algae of New Caledonia in collaboration with Professor Claude Payri from the University of French Polynesia, Tahiti. The ten-day expedition resulted in the discovery of 46 new records for the territory as well as the confirmation of several poorly known endemic genera.

Nick Yee's research on the molecular phylogeny of the brown algal order Sporochnales (supervised by Dr Millar) has resulted in several robust trees showing the group to be monophyletic and the traditional morphological characters sets to be well founded. This and other research by Dr Millar was recently presented at the European Phycological Congress in Belfast, Northern Ireland where Dr Millar was an invited symposium speaker. Of interest during the year was the description of a new species, *Ceramium juliae*, honouring volunteer Julie Taylor's long association with the Trust, and the publication of the world's first recorded extinction of a marine alga (from Port Jackson), *Vanvoorstia bennettiana*.

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 New South Wales. A paper 'Clades, clocks, and continents: historical and biogeographical analysis of Myrtaceae, Vochysiaceae, and relatives in the southern hemisphere' was submitted to the *International Journal of Plant Sciences*. Dr K.J. Sytsma (University of Madison, Wisconsin) is the senior author of this paper that combines our molecular data (from the chloroplast *mat*K region) with his own work (from the chloroplast *ndh*F region). A paper describing *Stockwellia*, a genus of rainforest trees with one species of restricted distribution on the Atherton Tableland, was published in the *Botanical Journal of the Linnean Society*. This genus is a member of the same group as the eucalypts and appears to be most closely related to the genus *Eucalyptopsis* from New Guinea.

A detailed analysis of the *Baeckea* complex of Myrtaceae was started by BSc.(Hons) student Nikolas Lam, and expanded into an analysis of the *Chamelaucium* alliance with funding from the Australian Biological Resources Study and with the assistance of Margaret Heslewood. This work was presented at the Australian Institute of Biology symposium in Adelaide in September 2002. A second paper on progress in understanding relationships within the *Chamelaucium* alliance will soon be published in *Australian Biologist*. A second Australian Biological Resources Study grant has been received to continue looking at relationships within this group, particularly focusing on *Micromyrtus* and *Thryptomene*. Molecular evidence to date indicates much generic revision is needed within this alliance.

A visiting academic from China, Dr Xueying Zhuang (College of Forestry, South China Agricultural University, Guangzhou), spent some time at the Trust looking at seed and leaf characters within the *Babingtonia* and *Baeckea* clades of the alliance. This work included investigation of seed structure using the scanning electron microscope. In combination with other morphological data, the evolution of various seed, leaf and floral characters in the alliance are being assessed in light of the molecular estimates of phylogeny.

Poaceae

Joy Everett and Dr Surrey Jacobs increased sampling for molecular studies in the Australian native species of *Austrostipa* and other genera in the grass tribe Stipeae. The results of ITS sequencing, and analysis to date, were presented at the 4th International Symposium on Grass Systematics and Evolution in California, March–April 2003. Data from scanning electron microscopy studies have also been recorded for selected material, to estimate variation and establish scoring systems to enhance the molecular analyses.

Honorary Research Associate Dr Peter Michael continued work on various weed species of Poaceae (particularly in the genus *Echinocloa*) and other families.

Proteaceae

Dr Peter Weston and Rob Kooyman published a paper describing and naming the 'Nightcap Oak', *Eidothea hardeniana*, a new species of rainforest tree that provoked major media and public interest when its discovery was announced late in 2000. *Eidothea* is an unusual genus in a number of respects, having diverged early in the evolutionary history of the subfamily Proteoideae.

Dr Nigel Barker (formerly a Trust-funded visiting research fellow in Plant Sciences, now at Rhodes University, South Africa) published a phylogenetic analysis of relationships amongst southern African genera in the Proteoideae, co-authored with Principal Research Scientist Dr Peter Weston and South African botanists John Rourke and Gail Reeves. This study involved the cladistic analysis of an alignment of DNA sequences of the nuclear ribosomal Internal Transcribed Spacers. Although it corroborated a number of existing hypotheses, this analysis also made several surprising discoveries. Firstly, the largest clade of African taxa, which includes the familiar horticultural subjects *Leucadendron*, *Leucospermum* and *Serruria*, is more closely related to the Australian genera *Isopogon* and *Adenanthos* than it is to the African genera *Protea* and *Faurea*. This establishes yet another instance of a repeated Gondwanic distributional pattern linking Australia and Africa. Secondly, several genera turned out to be non-monophyletic. Perhaps most interesting of these is the primarily bird-pollinated genus *Mimetes*, within which is nested the insect-pollinated *Diastella*.

Ranunculaceae

Two new aquatic species of *Ranunculus* in eastern Australia have been named. *R. meristus*, described by Honorary Research Associate Dr Barbara Briggs and Bob Makinson, is widespread in southern Queensland and northern and central New South Wales. *Ranunculus amplus*, named by Neville Walsh of the Royal Botanic Gardens Melbourne and Dr Briggs, occurs in western Victoria. Chromosome counts previously made on species of *Ranunculus,* and on a range of other angiosperm families, were published by Dr Briggs.

Restionaceae

Study of the Restionaceae by Dr Briggs continued, using both morphological and DNA data. Papers naming new Western Australian species of *Hypolaena* and *Chordifex* have been submitted as part of the program to formally name the many undescribed species that have been distinguished.

Asia–Pacific Biodiversity Initiative Theme

Araceae

Dr Alistair Hay continued work on the revision of the genus *Homalomena* in Malesia. A paper co-authored with Clare Herscovitch, describing two new Malesian species of *Homalomena*, was published in *The Gardens Bulletin of Singapore*, and another paper

has been accepted for publication. Another two new aroid species were described in two papers, one co-authored with Yuzammi, a former MSc student from Bogor Botanic Gardens in Indonesia.

A revision of the tribe Potheae in Malesia, Australia and tropical Western Pacific, co-authored by Dr Peter Boyce, formerly of Royal Botanic Gardens Kew, and Dr Hay, was published in *Telopea*.

Clare Herscovitch continued to prepare, database, incorporate in the herbarium and distribute to other herbaria, material from the living research collection of Araceae. This work was largely funded through the Cosh Bequest, held by the Trust.

Blechnaceae

Honorary Research Associate Professor Carrick Chambers continued his research on the Blechnaceae. He has been focussing on Australasian–Pacific species in the genus *Blechnum* correlating morphological analysis and cytology with taxonomic interpretation in order to define species boundaries and the biogeography of selected groups on a worldwide basis.

Cycadophyta

Work continued on the classification and phylogeny of the Asian cycads. Analysis of molecular and morphological data continued for data accumulated for the cycad genera and the genus *Cycas* in particular. A paper on the molecular phylogeny of the Cycadales written in collaboration with Dr M.W. Chase of the Royal Botanic Gardens Kew (UK) and Dr D.W. Stevenson of the New York Botanical Garden (USA) was accepted for publication. Ken Hill travelled to Thailand and Vietnam in July–August 2002 as a contributor to a conference on cycad biology in Thailand and to lead a post-conference field trip in Vietnam.

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 (Royal Botanic Gardens Kew), an 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.

Eucalypts

Ken Hill continued a systematics study of the *Eucalyptus alba* group, a complex of species occurring across tropical Australia, New Guinea, East Timor and the Nusa Tenggara region of Indonesia.

Juncaceae

Karen Wilson contributed to the treatment of the family Juncaceae for the International Organization for Plant Information (IOPI) Species Plantarum *World Flora*, which was published in late 2002. PhD student John Hodgon started a study in March 2003, supervised by Associate Professor Jeremy Bruhl (UNE) and Karen Wilson, on sectional and species limits and hybridisation in *Juncus*.

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 its 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, Chair of the *Global Plant Checklist Committee* of *International Organization for Plant Information*, vice-chair of the *Global Biodiversity Information Facility (GBIF) Node Managers Committee*, and vice-chair of the project team of *Species 2000*). Karen Wilson was one of the editors of the Species 2000/ITIS Catalogue of Life Annual Checklist 2003 on CD-ROM (also online at www.sp2000.org/annualchecklist.html), and Helen Stevenson (Graphic Designer) designed the booklet to accompany the CD-ROM.

The Trust is also represented on the *Species 2000 Asia–Oceania* group by Karen Wilson. This group encourages international and national biodiversity activities in the broad region, including organizing the first Global Taxonomy Initiative workshop for Asia, held in Putrajaya, Malaysia, in September 2002. Karen Wilson was one of the four editors who produced the report of this meeting for the Convention on Biological Diversity.

Urticaceae

Dr Barry Conn, Juli Hadiah, Esti Ariyanti, Dr Chris Quinn and Dr Murray Henwood (The University of Sydney) have continued their systematic studies in the tribe Lecantheae. Phylogenetic analyses of the Urticales, based on chloroplast DNA data, support the monophyly of the Urticaceae, *Boehmeria, Pilea* and *Procris*, but not of *Elatostema*. Preliminary analyses of relationships within *Elatostema* do not support the recognition of the subgenus *Pellionia*. A field survey of *Elatostema* and *Procris* was successfully undertaken in Sulawesi and Bali, in Indonesia.

Origins and Evolution Theme

Basal-relictual angiosperms

Principal Research Scientist Dr Peter Weston has been collaborating 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 the New Caledonian *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), from Australia, 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 (University of Tasmania, Hobart) and Professor Robert Hill (University of 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. To date, sequencing of the *mat*K region of the chloroplast genome confirms the family as monophyletic, highly derived and remote from its nearest relatives. As postulated from morphological data, *Gymnostoma* appears to be the most primitive of the four genera, while sister genera *Allocasuarina* and *Casuarina* are probably the most derived.

The team is currently analysing a smaller region of the chloroplast genome (the *psbA-trnH* spacer region) to increase the resolution between species within each genus. The ITS region of the nuclear genome has proved too variable to resolve phylogenetic relationships in the Casuarinaceae, but a pilot study of the usefulness of the nuclear 26S ribosomal DNA is being carried out by Dr Andrew Perkins for the team.

Dennstaedtiaceae

Honorary Research Associate, Professor John Thomson, has now completed the DNA fingerprinting required for review of the bracken fern genus *Pteridium* worldwide. Taxonomic studies of Central and North American brackens in collaboration with Dr John Mickel (New York Botanic Garden) and Dr Klaus Mehltreter (Institute of Ecology, Xalapa, Mexico) and of African brackens with Dr Augustin Chikuni (Malawi National Herbarium and Botanic Gardens) and Colin McMaster (Chengelo School, Zambia) are being prepared for publication. Additional molecular investigations of European bracken morphotypes are currently nearing completion, providing a data base for ongoing phylogenetic analyses in which Dr David Bryant (McGill University, Montreal)

and a consortium of European pteridologists are participating. The project should be finalised by mid–2005.

Elaeocarpaceae and 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 begun a 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 longstanding collaboration between Dr Tim Entwisle and Dr Morgan Vis (Ohio University, USA) continued, with funding achieved for collecting in New Caledonia, New Zealand and Tasmania. 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 Batrachospermales, particularly those of Gondwanic origin. A proposal was submitted for a conference session and workshop on the biogeography of the Batrachospermales at the International Phycological Congress to be held in South Africa in 2005.

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 extended 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 strong support for the Centrolepidaceae as the sister group to Restionaceae, differing from earlier suggestions by other researchers that Centrolepidaceae is embedded in Restionaceae. 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. Both members of Ecdeiocoleaceae, *Georgeantha* and *Ecdeiocolea*, have been sequenced. A paper on these findings was presented at the Monocots3 conference in California.

Proteaceae

Peter Weston's collaboration with Honorary Research Associate Assoc. Professor Peter Bernhardt (St Louis University) and Robert Kooyman (University of New England) on the reproductive biology of *Eidothea hardeniana* and *Triunia youngiana* did not advance significantly during this year but remains an active project.

Restionaceae

Honorary Research Associate Dr Barbara Briggs collaborated with Professor Peter Linder (University of Zurich, Switzerland), and Dr Pia Eldenas (Molecular Laboratory, Stockholm, Sweden) on an investigation of contrasting patterns of diversification and molecular evolution in African and Australian Restionaceae. Since Restionaceae first appeared in the fossil record, some 65 million years ago, it appears that the rate of evolution may have been relatively uniform in Australia but that slow molecular evolution in South Africa was followed by a burst of rapid evolution. Hypotheses have been developed to interpret these differences, in accord with the environmental history of the regions, and a paper accepted for publication in the journal *Evolution*.

Management of Preserved Collection

Australia's Virtual Herbarium (AVH)

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. In 2001/02, 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 State Government component of the funding package supported databasing to the end of June 2003. The total number of specimens databased through this project is now 97,700 (64,700 during 2002/03, still somewhat lower than the required rate but improved upon the previous year's). Further delays were experienced due to the NSW Collections database installation. However, the implementation of the rapid-entry screen and improved access of data for duplicate specimens processed in other herbaria has improved the speed of data entry. Major groups completed were Poaceae, Annonaceae, Lauraceae, Monimaceae, Winteraceae, Piperaceae, Polygalaceae, Casuarinaceae, *Acacia*, *Solanum* and major sections of Fabaceae, Proteaceae, Myrtaceae and Asteraceae.

In addition to databasing, the AVH project provides many curatorial benefits to the collection, including the verification of identifications and the incorporation of recently published nomenclatural changes. As in the previous year, there have also been improvements in the physical curation of numerous specimens, including correct annotation, botanical divisions, mounting, etc. of specimens. Type specimens have been singled out for special treatment, including mounting and photography.

New Herbarium Plus

A capital bid to Treasury for funding the expansion of the herbarium and increasing laboratory space, including use of the disused oil tanks on the Sydney site, was unsuccessful.

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 Trust. 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.

Communication and Services

Botanical Information Service

INQUIRY STATISTICS	2001–2002	2002–2003
Inquiries by mail	1353	1198
Inquiries by telephone	1841	1487
Inquiries in person	447	531
Inquiries by Internet	352	635
Requests for Electronic Data	16	26
Specimens Identified	7099*	5246*
Revenue	$9,729**	$25,461**

*Including specimens identified as part of the NSW Vegetation Mapping Program contract with Department of Land and Water Conservation. **Charging was introduced part-way through 2001–2002.

The reduction in the number of specimens identified reflects the cuts to staffing in the Botanical Information Service, resulting from the organisation-wide staff freeze in the first half of 2003. However, service levels throughout our information services were maintained, and delivery continued to improve through greater use of the Internet. Satisfaction with the PlantNET service is to some extent measured through email feedback, which has been positive. The total number of email enquiries was 432 (up again from the previous year's 352). The major organisations represented were: CSIRO (5), Federal Department of Agriculture, Fisheries & Forestry (4), NSW Agriculture (21), NSW Department of Infrastructure, Planning and Natural Resources (as Department of Land & Water Conservation) (25), NSW Fisheries (1), NSW National Parks & Wildlife Service (22), NSW State Forests (4), Sydney Water (4) and Hunter Catchment Management Trust (22). The total number from educational organisations in Australia was 28, and from government organisations in Australia, 101.

Flora of New South Wales

The *Flora of New South Wales* is now being updated and developed on-line as part of PlantNET. The pilot internet version, including species from volumes three and four, is completed and ready to go live. Due to technical issues, its launch has been delayed until later in 2003.

Forensic identification

Approved Trust staff identified forensic material (mostly *Cannabis*) in 32 cases for the Police Service, resulting in revenue of $1760 (last year 19 cases yielded $1045).

PlantNET

The development of the electronic plant information network of the Royal Botanic Gardens and Domain Trust (PlantNET) continued, mostly due to funding through the Community Access to Natural Resources Information scheme. Unfortunately, many technical problems made this a difficult year for staff and users alike. However almost 10,000 digital images of herbarium specimens were prepared for presentation on PlantNET, a significant increase over last year. Another major initiative was the enhancement of the Australian Freshwater Algae module. Most significantly, an interactive key to the genera of freshwater algae in New South Wales, and effectively Australia, joins a simple-to-use photogallery key and revised background information pages under the general banner of 'AFA – Australian Freshwater Algae'.

Public Reference Collection

Environmental consultants, students, government agencies, and the general community spent nearly 100 hours using the Public Reference Collection, a drop of 50% from last year.

Telopea

Two issues of *Telopea*, New South Wales' leading scientific journal for the publication of plant diversity information, were published. 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.

Highlights of volume 9, part 4 included:

- The formal description of the Nightcap Oak as *Eidothea hardeniana* (named after well-known botanist Gwen Harden), as foreshadowed by the Minister at the centenary of the Herbarium least year.
- A clever new technique for extracting DNA from plants. Through a minor variation in the preservative mixture, DNA can be easily obtained from leaves that have been poorly transported or stored.
- A new species of the underground orchid-relative *Thismia* from Moreton National Park. Only two small clusters of plants have been located and it may need to be listed as Critically Endangered (however, further surveying of the local area is required first).
- A new species of eucalypt, *Eucalyptus castrensis*, from the Singleton Army Base.
- Five new species of moss from Australia.
- New species of a native mint (*Teucrium*), buttercup (*Ranunculus*) and daisy (*Craspedia*).

Volume 10, part 1, was a special issue devoted to the proceedings of the 5th International Flora Malesiana Symposium held in 2001, at Sydney Gardens. Flora

Malesiana is a worldwide network of botanists whose goal is to document the plant species of the region and to train new biodiversity experts within Malesia. This issue contains 26 papers, including:

- The results of DNA analysis on several groups of plants leading to reassessments of relationships in the Urticaceae, and to the formal publication of two new subtribes in a major review of the orchids.
- A major revision of Australian fig species.
- Biogeographic studies of the heath family and the fern family Grammitidaceae.
- New programs and database methods to extend and speed up the discovery and communication of plant biodiversity in the Malesian region with an emphasis on practical outcomes for users and decision-makers.

Vegetation mapping identifications

The Trust continued to provide a consultant identification service to the State Vegetation Mapping Program run by the Department of Infrastructure, Planning and Natural Resources (previously Department of Land and Water Conservation). Service levels were maintained at a high level, with all adequate material submitted with appropriate documentation usually processed within a few weeks.

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 oversees 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.

Section Staffing

There were a number of major staff changes in the Section (due mostly to an organisation-wide freeze on the filling of vacancies), some of which impacted substantially on service delivery:

- Anna Hallett resigned as Librarian after 23 years of dedicated service, guiding the library through many changes and developments. After a period of several months with temporary managers, the Librarian's position was reduced to half-time and Judy Blood was appointed on contract until November 2003.
- Catherine Wardrop's position as part time Botanical Illustrator was extended until October 2003.
- Kathleen Taylor was appointed to the position of Herbarium Assistant on 25 March 2002 to replace Rosie Arnold who is on leave without pay. Kathleen left on 31 January 2003 and the position was not filled, with the duties shared among other Plant Sciences technical staff.
- Helen Jolley's temporary position (including two days per week in the Resource Section) ended and her previous position was not filled.

Library

The Trust Library houses a collection of botanical and horticultural literature, ranging from pre-Linnaean monographs to the latest issues of international research journals. The Library also administers the Trust's archives, and provides users with access to on-line catalogues of the collections, as well as a document delivery service.

Developments

The Library electronic catalogue has been converted to the powerful and sophisticated Horizon library software. Horizon replaces the archaic TinLib catalogue which, along

with its computer server, was no longer supported. The data and software are housed on the Horizon server in Adelaide. The new catalogue was made available to staff via the internet, and will soon be available more widely. The full conversion process will continue for many months, as considerable manual input is required before conversion errors are rectified and all services are operational. There is also an extensive card file catalogue that must be converted.

The demanding nature of the conversion process, and staff training in the new system, have affected the levels of service offered to both staff and visitors and of the processing and acquisition of books. In addition, the circulation of serials to staff has ceased. The Library did benefit by the contributions of a work experience student and volunteers in handling daily processing work.

All aspects of the Library's collections, facilities and procedures are undergoing review and options for future development are being investigated.

Botanical Illustration

Major taxonomic projects

Illustrations were prepared for a range of systematics papers, in journals such as *Telopea*, *Blumea*, *Cunninghamia*, *American Journal of Botany* and *Australian Systematic Botany*, as well as for PhD theses.

Major projects completed include:

- Illustration of seeds from 48 species of plants from the Mount Annan Cumberland Plain Woodland.
- Seven fern illustrations of *Blechnum* and *Stenochlaena* species.
- Six plates of *Lissanthe* species
- Five plates of marine algae species.
- Eighteen plates of Urticaceae species.
- Ongoing illustration of Restionaceae taxa.

The illustrators also assist other branches (e.g. Marketing and Communication) in the preparation of illustrative material.

Digital imaging project

Illustrations are scanned as they are completed, added to the multimedia module of *NSW Collections* and linked to the taxonomy and catalogue modules. Images will be accessible across the internet (currently only a small 'gallery' is available), with higher resolution scans available on demand.

Endangered and vulnerable plants

The national Endangered and Vulnerable Species Project is continuing with 60 endangered species now illustrated. The aim of this project is to illustrate New South Wales species listed as endangered nationally. As an adjunct, the illustrators are working with the National Parks and Wildlife Service's Conservation, Programs and Planning Division (Northern Directorate) to provide illustrations for their Threatened Species Recovery plans. The illustrations, provided for a fee, are either sourced from the archive or done to order. Approximately 16 species have been illustrated to date.

Illustration archive

Illustrations from previous publications have now been collated and will be incorporated into the Digital Image Project (see above).

Promotion

The botanical illustration team increased its public profile and the profile of botanical illustration through the following activities:

- As guest speakers for International Women's Day the illustrators presented 'The Life and Work of Margaret Flockton', about the Trust's first botanical illustrator. Much interest followed this speech, which will be presented again upon the opening of the Atrium exhibition space in late 2003.
- As an off-shoot from the Flockton presentation, the illustrators worked with the Friends of the Botanic Gardens to establish the Margaret Flockton Illustration Award for Australian botanical illustrators. The first award will be announced at *Botanica* in March 2004.
- Lesley Elkan featured in articles in magazines such as *Australian Artist*, and most notably, in the *Sun Herald* My Career section under the title 'A day in the life of a Botanical Illustrator'.
- Lesley also represented the Trust on a panel discussing technology as an aid to illustrating, for the Australian Society of Botanical Artists (BASA).

Volunteers and training

Training was provided for Canberra-based illustrator William Murray for a period of one week. William's skills were improved to allow him to create professional quality illustrations for the Australian National Herbarium. Ongoing assistance on scanning images is provided to Trust staff.

The Illustration section accepts occasional volunteers (chosen by portfolio) to join the team for three or four months and produce several illustrations. The most recent volunteer was Hannah Finlay, zoological illustrator for the Australian Museum who illustrated *Homoranthus darwinoides* for the Endangered and Vulnerable Species Project.

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 less than –18˚C) prior to mounting. This ensures specimens are free from pests before they are incorporated into the collection. Incoming and outgoing 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.

Air conditioning upgrades in May 2002 resulted in better control and monitoring of the building environment. This year there were few reported incidences of herbarium pests indicating that the IPM program has been successful. Further ongoing improvements to the air conditioning system should result in even better control of the environment and therefore pest minimisation.

Volunteer Programs

The major volunteer program in the Plant Sciences Branch is the herbarium mounting program. Its primary objective is to mount pressed plant specimens securely on archival quality materials, clearly and correctly labeled, and catalogued in the collection database. A major priority is to ensure that all out-going loan material is mounted and databased before being sent out. The program relies on a group of 57 dedicated volunteers, who each give one day per week.

Databasing program

Volunteers databased over 4,400 specimens during the year, a sharp increase on last year's 2,228 specimens. This increase was due largely to the introduction of the new *NSW Collections* management system. However, the facility for importing exchange data was not fully operational during 2002–03, leading to a reduction in the total number of specimens that could be databased.

Specimen mounting program

Volunteers mounted 25,760 specimens on archival paper, similar to last year (25,650 specimens). Highest priority was given to: outgoing loans, incoming exchange, specimens databased by Australia's Virtual Herbarium, and fragile or vulnerable groups within the Herbarium collection. A total of 1,550 cryptogram specimens were also mounted, databased and packaged, again slightly up on last year.

Other volunteer programs

Volunteers assisted with limited general curation and research in the Plant Sciences Branch. Projects included: maintenance of the Public Reference Collection, assisting with herbarium research for the Ecology of Sydney Plant Species series, and curation of marine algae. In a new project this year, two volunteers assisted with the setting up of the computer-based Topographical Map system. This will enable the calculation of latitude and longitude for previously databased specimens that didn't carry this information.

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 and associated preparation equipment. We also have access to a transmission electron microscope through Sydney Hospital.

External film development and low resolution scanning of the negatives to CD has given users a relatively fast return of images in a user friendly format. Over time, however, the cost may be more expensive than purchasing digital capture software for the SEM.

Projects

1. Scanning electron microscopy (SEM)

- Kioumars Ghamkhar, PhD student, The University of New England, completed a pollen morphology study of Abildgaardieae (Cyperaceae).
- Visiting Chinese academic Professor Xueying Zhuang (College of Forestry, South China Agricultural University, Guangzhou), working in collaboration with Dr Peter Wilson, used the SEM to investigate seed morphology in the genera *Babingtonia* and *Baeckea* from the *Chamelaucium* alliance of Myrtaceae. In combination with other morphological data, the evolution of various seed, leaf and floral characters in the alliance are being assessed in light of the molecular estimate of phylogeny.
- Will Cuddy together with Hannah McPherson investigated spores and elaters of *Fossombronia* for a taxonomic revision.

- Lia Muliliya, Masters student, The University of New South Wales, is recording details of the leaf and lemma epidermis of species of *Austrostipa* using the SEM. From these results she has assembled a matrix and analysed the results with respect to the subgeneric groupings within *Austrostipa*.
- Honorary Research Associate Dr Chris Quinn commenced a comprehensive study of pollen and the micromorphology of leaf surface waxes in members of the Styphelieae (Ericaceae). This work will complement the molecular analyses of this group and hopefully identify characters to aid circumscription of new genera.

2. Transmission electron microscopy (TEM)

- 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 23 samples were processed for AQIS this year.

Molecular Systematics Laboratory

The primary function of the Molecular Systematics Laboratory is to provide facilities for DNA-based studies of plant relationships, to supplement whole plant and anatomical comparisons. It is also used for other molecular sequencing projects.

Projects

1. Graduate student research projects

- Xiufu Zhang completed her studies (under the supervision of Associate Professor Jeremy Bruhl from University of New England, Karen Wilson and Dr Adam Marchant) on systematics of the tribe Schoeneae, in Cyperaceae. Her thesis has been accepted by the University for the award of PhD.
- Kioumars Ghamkhar finished his laboratory studies for his PhD work (under the same supervision as Xiufu Zhang) on Abildgaardieae (Cyperaceae), and is now writing his thesis. He presented the results of his work at the Monocots III conference in California in March–April 2003.
- Nicholas Yee is close to finishing his molecular genetic research on the *Sporochnales* (Phaeophyta), for an MSc degree from The University of Melbourne (supervised by Dr Gerry Kraft from The University of Melbourne, Dr Alan Millar and Dr Marchant). His results on the phylogenetics and biogeography of this group were presented by Dr Millar at the European Phycological Congress in Belfast, in July 2003.
- Juli Hadiah has finished laboratory work for her University of New South Wales PhD (supervised by Professor Paul Adam from University of New South Wales, Dr Barry Conn, and Dr Chris Quinn), on systematics of *Elatostema* in Urticaceae.
- Nikola Streiber has finished her laboratory work for her University of Sydney PhD (supervised by Dr Murray Henwood from The University of Sydney, Dr Elizabeth Brown, and Dr Conn) on phylogenetics of Chloanthaceae.

- George Orel has almost finished his laboratory work on relationships between species in Juglandaceae, for his University of Western Sydney PhD (supervised by Judyth McLeod and Graeme Richards from University of Western Sydney, and Dr Marchant). A paper reporting his results is in press in the journal *HortScience*.

2. Staff and research associate projects

- Professor Wilson Freshwater from the University of North Carolina, was the Trust's Visiting Research Fellow for three months, during which time he studied the taxonomy and biogeography of Gelidiaceae (Rhodophyta), in collaboration with Dr Millar and Nick Yee.
- Carolyn Porter has been investigating genetic variation within *Eidothea hardeniana* (Proteaceae) with Dr Maurizio Rossetto.
- Professor John Thomson's work on relationships within *Pteridium* has resulted in a publication (co-authored by Miguel Alonso-Amelot, University of the Andes, Venezuela) on *P. caudatum* in South America. Two other reports are in preparation: one, together with Klaus Mehltreter (Institute of Ecology, Xalapa, Mexico) and John Mickel (New York Botanic Gardens) on the placement of Central American *P. feei*, and the other, with Colin McMaster (Chengelo School, Zambia) and Augustin Chikuni (National Herbarium and Botanic Gardens, Malawi), on a revision of African species.
- Hannah McPherson, Will Cuddy, Margaret Heslewood and Dr Brown are progressing with their molecular systematic research on Lepidoziaceae.
- George Orel's studies of relationships within the Theaceae from South East Asia (co-authored by Dr Marchant and Graeme Richards, University of Western Sydney) were presented at the International Camellia Congress in JinHua, China, in March 2003.
- Dr Darren Crayn, Carolyn Porter and Dr Rosetto commenced a study of genetic variation in *Elaeocarpus* (Elaeocarpaceae).
- Dr Marchant and Dr Barbara Briggs' work on relationships between families in the Poales was presented at the Monocots III conference in California, and is now being prepared for publication.
- Dr Bettye Rees and Adam Marchant are investigating relationships within Agaricales. A paper (with co-authors G. Zuccarello, National Herbarium Netherlands, Margaret Heslewood, and J. Bartlet, Bribie Island Aquaculture Research Centre) was published in *Australasian Mycologist* in early 2003.
- Dr Marchant's project (with Dr Peter Wilson, George Orel, Gillian Towler and Dr Andrew Perkins) on genetics of Australian native *Solanum* is progressing.
- Margaret Heslewood continued research on *Baeckea*, with Dr Peter Wilson and Dr Quinn.

- Margaret Heslewood is also continuing to work on Ericaceae, in collaboration with Dr Brown, Dr Crayn, Wayne Cherry and Dr Quinn.
- Dr Marchant is collaborating with Peter Stiles (Australian Lavender Industry), Laurent Legendre, Munro Myers (both at University of Western Sydney) and George Orel, on molecular methods of cultivar identification in Lavenders. Dr Marchant was an invited speaker at the National Lavender Conference in September 2002.
- Dr Perkins has been assisting Dr Dorothy Steane (University of Tasmania) and Karen Wilson in studying relationships within Casuarinaceae.

Building Infrastructure

Atrium redevelopment

The Atrium area, on Level 2 of the Brown Building, has been used for both permanent and temporary exhibitions. An exhibition outlining Cook's first voyage to Australia and the botanical collecting of Joseph Banks and Daniel Solander has been on permanent display since the building was opened. As part of a move towards temporary, topical exhibitions, two exhibitions were prepared during the year:

- *Forgotten Flora*, an exhibition on bryophytes prepared by Technical Officer Helen Jolley and others.
- *Fascinating Fungi*, an exhibition on macrofungi prepared by Honorary Research Associate Dr Bettye Rees.

The Atrium is to be refurbished as a dedicated exhibition space thanks to the generous bequest from the estate of Miss Nellie Mackie, a former volunteer in the Herbarium Volunteer Mounting Program. The space will be reconfigured to stage exhibitions displaying the wealth of cultural, historic and botanical material held in Trust collections. It will be also used as a function area and be let out as a commercial exhibition venue. Preliminary design work was completed and the exhibition space will be available by November 2003.

Brown Building water leaks

The Department of Commerce (formerly DPWS) has continued to investigate the cause of leaks in the roof of the Brown Building. Work done to prevent the leaks carried out at the departments suggestion has not worked. Additional funds have been allocated in the 2003/04 Capital Program to properly investigate the leaks, with the Department of Commerce agreeing to fund half the investigation costs.

Energy performance contract

An Energy Performance Contract (EPC) was entered into between the Trust and Tarong Energy Corporation. An EPC is an arrangement where Treasury advance funds to carry out energy saving projects. The savings are guaranteed by the contractor and the loan is repaid from the energy savings with the agency retaining the savings after

the loan has been repaid. The Brown Building air conditioning chillers were replaced as part of this project, and other air conditioning improvements made. This work constitutes Stage 1 of the EPC (implemented May 2002) with Stage 2 to be implemented in the 03/04 financial year. The Stage 1 EPC, with a capital cost of $105,000 and guaranteed savings of $19,975 per annum, exceeded its guaranteed savings by $9,000 per annum, leading to a total saving of $28,000 in the first year. The installation of the new chillers as part of the EPC has reduced down-times and maintenance call frequency, and improved our ability to maintain a constant environment within the Brown Building (thus assisting our Integrated Pest Management program).

Health and Safety

Throughout the year, with the cooperation of the Trust's OH&S officer and the OH&S Committee, the Branch continued to implement 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.

Achievements throughout the year include:

- ongoing training of staff in emergency procedures
- update of evacuation procedures on the Sydney site
- update of the Sydney CIP.

Lost-time injuries

There was one time lost-time injury reported for the branch during the year.

Risk assessments

The Plant Science Branch continued its risk assessment of all activities in the branch, including this year the preparation of Safe Working Method Statements. The Herbarium and Plant Pathology laboratories were assessed in the previous year, with field work assessed in 2002/03. Safe Working Methods Statements are in preparation for all three areas.

Part 6: Centre for Plant Conservation

The Centre for Plant Conservation completed its second year, providing a stronger focus for the broad range of conservation programs in the Gardens, and linking them more closely to the activities of other natural resource agencies and the wider community. The Royal Botanic Gardens and Domain Trust has always played an important role in the conservation of biodiversity in New South Wales, providing education, research and inspiration. It is intended that the Centre will become a key focus for plant conservation in New South Wales over the next few years, and a major hub for the Australasian region.

During the year, the Centre's extension activity concentrated on strengthening links and alliances of interest with a variety of government agencies and community groups. The Centre and the Trust are well placed to act as an information hub and a catalyst for linkages that are otherwise difficult to achieve, particularly in creating effective communication between researchers, conservation planners and managers, and community-level conservation practitioners.

Highlights of the year include:

- A two-day scientific workshop on 'The consequences of habitat fragmentation', attended by over 100 plant and animal researchers and students, with 32 papers and 30 posters presented.
- Trust representation at stakeholder meetings for the three Sydney area Catchment Blueprints, and facilitation of funding applications through the Catchment mechanism by various Trust work units.
- The alliance established in 2001 with the Australian Network for Plant Conservation and the Australian Association of Bush Regenerators continued with successful public seminars on 'Community perceptions of bushland' and 'Urban stream management'. The Centre also led the organisation of three special awareness-raising public events on *Phytophthora* (Dieback Disease), co-sponsored by the above three organisations and the Sydney Harbour Federation Trust.
- Redevelopment of the Centre's website (www.rbgsyd.nsw.gov.au/conservation_research/plant_conservation) to reflect a wider range of Trust conservation activity, and provide a comprehensive range of information and site links for plant conservation in Australia. A new feature is a compilation of resources on the conservation of the much-neglected cryptogams (mosses, algae, lichens and fungi).
- Production of several issues the Centre's email bulletin, *CPC News*, which promotes the Trust's conservation activities among both Trust staff and a growing subscriber base in the agencies and community groups.

- A grant-funded project with National Parks and Wildlife Service to develop a trial set of assessments of biodiversity on private lands in north-western New South Wales that have Wildlife Refuge status. The project was delayed due to drought, but has now commenced. In addition to providing much-needed data on off-reserve conservation of native vegetation, this project will allow the trialing of service and information modules for landowners that will result in close and ongoing relationships with the Trust.
- Significant input to the national work of the Australian Network for Plant Conservation (ANPC) Inc., the peak non-Government body in this field. The Trust was well-represented by staff attending and presenting at the 2003 ANPC National Conference in Geelong; it has two staff involved with the preparation of the ANPC's revised national guidelines on translocation of threatened plant species, and there are two staff members (in individual capacities) on the ANPC national management committee.
- Contributions towards the development of a major proposal for external funding of a new initiative in seed-banking and seed research, and another (to the Environmental Trust) for the delivery of workshops and other events to allow public debate of critical environmental issues.

Part 7: NSW Biodiversity Strategy Report

The Trust is represented on the NSW interagency Biodiversity Strategy Implementation Group (BSIG). This committee coordinates and reports on the implementation of the NSW Biodiversity Strategy and is responsible to National Parks and Wildlife Service as well as the Biological Diversity Advisory Council (BDAC). The Director Plant Sciences continued to chair the Biological Diversity Advisory Council, advising the Ministers of Environment and Fisheries on biodiversity issues in NSW, and overseeing the review of the NSW Biodiversity Strategy. The Council prepared a new strategy, Living NSW, to be released for public comment later in 2003. Accompanying this will be a review of the previous strategy and an implementation plan for Living NSW.

Implementation of the previous Strategy focussed on the achievement of 22 priority actions by 2001; of these the Trust is listed as a lead agency in four and as a support agency in 10. Subsequent to the original funding of $5.3 million in 1999, an additional $2.8 million over two years was allocated to seven Government agencies, including the Trust. In 2002/03, the Trust received $207,126. Further funding was achieved through the Community Access to Natural Resources Information (CANRI) program, some of which derives from NSW Biodiversity Strategy funds. All other contributions were achieved within existing recurrent expenditure.

The following Priority Actions from the NSW Biodiversity Strategy list the Trust as a Lead (L) or Support (S) organisation. Performance targets (in brackets) were originally to be achieved by 2001, but most program continued through to June 2003. Only those targets relevant to the Trust are listed.

1. Improve the accessibility of biodiversity information (S)

(Agency databases linked and compatibility enhanced to provide user-friendly computer information systems, with community access to information facilitated through linked Internet sites) FUNDED

Further funding of $107,000 for PlantNET was achieved through the Community Access to Natural Resource Information (CANRI) program. New modules added this year include an interactive key to the genera of freshwater algae in New South Wales and associated webpages (AFA – Australian Freshwater Algae). The ongoing capture of herbarium specimen images continued, with most threatened species now 'digitised' and some progress made towards fully illustrating the forthcoming on-line *Flora of New South Wales.*

11. Incorporate biodiversity components into education courses (S)

(Relevant primary school syllabuses and associated curriculum support material enhanced to incorporate components by 2000. Relevant secondary school syllabuses and associated curriculum support material enhanced to incorporate components by 2001. Curriculum resources, including teaching kits and teacher training programs, targeting biodiversity

issues relevant to the rural community developed by 2000. Home-study packages focusing on educational opportunities for the rural community developed by 2000)

The Trust's Community Education Unit continued to include various biodiversity topics in its programs for primary and secondary school students and community groups. Major initiatives this year included:

- a collaborative program with the Australian Museum and Taronga Zoo for Australian Biota Study Days, with 760 Year 11 Senior Biology students attending sessions at all three of Garden estates, and
- contributing to Biodiversity in the City, part of Science in the City. The Trust's program targeted early childhood students (3 to 5 year olds).

13. Bioregional planning (S)

(Audit of data and information gaps for western NSW completed by 1999. Audit of the conservation status of NSW plant communities completed and information accessible by 2000. Statewide map-based GIS system developed and widely accessible by 2000)
FUNDED

The Trust was allocated a further $29,700 through the NSW Biodiversity Strategy towards classification and assessment of vegetation communities in the State. Data for the Western Plains area (including the eight westernmost Bioregions in NSW) has been entered, and a publication covering this work and the methods used will be prepared for submitting to *Cunninghamia* in later 2003. Some 160 communities have been fully scored for the Western Plains areas, and $70,000 has been provided by Environment Australia to complete this section of the project in 2003/04.

19. Continued establishment of a comprehensive system of marine parks (S)

(Marine parks at Solitary Islands, Jervis Bay and Lord Howe Island established. Zoning and operational plans prepared for Solitary Islands and Jervis Bay through a comprehensive community consultation process to be completed by the end of 1999 and for Lord Howe Island by the end of 2000. Initial assessment of Julian Rocks, Byron Bay completed by the end of 1999)

The Trust phycologist continued to contribute to the establishment of a comprehensive system of marine parks by providing algal diversity information on areas such as Jervis Bay, Byron Bay and Lord Howe Island. Surveys of areas of significance along the NSW coast continued.

24. Prepare, implement and review recovery plans (S)

(144 recovery plans prepared by 2001. Critical habitats declared and identified in environmental planning instruments)

Trust staff continue to contribute to recovery plans when requested by the National Parks and Wildlife Service. The majority of these are informal (i.e. the Service seeking advice from staff), but an increasing number of scientists are members of Recovery Teams.

29. Implement ex situ conservation measures (L)

(Techniques developed for enhancing reproductive output and storage of reproductive tissues, sperm, eggs, embryos and seeds of threatened species and populations)

Further funding of $24,750 through the NSW Biodiversity Strategy supported accession and testing of seed in the NSW Seedbank housed at Mount Annan Botanic Garden. The project was completed, with the following outcomes.

- Seed accessions of threatened species held in the NSW Seedbank have been viability-tested.
- Seed germination results have been analysed to determine the effectiveness of different storage regimes.
- The ability of the NSW Seedbank to assist in recovery planning and implementation has been reviewed and enhanced.
- Taxa requiring further collection, seedbanking and research have been identified on the new seed information database NSWSEED.
- Resources for further threatened species *ex situ* conservation have been identified
- NSWSEED database prototype has been developed and requires further inputs.

33. Identify threatening processes and prepare and implement threat abatement plans (S)

(Compliance with the provisions of the TSC Act)

Doug Benson and Dr Alan Millar continued to sit on the NSW Scientific Committee and the NSW Fisheries Scientific Committee respectively. Trust scientists continue to provide technical information for the identification of threatening processes and the preparation of abatement plans.

55. Review legislation relevant to biodiversity conservation (S)

(Compliance with the provisions of the TSC Act. Completion of the review within targeted time-frame)

A process for reviewing the relevant legislation is under consideration by the NSW Biological Diversity Advisory Council.

56. Develop local biodiversity action plans (S)

(Local Biodiversity Fund established by 1999. Guidelines for the development of biodiversity action plans prepared by 1999. Biodiversity action plans developed and implemented by councils by 2000)

The working group formed by the Biodiversity Strategy Implementation Group does not include a Trust representative.

122. Enhance taxonomic research (L)

(In addition to ongoing research efforts, an extra 50 new invertebrate species and 25 new non-vascular plant species will be described each year in NSW)

Dr Winston Ponder (Australian Museum) and Dr Tim Entwisle have a lead role in the inter-agency working group responsible for this priority action. $47,500 was allocated to the Trust in 2002/03 to discover and document new species of non-vascular plants. The results of the work to June 2003 were:

- Field work on bryophytes carried out on Lord Howe Island and some regions of New South Wales (significant impact on field work by drought prevented more extensive surveys).
- A total of 748 records of Proteaceae leaf spot specimens collected and 965 isolations of fungi made, collections of *Fusarium* species increased by 1276 isolates during period of grant and miscellaneous collections of fungi increased by 264.
- Bryophyte identification and research on the group *Fossombronia* commenced but DNA studies are needed to assess variation within populations as well as variation between populations and species (this follow-up work will be funded by the Trust).
- Combination of AFLP's and sequencing of two protein genes developed for identification of *Fusarium* spp of fungi, ITS sequencing used for identification of Proteaceae fungi; variety of techniques used for identification of other taxa. This information is combined with morphological features for polyphasic identification of taxa and delineation of new species.
- One manuscript on freshwater algae submitted to *Telopea* December 2002, and a second in draft form (after deciding not to submit in December due to new data) in June 2003.
- Two manuscripts on microfungi have been published (Mycologia and Sydowia), further manuscripts (7) in preparation including 5 papers on Proteaceae microfungi for submission by the end of 2003. Papers were presented at International Congress of Plant Pathology in New Zealand in February.
- The new species of bryophyte is being described by Tamas P_cs and a manuscript has been submitted.

Summary of discoveries to date

Group	New species to science in NSW	New records of species for NSW*	Other taxa revised and circumscribed for NSW
Freshwater algae	1	11	3
Fungi	27	28	5
Bryophytes	1	2	–
Total to date	**29**	**41**	**8**

*excluding those already included in the first column

129. Establishment of mechanisms for long-term biodiversity monitoring (L)

(Identify and select standardised, best practice approaches for monitoring biodiversity. Undertake long-term biodiversity monitoring covering a broad range of species and ecosystems)

See next objective.

130. Implement biodiversity survey program (S)

(Publication of Biodiversity Survey Program Action Plan, detailing a program of prioritised studies and timeframes. Agreed standards, methods and protocols for the collection and management of biodiversity data established. A wider taxonomic range of organisms included in biodiversity studies. Studies and products from the BSP published and widely promoted and disseminated. Greater community involvement in biodiversity studies achieved)

The objective of the Biodiversity Survey Program is to develop, publish and promote guidelines that will support the systematic acquisition and assessment of survey data through agreed survey methods, well-planned surveys, and a standard reporting framework. A range of guidelines will be produced to suit the differing needs of stakeholder groups. The Trust received $64,000 through the NSW Biodiversity Strategy for a collaborative project with David Eldridge, from Department of Infrastructure Planning and Natural Resources. The aim of this component of the program was to produce guidelines for surveying and monitoring non-vascular plants in non-marine habitats, based on an assessment of current literature, expert opinion and an evaluation of the utility of using morphological characteristics and functional groups. A final report was submitted to the Biodiversity Strategy Implementation Group in June, to be released later in the year in hardcopy and on the NSW Biodiversity Strategy website. A trial workshop using some of the techniques in this report was included in Fifth Australian Network for Conservation National conference and Conservation Techniques Workshops, in Geelong (March 2003).

135. Develop and implement a biodiversity research strategy (L)

(In consultation with the community, a NSW Biodiversity Research Strategy developed and implementation commenced by 2000)

Dr Tim Entwisle continued to chair the NSW Biodiversity Research Network (BRN), including representatives of NSW Agriculture, Zoological Parks Board, Royal Botanic Gardens and Domain Trust, Australian Museum, National Parks and Wildlife Service, Department of Infrastructure, Planning and Natural Resources, State Forests of NSW, CSIRO, Macquarie University, University of Wollongong, University of Sydney and University of NSW. Over 300 people have now registered their interest in the BRN, and the list is steadily growing: BRN stakeholders include academic teachers, researchers and students, government researchers and natural resource managers, biotechnology and agricultural researchers, private consultants, members of scientific societies and

community groups, indigenous people, farmers, fishers, zookeepers, aquarists, and interested bystanders. A website was launched and a *Framework for Biodiversity Research in New South Wales 2003–2007* was approved for release by organisations represented on the Steering Committee. Final editing and production will be completed in August 2003.

Part 8: 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)

Executive Assistant

Lauris Hudson (temp) (LDD 9.4.03)

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

Biodiversity Network Officer
Meredith Peach BA, BSc(Hons), PhD (Syd) (LDD 17.1.03)

CONSERVATION AND HORTICULTURAL RESEARCH

Manager
Brett Summerell BScAgr(Hons), PhD(Syd) (Senior Research Scientist)

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 Electrical Engineer, BSc Biology (Syd), PhD (Syd)
Jocelyn Howell BPharm(Syd), BSc(Macq)

Technical Officer
Chris Togher BEnvSc(Wollongong) (temp) (LDD 19.1.03)

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

Horticultural Research Officer
Catherine Offord BScAgr(Syd), MScAgr(Syd), PhD(Syd)

Technical Officers
Joanne Tyler HortCert, BScUrbanHort(UTS)
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
Glenn Brooks BScUrbanHort(UTS), HortCert (temp)

Technical Assistant
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)

Senior Research Scientists
Alan Millar BSc(Hons), PhD(Melb)
Ken Hill BSc(Hons), MSc(UNE)

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

Senior Botanists
Joy Everett BioTechCert (Syd TAFE), BSc(Hons), MSc(Syd)
Peter Wilson BSc(Hons), PhD(UNSW)

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)
Clare Herscovitch BSc(Hons)(Syd)
Gillian Towler BSc(Macq), AssDipAppSc (HortParkMgt), TreeSurgCert
Hannah McPherson BSc (Hons) (UNSW)
Jane Dalby BA(Hons), CBLT(QIT) (LDD 3.8.01)
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)
Nikola Streiber, BSc(Hons) (Bonn) (temp)
Wayne Cherry BScAgr(Syd), GradDipBioSc(UNSW)
Will Cuddy BSc(AppPhysGeog) (Hons) (UNSW) (temp)

Herbarium Assistant
Zonda Erskine AssDip in FAP(Sydney TAFE)

Australia's Virtual Herbarium

Co-ordinator
Phillip Kodela BSc(Hons), PhD(UNSW) (temp) (commenced 4.03)
Katherine Downs, BA (UNSW), BSc(Hons) (Syd) (LDD 17.1.03)

Botanists
Phillip Kodela BSc(Hons), PhD(UNSW) (temp)
Peter Jobson BSc(Hons) (La Trobe), MSc (James Cook) (temp)

Database staff
Karen Biddle (temp)
Emma Cornelius BSc(Hons) UNSW (temp)
Katherine Downs, BA(UNSW), BSc(Hons) (Syd) (commenced 1.03)
Camilla Freestone BSc(Wollongong) (temp) (LDD 23.5.03)
Helen Jolley BSc (temp)
Gary Koh BA (Commerce) (Hons) ANU (temp)
Andrew Orme, Hort TradeCert (TAFE) (temp)
Ifeanna Tooth BSc(Syd), Adv Cert Urb Hort (OTEN) (temp; in part)

Botanical Information Service

Botanist
Barbara Wiecek BSc(Syd)

Senior Technical Officers
Seanna McCune BAppSc(Hawkes), BushRegenCert (Acting)
Jenny Hart PhD(Syd), BSc(Syd) (Temp) (LDD 31.1.03)

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 Assistance
Rosie Arnold (on leave 15.7.02)
Katie Taylor BSc (Bris) (LDD 17.1.03)

Laboratories

Senior Technical Officer
Adam Marchant BSc(Hons), PhD(ANU)

Technical Officer
Carolyn Porter BAppSc(Hons)(UTS)

Library

Senior Librarian
Anna Hallett BA(Syd), DipLib(UNSW)(LDD 23.8.03)
Judy Blood BA, Dip Ed (LaT) DipLib (RMIT) BushRegenCert, ArboricultureCert, Multimedia Cert IV (commenced 1.11.02, temp)

Library Technician
Miguel Garcia AssocDipLibPrac(STC)

Botanical Illustration

llustrators
Lesley Elkan BSc(UTS), PostGradDipIllus(Newc)
Catherine Wardrop BA(Vis)(ANU), PostGradDipIllus(Newc) (on leave 22/3/02)

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)
Norman Hall BForSc
John Leslie BA(Dall), MS(UWisc), PhD(UWysc)
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)
John Thomson MSc, MAgrSc, PhD(Melb)
Elsie Webster Hon. D Litt (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, Margaret Hafey, 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[1]

Student	Degree	University	Supervisors	Project Title
Esti Ariyanti	MSc	University of Sydney	+Dr M Henwood, Dr B Conn	Systematic Studies of *Procris* (Urticaceae)
Abdul Asir Abubaker	MScAgr	University of Sydney	+Prof L. Burgess, Dr B. Summerell	Biology of fungi causing crown rot
Stacey Azzopardi	BSc (Hons)	University of Sydney	+Prof L. Burgess, Dr B. Summerell	*Fusarium* associated with wild sorghum
Kerri Clarke	PhD	University of New England	+Dr J. Bruhl, +Dr N. Prakash, K. Wilson	Systematic studies in Abildgaardieae (Cyperaceae)

[1] Honours, post-graduate, undergraduate research projects; + external supervisor

Student	Degree	University	Supervisors	Project Title
Yvonne Davila	PhD	University of Sydney	+Dr G M Wardle, Dr M Rossetto (Apiaceae)	Reproductive and evolutionary ecology of *Trachymene incisa*
Pete Donaldson	BScAgr	University of Sydney	+ Dr Lindsay Campbell, Dr C. Offord, L. von Richter	Seed germination of Australian species
Imogen Edmunds	MSc	University of New England	+Dr Andrew Boulton, Dr Tim Entwisle	Sequestering of heavy metals by algae
Heather England	BSc (Hons)	University of NSW	+Assoc Prof 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*
Joanne Green	BSc(Hons)	Southern Cross University	+, Dr S. Skinner, Dr S.Jacobs	Aufwuchs as a stream health indicator
Kioumars Ghamkhar	PhD	University of New England	+Dr J. Bruhl, Dr A. Marchant, Mrs K. Wilson	Molecular study of Abildgaardieae (Cyperaceae)
Robert Gibson	PhD	University of New England	+Dr J. Bruhl, +Dr G. Vaughton, Dr B. Conn	Systematics of *Drosera peltata* complex
Joanne Green	BAppSc	Southern Cross University	+, Dr S. Jacobs, S. Skinner	
Greg Guerin	PhD	University of Adelaide	+Dr W. Barker, +Dr R. Hill, Dr B. Conn	
Tran Nget Ha	PhD	University of Sydney	Dr. B. Summerell +Prof L Burgess	Populations of *Fusarium* on maize
Julisasi Hadiah	PhD	University of New South Wales	Dr C.Quinn, Dr B. Conn + Assoc Prof P Adam	Systematics of *Elatostema* in Indonesian Archipelago
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 D. Morrison, Dr P. Weston	Phylogeny and biogeography Technology of the genus *Cycas*
John Hodgon	PhD	University of New England	+Dr J. Bruhl, Mrs K. Wilson	Systematics of *Juncus* (Juncaceae)

Student	Degree	University	Supervisors	Project Title
James Indsto	MSc	University of Wollongong	Dr P. Weston, +Prof R Whelan +Dr M Clements	Species relationships and pollination ecology of *Diuris* (Orchidaceae) of the Sydney region
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, 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
Rachelle McConville	BSc(Hons)	University of Wollongong	+, Dr A. Millar	Macro-algal distribution of southern NSW lakes
Kylie McColl	BHortSc	University of Sydney	+Dr Robyn McConchie, 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)
Jim Mant	PhD	Australian National University	+Dr R. Peakall, Dr P. Weston	Comparative biology of *Chiloglottis* (Orchidaceae) and its thynnine wasp pollinators (Tiphiidae)
Amelia Martyn	PhD	University of Sydney	+Dr R. McConchie, Dr C.Offord	Causes of bract browning in *Telopea* species
Betty Mauliza	MSc	University of New South Wales	+Dr P. Adam, J. Everett and Dr S. Jacobs	Systematics of *Austrostipa* (Gramineae)
Lyle Mildenhall	BEnvSc (Hons)	University of Wollongong	+, L. von Richter	Seed ecology and population structure of the endangered plant species *Leionema lachnaeoides*

Student	Degree	University	Supervisors	Project Title
Lucy Nairn	PhD	University of Melbourne	+Dr B. Downes, Dr T. Entwisle	Ecology of stream algae
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
Antoine N'Yeurt	PhD	University of the South Pacific	+Prof. R. South, Dr A. Millar	Marine algae of Fiji

Appendix B: REPRESENTATION OF 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 Nordic Journal of Botany; Committee Member, NSW Division of Australian & New Zealand Association for the Advancement of Science (ANZAAS).

Professor Carrick Chambers (Honorary Research Associate)
Member, Research Committees of Australia and Pacific Science Foundation; Member, Pacific Science Foundation; Member, Willoughby City Council – Reserves Advisory Committee; Committee Member for preparing Australian Standard for Amenity Trees – Guide to Valuation; Member, Walter Burley Griffin Society Inc. Committee.

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.

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*.

Seanna McCune
Member, Scientific Advisory Panel, Manly Council.

Lyn McDougall
A Trustee, Katandra Bushland Sanctuary Trust

Bob Makinson
RBG representative, Native Vegetation Implementation Group (interdepartmental committee); Member, Species Recovery Team for *Grevillea wilkinsonii* ; Member, Goobarragandra Valley Reserves Trust (Crown Lands Trust under DLWC), Member, National Committee Australian Network for Plant Conservation Inc.; Member, Scientific Committee, International Dendrological Society.

Tony Martin
President, Committee for the 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.

Cathy Offord
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
Vice President and Regional Councillor, NSW, Australasian Plant Pathology Society; Member, International Society of Plant Pathology Committee on *Fusarium*; Member, Executive Committee, International Mycological Association.

Dr Mary Tindale (Honorary Research Associate)
Member, Special Committee for Pteridophyta, International Association for Plant Taxonomy.

Dr Peter Weston
Member, *Persoonia mollis* subsp. maxima and *Eidothea hardeniana* species recovery teams; Member, editorial board, *Australian Systematic Botany*; Member, Lane Cove Council Bushland Management Advisory Committee; Member, Hansjorg Eichler Research Fund Selection Committee, Australian Systematic Botany Society, Member, Editorial Advisory Board, *Kew Bulletin*.

Karen Wilson
Convener, Global Plant Checklist Committee, International Organisation for Plant Information; Vice-President, 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, KSU/CODATA ad hoc Group on Data and Information; Commission on Data Access; Vice-Chair, Species 2000; Vice-Chair, Participant Node Managers Committee, GBIF; Member, Species 2000 Asia–Oceania Committee.

Dr Peter Wilson
Member, International Advisory Board, *Candollea* (Geneva) and *Boissiera*.

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

Australian Biological Resources Study
Dr Surrey Jacobs – Flora of Australia manuscript for Stipeae $12,000
Dr Surrey Jacobs & Joy Everett – Flora of Australia manuscript for *Agrostis* $2,600
Dr Peter Wilson – Defining generic limits within the Chamelaucium alliance (Myrtaceae) $40,000 (1st year of 3-year $118,000 grant)
Dr Tim Entwisle and Dr Stephen Skinner – Taxonomic revision of *Oedogonium* (Chlorophyta) $30,000 (2nd year of 3 year $75,000 grant)

Commonwealth Department of Education, Science and Training
Nikola Streiber and Dr Barry Conn – International Postgraduate Research Scholarship $17,070 (3rd year of 3-year $51, 210 grant)
Nikola Streiber – International Postgraduate Award: living allowance $18,200 (3rd year of 3-year $54,600 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

Department of Infrastructure, Planning and Natural Resources (DIPNR) (formerly Department of Land and Water Conservation)
Dr Barry Conn and Barbara Wiecek – Plant Identification for native vegetation mapping $50,000 (3rd year of 3-year $ 150,000 grant)
Dr Brett Summerell – Mapping validation $112,000 (2nd year of 3-year $336,000 grant; delayed start)
Dr Surrey Jacobs – Biological Assessment of wetlands: testing techniques $8,000

Hermon Slade Foundation
Dr Elizabeth Brown – Relationships of the Austral family Lepidoziaceae $18,500 (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 (1st year of 3-year $61,550 grant)
Dr Darren Crayn & Dr Maurizio Rossetto – Evolution and conservation genetics of Australasian Eleocarpaceae $29,490 (1st year of 3-year $90,000 grant)
Dr Cathy Offord – Seed development of the Wollemi Pine $12,000 (1st year of a 2-year $24,556 grant)
Dr Alan Millar – Marine Benthic Algae and Invertebrates of Southern NSW $11,000 (1st year of 2-year $23,000 grant)
Dr Alan Millar – Marine algae and associated invertebrates of the NSW coast $26,000 (2nd year of 2-year $96,000 grant)

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

NPWS, Northern Zone
Dr Maurizio Rossetto – Establish a microsatellite library for *Acronychia littoralis* $8,000

NSW Biodiversity Strategy
John Benson – Plant Community Classification Project $29, 700 (2nd year of 2 year $67,320 grant)
Dr Cathy Offord – Testing and viability assessment of NSW threatened species seedbank collection $24,750 (2nd year of 2-year $54,450 grant)
Dr Tim Entwisle – Enhance taxonomic research $47, 500 (2nd year of 2-year $95,000 grant)
Dr Tim Entwisle – Develop and implement a NSW Biodiversity Research Strategy $35,000 (2nd year of 2-year $70,000 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

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 (1st year of 3-year $45,000 grant)

Royal Botanic Gardens and National Herbarium Research Fund
John Thomson – Research on *Pteridium* $480
Alistair Hay – Completion of technical work for revision of *Alocasia, Schismatoglottis* and *Homalomena* (Araceae) for Flora Malesiana $5,562
Karen Wilson & Kioumars Ghamkar – Phylogenetic study of the tribe Abilgaardieae using molecular and SEM data & laboratory consumables $4,000

Society of Wetlands Scientists Mid Atlantic Chapter
Joanne Ling – Student Travel Grant to attend 24th Annual Meeting in New Orleans Louisiana USA in June 2003 $1,500

FUNDING TO PARTNER ORGANISATIONS

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 (1st year of 3-year $158,000 grant to the University of Western Australia)
Dr Alan Millar (with La Trobe University) – Non-geniculate coralline algae $50,000 (3rd year of 3-year $150,000 grant to La Trobe University)

APPENDIX E: OVERSEAS TRAVEL

Name & position	Countries/ Cities visited	Purpose of visit	Duration	Cost	Source of Funds
Surrey Jacobs, Principal Senior Research Scientist	Logan, Utah; North Adams, Massachusetts; Storrs, Connecticut; and Ontario USA	Collaboration and fieldwork with Dr M Bankworth, Dr Barre Hellquist and Dr Don Les (Stipoid Grasses Working Group) and participate in Monocots III symposium Stipoid Grasses	21 March – 12 May 2003	$19,220	$10,000 Grant funded, remainder self funded
Brett Summerell, Manager Conservation and Horticultural Research	Christchurch, New Zealand	Participate in International Congress of Plant Pathology	1 to 9 Feb 2003	$2,950	Grant funded
Karen Wilson, Special Botanist	London, Reading, Kew, Cambridge, UK and Paris, France	Participate in GBIF Nodes managers meeting, 'Flora of the World' meeting, Paris herbarium research studies, Species 2000 Directors' meeting, Kew and Cambridge herbarium research studies and talk to project collaborators	26 Feb to 7 March 2003	$5,600	$3,500 from Global Biodiversity Information Facility. Remainder self funded.
Peter Weston, Principal Research Scientist	Los Angeles, Ontario, USA	Participate in 3rd International conference on comparative biology of Monocotyledons (Monocts III)	28 Mar to 6 Apr 2003	$3,820	Slade Foundation
Karen Wilson, Special Botanist	Edinburgh, Reading, UK, and Copenhagen, Denmark	Participate in GBIF Node Managers meeting, Royal Botanic Gardens Edinburgh resarch review and Species 2000 AGM and Project Management Team meeting	28 Apr to 8 May 2003	$4,900	$700 K Wilson $3,200 Royal Botanic Gardens Edinburgh $1,000 CODATA
Barry Conn, Manager Plant Diversity	Lae, Papua New Guinea and reginal centres within the Morobe province	Development of framework for the 'Electronic Interactive key to Common Trees of Papua New Guinea' project	12 June to 12 July 2003	$3,800	Pacific Biological Foundation
Brett Summerell, Manager, Conservation and Horticultural Research	Manhattan, Kansas, USA and Ottawa, Canada	Teach and participate in Fusarium workshop and present seminar and attend meetings on fungal taxonomy	16 June to 3 July 2003	$4,900	$3,500 Kansas State University $1,400 Agriculture and Agri-Food Canada

Name & position	Countries/ Cities visited	Purpose of visit	Duration	Cost	Source of Funds
Brett Summerell, Manager Conservation and Horticultural Research	Oslo, Norway	Attend International Mycology (Fungi) Congress	12 to 19 August 2002	$5,600	Research funding through consultancy to Australian Cotton industry for Fusarium research
Brett Sumerell, Manager Conservation and Horticultural Research	Hanoi, Vietnam	Participate in release of CD-ROM and in planning meetings for new projects in Hanoi	28 Aug to 1 Sept 2002	$5,200	AUSAID through the University of Sydney
Alan Millar, Senior Research Scientist	Noumea, New Caledonia	Participate in field surveys of marine plants of New Caledonia	11 to 20 Sept 2002	$4,500	French Embassy in Australia
Tim Entwisle, Director Plant Sciences	London, England and Dublin, Ireland	Attend the Science for Conservation conference, and visit Darwin Centre	2 to 11 July 2002	$4,900	$1500 grant funding, remainder from Trust
Karen Wilson, Special Botanist	Kuala Lumpur, Malaysia	Participate in Global Taxonomy Initiative regional workshop, Species 2000 Asia–Oceania forum, international advisory committee meeting for Initiative on Biodiversity Information Facility project and field trip.	9 to17 Sept 2002	$3,000	Species 2000 Asia Oceania
Karen Wilson, Special Botanist	San Jose, Costa Rica and Indaiatuba, Sao Paulo State, Brazil	Participate in Global Biodiversity Information Facility meetings and Biodiversity Informatics Forum and associated Species 2000 and Global Plant checklist committee meetings.	17 to 11 Oct and 16 to 25 Oct 2002	$8,000	$2,000 from Trust and $6,000 CODATA
Elizabeth Brown, Systematic Bryologist	New Zealand	Participate in Taxonomy workshop and biodiversity discussions	27 Nov to 6 Dec 2002	$1,200	Self funded
Maurizio Rossetto, Research Scientist	Strasbourg, France	Participate in and present a paper to the international conference Dynamics and Conservation of Genetic Diversity in Forest Ecosystems	29 Nov to 7 Dec 2002	$2,945	Grant funding

Name & position	Countries/ Cities visited	Purpose of visit	Duration	Cost	Source of Funds
Barry Conn, Manager, Plant Diversity	Java and Sulawesi, Indonesia	Participate in joint field studies of plants of the Urticaceae (Stinging Nettle family of plants)	9 Feb to 10 Mar 2003	$7,000	NSF Urticaceae research grant

Appendix F: COOPERATIVE RESEARCH

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

John Benson
- Classification and assessment of the status of the plant communities in New South Wales with the National Parks and Wildlife Service and Environment Australia.

Dr Barbara Briggs
- Australian *Ranunculus* species with Dr N. Walsh, Victorian National Herbarium.
- Phylogeny of Restionaceae with Dr H.P. Linder, University of Cape Town, South Africa.

Dr Elizabeth Brown
- Systematics of *Asterella* (Aytoniaceae) with Dr Christine Cargill, Centre for Plant Diversity, Canberra.
- Molecular Phylogeny and Systematics of *Fossombronia* in NSW with Will Cuddy, Hannah McPherson and with Dr Christine Cargill, Centre for Plant Diversity, Canberra.
- Systematics of *Epacris* (Epacridaceae) in New South Wales with Dr Yvonne Menadue, University of Tasmania.
- Reconstructing Phylogeny using epacrids as a case study with Dr Peter Schols and Dr Frederic Lens, Institute of Botany and Microbiology, Leuven, Belgium.

Dr Barry Conn
- Phylogeny of *Westringia* (Lamiaceae) with Dr R. de Koh, Royal Botanic Gardens, Kew, UK.

Dr Darren Crayn
- Systematics and the evolution of ecophysiological traits in Bromeliaceae and relatives. Collaboration with Prof. J. Andrew C. Smith, University of Oxford, UK and Dr Klaus Winter, Smithsonian Tropical Research Institute.
- Systematics, classification and evolution of the Ericaceae *s. lat.* Collaboration with A/Prof. Kathleen A. Kron, Wake Forest University, NC, USA.
- Systematics and Evolutionary Dynamics of Elaeocarpaceae with Dr Maurizio Rossetto and Mark Coode, Royal Botanic Gardens, Kew, UK.

Dr Tim Entwisle
- Molecular systematics, biology and biogeography of freshwater red algae with Dr Morgan Vis of Ohio University, USA and Dr John West, The University of Melbourne, Victoria.
- Ecology of algae in mountain streams with Dr Barbara Downes of The University of Melbourne, Victoria.

Joy Everett and Dr Surrey Jacobs
- Continuing studies in the grass tribe Stipeae with the Stipoid Grasses Working Group, including Dr M. Barkworth, Utah State University, USA; Dr Randall Bayer, CSIRO, Canberra; Cathy Hsiao, USDA, USA; Dr Minta Arriaga, Buenos Aires; Dr Amelia Torres, Buenos Aires and Dr Francisco Vasquez, Spain.

Dr Alistair Hay
- Coordinator, Flora Malesiana Araceae Project with P.C. Boyce, Royal Botanic Gardens, Kew, J. Bogner, Munich Botanic Garden, Prof. N. Jacobsen, Royal Agricultural and Veterinary University, Copenhagen, W.L.A. Hetterscheid, Hortus Botanicus, Leiden, Prof. J. Murata, Makino Herbarium, Tokyo Metropolitan University, Dr D.H. Nicolson, Smithsonian Institution, Washington D.C.,

Dr M. Sivadasan, University of Calicut, Dr E.A. Widjaja, Herbarium Bogoriense.
- Commentary on Aroids in *Curtis's Botanical Magazine* with P.C. Boyce, Royal Botanic Gardens Kew.

Ken Hill
- Cycad nomenclature with Dr D. Stevenson, New York Botanical Garden, USA.
- The Cycad Pages Internet site with Dr D. Stevenson, New York Botanical Garden, USA.
- Taxonomy of Asian Cycads with Dr C.J. Chen, Beijing Herbarium, Beijing, China, Dr N.T. Hiep, Hanoi Herbarium, Hanoi, Vietnam and A. Lindstrom, Nong Nooch Tropical Garden, Sattahip, Thailand.
- Molecular Phylogeny of the Cycadophyta with M. Chase, Jodrell Laboratories, Royal Botanic Gardens Kew, UK and D.W. Stevenson, New York Botanical Garden, USA.

Jocelyn Howell
- Seedling recruitment of the endangered species *Pimelea spicata* with Tricia Hogbin, Threatened Species Unit, National Parks and Wildlife Service.
- Fire responses of Cumberland Plain Woodland species with Penny Watson, University of Western Sydney.

Dr Surrey Jacobs
- Macrophytes as indicators of stream health with G. Sainty, Sainty and Associates.
- Aponogetonaceae, Zosteraceae and Hydrocharitaceae with D. Les, University of Connecticut, USA.
- Nymphaeaceae with Dr T. Borsch, Germany, Khidir Hiln, Virginia, USA and C.B. Hellquist, North Adams, Massachusetts, USA.

Dr Phillip Kodela
- Flora surveys and assessment of Wingecarribee Swamp with Geoff Sainty *et al.* for Sydney Catchment Authority.

Professor David Mabberley
- Molecular systematics of Labiatae (Viticoideae, Teucrioideae), with Dr R.J.P. de Kok, CSIRO, Canberra, Dr D.L. Steane, Dept. Plant Science, University of Tasmania, Dr A. Paton, Royal Botanic Gardens, Kew, Dr S.J. Wagstaff and Dr R.G. Olmstead, University of Colorado.
- Revision of Labiatae of New Caledonia, with Dr R.J.P. de Kok, CSIRO, Canberra.
- Ecology and systematics of *Vitex* (Labiatae) in Sri Lanka with Dr B.M.P. Singhakumara, University of Jayawardenepura, Colombo.
- Systematics of Malesian Meliaceae, with Dr C.M. Pannell, Oxford, UK.
- Botany of red cedar, with John McPhee, Historic Houses Trust NSW.
- Revision of *Picrella* (Rutaceae) in New Caledonia, with T.G. Hartley, CSIRO, Canberra and Dr E. Soepadmo, FRIM, Keping Malaysia.
- Revision of *Grewia* in Madagascar with Prof. P. Morat, Natural History Museum, Paris.
- Study of Ferdinand Bauer's colour-code for plant illustration with Dr E. Pignatti-Wikus, Trieste and Dr C. Riedl-Dorn, Vienna.
- Study of Ceratonia in the Mediterranean with Luis Ramon-Laca, Jardin Réal Botanico, Madrid.
- Nomenclature of Kauris with Timothy Waters, University of Oxford, UK.
- Effect of fire on Borneo Rainforests with Karl Eichhorn, University of Leiden, The Netherlands.
- *Ficus* nomenclature with Dr D. Dixon, Darwin.
- *Iris* nomenclature with Dr P. Goldblatt, Missouri Botanic Garden, St. Louis, USA.

Bob Makinson
- Taxonomy of *Astrotricha* with M.J. Henwood, University of Sydney, monograph and Flora of Australia treatment.

Dr Adam Marchant
- Affinities of Juglandaceae species from South and Central America, and from South-East Asia with George Orel, Judyth McLeod and Graeme Richards, UWS, Hawkesbury.
- Systematic studies in Abildgaardieae (Cyperaceae) with Assoc. Prof. Jeremy. Bruhl, Ms K. Clarke and Mr Kioumars Ghamkhar, University of New England.
- Relationships of SEAsian *Camellia* spp, with George Orel and Graeme Richards, UWS.
- Systematics of Schoeneae (Cyperaceae), with Dr Xiufu Zhang (CSIRO–PI, formerly UNE), Dr Jeremy Bruhl (UNE) and Karen Wilson.
- Cultivar identification of Lavenders, with Peter Stiles (Australian Lavender Industries), George Orel, Dr

Laurent Legendre, and Munro Myers (UWS).
- Relationships among Southern Hemisphere Basidiomycete spp., with Dr Bettye Rees (UNSW).
- Relationships within Sporochnales (Phaeophyceae) with Nick Yee and Prof. G. Kraft (UMelb).

Dr Alan Millar
- DNA research on Sporochnales with Nick Yee, Dr G. Saunders and Dr G.T. Kraft, University of Melbourne.
- Taxonomy and ecotoxity of *Caulerpa taxifolia* with Prof. A. Meinesz and O. Jousson.
- Systematics of coralline algae of the east coast of Australia with Dr Wm J. Woelkerling, La Trobe University, Victoria.
- Isolation and extraction of secondary metabolites of marine algae towards antifouling compounds with Dr Rocky de Nys, University of NSW.
- New Zealand representatives of the red algal family Delesseriaceae with Dr Wendy Nelson, Museum of New Zealand, Wellington.
- Marine floristics of East African coast with Prof. Eric Coppejens and Dr Olivier De Clerck, University of Gent, Belgium.
- Molecular phylogeny of red algal order Gelidiales with Dr Wilson Freshwater, University of North Carolina.
- Marine algae of New Caledonia with Prof. Claude Payri, Univerity of French Polynesia
- Biogeographical similarities between South Africa and eastern Australia with Prof. John Bolton (University of Cape Town).

Cathy Offord
- Genetics of the Wollemi Pine with Dr Rod Peakall, Australian National University.
- Reproductive biology and breeding of *Grevillea* with Dr Peter Martin & Ms Alex Freebairn of the University of Sydney.
- Bud anatomy of the Wollemi Pine with Dr Geoff Burrows, Charles Sturt University.
- Pollination and seed set in *Wollemia nobilis* (Araucariaceae) with Prof. N. Prakash, University of New England.
- Causes of bract browning in *Telopea* species with Dr Robyn McConchie and Ms Amelia Martyn, University of Sydney.
- Flannel flower development with Dr R. Worrall, Dr N. Wade and Len Tesoreiro, NSW Agriculture and Dr L. Campbell, University of Sydney

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

Dr Helen Ramsay
- Study of Bryaceae with Dr J.R. Spence, National Park Service, Page, Arizona, USA.
- Australian Sematophyllaceae with Dr B.C. Tan, Farlow Herbarium, Harvard University, USA and Dr W.B. Schofield, University of British Columbia, Canada.

Dr Maurizo Rossetto
- Population and conservation genetics of three *Elaeocarpus* species (Elaeocarpaceae), with Prof. Peter Baverstock, Southern Cross University and John Hunter, NSW NPWS.
- Phylogenetic studies on the Australian Vitaceae, with Assoc. Prof. Betsy Jackes, James Cook University.
- Population dynamics of two *Cissus* species (Vitaceae), with Dr Claire Arnold University of Agricultural Sciences, Vienna.
- Evolutionary and ecological studies of *Trachymene* (Apiaceae), with Dr Glenda Wardle and Yvonne Davila, University of Sydney.
- Genetic diversity in fragmented populations of *Davidsonia* (Cunoniaceae), with Prof. Robert Henry and Frances Elliot, Southern Cross University.
- Patterns of microsatellite mutation in bush rats, with Prof. Peter Baverstock and Gavin Hinten, Southern Cross University.
- Conservation genetics of the rare and endangered *Hakea pulvinifera* (Proteaceae), with Caroline Gross and Jennifer Smith, University of New England.

Dr Stephen Skinner
- Survey and assessment guidelines for monitoring non-vascular (non-marine) plants with Dr David Eldridge, Department of Land & Water Conservation, Sydney.

Dr Brett Summerell
- Ecology and taxonomy of *Fusarium* and related fungi, soilborne diseases of plants caused by fungi, and fungal diseases in Vietnam with Professor Lester Burgess, University of Sydney.
- Ecology and taxonomy of Fusarium with Dr David Backhouse, University of New England.
- Genetics of *Fusarium* with Prof. John Leslie, Kansas State University.
- Biology of the fig psyllid with Prof. Dinah Hales, Macquarie University.
- Biology of the fig psyllid with Dr Alan Clift, University of Western Sydney.
- Biosystematics of fungi on Proteaceae with Prof. Pedro Crous, University of Stellenborch & Dr Joanne Taylor, University of Botswana.
- *Phytophthora* root rot in NSW National Parks with Dr Keoth McDougall from NPWS.

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 and Mr R.M. Kooyman, University of New England, Dr S. Hoot, University of Wisconsin, Ms C. Porter.
- Systematics, biogeography and comparative biology of the Diurideae (Orchidaceae) with Dr A.P. Brown, Department of Conservation and Land Management, Western Australia, Dr K.M. Cameron, New York Botanical Gardens, Dr M.W. Chase, Royal Botanic Gardens Kew, Dr M.A. Clements, CSIRO Division of Plant Industry, Dr M. Henwood and Dr A. Perkins, University of Sydney, Dr S.D. Hopper, Kings Park and Botanic Garden, Perth, Mr J. Indsto, Westmead Institute for Cancer Research, Dr P.J. Kores and Dr M. Molvray, University of Oklahoma, J. Mant and Dr R. Peakall, Australian National University, Dr F. Schiestl (Geobotanical Institute ETH Zurich, Switzerland), Professor R. Whelan (University of Wollongong).
- Systematics, biogeography and comparative biology of the Mirbelieae–Bossiaeeae (Fabaceae) with Associate Professor M.D. Crisp, Australian National University, Mr J. Indsto, Westmead Institute for Cancer Research, Mr P.C. Jobson, University of Technology Sydney.
- Evolution of the breeding systems of relictual angiosperms with Associate Professor P. Bernhardt, Saint Louis University, Associate Professor J. Bruhl, University of New England, Dr T. Sage, University of Toronto, Dr H. Azuma, Kyoto University, Professor L.B. Thien, Tulane University.
- Molecular systematics of Bracken (*Pteridium*) with Professor J.A. Thomson, Dr M.-K. Tan, Elizabeth McArthur Agricultural Research Institute, Camden.
- Phylogeny of the Goodeniaceae with Dr Siegfried Krauss, Kings Park and Botanic Garden, Perth.

Karen Wilson
- Systematic studies in Juncaceae with Dr Jeremy Bruhl, Bob Makinson and John Hogdon.
- Polygonaceae for Flora of Australia with Mrs G. Perry, Western Australian Herbarium.
- Systematic studies in Abildgaardieae (Cyperaceae) with Assoc. Prof. Jeremy Bruhl, Ms K. Clarke and Mr K. Ghamkhar, University of New England.
- Systematics of *Carpha* (Cyperaceae) with Assoc. Prof. J. Bruhl and Ms Xiufu Zhang, University of New England.
- Systematics of *Lepidosperma laterale* (Cyperaceae) with Assoc. Prof. J. Bruhl and Mr J. Hodgon, University of New England.
- Phylogenetic study of Casuarinaceae with Dr D. Steane, University of Tasmania and Prof R. Hill, University of Adelaide.
- Relationships in *Schoenus* (Cyperaceae) with Assoc. Prof. Jeremy Bruhl & Ms Linda McLoughlin, University of New England.

Dr Peter Wilson
- Molecular phylogeny and systematics of Myrtaceae with Prof. K.V. Sytsma, University of Wisconsin, Madison, USA.

APPENDIX G: PLANT SCIENCES PUBLICATIONS[1]

[1]Names in bold are Plant Sciences staff, Honorary Research Associates or supervised students. Note there are some inconsistencies in format which have not been rectified.

SCIENTIFIC AUDIENCES

Archer, A.W. (2003). Additional lichen records from Australia 50. Graphidaceae from Christmas Island. *Australasian Lichenology* 52: 14–15.

Archer, A.W. & Elix, J.A. (2003). Additional lichen records from Australia 52. The genus *Sclerophyton. Australasian Lichenology* 52: 14–15.

Archer, A.W. (2003). *Graphina streblocarpa, Graphina subserpentina* (Lichenised Ascomycota) and their synonyms. *Mycotaxon* 86: 31–36.

Archer, A.W. (2003). New species in the genus *Sclerophyton* (Ascomycota, Opegraphaceae) from Australia and the Solomon Islands. *Mycotaxon* 87:85–89.

Archer, A.W. (2003). New species in the lichen family Graphidaceae (Ascomycota) from Australia and the Solomon islands. *Mycotaxon* 88: 143–148.

Messuti, M.I. and **Archer, A.W.** Two new synonyms of *Pertusaria melanospora. Lichenologist*, [in press 30.vii.2003]

Arnold, C. and **Maurizio, R.** (2003) Comparative population studies in two *Cissus* species (Vitaceae) across fragmented and undisturbed rainforest habitats. *Cunninghamia* 7(4): 638–694.

Barker, N.P., **Weston, P.H.**, Rourke, J.P. and Reeves, G. (2002) The relationships of the southern African Proteaceae as elucidated by the internal transition by internal transcribed spacer (ITS) DNA sequence data. *Kew Bulletin* 57: 867–883.

Barkworth, M.E. and **S.W.L. Jacobs.** (2002). Valuable research or short stories: what makes the difference? *Hereditas* 135: 263–270.

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Benson, D. and **Howell, J.** (2003) Cumberland Plain Woodland ecology then and now: interpretations and implications from the work of Robert Brown and others. *Cunninghamia* 7(4): 631–650.

Benson, D. and **McDougall, L**. (2003) Ecology of Sydney Plant Species Part 9: Monocotyledon families Agavaceae to Juncaginaceae. *Cunninghamia* 7(4): 695–930.

Briggs, B.G. (2002) Chromosome numbers of some native and naturalised plant species in Australia. *Telopea* 9(4): 833–836.

Briggs, B.G. and **Makinson, R.O.** (2002) *Ranunculus meristus* (Ranunculaceae), a new stoloniferous species from eastern Australia. *Telopea* 9(4): 809–812.

Burgess, L.W., **Summerell, B.A.**, Giblett, G., Backhouse, D., Blake, M.L., **Smith-White**, J. and Colville, M. (2002) Role of sorghum in overseasoning of *Gibberella zeae. Sorghum and Millets 2001*. Pp. 301–303. J.F. Leslie (ed.). Iowa State University Press.

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APPENDIX H: PERFORMANCE INDICATORS