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Highlights of the Year

- Commencement of Australia's Virtual Herbarium (Stage I), a 5-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 48 students, and hosting the first residential school at the Gardens as part of our on-going commitment to the University of New England Biosystematics Course.
- Grant and enhancement funding of over \$1.5 million (including Australia's Virtual Herbarium \$400,000, Global Biodiversity Information Fund support for Bioforum conference series \$260,000, and a collaborative ACIAR grant for disease control in Indonesia \$133,333).
- Successful hosting of three international conferences: the 5th International Flora Malesiana Symposium, Robert Brown 200 and the Bioforum series (the Biodiversity Knowledge Management Forums).
- Appointment of Conservation Geneticist (Dr Maurizio Rossetto) and Subtropical Systematist (Dr Darren Crayn).
- Maintenance of diverse and high quality research programs, with addition of new projects such as Liverpool Plains grassland survey, seed biology of Cumberland Plains species, *Phytophthora* dieback survey in NSW national parks, and reproductive biology of the so-called 'basal' angiosperms.
- Continued leadership role in the NSW Biodiversity Strategy, including key committee contributions and significant funded projects.
- Series of collaborative workshops (starting with 'Orchid conservation in south-eastern Australia') organised as part of the Centre for Plant Conservation.
- Coediting and contributing to major international book on the economically important pathogenic fungus *Fusarium*.
- Coauthorship of the third edition of the popular *Grasses of New South Wales*.
- Increase in number of cryptogam (bryophytes, lichens and algae) publications, particularly in *Telopea*.
- No lost-time injuries within the Branch, and risk assessments completed for all laboratory facilities.
- Replacement of the air conditioning chiller and improvements to the environmental control system in the Brown (herbarium) Building.

Part 1: Introduction

The Plant Sciences Annual Report is structured around the *Three Year Vision for Plant Sciences Branch (2000-2003)*, prepared in response to the 1999 Review of Plant Sciences. The following introductory material is taken from the Vision document.

Our Environment

The Plant Sciences Branch of the Royal Botanic Gardens Sydney is:

- Obligated first and foremost to the Royal Botanic Gardens and Domain 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 Royal Botanic Gardens, 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 if Royal Botanic Gardens Sydney is 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 Sydney 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 Gardens will work in partnership with government agencies, universities, botanic gardens and herbaria to achieve these aims. By 2002, 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 (e.g. no. 6) 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' (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 Royal Botanic Gardens.
9. Effectively communicate outcomes to the appropriate audience.
10. Raise or maintain the profile of the Royal Botanic Gardens.
11. Preferably attract external funding or result in income to the Royal Botanic Gardens.
12. If consistent with the above criteria, be targeted to meet the greatest needs of the identified stakeholders.

Part 2: Plant Sciences Branch

Mid-term Review of *Three Year Vision for Plant Sciences Branch (2000-2003)*¹

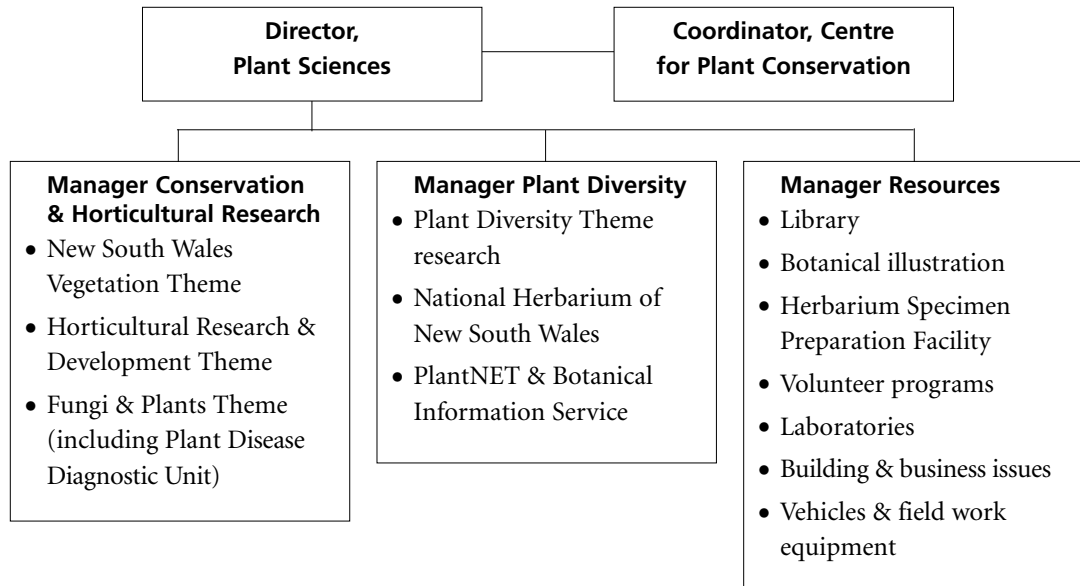
Overall there has been steady but significant change in the Plant Sciences Branch from June 2000 to December 2001. The strengths of the Branch, including its high national and international reputation and the dedication and enthusiasm of staff, have been maintained while new programs have been introduced and some existing programs more clearly focussed. The number of students and 'in-house' honorary research associates has increased and the level of grant funding has risen considerably. This has meant an increase in our outputs as measured by scientific and general publications and presentations, and a stronger focus on research of importance to the community of New South Wales.

Major achievements

- **Large increase in media stories to 60 in 2000/01, compared to 35 the year before:** The number of media opportunities continues to increase.
- **Dramatic increase in grant funding to 29% of Plant Sciences Branch budget in 2000/01, from 4% of budget in 1996/97:** A target of 30% of budget will be set for future years. Increased grant funding has enabled the Branch to take on new projects, purchase new equipment and maintain existing strengths - all of which would not have been possible with the effective reductions to our core budget. [Grant/enhancement funding in 2001/02 was in excess of \$1.5 million, but this does include \$250,000 of direct conference support (mostly to delegates) and the \$400,000 Australia's Virtual Herbarium enhancement.]
- **Doubling research students supervised to 39 in 2000/01 from 19 in 1998/99:** An important part of increasing our outputs, communication and relevance in NSW. [The number of students in 2001/02 was 48.]
- **100 community talks in 2000/01, well above last year's 60 and the previous year's 80:** The general increase in talks is encouraging and represents a change in perception that such outputs are valued equally with scientific ones.
- **70 scientific papers of over 3000 pages and 100 scientific presentations in 2000/01, at or above the levels of the previous year:** Maintaining high scientific output while increasing our general community and media contributions.
- **Bryophyte (mosses and liverworts) position filled:** Increasing our commitment to the 'forgotten flora', a high priority for basic taxonomic work to discover and document our State and national flora; also continued grant funding for taxonomic work on bryophytes, algae and fungi.
- **Conservation Ecologist position established:** A new position focussing on research ecology in NSW, particularly focussed on objectives of *NSW Biodiversity Strategy*. This was a key outcome of review, shifting a position from Plant Diversity to an area that would interact with other programs and be State focussed.
- **Centre for Plant Conservation established:** Establishment and appointment of coordinator has opened up a lot of new opportunities for collaboration within the Gardens and with external partners.

¹Presented at 25 February 2002 meeting of the Royal Botanic Gardens & Domain Trust.

- **Administrative Assistant position working well:** This part-time position has meant we can keep better track of key performance indicators for the branch and help staff to locate and access funding opportunities; the role continues to evolve, particularly looking at ways to assist in grant applications.
- **Management group for Plant Sciences functioning well:** Better inclusion of all facets of the branch in decision-making and communication; small increase in collaboration between expert areas, particularly in Conservation and Horticultural Research Branch.



- **Degree in Biosystematics course developed at University of New England, and contributions to other courses maintained:** Teaching increases our profile and provides a way for us to transfer skills to the NSW community; it also provides a source of research students.
- **Chairing NSW Biological Diversity Advisory Council and NSW Biodiversity Research Network:** Expanding the involvement of the Gardens in policy and planning for biodiversity conservation, and providing leadership in this area.

In progress

- **Reviewing research priorities for Flora of Australia, Origins and Evolution and Asia-Pacific Taxonomy Initiative programs in the Plant Diversity Branch:** Dr Entwisle will lead a working group of three program leaders to determine gaps and funding/expansion opportunities; position papers will be presented to the Scientific Committee of the Trust for feedback (the first will be at the October meeting, on the Origins and Evolution program).
- **Filling Tropical Systematics Botanist position:** This position, with the review mentioned above, is needed to clarify our role in the Asia-Pacific area and in meeting national responsibilities for biodiversity conservation in our region; it also replaces expertise lost in tropical and sub-tropical vegetation in Australia (and in the Sydney Gardens).
- **Setting research priorities for vegetation programs in Conservation and Horticultural Research Section:** Focus shifting to preparing and managing a Statewide vegetation classification system, monitoring and assessment of threatened communities, production of general and specialist publications, and a validation or research role in vegetation mapping.

- **Expanding aquatic ecology programs with move of scientific officer from Plant Diversity to Conservation and Horticultural Research Branch:** While maintaining herbarium curation responsibilities the research focus of one scientist is moving from systematics to ecology, and already including new students.
- **Setting research priorities for horticultural research in Conservation and Horticultural Research Section:** Following discussion at Trust and further development of a strategic plan for horticultural research the core focus on conservation has been accepted with an opportunistic approach to research for commercialisation.
- **Developing PlantNET:** Continues to provide a means of better communicating our scientific work.
- **Greater involvement in Botanic Gardens and Public Programs Branch programs:** The Centre for Plant Conservation provides a mechanism for enhanced communication and interaction on conservation issues. There has also been increased involvement by Plant Sciences staff in 'living collection curation committees' at each site. Plant Sciences staff involved in horticultural research and plant pathology continue to contribute regularly to botanic gardens programs. Specific projects such as Significant Trees of Sydney will involve Plant Sciences staff to some extent, but other possibilities need to be explored.
- **Improved career development and work arrangements for Technical Officers:** A review was held in mid-2000, leading to a number of actions such as enhanced team work in some areas and a commitment to work with Public Service Association on Statewide improvement to TO career path. There is still further progress to be made in this area.

To be done

- **Increase the number of publications to general audiences:** The 22 general papers in 2000/01 is similar to the previous few years and should be increased - including items in *The Gardens* but more widely as well. The major approach will be to lead by example.
- **Manage major initiatives such as Australia's Virtual Herbarium:** These have to managed carefully to achieve ownership and involvement throughout the branch but to also allow other programs to continue.
- **Resolution of technical support for new Conservation Ecologist:** To be drawn from existing technical officer pool depending upon expertise of incumbent.
- **Promotion of science programs:** Still not fully realised despite increase in media stories. Signage in Gardens and on Brown Building is on hold as Gardens' brand is resolved but this will be important action. Another priority will be to work with Public Relations area to develop better media profile for key staff.
- **Molecular diagnosis in plant pathology:** Delayed due to position being filled by officer with different skill set.
- **Opportunities for Technical Officers to be involved in research projects:** This happens to varying extents in the Branch but needs further encouragement where there is a desire and a benefit from technical staff making a greater contribution to research (as a general principle at least 20% of time should be available for research contributions); progress will be through individual encouragement and workplanning.

Program Reviews

During 2002 and 2003 all major programs will be reviewed to ensure we are taking best advantage of our existing resources and opportunities, and to identify gaps and priorities for future planning (e.g. to assist in selection of grant funding and/or student supervision). In the first half of 2002, reviews commenced for the three research themes in the Plant Diversity Section: Flora of Australia, Origins and Evolution, and Asia-Pacific Biodiversity Initiative (previously Asia-Pacific Taxonomic Initiative). The Horticultural Research program is near to completing a longer-term review of its research priorities, and reflecting the evolution to largely conservation-based research. The reviews include a presentation to the Scientific Committee of the Trust, and a written summary to the Trustees of the Royal Botanic Gardens and Domain Trust.

Complementing the existing weekly seminar series (which includes internal and external speakers), two whole-day seminar days are planned for July-August to improve communication about programs and projects within the Branch.

Science Promotion

The excellent media coverage for Plant Sciences programs is covered in the Mid-Term review (above). Staff continued to publicise their work in print, radio and television wherever the opportunities arose. The first four articles for a regular column with *Nature Australia* were submitted and negotiations commenced for a regular radio spot with 702 ABC. Publications for general audiences are included in the detailed reports for each section, and in the reference list at the end.

Royal Botanic Gardens Sydney Eureka Prize for Biodiversity Research

The Friends of the Gardens again sponsored this Eureka Prize on behalf of the Royal Botanic Gardens and Domain Trust. Due to the shifting of Science Week from May to August, there was no award made during 2001-02. However nominations were received and judging took place for the award to be announced on 13 August 2002.

Science Week

Planning for the 2002 Science Week in August commenced. This year's contribution from the Plant Sciences Branch will include an Open Day for the Herbarium Volunteer Program, behind-the-scenes tours for visiting school groups and enhanced media coverage for our research programs.

Conference Hosting

Robert Brown 200

It is 200 years since Robert Brown first set foot in Sydney, in May 1802, aboard the 'Investigator' with Matthew Flinders. Brown returned several times over the next three years, making a pre-eminent contribution to knowledge of our local flora. A three-day conference celebrating his time in this region and his lasting scientific contributions was held in the Maiden Theatre, 8-10 May 2002, organised jointly by the Royal Botanic Gardens Sydney and Greening Australia (NSW) Inc. It included talks and posters on two broad themes: (1) Brown's lasting influence on botanical systematics, and (2) Changes in the vegetation of the Sydney region since his visit: current conservation and land management issues. The audience included a wide range of both professional and amateur biologists (85-95 for each day, with considerable overlap) and everyone responded well to the unusual mix of subjects. Most papers will be published in the Gardens' two scientific journals.

Also part of the program was a one-day excursion which revisited areas of western Sydney collected in by Brown and his collaborators such as George Caley, including sites that have been greatly changed and are now being restored, as well as natural areas around Grose Vale. In the evenings, two lectures were delivered by Honorary Research Associate Professor David Mabberley. An associated exhibition about Robert Brown included one of his microscopes (kindly lent by the Linnean Society of London) for the week of the conference.

Throughout the year, Professor Mabberley also delivered a travelling series of talks on Brown and related topics, funded mostly by the Australian Systematic Botany Society, starting in Albany and working his way through Esperance, Adelaide, Launceston, Hobart, Melbourne, Sydney and Canberra.

Post-graduate students at the Royal Botanic Gardens Sydney organised a one-day conference in systematics and ecology, to link to the Robert Brown 200 meeting. The conference was co-sponsored by the Gardens and the *Australian Systematic Botany Society*, and included a wide range of topics presented by 14 students.

Bioforum

The first part of the Biodiversity Knowledge Management Forum (BioForum 1), held in November, was extremely successful. The forum allowed extensive exchange of ideas between the various national and international groups meeting here, and brought in some enthusiastic new faces. There were about 120 participants from 20 countries (2/3 from overseas), with a good mixture of botanists, zoologists and computer scientists interested in electronic biodiversity data. The International Taxonomic Databases Working Group (TDWG) conference was the major component of the BioForum, attracting 86 participants (in comparison, last year's meeting in Frankfurt had 90). The forum was strongly supported by Gardens' staff, adding to the quality and hospitality of the meetings, as well as making the Bioforum affordable to those from developing countries. The second part, Bioforum 2, was held in March and attracted over 60 delegates (three-quarters from overseas). The major component of Bioforum 2 was a meeting of the Global Biodiversity Information Facility (GBIF) scientific and technical advisory group to discuss the electronic 'Catalogue of Life'. A grant of \$260,000 was provided by the Global Biodiversity Fund to support conference infrastructure and participants to attend.

Flora Malesiana

The 5th International Flora Malesiana Symposium was held in Cairns and Sydney in September, jointly organised by the Royal Botanic Gardens Sydney and the Centre for Plant Biodiversity Research, Canberra. 'Malesia', comprising Malaysia, Singapore, Brunei, The Philippines, Indonesia and Papua New Guinea, is home to an estimated 40,000 plant species. Every three years botanists working on the flora of the Malesian region gather together for a symposium to learn of each other's research, exchange ideas and to make and renew contacts. Some 130 delegates from 19 countries attended this first symposium to be held in Australia. The sessions in Sydney covered a wide range of topics, from electronic documentation of the flora, indigenous use and significance of plants, various stakeholder views, and the latest developments in orchids, palms, ferns, bryophytes and algae.

Teaching

As mentioned in the mid-term review, the number of students supervised continues to increase. 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 and Dr Brett Summerell at the University of Sydney).

Biosystematics course

In particular, the Gardens continued its strong involvement in the Biosystematics units for tertiary students run in conjunction with the University of New England and the Australian Museum. A week-long residential school was held at the Australian Museum in April, and planning commenced for a second school to be held at the Gardens in July 2002. The number of participants (20) was the highest yet and the course is gaining wide recognition. It addresses directly the lack of opportunities in Australia to gain the training necessary to name, describe and understand the origin of our biodiversity.

Honorary research associates

Professor Chris Quinn, Phil Spence and Ed Wilson joined our distinguished group of Honorary Research Associates (see full list in appendix), while Dr Lionel Gilbert, author of major books on the history of the Gardens and more recently Joseph Maiden, resigned after a long association with the Plant Sciences Branch. The major research achievements of our Associates are included within the relevant program below.

Janet Cosh studentship

Not filled in 2001.

Part 3: Conservation & Horticultural 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 Department of Agriculture by focussing on pests and diseases of ornamental plants. It also plays an important role in the Gardens' 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 a student, Joanne Ling, who is comparing different assessment techniques and examining the effects of errors in sampling and identification. Joanne presented talks at three different conferences and was able to attract funding to the project.

Classification and status assessment of the vegetation of NSW

John Benson and Chris Togher are reviewing the literature and all vegetation mapping and surveys in NSW with the aim of deriving an authoritative typology of the vegetation of the State. It mirrors similar work in the United States, Canada and Europe. A database with 57 fields has been established to store information on each listed plant community. These fields include scientific name, common name, characteristic species, distribution by various regional boundaries, physiography, estimated or measured areas for pre-European and current extents, threat codes based on IUCN criteria, reservation codes, photograph and a general description. Standard reports from the database will provide summaries of the status of each community. Over the longer term this data should form the basis for a detailed book on the vegetation of NSW.

In the first two years of the project, the plant communities of the western plains of NSW have been classified, assessed for their threat and conservation status, and about 200 records have entered onto the database. Data entries for communities on the Western Slopes has commenced, and the literature review is near complete for this region. A literature review is part complete for the Tablelands. When more data is entered for the Western Slopes it is anticipated that a report will be compiled on the 'Vegetation of western NSW'. Applications for further grant funds have been made and if successful these funds would allow the project to expand to include the Tablelands over the next two years.

Conservation committees

Staff had input to a number of key committees that deal with issues relating to legislation or issues about the conservation of species or habitats. Two important statutory committees that Gardens' staff are represented on are the NSW Scientific Committee (Doug Benson) and the NSW Fisheries Scientific Committee (Dr Alan Millar). The Gardens 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.

Conservation genetic research

Dr Maurizio Rossetto has recently joined the Conservation and Horticultural Research team. He brings to the Royal Botanic Gardens his experience and projects centred on the development of genetic based strategies for the conservation and management of rare flora and fragmented habitats. His current projects include an ARC funded project 'Consequences of habitat fragmentation on three *Elaeocarpus* species', a NSW National Parks and Wildlife Service collaborative study 'Evolution via hybridisation of the rare *Acronychia littoralis*' and a study on 'Genetic diversity in the Nightcap Oak (*Eidothea hardeniana*)'. Dr Rossetto is also supervising three PhD students and collaborating with a number of tertiary institutions on a range of genetic based projects.

Ecology of Sydney plant species

Part 8 of the popular series documenting the ecology of plants in the Sydney region was published in the second issue of *Cunninghamia* volume 7, covering families Rutaceae to Zygophyllaceae (with 325 species). The largest family, Rutaceae, includes the well-known Sydney species of *Boronia*, *Zieria* and *Eriostemon*. Other major families include Sapindaceae, Scrophulariaceae and Solanaceae. This part completes treatment of the Dicotyledons, leaving a further three parts for the monocotyledons still to come. An accompanying paper provides a comprehensive overview of the ecology of Rutaceae with special reference to the Sydney region.

Ecological monitoring

The Gardens has contributed over the years to a number of long-term monitoring projects, providing information of importance to vegetation management and conservation. Doug Benson and Jocelyn Howell continued their long-term monitoring program of Cumberland Plain Woodland vegetation started in 1990. This project, based at Mount Annan Botanic Garden, now includes monthly assessments of plant species abundance to gain insights into seasonal changes. An experimental burn was conducted in September 2001 and the recruitment of seedlings following fire is being studied. This project provides insights into issues such as plant species distributions and recruitment 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 Valley, south of Sydney. The project is funded as part of a large ARC grant held by co-supervisors Dr Barbara Downes, The University of Melbourne, and Dr Tim Entwisle. Lucy is investigating the influence of various environmental variables, including water temperature and depth; nutrients; riparian vegetation; flow velocity; light availability and substratum, on macroalgal communities. Macroalgae are likely to act as good indicators of stream 'health'. However, before they can be confidently used in this way we

need a better understanding of the natural processes that influence the structure and composition of these communities. The focus for 2001-02 was quantitative sampling of selected sites, general survey in the Sydney region, and design of experiments to test the impact of light and substrate texture on algal composition.

A paper resulting from work with Dr Downes in the catchments near Melbourne, Victoria, was accepted for publication in *Regulated Rivers*. The paper documents for the first time the effect of river regulation on macroalgal and bryophyte communities in an Australian stream. A major finding was that rock communities may be effected more by fluctuations in flow than by scouring floods.

Masters student Jennie Nelson is continuing her 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 Shelly Burgin at the University of Western Sydney.

Liverpool Plains native grassland survey

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 listed under the TSC Act. Less than 10% of the community remains – most of it has been ploughed for crops and improved pasture. GIS layers on soils, woody vegetation, salinity, cadastra, travelling stock routes have been obtained. A stratified sampling program based on soils, slope, and distribution has been developed. Sampling was to commence in spring 2002, but the drought may mean this project gets delayed until it rains. In the meantime mapping of the extent of the grasslands may be undertaken and a set of permanent plots for sampling and monitoring may be placed across the remnant grasslands.

Population 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 elucidate the causes of rarity in fire-sensitive *Persoonia* species by comparing the genetic structure (Rymer) and demography (McKenna) of rare and common species. They have set up 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.

Initially, a survey of potential habitat for known and unknown populations of the selected *Persoonia* species was undertaken, resulting in the discovery of several previously unknown populations of *P. bargoensis* and *P. glaucescens*. Several populations across a range of size and age classes of all the species have been mapped, individual plants tagged and baseline measurements of plant size and reproductive output recorded. All plants are being monitored for growth, survivorship and fruit production. A seed burial trial has been set up for all of the species in question to examine the role of the soil-stored seed bank as a stage in the overall life history of these species. The demographic data collected for these species is being used to construct population viability models for the various populations of each species. The aim of these models is to obtain a relatively rapid insight

into what is happening to these species given that little is known of their general ecology. Amplified Fragment Length Polymorphisms (AFLPs) and allozymes have been selected as genetic markers with which to infer population structure. For one population of *P. mollis* subsp. *nectens*, the genetic identity of adult plants (all killed by fire in 1998) was determined by Dr Siegy Krauss (formerly a Gardens postgraduate student) and this enabled seedlings that germinated after the 1998 fire to be genotyped and assigned to parents. AFLP variation will be used to quantify gene flow through pollen and seed dispersal.

Persoonia fruits are plum-like and are reported as being eaten by birds. An experiment was set up to test whether animals disperse *Persoonia* seeds. This found that the majority of fruits were removed (probably by wallabies) while some were destroyed (probably by rats). The removal of fruits was spatially variable at several scales, probably reflecting the foraging behaviour of the dispersing animals. Pollinator observations and hand pollinations have been carried out to determine the preferred mating systems of the study species and to characterise any spatial variability in mating system.

Sydney Region vegetation studies

Ecologists Doug Benson and Jocelyn Howell are continuing 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, and associated riparian vegetation. Sites along the Colo were included in 2001.

Wollemi Pine

John Benson and a research scientist from the National Parks and Wildlife Service are conducting long term monitoring of the main population of the Wollemi Pine in Wollemi National Park. This involves measuring growth rates and recording mortality of tagged seedlings. John Benson also measured the stem diameters and stem heights of all coppices from all Wollemi Pine trees as well as documenting associated plant species. Papers are to be prepared on the stand dynamics and seedling dynamics of the Wollemi Pine. A number of Gardens' staff are members of the Wollemi Pine Recovery Team.

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 understorey and mid-storey species from these communities with a view to implementation of conservation measures including restoration. This year, a number of student projects focused on key groups such as grasses.

Orchid research

A Centre for Plant Conservation workshop on Australian east-coast orchid conservation held at Mount Annan was attended by most of the practitioners and researchers in this field. This helped set the direction for orchid research in the Gardens including the development of seed and mycorrhizae storage techniques. Representative populations of threatened species have been established in the nursery at Mount Annan to investigate seed biology. Access to seed from cultivated plants means that we do not deplete natural populations to conduct this work.

Proteaceae development

Results from the first year of a study by PhD student Amelia Martyn, on bract browning of waratahs, showed that sunlight is a major contributor to this disorder. Calcium deficiency and water status were of lesser importance. The work is funded by various groups in the cut-flower industry including the Rural Industries Research and Development Corporation (RIRDC) and is considered important because bract browning severely affects the quality of waratah blooms grown for the export market. Preliminary results of this work and final results of a reproductive biology and breeding study of the waratah by Dr Cathy Offord were presented at the International Protea Conference in the USA and at the Australian Wildflower conference in Sydney. Amelia Martyn won a travel scholarship from RIRDC for best presentation at the latter conference. A paper by Cathy Offord, on natural waratah variation, has been accepted by *Australian Journal of Botany*.

A PhD project was initiated on reproductive biology and breeding of *Grevillea*, also funded by RIRDC. The student, Alex Freebairn from the Plant Breeding Institute of the University of Sydney, will be investigating horticultural improvement of this group, targeting development of species not yet widely in cultivation, as well as further improvement of common species and cultivars.

Seed biology of threatened species

In conjunction with the NSW Seedbank, located at Mount Annan Botanic Garden, the Horticultural Research group began an extensive review of the seed banking procedures for threatened Australian plant species. With funding under the NSW State Biodiversity Strategy, key taxonomic groups stored for up to 15 years have been tested, some for the first time, providing baseline data on viability and indicating the success of storage techniques. This information is being used in the development of collection and storage guidelines for general collections and the needs of specific taxa.

Wollemi Pine

A cooperative project continued with the University of New England on the reproductive biology of the Wollemi Pine and was boosted by significant funding from the Hermon Slade Foundation. Technical Officer Patricia Meagher presented work on a range of Wollemi Pine research projects to the International Araucariaceae Symposium in Auckland in March 2002.

Fungi and Plants Theme

***Armillaria* root rot**

A molecular detection method for *Armillaria* developed by PhD student Jillian Smith-White was validated throughout the year, and a research paper on the technique accepted for publication by *Australasian Plant Pathology*. This technique not only allows the detection of minute levels of *Armillaria* but also enables differentiation between the different Australian species. A molecular study using AFLPs has been initiated using a large number of isolates to investigate the population dynamics and genetic structure of *Armillaria* populations in both natural and cultivated ecosystems. A major study and report on the *Armillaria* root rot problems in the Australian National Botanic Gardens, Canberra was also completed by Dr Brett Summerell.

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 has been funded by the Hermon Slade Foundation.

Professor Pedro Crous, of the University of Stellenbosch in South Africa, and Dr Joanne Taylor, University of Botswana, are collaborating on research on this project. 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.

Fusarium

Dr Brett Summerell coedited and contributed to a major international book on *Fusarium*, an economically important pathogenic fungus that attacks ornamental and agricultural plants. Following an agreement with the Iowa State University Press to publish a book on the identification of *Fusarium* species, work was initiated on photographing and describing all known species of *Fusarium*. This second book will be published in 2002. Dr Brett Summerell was also a guest lecturer at a Laboratory workshop on *Fusarium* identification held at Kansas State University in June.

Phytophthora root rot in New South Wales national parks

Research was initiated on the role of the *Phytophthora cinnamomi* causing dieback in several National Parks throughout New South Wales. This research is in collaboration with Dr Keith McDougall, National Parks and Wildlife Service. To date the research has shown that the organism is present in several national parks and is causing significant damage to certain ecosystems with potential detrimental effects to several threatened plant and animal species. Current projects are also looking at the genetic make up of the organism to determine the extent of variability in populations within New South Wales; this may help us to determine whether the pathogen is exotic or indigenous to New South Wales.

Communication and Services

Cunninghamia: a journal of plant ecology for eastern Australia

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

Each issue contains a diverse range of papers, from large vegetation surveys to detailed accounts of rare species and communities. Highlights of issues 1 and 2 of volume 7 include:

- Individual studies on the ecology and conservation status of threatened species including *Senecio garlandii*, *Doryanthes palmeri*, *Cryptostylis hunteriana* and *Grevillea kennedyana*
- A vegetation map of Kinchega National Park in western New South Wales
- Survey of vegetation of Narran Lakes Nature Reserve
- A study of the extent and rate of clearing of woody vegetation in New South Wales and the implications for biodiversity
- Revegetation of an abandoned quarry
- Dioecy, self-compatibility and vegetative reproduction in Australian subtropical rainforest species
- Part 8 of the Ecology of the Sydney plant species series (see above)

Plant disease diagnosis

The Plant Pathology section, through the Plant Disease Diagnostic Unit, continued to offer a comprehensive commercial service for the detection and appropriate control of plant diseases. In recommending control treatments, the Unit's emphasis is firstly on appropriate horticultural practices to minimise disease and promote plant health, and secondly, if fungicides are required, the application of biological agents or environmentally safe chemicals wherever possible.

The Unit processed 193 samples, 132 from external clients and 61 from the three Gardens' sites. The majority of external samples received (38%) were from private gardens (and keen gardeners) in the Sydney area, with a further 30% from horticultural consultants. The remainder were from local councils, other government departments, universities and commercial nurseries. As always, soil-borne diseases (*Phytophthora* spp., *Rhizoctonia* spp. and *Armillaria* spp.) predominated (34%) in the diagnoses, followed by foliar diseases and cankers (16%) and stem wilt and crown rots generally induced by species of *Fusarium* (7%). For the first time, the number of *Phoenix canariensis* (Canary Island date palm) samples submitted for the diagnosis of Fusarium Wilt decreased, and only one new case in the Sydney area was detected. This is a hopeful indication that the spread of the disease is slowing.

Within the three Gardens, *Phytophthora* spp. and *Armillaria* spp. were by far the most frequently diagnosed problems (64%). The unit is continuing to map the location of sites where these two soil-borne diseases are detected as part of the overall management plan for the living collections. The death of established trees from *Armillaria* is a serious problem at the Sydney site and some parts of the Garden are currently being extensively treated to limit the spread of the fungus further. For the first time, the Unit detected *Phytophthora cinnamomi*, the most aggressive species of *Phytophthora*, at Mount Tomah.

As well as single diagnoses, the Unit also carried out a number of consultancies. These included a survey of trees and soils around the foreshores of Sydney Harbour and various National Parks within NSW for the incidence of *Phytophthora* spp. The Unit also carried out a large-scale assessment of cotton-seed for the incidence of *Fusarium oxysporum*.

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 Gardens. Three key research themes have been established, and user-friendly access to data 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 Gardens 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 Gardens' 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 Gardens 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 the where the State holds its reference library of a million preserved plants. 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 scientific 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 in press. Further field collections for DNA analysis have been made.

Bryophytes

In collaboration with Dr Ron Oldfield and Allison Downing (Macquarie University), Dr Elizabeth Brown and Bob Coveny organised and ran a bryological workshop in the Blue Mountains in September. Further fieldwork was undertaken throughout New South Wales by Will Cuddy, Hannah McPherson and Dr Brown for research work on the groups *Fossombronia* and *Asterella*. A number of interesting taxa were found, including *Fossombronia megaspora*, previously known only from one collecting locality.

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

Cyperaceae

Karen Wilson continued studies of various genera in the family Cyperaceae, largely in collaboration with Dr Jeremy Bruhl (University of New England) and students whom they jointly supervise. The large widespread genus *Fimbristylis* and its allies is being studied morphologically and anatomically by PhD student Ms Kerri Clarke, and is also being studied from a molecular standpoint by Kioumars Ghamkar, another PhD student, with Dr Adam Marchant as a co-supervisor. PhD Student Xiufu Zhang is working on the delimitation of the genus *Carpha* using morphological, anatomical and molecular characters. Honours student Linda McLaughlin is investigating sectional relationships within the genus *Schoenus* using morphological and anatomical characters. Karen Wilson collected samples for these studies in New Caledonia in August and in the Top End and Kimberley in June-July 2002.

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 corrected reprints of the second edition of his *The Plant-book*. A notable focus has been fruit-trees and tropical conifers.

Ericaceae: Epacridoideae

In collaboration with Honorary Research Associate Professor Chris Quinn and Margaret Heslewood, Dr Elizabeth Brown has continued revision of the systematics of subfamily Epacridoideae. Their current work concentrates on the *Cyathodes* group where they are attempting to resolve the molecular information against morphological characters.

Darren Crayn and Elizabeth Brown are working on the systematics of the genus *Lissanthe*, building on the considerable body of unpublished work of Jocelyn Powell by conducting cladistic analyses of molecular data as well as continuing the descriptive work. Results to date have established the limits of the genus and identified at least one new species from Western Australia.

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. Ken Hill continued a systematic 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. A trial version of the Eucalink web site was opened to the public, with funding assistance from the Community Access to Natural Resources Information program.

Fabaceae: Faboideae

Dr Peter Wilson continued work on the genus *Indigofera*, in the family Fabaceae, and described a distinctive new species from the Northern Territory. The *Indigofera pratensis* species complex, distributed along the Queensland coast and west to Mt Isa and the Northern Territory, has been the subject of morphological and molecular studies by PhD student Ms Aniuska Kazandjian, a student from James Cook University, Townsville. PhD student Ms Kazandjian, jointly supervised by Prof. Betsy Jackes and Dr Wilson, relocated to Sydney for the final stage of her project. A number of new taxa are likely to be recognised as a result of this study.

Fabaceae: Faboideae

Postgraduate student Peter Jobson and his co-supervisor Dr Peter Weston made progress in preparing descriptions, as well as a morphological data matrix, for a cladistic analysis for species of *Dillwynia* as part of their taxonomic revision of the genus. They also published a revised treatment of *Dillwynia* in the second edition of *Flora of New South Wales* volume 2. Data on all species of *Dillwynia* was provided for a computerised, interactive identification system for Australian peas, to be published by the Australian Biological Resources Study.

Fabaceae: Mimosoideae

Drs Mary Tindale and Phillip Kodela published a revision of *Acacia wickhamii* with four subspecies, from northern tropical Australia, in the *Flora of Australia* Volume 11B. A revised and much expanded treatment with 238 species of *Acacia* by Dr Kodela and Gwen Harden was published in the 2002 edition of the *Flora of New South Wales* Volume 2 (217 species were included in the 1991 first edition). Dr Kodela continued systematic studies, curation and advising on acacias.

Flora of Lord Howe Island

Dr Elizabeth Brown, Alan Leishman and Marion Westmacott continued work on surveying liverworts, freshwater algae and weedy species from Lord Howe Island for a web-based interactive guide to the flora of this region. This is a collaborative project with Ian Hutton, Jenni Le Cussan and the Lord Howe Island Board. A number of new records for the island have been made, as well as a liverwort new to Australia and one that is to become a newly described species. Marion made the initial sketches for a painting that will form the backdrop for the web site and it was subsequently auctioned to raise money for the Friends of Lord Howe Island.

Freshwater algae

Four papers published in *Telopea* by Dr Tim Entwisle and Dr Stephen Skinner document new species and new records of macroalgae from freshwater habitats in New South Wales. This first stage of the NSW Biodiversity Strategy funded project resulted in 5 new species to science, and 27 new records for New South Wales. The second stage was completed in June and will result in two more papers on filamentous green algae (including one new species, 11 new records and 3 reassessed taxa) based on 139 collections of freshwater algae from catchments of Murray and Murrumbidgee Rivers, south coast, far north coast and incidental locations elsewhere.

Dr Skinner and Dr Entwisle also 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. *Oedogonium* is 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 new species to science and twenty or more new records, in a total flora of at least one hundred species. Many 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 subcontinent.

Two possible new genera of freshwater red algae collected from Queensland are still under study by Dr Entwisle in collaboration with Professor John West (University of Melbourne) and Dr Morgan Vis (Ohio University, USA). One is a uniseriate filamentous algae from tropical rainforest streams in northern Queensland, the other is a tiny terrestrial tuft from a rock seep in Lamington National Park.

Honorary Research Associate Mike Dingley published a paper in *Telopea* documenting five new species and 79 new records of desmids (microalgae) for New South Wales.

Lamiaceae

Dr Barry Conn, Nikola Streiber and Dr Rogier de Kok (Centre for Plant Biodiversity Research, Canberra) have continued 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 *Chloanthae* and *Westringieae*.

Lichens

Honorary Research Associate Dr Alan Archer continued work on the Australian Graphidaceae and three new taxa have been described. The type specimens of the two endemic, monotypic genera *Gymnographa* and *Diplogramma* have been identified as *Phaeographis eludens* and *Opegrapha australiensis* respectively. The Graphidaceae of the Solomon Islands is being studied for the first time and seven new taxa have been described from the Island of Guadalcanal. Specimens from the other islands are to be examined.

The two-day 15th Australasian Lichenologists Meeting was held at Blackheath in April. A list of taxa collected from the region is to be sent to NSW National Parks and Wildlife Service.

Professor J.A. Elix (Australian National University) and Dr Archer have been appointed co-supervisors for a PhD student in Majeo University, Chiang Mai, Thailand; she is studying the lichen genus *Pertusaria* in northern Thailand. A paper describing two new species is already in press.

Marine algae

Dr Alan Millar and Nick Yee continued their critical surveys of the marine algae of the coastline from Twofold Bay to Montague Island, resulting in the discovery of several new genera and species and 23 new records for the State. Dr Millar was also involved in two international collecting expeditions, one to the Kwazulu Natal coast of South Africa, which resulted in the addition of 98 species to the herbarium holdings, and the other to the Shirahama Prefecture of Honshu, Japan. The latter resulted in the acquisition of a six-volume exsiccatae containing 189 species of pressed marine algae from Japan, in addition to 30 species collected by Alan himself.

The publication of a world monograph of the green macroalgal genus *Rhipilia* completed a seven-year research program in collaboration with Dr Gerald Kraft (The University of Melbourne). Clarification of the taxonomy of the red algal genus *Sciadophycus* also resulted in a publication in the International Phycological Society's journal *Phycologia*.

Major grants from the Hermon Slade Foundation and the NSW Biodiversity Strategy continued to support much of the research on marine algae of the State, while students from Wollongong University and La Trobe University complete theses under the co-supervision of Dr Millar.

Poaceae

Sampling for molecular studies was completed for the Australian native species of *Austrostipa* but sequencing and analysis has shown a serious problem with the ITS sequences used. Dr Joy Everett and Dr Surrey Jacobs uncovered the problem while analysing results and are now working on ways to overcome the setback. Some resampling and resequencing is part of the process. Scanning Electron Microscopy was tested on selected material to estimate variation and establish scoring systems. New sequences are now available and will be analysed.

The third edition of *Grasses of New South Wales* (D.J. Wheeler, S.W.L. Jacobs and R.D.B. Whalley) was published during the year. It is an expanded and updated treatment of our grasses, including additional species descriptions and many more references.

Honorary Research Associate Dr Peter Michael completed an account of *Echinochloa* for the forthcoming Grass Flora of North America. A revision of the genus in Australia, particularly as a weed of rice crops, continued.

Proteaceae

Dr Peter Weston and Rob Kooyman prepared 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. The one tree of *E. hardeniana* that has accessible flowers is especially unusual in showing a tendency to producing 5-merous flowers. This feature is found in other taxa of Proteaceae only as an occasional developmental abnormality, so it will be interesting to see whether other individuals show this tendency too.

Pteridophyta

A cytotaxonomic survey of the Pteridophyta in Australia by Dr Mary Tindale and Professor S.K. Roy (formerly Banavas Hindu University, India) undertaken some years ago has now been published in *Australian Systematic Botany*. (See also Blechnaceae in the next section.)

Ranunculaceae

Studies of the aquatic species of *Ranunculus* in eastern Australia by Honorary Research Associate Dr Barbara Briggs and Robert Makinson led to the submission for publication of the description of a species widespread in southern Queensland and northern and central New South Wales. A further new aquatic species was distinguished in western Victoria by Dr Briggs and Neville Walsh of the Royal Botanic Gardens Melbourne. Chromosome counts previously made on species of *Ranunculus*, and on a range of other angiosperm families, were assembled for publication.

Restionaceae

Study of the Restionaceae by Dr Briggs continued using both morphological and DNA data. A paper was submitted naming new Western Australian species in the genus *Hypolaena* 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 revision of the genus *Homalomena* in Malesia with Clare Herscovitch. Clare Herscovitch continued to prepare, database and distribute to other herbaria, material from the living research collection of Araceae, and to distribute remaining living material from the collection to other botanic gardens.

Senior Horticulturalist Lorraine Perrins and Horticulturalist Darcy Tordoff established propagation trials of *Amorphophallus titanum* at Bogor Botanic Garden, Indonesia. The project, overseen by Dr Alistair Hay, seeks to demonstrate that this plant can be commercially propagated using low technology methods.

Blechnaceae

Honorary Research Associate Professor Carrick Chambers continued studies on several morphologically based groups within the genus *Blechnum* with comparative studies of herbarium specimens across their geographic range in Africa, Malesia, Australasia, Oceania, southern North, Central, and South America. Following the publication in *Blumea* of a monograph on the genus *Blechnum* in Malesia, a 'Flora of Australia' account is now in preparation. Other studies include world-wide treatments of five selected groups of species of *Blechnum* primarily focussing on those well represented in the Australian and Pacific regions. A monograph on the blechnoid genus *Stenochlaena* is nearing completion and the relevant species from this study will be prepared for a Flora Malesiana account.

Collaboration with Indonesia

A Memorandum of Understanding between the Gardens and the Center for Plant Conservation - Bogor Botanic Gardens (part of The Indonesian Institute of Sciences) was signed by Gardens Director Frank Howarth and Dr Dedi Darnaedi at the *Flora Malesiana Symposium*. This MoU covers collaborative work in conservation and research, such as the *Amorphophallus* propagation project. The Gardens also contributed to an Australian Centre for International Agricultural Research (ACIAR) funded program in Sulawesi, Indonesia, conducting disease surveys and training scientists.

Cycadophyta

Ken Hill completed three-weeks field study on cycads in North Queensland in August 2001, in collaboration with visiting Chinese research scientist Prof. Liu Nian from the South China Institute of Botany, and with Leonie Stanberg. Work continued on the cycads of Indonesia and the Philippines, and funding was obtained from the Bressler Foundation (USA) to assist with field work during the 2002-2003 financial year. Analysis of molecular data continued for data accumulated for the cycad genera and the genus *Cycas* in particular, and a paper on the molecular phylogeny of the cycadales has been submitted 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). Ken Hill travelled to California in October 2001 to act as an expert witness in a cycad smuggling case, and to Miami in April 2002 as an invited and sponsored contributor to a symposium and workshop on cycad classification concepts.

Juncaceae

Karen Wilson contributed to the treatment of the family Juncaceae for the International Organisation for Plant Information (IOPI) Species Plantarum *World Flora* – now in press. Her revised treatment of the genus *Juncus* for the Malesian region (the original treatment was published in 1951 and was very out of date) was published in *Telopea*. This paper includes an overview of related septate-leaved species native to Australasia and continental Asia. She also published a new species, *Juncus edgariae*, from New Zealand, honoring Dr Elizabeth Edgar of CHR. These papers bring to a conclusion part of the work on this family started many years ago by the late Dr Lawrie Johnson.

Management of plant diversity information

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

The Gardens continued its contribution to national and international committees related to the management and dissemination of plant diversity data. In particular, the Gardens is represented on the Executive Committees of key international database groups (particularly, Executive Committee of the IUBS *Taxonomic Database Working Group*, Chair of the *Global Plant Checklist Committee of International Organisation for Plant Information*, vice-chair of the *Global Biodiversity Information Facility (GBIF) Node Managers Committee*, and vice-chair of the project team of *Species 2000*). The Gardens organised a *Biodiversity Knowledge Management Forum (BioForum1)* held here in November 2001, building on our expertise in the management and theory of biodiversity information. In addition, we organised *BioForum2* here in March. This included meetings of management and working groups of TDWG, IOPI, and Species 2000, followed by the *Catalogue of Life* workshop – a GBIF advisory group meeting.

The Gardens is also a member of the *Species 2000 Asia-Oceania* group, with Karen Wilson on its committee. This group encourages international and national biodiversity activities in the broad region, including organizing the first GTI workshop for Asia, to be held in Kuala Lumpur in September 2002.

Urticaceae

Dr Barry Conn, Juli Hadiah, Esti Aryianti, Dr Chris Quinn and Dr Murray Henwood (The University of Sydney) have undertaken systematic studies in the Tribe Lecantheae. Molecular data supports the monophyly of the family. The current studies are concentrating on the systematics of the genera *Elatostema* and *Procris*. A field survey of these later two genera was successfully undertaken in Sumatra. A morphological review of the genus *Cypholophus* (Tribe *Boehmerieae*) is being undertaken by Dr Conn and T. Haryani (Institut Pertanian Bogor, Indonesia).

Origins and Evolution Theme

Basal-relictual angiosperms

Dr Peter Weston collaborated 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 includes Honorary Research Associate

Assoc. Professor Peter Bernhardt (St Louis University, U.S.A.), Dr Tammy Sage (University of Toronto, Canada), Professor Leonard Thien (Tulane University, U.S.A.), Dr Hiroshi Azuma (Kyoto University, Japan), and Dr Jeremy Bruhl (University of New England). They have found that both *Amborella trichopoda* (Amborellaceae), the sister species of all other extant angiosperms, and *Trimenia moorei* (Trimeniaceae), are each pollinated by diverse arrays of insect species, representing several different orders. These findings are consistent with the hypothesis that ancestral angiosperms had relatively unspecialised pollination systems. *Amborella trichopoda* was also found to be highly specialised in playing host to a remarkably complex community of insect parasites and parasitoids. Dr Weston and his colleagues are working on manuscripts describing these symbiotic interactions and other aspects of the reproductive biology of these plants.

Casuarinaceae

Karen Wilson continued a major study of the family Casuarinaceae with interstate collaborators, with ABRIS funding for the molecular component being carried out in Hobart by Dr Dorothy Steane. The project will bring together molecular, morphological, anatomical and palaeontological data (the latter from the third collaborator, Professor Robert Hill, Adelaide) to investigate relationships of and within the family, testing hypotheses put forward by the late Dr Lawrie Johnson. To date, sequencing of the *matK* 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 the plan is to investigate nuclear 26S ribosomal DNA if funding is found. Karen Wilson collected more samples in New Caledonia in August, both for this study and for her nearly-completed treatment of the family for the *Flore de la Nouvelle-Calédonie*.

Dennstaedtiaceae

Analysis of the biogeographic and evolutionary history of the bracken ferns (*Pteridium*) world-wide by Honorary Research Associate Professor John Thomson continued. Collaborative work with Professor Miguel Alonso-Amelot (University of the Andes, Merida, Venezuela) has now permitted generalisation of the previously tentative conclusion that the morphotype *caudatum* is an allotetraploid derived from northern and southern hemisphere progenitors, and this work has been submitted for publication. Attention is now focused on resolving the relationships and taxonomy of morphotype *centrali-africanum* from tropical East Africa.

To finalise collection of the information needed for a formal review of the genus *Pteridium* as a whole, an informal international consortium involving bracken researchers from the United Kingdom, Sweden, Russia and Ukraine has provided material for DNA fingerprinting at the Gardens. This study should when completed resolve outstanding questions of relationship and status amongst controversial European bracken morphotypes, especially in relation to the principal pan-boreal *latiusculum* lineage. New ISSR markers have been identified during the year, improving the resolution achieved by DNA fingerprinting in this lineage.

Freshwater red algae

The collaboration between Dr Tim Entwisle and Dr Morgan Vis of Ohio University in the USA continued with a third paper in preparation. This study examines relationships within the red algal order Batrchospermales, so far identifying a distinctive Australian clade as well as some more widespread taxa. The work is also revealing variation at species level and will be used to resolve the *B. pseudogelatinosum* and *B. theaquum* complexes in Australia and New Zealand.

Myrtaceae

The phylogeny of the family Myrtaceae has been the subject of ongoing collaborative work between Dr Peter Wilson and Associate Professor Chris Quinn of the University of NSW. This collaboration has continued since Dr Quinn's recent retirement and relocation to the Gardens as an Honorary Research Associate. A paper on progress in understanding relationships within the *Chamelaucium* Alliance, based on an analysis of molecular data, has been accepted for publication in the journal *Australian Systematic Botany*. This project was started by BSc.(Hons) student Nikolas Lam and has continued with funding from the Australian Biological Resources Study. Work is continuing on this group with the assistance of Margaret Heslewood.

A paper was published in the *American Journal of Botany* on relationships within the family Myrtaceae, based on the combined analysis of morphological and molecular (*matK* sequence) data. This analysis was carried out on an identical set of exemplar species chosen to represent the core genera or groups of genera in the family. This study confirmed the view that fleshy fruits have arisen independently in at least two separate groups of genera, the Lilly Pilly and Myrtle/Guava groups.

A paper describing *Stockwellia*, a genus of rainforest trees with one species of restricted distribution on the Atherton Tableland, has been accepted for publication in the *Botanical Journal of the Linnean Society*; this paper was written in collaboration with four other authors. The genus is a member of the same group as the eucalypts and appears to be most closely related to the genus *Eucayptopsis* from New Guinea.

Orchidaceae

Phylogeny reconstructions allow us to make all kinds of scientific inferences about evolutionary history that previously were the realm of pure speculation. The chloroplast DNA phylogeny for the predominantly Australian orchid tribe Diurideae, published in late 2001 in the *American Journal of Botany*, by an international team including Dr Peter Weston, is a case in point. Perhaps the most interesting implication of this phylogenetic tree is that pollination by sexual deception has evolved independently in at least five different diurid lineages. The flowers of sexually deceptive orchids mimic the smell, feel, and appearance of female insects and are pollinated by male insects, which attempt to copulate with them. Why are diurid orchids so good at mimicking different kinds of female insects? Female insects exude specific chemicals (pheromones) to 'tell' males that they are ready to mate. It seems that, fortuitously, the epicuticular waxes of diurid flowers are chemically very similar to the pheromones used by some insect groups, thus facilitating their sexual exploitation.

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. Postgraduate student Jim Mant and his co-supervisor, Dr Peter Weston, have investigated the evolution of sexual deception in this genus by reconstructing the phylogenies of both

the orchid species and their pollinators. They did this to test the hypothesis that highly specialised symbiotic relationships are likely to have co-evolved over a long time. 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.

The route to a male insect's heart may also be through his stomach as well as through his genitalia. Many other species of Diurideae are thought to be food mimics. One species, *Diuris maculata*, for instance, has been shown in Victoria to mimic the flowers of 'egg and bacon peas' and is pollinated by the same male bees that collect pollen and nectar from the peas. This prompted postgraduate student James Indsto and his co-supervisor, Dr Peter Weston, to investigate the generality of this phenomenon in *Diuris*. However, food mimics present a major technical difficulty: bees soon learn to distinguish food-bearing flowers from foodless replicas and are rarely observed visiting *Diuris* flowers. James Indsto has evaded this problem using genetic fingerprinting techniques. He has used a recently developed class of molecular markers, Amplified Fragment Length Polymorphisms, or 'AFLPs' to derive a unique genetic fingerprint for each major species group in *Diuris*, allowing them to be distinguished from each other and from other orchid genera. Although bees rarely visit *Diuris* flowers, a high proportion of individual bees have visited one or two flowers, and still carry the remains of pollinia on their heads. James Indsto catches bees in the vicinity of a *Diuris* population, removes any remnants of pollinia from their bodies, and identifies these scraps of plant tissue on the basis of their AFLP fingerprints. He has been able to show that a number of *Diuris* species are probably bee-pollinated. His field work will resume in Spring, 2002.

Proteaceae

Peter Weston collaborated with Honorary Research Associate Assoc. Professor Peter Bernhardt (St Louis University) and Robert Kooyman (The University of New England) in conducting preliminary research into the reproductive biology of *Eidothea hardeniana* and *Triunia youngiana*. Their observations suggest that *E. hardeniana* may be pollinated primarily by beetles and *T. youngiana* by butterflies and moths. They hope to follow up on this study with more field work in 2003.

Restionaceae and allied families

Honorary Research Associate Dr Barbara Briggs and Dr Adam Marchant made further progress in studies to clarify relationships within the Restionaceae and the affinities of this and related families, especially the Centrolepidaceae. The range of Centrolepidaceae available for DNA sequencing was expanded through fieldwork in Tasmania, with the assistance of Dr Gintaras Kantvilas and Dr Jean Jarman of the Tasmanian Herbarium. Dr Briggs also collaborated with Professor Peter Linder of the University of Zurich, Switzerland, and Dr Pia Eldenas of the 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 to explain these differences, in accord with the environmental history of the regions, have been developed.

Management of Preserved Collection

Australia's Virtual Herbarium

The herbaria of Australia—held in botanic gardens, environment agencies and CSIRO — hold a vast source of largely untapped information about the plants of this country. In particular, only half of the more than 6 million preserved plant collections are databased, and there is no 'one-stop shop' for accessing the nation's plant information. 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 plants 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 will support databasing until June 2003. The total number of specimens databased to date is 33,000, somewhat lower than the required rate. Some delays were due to the new NSW Collections database being installed. The process took much longer than expected due to a range of technical issues and existing data errors. Once fully operational, NSW Collections, will increase efficiency and accuracy in handling data within the Gardens as well as open up new opportunities for delivering plant information to the wider community. Further developments to increase the databasing rate for Australia's Virtual Herbarium include a rapid-entry screen and improved access to data from replicates processed in other herbaria.

In addition to databasing thousands specimens the AVH project has resulted in many curatorial benefits to the collections: e.g. identifications of thousands of specimens have been checked, and numerous nomenclatural changes from the literature have been incorporated. There have also been improvements in the physical curation of 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 needs-analysis was completed as the first part of a position paper to the Trustees concerning future needs for the Herbarium and associated office and laboratory space. The results will help us plan for expansion in staff and students, as well as the preserved plant collection.

NSW collections management system

Dr Barry Conn, Gary Chapple, Peter Savio and Chris Ward continued to work with KE Software to develop the NSW Collections database for the Gardens. The new system will incorporate herbarium, living (horticultural), and floristic survey data into a single database system.

The Australia's Virtual Herbarium team has also assisted by testing the new system, in particular by inserting and editing catalogue records, but also helping maintain the taxonomy module of plant names and party module of people's names. The team have made numerous recommendations towards improvements to the workings of the new database at critical points in its implementation.

Communication and Services

Botanical Information Service

Service levels throughout our information services were maintained and delivery improved through greater use of the Internet. Satisfaction with the *PlantNET* service is measured through email feedback. 352 enquires (cf. with 294 last year) were processed through *PlantNET*, of which about 200 were from Australia (of which 43 were from State Government agencies and 20 from educational organisations).

INQUIRY STATISTICS*	2000–2001	2001–2002
Inquiries by mail	1082	1353
Inquiries by telephone	1997	1841
Inquiries in person	322	447
Inquiries by Internet	294	352
Requests for Electronic Data	18	16
Specimens Identified	5822	7099**
Revenue	2000-2001	2001-2002
	\$9,543	\$9,729

* Staff also identify species and provide botanical information outside the Botanical Information Service.

**Including specimens identified as part of the NSW Vegetation Mapping Program contract with Department of Land and Water Conservation.

Flora of New South Wales

The fully revised Volume 2 of the *Flora of New South Wales* was launched on 25 March by Royal Botanic Gardens and Domain Trustee, Ros Andrews. Present were Gwen Harden (editor) and many of the contributors to the volume, as well as representatives of the publishers UNSW Press.

The revised edition of volume two of the *Flora of New South Wales*, published in March, will be the last of the current hard-copy series; the *Flora* will now be updated and developed on-line. A pilot internet version for the species included in Volume 3 (69 families, including Asteraceae, Lamiaceae and Epacridaceae) was prepared by Ken Hill and Andrew Perkins, and is almost ready to launch. Funded by royalties from the hard-copy series, the on-line version will include semi-interactive identification keys (i.e. reduced dichotomous keys generated from information such as flowering time and biogeographical regions), a complete description of each species, ecological information from the Sydney Region (sourced from the 'Ecology of Sydney Plant Species' series published in *Cunninghamia*), and links to images available on the web as well as our own illustrations.

Stage one of a new PlantNET module, WattleWeb, is now available on-line at plantnet.rbgsyd.nsw.gov.au/PlantNet/wattle. This 'web guide' to the genus *Acacia* in New South Wales includes a full interactive key, distribution maps, and ecological and horticultural information. The next stage will include full descriptions and illustrations.

Forensic identification

Government analysts identified forensic material (*Cannabis*) in 19 cases for the Police Service, resulting in revenue of \$1045.

PlantNET

The Gardens' on-line plant information service, PlantNET (lantnet.rbgsyd.gov.au), was developed further. The site provides 'live' access to the herbarium database, including a

listing of every native and naturalised plant in NSW (with common names and distribution by botanical region), as well as rapid searches and email notification of new weeds and rare or threatened species in the State. It is part of the State's Community Access to Natural Resource Information website and will soon be linked to the national Australia's Virtual Herbarium website.

Various modules are in development. WattleWeb was further enhanced with images, including drawings and habit photographs. Photographic images of herbarium specimens were prepared as part of the HerbLink module of PlantNET. These images of herbarium specimens of the species that occur within the State can be used as a authenticated reference for field identification. A census of liverworts and an interactive key to eucalypts were also added.

Public Reference Collection

Environmental consultants, students, government agencies, and the general community spent nearly 200 hours using the Public Reference Collection to identify plants that they had collected. Volunteers continued to update and expand the collection.

Telopea

Telopea is New South Wales' leading scientific journal for the publication of plant diversity information. The focus of the journal is the discovery and documentation of plants, 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.

A single issue, number three of volume nine, was published during the year. The second issue was prepared for publication in July 2002. Highlights of 9(3) include:

- A series of seven papers by staff and associates of the Gardens reporting on cryptogam work funded through the *NSW Biodiversity Strategy*. Twelve new species are described and 48 species reported for the first time from Australia. The cryptogams — algae, fungi, lichens and bryophytes — include many more species than flowering plants, and these papers make a major contribution to our knowledge of the flora of New South Wales. Some of the intriguing groups studied include:
- The 'gelatinous blue-green algae' group, including Troll's Butter (in time for Harry Potter and Lord of the Rings celebrations) and Black Moss (imported into New South Wales as a speciality food).
- The 'script' lichens that produce squiggles and weal-like markings on tree trunks
- The microscopic desmids that inhabit almost all pools and ponds no matter how temporary.
- A full taxonomic revision of three genera in the aroid family from Malesia, Australia and tropical Pacific. Of the 46 species recognised, three are new to science.
- A revision of some closely related grass genera, resulting in the description of a new genus *Lachnagrostis* with 20 species found throughout temperate areas of Australasia, as well as four new species of *Agrostis* from New South Wales.
- Six new species of *Solanum* (in the tomato/potato family) from New South Wales.

To further our objective to expand the scope and audience of *Telopea*, the format was modified for some of the cryptogam papers to reflect the different traditions in these disciplines.

Vegetation mapping identifications

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

Part 5: Resources Section

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

Library

New accessions

This year the library acquired 2100 items (715 monographs and 1385 journal issues). 4064 items were loaned or circulated, and 800 inquiries processed. 397 visitor hours were spent in the library.

Physical care

Monitoring of the physical climate in the library continued. The upgrade of the air-conditioning system for the entire Brown Building (see below) improved the stability of both temperature and humidity.

Highlights

The physical rearrangement of the library collection, commenced several years ago by volunteers, was completed. Additional shelving was added and better use made of space in the compactus shelving.

Botanical Illustration

Illustration archive

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

Digital imaging project

As part of the Digital Imaging Project, a large proportion of the illustration archive was scanned and attached to the multimedia module of the NSW Collections database. Electronic versions of the illustrations are now available to staff and will shortly be available on the internet. Higher resolution scans will be available for publishing if required. The remaining works, namely Margaret Flockton's drawings and approximately 100 *Eucalyptus* and *Corymbia* illustrations, are yet to be scanned and added to NSW Collections.

Endangered and vulnerable plants/WattleWeb

The WattleWeb project is ongoing with all of the Schedule 1 and Schedule 2 listed New South Wales *Acacia* species completed. In addition, the more common species of *Acacia* in the State continue to be illustrated, with a total of 63 species now completed. The national Endangered and Vulnerable Species Project is continuing with 20 endangered species fully illustrated. The current focus of this project is to illustrate New South Wales species being listed as endangered nationally.

Other major projects

- Taxonomic work has been completed for publication in *Telopea*, *Blumea*, *Cunninghamia*, *Hattori Botanical Laboratory*, *RBG news*, and PhD theses for botanists, honorary research associates and students.
- Training has been provided for horticultural apprentice, Adam Gill, for a period of 3 months where he produced 5 *Acacia* and 3 endangered species illustrations that have been added to the archive and NSW Collections.
- The Illustration section accepts occasional volunteers (chosen by portfolio) to join the team for three or four months and produce several illustrations.

Herbarium Specimen Preparation Facility

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.

Experimental program

During 2001, Rosie Arnold conducted a study to determine the best protocol for treating outbreaks of *Stegobium paniceum* at the National Herbarium of NSW. This insect, commonly referred to as the herbarium beetle, is extremely destructive to botanical specimens and poses a considerable threat to the preservation of the collection.

The study involved freezing different developmental stages of *S. paniceum* at -18°C , for various time periods. Results indicated the most efficient freezing time to achieve 100% mortality of the insects was 11 hours (this incorporates the time taken for specimens within the boxes to reach -18°C). This study also provides evidence that freezing can be used as an ongoing and efficient method of pest control and pest eradication as part of the Integrated Pest Management procedures.

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.

This year has seen the implementation of the final stages towards our IPM program through the upgrade of the air conditioning system to allow better control and monitoring of the building environment. This year has also seen the introduction of continuous pest monitoring and the use of low toxic pheromone traps specifically targeting insect pests.

In 2002 we were fortunate that there were relatively few reported incidences of herbarium pests indicating that the IPM program has been successful. This was in spite of long periods of poor environmental control during the summer months whilst new air conditioning chillers were being installed.

Volunteer Programs

Databasing program

Volunteers databased in excess of 2,228 specimens during the year, a sharp decrease on last year's 5,718 specimens. This decrease was due to the development and introduction of the new NSW Collections database. The transfer of data from disks to the new database for

exchange specimens for which electronic records were provided from other herbaria has not been operating during the 2001-2002 period. This also contributed to the reduction in numbers of specimens databased.

Specimen mounting program

Fifty-three regular volunteers mounted 25,650 specimens on archival paper, slightly increased from last year (24,300 specimens). Outgoing loans, incoming exchange and fragile or vulnerable groups within the Herbarium collection were given highest priority. A total of 1,120 cryptogram specimens were also mounted, data based and packaged, again slightly down from last year.

Other volunteer programs

Volunteers assisted with limited general curation and research in the Plant Sciences Branch. Projects included the photographing of Type specimens, maintenance of the Public Reference Collection, and assisting with herbarium research for the *Ecology of Sydney Plants Species* series. Mounting and some curation of marine algal material were also carried out.

Electron Microscopy

Facilities

The Cambridge S360 SEM was out of action for extended periods during the year due to power supply and other failures. It is becoming difficult to continually maintain the microscope due to its age (12 years). Consideration is being given to replacing the microscope within the next few years. Due to the difficulty of maintaining darkroom facilities following the introduction of digital technology, the out-sourcing of film processing was investigated and is being implemented.

Transmission Electron Microscopy (TEM). The RBG does not have a TEM, but has access to facilities at Sydney Hospital. The major application is the examination of specimens for the Australian Quarantine and Inspection Service (AQIS) on behalf of the Plant Pathology Diagnostic Service. A total of 48 samples were processed for AQIS this year.

Projects

- Kioumars Ghamkhar, PhD student, University of New England, commenced a pollen morphology study of *Fimbristylus* (Cyperaceae).
- Continuing studies by Liz Norris of *Nassella lemma* and leaf epidermis as part of an international Stipeae (Poaceae) working group.
- Professor John Thomson investigated the false indusium (recurved leaf segment margin) and stomatal guard cells of bracken ferns (*Pteridium*), from samples from tropical Central and South America. The Linnean Herbarium, London gave permission to examine historic Linnaeus' specimens labelled *Pteris caudata*, including the sheet currently recognised as the lectotype of *Pteridium caudatum*, confirming that *P. caudatum* is a tetraploid species derived by hybridisation of diploid northern and southern hemisphere progenitors.
- The taxonomy of the fungal world was further enhanced through ongoing studies of taxonomy of *Acacia* (Mimosoideae) rusts (NSW Agriculture).
- Taxonomy of basidiomycetes based on spore morphology (NSW Forestry).
- Scanning Electron Microscope demonstrations for high school biology teachers, TAFE students, Biological Evidence Course students and Botanical Illustration Course students.

Molecular Systematics Laboratory

Graduate student research projects

- Andrew Perkins was awarded a doctoral degree by The University of Sydney, in May 2002 for his work on the orchid genus *Calochilus*, becoming the first graduate from the Gardens' molecular systematics program.
- Jim Mant (PhD student, Australian National University) finished his laboratory research on another orchid genus, *Chiloglottis*, and will submit his thesis in the coming year. A paper on his work (with Dr Peter Weston) has been published in *Evolution*.
- Other PhD student research includes investigation of two tribes within Cyperaceae – Abildgaardieae, by Kioumars Ghamkhar, and Schoeneae, by Xiufu Zhang. Both of these scientists are enrolled at The University of New England. Kioumars presented his results at the Genetics Society of Australia conference in Sydney.
- Paul Rymer (PhD student, The University of Wollongong) also gave a presentation to the Genetics Society, on his work on population genetics in *Persoonia*.
- Juli Hadidah (PhD student, The University of New South Wales) continued her research into the relationships within Urticaceae, and Nikola Streiber (PhD student, The University of Sydney) into the Chloanthaceae. George Orel (PhD student, The University of Western Sydney) is continuing studying the genetics of *Juglans*, and he presented some of his results to the Genetics Society of Australia.
- Nick Yee is studying molecular genetics of the brown algal order Sporochinales, towards a MSc. degree at The University of Melbourne.

Staff and honorary associates research projects

- Carolyn Porter has been investigating relationships within *Persoonia*, together with Dr Peter Weston, and genetic variation within *Eidothea hardeniana*, with Maurizio Rossetto.
- Professor John Thomson continued his research into the genus *Pteridium*, particularly on the European species, and also adding material from tropical Africa to his study.
- Dr Adam Marchant, with Dr Barbara Briggs, continued research into the affinities of the Restionaceae and related families. He commenced a project on genetics of Australian native *Solanum*, together with Dr Peter Wilson. He also worked on developing molecular fingerprinting techniques for cultivar identification of *Actinotus* varieties developed by Dr Cathy Offord's team, and a presentation on this work was made at the 6th Australian Wildflower Conference in Warwick Farm.
- Margaret Hesslewood continued research on *Baeckea*, with Dr Peter Wilson and Professor Christopher Quinn, presenting at the Genetics Society of Australia conference; on Asteraceae, and also conifers, again with Professor Quinn, and on Epacridaceae. Some of the Epacrid work, with Wayne Cherry, Dr Elizabeth Brown, Dr Darren Crayn, and Professor Quinn, was published in *Australian Systematic Botany*.
- Hannah McPherson and Will Cuddy, together with Dr Brown, began molecular systematic research on Lepidoziaceae.

Building Infrastructure

Several building modification projects were undertaken within the Brown Building during the year.

Energy performance contract

An Energy Performance Contract (EPC) was entered into between the Royal Botanic gardens 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 along with other air conditioning improvements. This work constitutes Stage 1 of the EPC with Stage 2 to be implemented in the 02/03 financial year.

Details of the Stage 1 EPC are:

- Loan - NSW Treasury
- Project cost - \$105,000
- Energy savings - 184 GJ pa, (equivalent to CO₂ savings of 325 tonnes pa)
- Guaranteed savings - \$18,975 pa

Brown Building modifications

Due to the increasing numbers of students and the commencement of the Australia's Virtual Herbarium project, several rooms have been modified with improved office accommodation for staff and students.

Other projects included the installation of 14 new shelving bays of herbarium shelving (108 metres of shelving).

Brown Building water leaks

The Department of Public Works and Services investigated the cause of leaks on level 4 of the Brown Building and have changed drainage arrangements on the roof to improve water run-off during heavy rain. The effectiveness of these measures is yet to be tested in heavy rain.

Health and Safety

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

Lost time injuries

There were no lost time injuries reported for the Plant Sciences Branch.

Risk assessments

As part of the Gardens program on risk assessment, inspections were carried out in the four laboratories (Molecular, Scanning Electron Microscopy, Plant Pathology and Mount Annan). Meetings with all laboratory staff to identified the most dangerous procedures or hazards in each laboratory. The results will be used to develop Safe Work Method Statements in line with the new WorkCover legislation. This procedure will be carried through to other areas, notably fieldwork.

Health and safety training

As part of ongoing health and safety training, 12 staff attended courses in 4-wheel drive, remote first aid and OH&S training.

Agency Projects

The Resources Manager undertook various other agency wide projects during the year.

Digital imaging project

As part of the implementation of the collection management system, \$230,000 of capital funds was allocated to develop an image database to allow electronic access to images held

within various collections within the RBG. The main outcomes of the Imaging Project included:

- Improved access to the image collections for both staff and general public
- Creation of over 7,000 records of images from the photographic collection and the illustrations archive
- Improved management of the collections for administrators
- Creation of digital resources for the production of journals, multimedia and web products, sales of images etc
- Dedicated work stations and imaging facilities installed at the Sydney, Mount Annan and Mount Tomah Gardens.

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:

- Introduction of visitor identification system in the Sydney Gardens
- Introduction of new digital staff identification badges
- Development of emergency procedures cards for all three sites
- Training of staff in emergency procedures
- Up-date of evacuation procedures on the Sydney site
- Up-date of the Sydney CIP
- Introduction of reporting procedures for all critical incidents
- Scenario training for Rangers on the Sydney site

Building code of Australia compliance report

During the implementation of the Critical Incident Plan, it was found that much of the Sydney site did not comply with the fire regulations of the building Code of Australia. A consultant was appointed to assess the degree of compliance and to identify deficiencies. The subsequent report was used to cost the modifications needed to ensure compliance and to form the basis of a Capital submission to Treasury.

Part 6: Centre for Plant Conservation

The Centre for Plant Conservation completed its first 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 & 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.

A major development was the appointment in February 2002 of Dr Maurizio Rossetto as Conservation Ecologist/Geneticist, bringing a new area of expertise to the Gardens. Dr Rossetto's research work initially is focussing on the genetic effects of fragmentation of native vegetation, particularly effects on the viability of remnant populations of species and of ecological communities. This work is of direct value in planning of on-ground conservation strategies for remnant bushland, and for threatened species management.

During the year, the Centre's extension activity concentrated on building links and alliances of interest with a variety of government agencies and community groups. The Centre and the Gardens 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.

In this role, the Centre organised two significant information-exchange events during the year, one on terrestrial orchid conservation in south-eastern Australia, and one on current botanical and ecological research efforts in the Cumberland Plain communities of western Sydney.

In a similar vein, the Centre, in alliance with the Australia Association of Bush Regenerators and the Australian Network for Plant Conservation, held two well-attended community seminars on the importance of genetic provenance issues in bush management and habitat restoration.

The Centre's website

(<http://www.rbgsyd.nsw.gov.au/HTML/SCIENCE/plantcon/index.htm>) has been redeveloped and now reflects a wider range of Gardens conservation activity, and provides a very 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 non-vascular plants (mosses, lichens and fungi).

Several issues have been produced of a Centre email bulletin, *CPC News*, which serves as an awareness vehicle for Gardens conservation activity among both Gardens' staff and a growing subscriber base in the agencies and community groups. Good publicity in the mainstream media was also achieved over the rediscovery of the long-lost species *Asterolasia buxifolia* in the Blue Mountains.

A grant for 2002/03 has been secured, jointly with NPWS, to develop a trial set of assessments of biodiversity on private lands in north-western New South Wales that have Wildlife Refuge status or Voluntary Conservation Agreements in place. In addition to

providing much-needed data on off-reserve conservation of native vegetation, this project will also allow the trialing of service and information modules for landowners that will result in close and ongoing relationships with the Gardens.

New South Wales Biodiversity Research Network

The Gardens continued to chair the NSW Biodiversity Research Network (BRN), which included representatives of the following agencies: NSW Agriculture, Zoological Parks Board, Royal Botanic Gardens Sydney, Australian Museum, National Parks & Wildlife Service, Department of Land and Water Conservation, State Forests of NSW, CSIRO, Macquarie University, University of Wollongong, University of Sydney.

A 10-month Project Officer position, funded through the *NSW Biodiversity Strategy*, commenced in March 2002 (Dr Meri Peach). The BRN was subsequently publicised to a wide range of stakeholders. Those who registered their interest (~240 people by August 2002) were placed on an e-mail list, which was used to disseminate information about biodiversity research, and to distribute a BRN newsletter every 2 months (commencing in June 2002). A website summarising the state of biodiversity research in NSW is under construction, to be hosted by National Parks and Wildlife within their new *NSW Biodiversity Strategy* website, which is currently in development.

Surveys to identify current research projects, and perceived research gaps and priorities, were sent out to BRN stakeholders and targeted universities around Australia in June-July 2002. The information gathered in these surveys is being incorporated into the BRN web pages. Dr Peach also prepared a submission to the Department of Education, Science and Training on behalf of the BRN, to nominate 'understanding and conserving Australian biodiversity' as a national research priority. Consultation with stakeholders during the preparation of this document was useful for identifying further research gaps and priorities, and along with the survey results, this will facilitate the listing and prioritising of research projects for the NSW Biodiversity Research Strategy. Dr Peach is also identifying and liaising with project officers responsible for identifying research gaps and priorities within other BRN agencies. A draft NSW Biodiversity Research Strategy is currently in development.

Part 7: NSW Biodiversity Strategy Report

The Gardens is represented on the inter-agency Biodiversity Strategy Implementation Group (BSIG). This group coordinates and reports on the implementation of *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, to advise the Ministers of Environment and Fisheries on biodiversity issues in NSW, and to oversee the *NSW Biodiversity Strategy*.

Implementation of the Strategy has focussed on the achievement of 22 priority actions by 2001; of these the Gardens 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 has been allocated to seven Government agencies, including the Royal Botanic Gardens. In 2001/02 the Gardens received \$133,040 for four projects, with a commitment to a further \$207,126 (including one additional project) in 2002/03. 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 Gardens as a Lead (L) or Support (S) organisation. Performance targets (in brackets) were to be achieved by 2001. Only those targets relevant to the Gardens 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 \$90,000 for PlantNET was achieved through the Community Access to Natural Resource Information (CANRI) program. New modules included a Census of liverwort names and an Interactive key for the Eucalypts in New South Wales. Herbarium images were captured using a new digital camera set-up, starting with threatened taxa and those included in the pilot 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 Gardens' Community Education Unit continued to incorporate various biodiversity topics in its programs for primary and secondary school students and community groups; especially in relation to rare and threatened plants (e.g. Wollemi Pine), rainforests and the Australian environment.

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 Gardens was allocated a further \$33,660 towards auditing the conservation status of NSW plant communities. An Access database has been developed, including records for all plant communities occurring on the Western Plains of NSW and some of the communities on the Western Slopes. Further funding through the NSW Biodiversity Strategy is available in 2002/03, and additional funding will be sought.

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 Gardens' 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)

Gardens' staff continue to contribute to recovery plans when requested by NPWS. The majority of these are informal (i.e. NPWS seeking advice from staff), but for a growing number, Gardens' staff are members of the Recovery Team.

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)

Funding of \$26,730 was made available to test and assess the viability of threatened species held in the NSW Seedbank at Mount Annan. Key taxonomic groups held within the seedbank for up to 15 years have been tested, some for the first time, providing baseline data on viability and indicating the success of storage techniques. This information is being used in the development of collection and storage guidelines for general collections and the needs of specific taxa.

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. Gardens' 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.

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) FUNDED

The working group formed by the Biodiversity Strategy Implementation Group does not include a Royal Botanic Gardens' 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) FUNDED

Dr Winston Ponder (Australian Museum) and Dr Tim Entwisle have a lead role in the inter-agency working group responsible for this priority action. \$38,000 was allocated to the Gardens in 2001/02 to discover and document new species of non-vascular plants. The results of the work to June 2002 were:

- 139 collections of freshwater algae from catchments of Murray and Murrumbidgee Rivers, south coast, far north coast and incidental locations elsewhere
- 222 collections of leaves containing 556 isolates of fungi causing leaf spots on Proteaceae from Southern Tablelands, Central and North Coast of New South Wales as well as Tasmania and north Queensland. 24 collections of 7 new species of *Fusarium* spp. from grasses in North West Plains and Western Division of NSW.
- Two manuscripts on freshwater algae in draft form - to be submitted to *Telopea* in July 2002.
- One manuscript on fungi submitted to *Mycologia*; three in preparation for submission to *Sydowia*, *Australian Mycologist* and *Australian Systematic Botany*.
- Summary of results so far:

Group	New species to science in NSW	New records of species for NSW*	Other Taxa revised and circumscribed for NSW	Notes
Freshwater algae	1	11	3	Research completed
Fungi	2	12	1	More to come
Bryophytes	–	–	–	Not yet commenced
Total to date	3	23	4	

*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)

No progress in 2001/02. Funding has been allocated for 2002/03 to prepare survey and assessment guidelines for monitoring non-vascular (non-marine) plants. This project will involve a collaboration between Dr Stephen Skinner and Dr Tim Entwisle from the Gardens, and Dr David Eldridge (DLWC).

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)

The Gardens continued to chair the NSW Biodiversity Research Network (BRN), including representatives of the following agencies: NSW Agriculture, Zoological Parks Board, Royal Botanic Gardens Sydney, Australian Museum, National Parks & Wildlife Service, Department of Land and Water Conservation, State Forests of NSW, CSIRO, Macquarie University, University of Wollongong, University of Sydney. Over one hundred 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 has been created and will be available to the public in August. One of the goals of the BRN is to identify gaps and priorities for biodiversity research in NSW. This will involve both collating the general research gaps and priorities already identified by government agencies, the biodiversity-specific gaps and priorities already identified by the BRN steering committee, and those that the BRN stakeholders identify. Surveys were sent to researchers and research users, with a response rate of 80 by the end of June.

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

Lynne Munnich BA(Syd) (on leave 5.10.2001)

Lauris Hudson (temp)

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

NSW Biodiversity Research Network Officer

Meredith Peach BA, BSc(Hons), PhD (Syd)

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)

Botanist

Maurizio Rossetto BSc (Hons)(La Trobe), MSc, PhD (UWA) (commenced 11.2.02)

Senior Technical Officers

Chris Allen Electrical Engineer, BSc Biology (Syd), PhD (Syd) (commenced 19.11.01)

Jocelyn Howell BPharm(Syd), BSc(Macq)

John Siemon, B.Hort.Sc (Hons) Uni Qld

Liz Ashby BSc(Syd) (on leave)

Technical Officer

Chris Togher BEnvSc(Wollongong) (temp)

Technical Assistant

Lyn McDougall BushRegenCert

Fungi and Plants

Senior Technical Officers

Linda Gunn BAgSc(Hons)(Melb)

Suzanne Bullock NZCS, MSc(UNSW)

Technical Officers

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

Julie Bates, AssDipAppSc(Ultimo TAFE)

Horticultural Research and Development

Horticultural Research Officer

Catherine Offord MScAgr(Syd), PhD(Syd)

Technical Officers

Joanne Tyler HortCert, BScUrbanHort(UTS)
Lotte von Richter MScAgr(Syd)
Patricia Meagher BScUrbanHort(Hons)(UTS) (temp)

Horticulturalists

Faye Cairncross AdvCertUrbanHort
Glenn Brooks BScUrbanHort(UTS), HortCert (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) (commenced 25.3.02)
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 (commenced new position 20.5.02)
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 BScAppPhysgeo (UNSW) (temp)

Herbarium Assistant

Zonda Erskine AssDip in FAP(Sydney TAFE)

Australia's Virtual Herbarium**Co-ordinator**

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

Botanists

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

Database staff

Karen Biddle (temp)
Emma Cornelius BSc (Hons) UNSW (temp)
Camilla Freestone BSc (Wollongong) (temp)
Gary Koh BA (Commerce) ANU (temp)
Andrew Orme, Hort TradeCert (TAFE) (temp)
Tim Donnan, BSc (UTS) (temp)
Derek Monks BSc (Syd)

Ifeanna Tooth BSc (Syd), Adv Cert Urb Hort (OTEN) (temp; in part)
Lucy Nairn, BSc (Hons) Monash University (temp)
Natasha Leist, BSc UNSW (temp)

Botanical Information Service

Botanist

Barbara Wiecek BSc(Syd)

Senior Technical Officers

Seanna McCune BAppSc(Hawkes), BushRegenCert (Acting)
Jenny Hart PhD(Syd), BSc (Syd) (Temp)

Technical Officers

Gary Chapple BSc(Syd), DipAg(Hawkes)
Robert Coveny HortCert
Helen Jolley Advanced Certificate Horticulture (Temp)

PlantNET Officer

Peter Hind HortCert

RESOURCES

Manager

Anthony Martin, BioTechCert, BioTechHigherCert, BAppSc(Riverina)

Technical Assistant

Rosie Arnold (on leave 15.7.02)
Katie Taylor BSc (Bris)

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)

Library Technician

Miguel Garcia AssocDipLibPrac(STC)

Botanical Illustration

Illustrators

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

Image Digitising Project

Anne Cleary, BAppSc (Information Sciences) (UTS)
Spike Deane
Olivia Patchett, BA, MA (Audio Visual Archiving)(UNSW)
Annette Hill, BAppSc (Information Sciences) (UTS)

HONORARY RESEARCH ASSOCIATES

Alan Archer PhD(City Lond), CChem, FRSC
Barbara Briggs BSc(Hons), PhD(Syd), PSM
Bettye Rees BSc(Hons)(Qld), PhD(UNSW)
Carrick Chambers AM, MSc(NZ & Melb), PhD(Syd), Hon.LLD(Melb), Hon.DSc(UNSW), AHRIH
Christopher Quinn, BSc (Hons) (Tas), PhD (Auk)
David Mabblerley MA, PhD(Cambridge), DPhil(Oxon)
Don Blaxell BSc(UNSW), DipAgr(Vic)
Edwin Wilson, BSc (UNSW)

Elsie Webster Hon. D Litt (Melb)
 Geoffrey Sainty DipAgr(WAC), GradDipExt(Hawkes)
 Helen Ramsay MSc, PhD(Syd)
 Joy Thompson BScAgr, MSc(Syd)
 Lionel Gilbert, OAM, BA (Hons) PhD(UNE), LCP(Lond)
 Mary Tindale MSc, DSc(Syd)
 Mike Dingley BioTechCert (STC)
 Norman Hall BForSc
 Peter Bernhardt BA, MA(SUNY), PhD(Melb)
 Peter Michael BAgSc(Hons)PhD(Adel)
 Phil Spence
 Prof John Thomson MSc, MAgrSc, PhD(Melb)
 Terry Tame DipIndArts(STC), DipEd(Syd)

VOLUNTEERS

Mike Atkinson, Lydia Bell, Chris Belshaw, Carol Bentley, Margaret Bell, Patricia Bradney, Harry Brian, Dawn Bunce, Lynette Burns, Margaret Carrigg, Kathryn Chapman, Murray Coleman, Eleanor Eakins, Gwen Elliott, Rosemary Farley, Helen Flinn, Gladys Foster, Muriel Gamble, Estelle Geering, Carole Gordon, Mien de Haas, Margaret Hafey, Pat Harris, Jane Helsham, Rachel Hill, Alick Hobbs, Beverley Honey, William Isbell, Fred Langshaw, Ian Lewis, Marie Lovett, Ann McCallum, Miriam Mathews, Ena Middleton, Joseph Minitier, Joan Moore, Jill Pain, Edwin Pearson, Aileen Phips, Syd Pinner, Christine Porter, Dorothy Pye, Elizabeth Radford, John Richards, Rod Roberts, Maria Rodofili, Mananejela Rodojih, Betty Ruthven, Graham Shields, Juliet Taylor, Betty Thurley, Ruth Toop, Shelagh Trengove, Sybil Unsworth, Rosemary Varley, Ann Wilcher.

STUDENTS¹

Student	Degree	University	Supervisors	Project Title
Esti Ariyanti	MSc	Gadjah Mada University, Yogyakarta (Indonesia)	Dr M. Henwood,+ Dr B. Conn	Systematic Studies of <i>Procris</i> (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	<i>Fusarium</i> associated with wild sorghum
Kerri Clarke	PhD	University of New England	Dr J. Bruhl,+ Dr N. Prakash,+ K. Wilson	Systematic studies in Abildgaardieae (Cyperaceae)
Samantha Clark	BSc (Hons)	University of Wollongong	K. French, +Dr L. Von Richter, Dr C. Offord	Seed biology of Cumerland Plain Proceae
Yvonne Davila	PhD	University of Sydney	Dr G.M. Wardle,+ Dr M. Rossetto	Reproductive and evolutionary ecology of <i>Trachymene incisa</i> (Apiaceae)
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
Kioumars Ghamkar	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 J. Bruhl,+ Dr G. Vaughton, Dr B. Conn	Systematics of <i>Drosera peltata</i> complex
Tran Nget Ha	PhD	University of Sydney	Brett Summerell, Prof L. Burgess+	Populations of <i>Fusarium</i> on maize

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

Student	Degree	University	Supervisors	Project Title
Julisasi Hadiyah	PhD	University of NSW	Dr C. Quinn, Dr B. Conn, Assoc Prof P. Adam ⁺	Systematics of <i>Elatostema</i> in Indonesian Archipelago
Adele Harvey	PhD	La Trobe University of NSW	Dr Wm J. Woelkerling, ⁺ Dr A. Millar	The crustose coralline algae
Ken Hill	PhD	University of Technology	Dr D. Morrison, ⁺ Dr P. Weston	Phylogeny and biogeography Technology of the genus <i>Cycas</i>
John Hodgson	BSc(Hons)	University of New England	Dr J. Bruhl, ⁺ Mrs K. Wilson	Systematics of <i>Lepidosperma laterale</i> complex (Cyperaceae)
James Indsto	MSc	University of Wollongong	Dr P. Weston, Prof R. Whelan, ⁺ Dr M. Clements ⁺	Species relationships and pollination ecology of <i>Diuris</i> (Orchidaceae) of the Sydney region
Karen Jackson	PhD	University of Sydney	Prof L. Burgess, ⁺ Dr B. Summerell	<i>Fusarium</i> mycotoxins in wheat grain
Peter Jobson	PhD	University of Technology	Dr D. Morrison, ⁺ Dr P. Weston	A taxonomic revision of <i>Dillwynia</i> (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
Ruth Kharis	BSc	Undergraduate research project Macquarie University	Dr S. Jacobs	Snowy River data analysis
Joanne Ling	PhD	University of Western Sydney	Dr J. Bauor, ⁺ 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
David McKenna	PhD	University of Wollongong	Prof R. Whelan, ⁺ Assoc Prof D. Ayre, ⁺ Dr T. Auld, ⁺ Dr P. Weston	Ecology of fire-sensitive <i>Persoonia</i> species: threatened Species recovery and Management
Linda McLaughlin	BSc (Hons)	University of New England	K. Wilson, Dr J. Bruhl, ⁺ Dr N. Prakash ⁺	Systematic studies in <i>Schoenus</i> (Cyperaceae)
Jim Mant	PhD	Australian National University	Dr R. Peakall, ⁺ Dr P. Weston	Comparative biology of <i>Chiloglottis</i> (Orchidaceae) and its thynnine wasp pollinators (Tiphidae)
Amelia Martyn	PhD	University of Sydney	Dr R. McConchie, ⁺ Dr C. Offord	Causes of bract browning in <i>Telopea</i> species
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 <i>Persoonia</i> 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

Student	Degree	University	Supervisors	Project Title
George Orel	PhD	University of Western Sydney	+Dr Judyth McLeod, +Graeme Richards, Dr A Marchant	Assessment of horticultural suitability of undomesticated species of Juglandaceae
Andrew Perkins	PhD	University of Sydney	+Dr M. Henwood, Dr P. Weston	Phylogenetics of the genus alochilus (Orchidaceae)
Sophie Peterson	BSc (Hons)	University of Sydney	+Prof L. Burgess, Dr B. Summerell	Fungi causing leaf spots of Grevillea
Tijana Petrovic	PhD	University of Sydney	+Prof L. Burgess, Dr B. Summerell	Populations of Fusarium on sorghum
Ratiya Pongpisutta	PhD	University of Sydney	+Prof L. Burgess, Dr B. Summerell	Variability of Phytophthora cinnamomi in National Parks in NSW
Karin Rutten	PhD	University of Wollongong	Dr A. Millar, +Prof R. West	Macro-algal blooms and Management
Paul Rymer	PhD	University of Wollongong	+Prof. R. Whelan, +Assoc. Prof. D. Ayre, +Dr T. Auld, Dr P. Weston	Genetics of fire-sensitive Persoonia species threatened species recovery and management
Catherine Smith	BScAg	Undergraduate research project University of Sydney	+Prof L. Burgess, Dr B. Summerell	Phytophthora cinnamomi in NSW
Jillian Smith-White	PhD	University of Sydney	+Prof L. Burgess, Dr B. Summerell	Molecular biology of Armillaria
Nikola Streiber	PhD	University of Sydney	+Dr M. Henwood, Dr E. Brown, Dr B. Conn	The systematics of Chloanthae (Lamiaceae)
Len Tesoriero	PhD	University of Sydney	+Prof L. Burgess, Dr B. Summerell	Control of soil borne diseases in glasshouse crops
Hien Pha Than	MSc	University of Sydney	+Prof L. Burgess, Dr B. Summerell	Fusarium spp. associated with Australian grasses in Northern Queensland
Sophie Townsend	BSc (Hons)	University of Wollongong	+Prof. R. West, Dr A. Millar	Rocky reef biodiversity
Jillian Walsh	BSc (Hons)	University of Wollongong	+Prof. R. Whelan, +Dr K. McDougall, Dr B. Summerell	Phytophthora cinnamomi in Royal National Park
Sabine Wilkins	PhD	University of Berlin	+Prof. Dr W. Greuter, Dr S. Jacobs	Taxonomic studies in the Floating leaved species of Potamogeton (Potamogetonaceae) in Australia
Deborah Wills	BSc	Undergraduate research project Southern Cross University	+Prof. P. Saenger, Dr A. Millar	Rare brown algae
Nick Yee	MSc	University of NSW	Dr A. Millar	Molecular phylogeny of the algal order Sporochneales
Xiufu Zhang	PhD	University of New England	+Dr J. Bruhl, +Dr. N. Prakash, K. Wilson	Systematic studies in (Cyperaceae) Schoeneae

Appendix B: Representation on External Committees

Doug Benson

Member, NSW Scientific Committee, Threatened Species Conservation Act; Member, Institute of Wildlife Research, University of Sydney;

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.

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; Regional Secretary (Oceania), 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); President, Australian Systematic Botany Society; Member, NSW Biodiversity Working Group (NRIMS); Board Member, CANRI (NRIMS); Coordinator, Flora Malesiana Urticaceae Working Group; Member, Vegetation Targets 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; Research Associate, School of Biological Sciences, The University of Sydney; Assembly representative, National Biodiversity Council; Member, Wollemi Pine Conservation Team; Member, International Organising Committee for Eighth International Phycological Congress; Member, Australian Biological Resources Study Advisory Committee.

Dr Alistair Hay

Member, Board of the Flora Malesiana Foundation; Coordinator, Australian Flora Malesiana Contributors Working Group; Member, National Living Collections Policy Working Group; Member, Sydney Harbour Executive; Member, NPWS Wildlife Issues Advisory Panel.

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)

Chief Executive Officer, Greening Australia (NSW); 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.

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.

Tony Martin

Member, Committee for the Microscopical Society of Australia.

Patricia Meagher

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

Dr Alan Millar

Member, International Organising Committee, International Phycological Congresses; Member, Nominations Committee, International Phycological Society; Member, Fisheries Scientific Committee, Threatened Species Conservation 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, Flowers 2000 Conference; Member, Organising committee for Australian Wildflower Conference 2002; Member, NSW NPWS Species Recovery Teams; 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

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; 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**

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

Fact Sheets

'Plant Disease Diagnostic Unit Fact Sheets': Fire Blight, Armillaria Root Rot, Fusarium Wilt of Palms, Fig Psyllid, Phytophthora, Thrips, Lace Bug, Scale Insects, Rose Aphids, Azaleas

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); *Proteaceae of New South Wales* (2000), edited by Gwen Harden, David Hardin & Dianne Godden (NSW University Press).

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

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.

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.

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

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

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

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.

Sydney's Bushland: More than meets the eye by J. Howell & D. Benson (Royal Botanic Gardens Sydney, 2000) \$27.95

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.

The nature of pre-European native vegetation in south-eastern Australia: a critique of Ryan, D.G., J.R. and 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.

Appendix D: Research Grants

Grants for research were maintained at the high levels achieved in 2000–2001. This funding allows us to pursue additional research projects within our core objectives. Success with grant applications is a measure of our previous performance, the professional standing of our scientists and the calibre of the proposed project.

Australian Biological Resources Study

Dr Tim Entwisle and Dr Stephen Skinner – Taxonomic revision of *Oedogonium* (Chlorophyta) \$30,000 (2nd year of a 3 year \$75,000 grant)

Dr Peter Wilson and Dr Chris Quinn – Generic concepts in the *Baeckea* complex (Myrtaceae) \$35,000 (final year of a 2.5 year \$90,000 grant)

Australian Centre for International Agricultural Research

Dr Brett Summerell (with the University of Sydney) – Diagnosis and control of soilborne diseases in Indonesia \$133,333 (2nd year of a 3 year \$400,000 grant)

Australian Geographic

Nikola Streiber and Dr Barry Conn – Revision of *Chloanthaceae* (Lamiaceae) \$1,000

Australian Research Council

Dr Alan Millar (with LaTrobe University) – Non-geniculate coralline algae \$50,000 (2nd year of a 3 year \$150,000 grant)

Dr Peter Weston – Ecology and Genetics of fire sensitive *Persoonia* species \$41,644 (final year of 2 year \$83,288 grant)

Dr Peter Weston – A biological basis for the efficient breeding of native plants for export markets: a case study for the family Goodeniaceae \$57,231 (1st year of a 3 year \$107,634 grant)

Dr Maurizio Rossetto (with P. Baverstock, SCU and J. Hunter, NSW NPWS) – Comparative population genetics of rare and common Quandong (*Elaeocarpus*) species and the effects of habitat fragmentation \$75,000

Georgina Sweet Fellowship Trust

Nikola Streiber and Dr Barry Conn – Revision of *Chloanthaceae* (Lamiaceae) \$1,500 (1st year of a 2 year \$3,000 grant)

Commonwealth Department of Education, Science and Training

Nikola Streiber and Dr Barry Conn – International Postgraduate Research Scholarship \$17,070 (2nd year of a 3 year \$51,210 grant)

Nikola Streiber – International Postgraduate Award - living allowance \$18,200 (2nd year of a 3 year \$54,600 grant)

Community Access to Natural Resources Information (CANRI)

Dr Elizabeth Brown – Census of liverwort names for NSW \$40,000

Dr Barry Conn – Images of Herbarium specimens \$30,000

Ken Hill – Interactive key for the Eucalypts in NSW \$20,000

Department of Land and Water Conservation

Dr Barry Conn and Barbara Wiecek – Plant Identification for native vegetation mapping \$50,000 (2nd year of a 3 year \$150,000 grant)

Dr Brett Summerell – Mapping validation \$112,000 (1st year of a 3 year \$336,000 grant; delayed starting by one year)

Joanne Ling – Biological assessment of wetlands: testing techniques \$5,500

Hermon Slade Foundation

Dr Alan Millar – Marine algae and associated invertebrates of the NSW coast \$26,000 (1st year of 2 year \$96,000 grant)

Jim Mant and Dr Peter Weston – Comparative biology of *Chiloglottis* (Orchidaceae) and its thynnine wasp pollinators \$25,000 (3rd year of a 3 year \$75,000 grant)

Janet Cosh Project Fund

Dr Brett Summerell – Curation of Fungal Herbarium \$2,103

Linnean Society of NSW

Nikola Streiber and Dr Barry Conn – Joyce W. Vickery Scientific Research Fund \$700

NSW Biodiversity Strategy

John Benson – Plant Community Classification Project \$29,700 (1st year of a 2 year \$67,320 grant)

Dr Cathy Offord – Testing and viability assessment of NSW threatened species seedbank collection \$24,750 (1st year of a 2 year \$54,450 grant)

Dr Tim Entwisle – Enhance taxonomic research \$47,500 (1st year of a 2 year \$95,000 grant)

Dr Tim Entwisle – Develop and implement a NSW Biodiversity Research Strategy \$35,000 (1st year of a 2 year \$70,000 grant)

Global Biodiversity Information Facility (GBIF)

Karen Wilson – Support for 'Bioforum', including general conference expenses and support for attendees \$260,000

NSW Fisheries

Dr Alan Millar – Marine algae of Port Jackson \$2,100

NSW State Government Enhancement

Dr Tim Entwisle – Australia's Virtual Herbarium \$400,000 (1st year of a 4 year \$1,600,000 grant; including funding from the Commonwealth and private sector)

Royal Botanic Gardens and National Herbarium Research Fund

Karen Wilson (with Dr. Dorothy Steane, University of Tasmania) – Using the nuclear 26S rRNA gene to obtain phylogenetic information in family Casuarinaceae, for primers and other molecular sequencing materials \$4,068

Rural Industries Research and Development Corporation

Dr Cathy Offord – International *Protea* Research Symposium \$2,394

Slade Orchid Fund

James Indsto and Dr Peter Weston – *Diuris* pollination \$5,500

Appendix E: Overseas Travel

Name and position	Countries/cities visited	Purpose of visit	Duration	Cost	Source of funds
Surrey Jacobs, Senior Research Scientist	Cordoba and Badajoz, Spain	Participate in 4th International Triticeae Symposium in Cordoba and the Stipoid Working Group Workshop in Badajoz	9-21/9/01	\$5,150	Externally funded
Alan Millar, Senior Research Scientist	Thasseloniki, Greece	Participate in International Phycological Conference	15-28/8/01	\$6,794	\$4,794 Agency. Remainder externally funded
Brett Summerell, Manager Conservation & Horticultural Research	Sulawesi, Indonesia North Sulawesi	Participate in disease survey and training in	12-19/9/01	\$3,500	Externally funded
Ken Hill, Senior Research Scientist	USA	Expert witness	15-30/10/01	\$4,000	Externally funded
Alan Millar, Senior Research Scientist	San Diego, USA	Participate in International Caulerpa Conference.	27/1/02-26/2/02	\$2,750	Externally funded
Cathy Offord, Horticultural Research Officer	Hawaii, USA	Participate in the International Protea Research Conference	8-18/3/02	\$4,356	\$1,962 Agency Remainder externally funded
Patricia Meagher, Conservation & Horticulture Research Officer	Auckland, New Zealand	Participate and present at International Araucariaceae Symposium	13-18/3/02	\$1,360	Agency
Karen Wilson, Special Botanist	Tsukuba and Kyoto, Japan	Participate in: Species-2000 Asia-Oceania briefing in Tsukuba. MEXT Advisory Committee and the Species-2000 AO meeting in Kyoto	11-14/2/02	\$2,500	\$400 Agency Remainder externally funded
Ken Hill, Senior Research Scientist	Miami, Los Angeles & San Diego, USA	Taxonomy workshop/ public lectures	6-26/4/02	\$5,000	Externally funded
Alan Millar, Senior Research Scientist	Hilo, Hawaii, USA	Lecture at Taxonomy of Economic Seaweeds Workshop	21/5/02-2/6/02	\$4,070	\$2,390 Agency \$1,680 Externally funded

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

- Review of classification and status of plant communities in New South Wales with New South Wales National Parks and Wildlife Service.

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.

Dr Barry Conn

- Leaf volatile oils of *Prostanthera* (Lamiaceae) with Dr A. Hayes, University of Western Sydney, NSW

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 sens. lat. Collaboration with A/Prof. Kathleen A. Kron, Wake Forest University, NC, USA.

Dr Tim Entwisle

- Molecular systematics, biology and biogeography of freshwater red algae with Dr Morgan Vis of Ohio University, USA and Prof. Judy West of The University of Melbourne.
- 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. Hettterscheid, 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

- Attributes of rare and abundant species with Dr Brad Murray, Australian National University.

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.

[See also Joy Everett]

Dr Phillip Kodela

- Flora surveys and assessment of Wingecarribee Swamp with Geoff Sainty *et al.* for Sydney Catchment Authority.
- Assisted with investigations of the nanoscale organisation of polymers in native *Acacia* woods by Dr Chris Garvey (Physics Division, ANSTO).

Professor David Mabberley

- Molecular systematics of Labiatae (Viticoideae, Teucroideae), 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 Jayawardanepura, Colombo.

- Systematics of Malesian Meliaceae, with Dr C.M. Pannell, Oxford, UK.
- Nomenclature of apples, with Dr B.E. Juniper, Dept. Plant Sciences, University of Oxford and Dr C.E. Jarvis, Natural History Museum, London.
- 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, Jardín Real Botánico, 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.

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 Dr J. Bruhl, Ms K. Clarke and Mr K. Ghamkhar, University of New England.

Dr Peter Michael

- SEM studies on achenes of *Senecio* with Dr I. Radford, CSIRO, Townsville.

Dr Alan Millar

- DNA research on Sporochneales with Dr G. Saunders and Dr G.T. Kraft, University of Melbourne.
- Taxonomy and ecotoxicity 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 Papua New Guinea and East African coast with Prof. Eric Coppejens, University of Gent, Belgium.
- Molecular phylogeny of red algal order Gelidiales with Dr Wilson Freshwater, University of North Carolina.

Cathy Offord

- Potting mix amendments with Dr Sally Muir, University of Western Sydney Macarthur.
- 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 *Teloepa* species with Dr Robyn McConchie and Ms Amelia Martyn, University of Sydney.

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 Maurizio 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 Mary Tindale

- Cytotaxonomy of Australian Pteridophyta with Dr S.K. Roy Varanasi, India.

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 relict 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.

Karen Wilson

- Polygonaceae for Flora of Australia with Mrs G. Perry, Western Australian Herbarium.
- Systematic studies in Abildgaardieae (Cyperaceae) with Dr J. Bruhl, Ms K. Clarke and Mr K. Ghamkhar, University of New England.
- Systematics of *Carpha* (Cyperaceae) with Dr J. Bruhl and Ms Xiufu Zhang, University of New England.
- Systematics of *Lepidosperma laterale* (Cyperaceae) with Dr J. Bruhl and Mr J. Hodgson, University of New England.
- Molecular study of Casuarinaceae with Dr D. Steane, University of Tasmania.

Dr Peter Wilson

- Molecular phylogeny and systematics of Myrtaceae with Prof. K.V. Sytsma, University of Wisconsin, Madison, USA.
- Relationships in *Schoenus* (Cyperaceae) with Assoc. Prof. Jeremy Bruhl & Ms Linda McLoughlin, University of New England.

Appendix G: Plant Sciences Publications¹

¹ Names in bold are Plant Sciences staff, Honorary Research Associates or supervised students

SCIENTIFIC AUDIENCES

- Archer, A.W.** (2001) The lichen genera *Phaeographis* and *Phaeographina* (Graphidaceae) in Australia 3: *Phaeographis* – new reports and new species. *Telopea* 9: 663-677.
- Archer, A.W.** (2001) New taxa and new reports in the lichen family Graphidaceae (Ascomycotina) from Australia. *Mycotaxon* 80: 367-374.
- Archer, A.W.** (2002) Graphidaceae (Ascomycotina) from the Solomon Islands: new species from Guadalcanal. *Mycotaxon* 83: 361-367.
- Barkworth, M.E. & **Jacobs, S.W.L.** (2002) Voucher specimens – a critical element in a scientific paper. pp 113-118 in: Hernández, P., Moreno, M.T., Cubero, J.I and Martin, A. *Proceedings of the 4th International Triticeae Symposium, September 10-12, 2001 – Córdoba, Spain* (Junta de Andalucía. Conserjería de Agricultura y Pesca: Cordoba).
- Benson, D. & McDougall, L.** (2002) Ecology of Sydney Plant species. Part 8 Dicotyledon families Rutaceae to Zygophyllaceae. *Cunninghamia* 7: 241-462.
- Benson, J.S.** (2001) Data requirements for regional vegetation planning. Proceedings Promotion, Practice and Partnerships (Australian Network for Plant Conservation: www.anbg.gov.au/anpc)
- Boyce, P.C. & **Hay, A.** (2001) A taxonomic revision of Araceae tribe Potheae (*Pothos*, *Pothoidium* and *Pedicellarum*) for Malesia, Australia and the tropical Western Pacific. *Telopea* 9: 449-571.
- Briggs, B.G.** (2001) The 'southern rushes' invade the north: the diaspora of the Restionaceae. pp. 237-241 in Metcalfe, I., Smith, J.M.B., Morwood, M., Davidson, I., & Hewison, K. (eds), *Faunal and Floral Migrations and Evolution in South-east Asia-Australasia*. (Balkema).
- Briggs, B.G.** (2001) *Leptocarpus laxus*: the correct name for *L. diffusus* (Restionaceae). *Taxon* 50: 891.
- Briggs, B.G.** (2001) Proposal to conserve the name *Leptocarpus* (Restionaceae) with a conserved type. *Taxon* 50: 919-921.
- Brown, E.A.** & T. Pócs (2001) A new species of *Radula* Sect. *Cavifolium* (Radulaceae: Hepaticae) from Queensland, Australia. *Telopea* 9(3):435-43.
- Cherry, W., Gadek, P.A., Brown, E.A., Heslewood, M.M. & Quinn, C.J.** (2001) *Pentachondra dehiscens* sp. nov. – an aberrant new member of Stypheliae. *Australian Systematic Botany* 14: 513-533.
- Conn, B.J.** (2001) *Acacia* [various species] *Flora of Australia* 11A.
- Crayn, D.M., Smith, J.A.C. & Winter, K.** (2001) Carbon-isotope ratios and photosynthetic pathways in the neotropical family Rapateaceae. *Plant Biology* 3: 569-576.
- Dearden, A. & **Hay, A.** (2001) A new species of *Cyrtosperma* (Araceae) from West Papua. *Aroideana* 24: 102-104.
- Entwisle, T.J. & Skinner, S.** (2001) Non-marine algae of Australia: 4. Floristic survey of some colonial green macroalgae (Chlorophyta). *Telopea* 9: 725-739.
- Harden, G.J.** (2002) *Flora of New South Wales* volume 2, 2nd edn. (University of New South Wales Press: Kensington).
- Harvey, A., Woelkerling, W. J. & **Millar, A.J.K.** (2002) The Sporolithaceae (Corallinales, Rhodophyta) in south-eastern Australia: Taxonomy and 18S rDNA phylogeny. *Phycologia* 41: 207-227.
- Hill, K.D. & Osborne, R.** (2001) *Cycads of Australia* (Kangaroo Press, Chatswood).
- Jacobs, S.W.L.** (2001) The genus *Lachnagrostis* (Gramineae) in Australia. *Telopea* 9: 439-448.
- Jacobs, S.W.L.** (2001) Four new species of *Agrostis* (Gramineae) from Australia. *Telopea* 9: 679-684.
- Jacobs, S.W.L.** (2001) A new combination in *Austrodanthonia* (Gramineae). *Telopea* 9: 741.
- Jacobs, S.W.L.** (2001) Review of leaf anatomy and ultrastructure in the Chenopodiaceae (Caryophyllales). *Journal of the Torrey Botanical Society* 128: 236-253.
- Jacobs, S.W.L. & Hellquist, C.B.** (2000) Die *Aponogeton*-arten (Aponogetonaceae) Australiens Teil 1. *Aqua-Planta* 2000(4): 142-147.
- Jacobs, S.W.L. & Hellquist, C.B.** (2001) Die *Aponogeton*-arten (Aponogetonaceae) Australiens Teil 2. *Aqua-Planta* 2001(1): 14-21.
- Jacobs, S.W.L. & Hellquist, C.B.** (2001) Die *Aponogeton*-arten (Aponogetonaceae) Australiens Teil 3. *Aqua-Planta* 2001(3): 120-126.

- Jobson, P.C. & Weston, P.H.** (2001) *Dillwynia rupestris* (Fabaceae: Mirbelieae), a new species of from the New England Tableland of New South Wales. *Telopea* 9: 323-327.
- Jones, R.C., McNally, J. & **Rossetto, M.** (2002) Isolation of microsatellite loci from a rainforest tree, *Elaeocarpus grandis* (Elaeocarpaceae), and amplification across closely related taxa. *Molecular Ecology Notes* 2(2): 179-181.
- Kodala, P.G.** (2001) *Acacia* [various species] *Flora of Australia* 11A.
- Kodala, P.G.** (2001) *Acacia* [various species] *Flora of Australia* 11B.
- Kodala, P.G.** (2001). Identification and review of *Acacia melvillei* specimens in New South Wales. Royal Botanic Gardens Sydney. Unpublished report prepared for the NSW Scientific Committee.
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