SCIENCE
IN THE GARDENS

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

**2000–2001 Annual Report
of the Plant Sciences Branch,
Royal Botanic Gardens Sydney**

www.rbgsyd.nsw.gov.au/html/science.html

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The Garden is open all year except Christmas Day.

Hours 10 am–4 pm April to September;
10 am–6 pm October to March.

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The Garden is open all year except Christmas Day.

Hours 10 am–4 pm March to September;
10 am–6 pm October to February.

Published by: Royal Botanic Gardens Sydney
Mrs Macquaries Road Sydney 2000

Cover photo: On 8 March 2001, the Gardens celebrated the opening, 100 years ago, of the first home dedicated to the National Herbarium of NSW — what is now called the R.H. Anderson Building. The actual herbarium (ie. the collection of dried specimens) effectively began with that opening. The photo shows the Director at that time, J.H. Maiden (aka Plant Sciences' botanist Dr Stephen Skinner), giving an address to staff in front of the Centenary Quilt, made by staff and friends to commemorate the centenary.

Contents

Highlights of the Year

- Celebrating the centenary of the National Herbarium of NSW with the unveiling of a staff and volunteer created quilt, the placement of a time capsule to be opened in 100 years, and a visit by 'J.H. Maiden'.
- Nearly $10 million of Commonwealth, State and private funding secured for Australia's Virtual Herbarium project. Over five years, the preserved plant collections held by all State and Territory herbaria will be data processed and made available to the community via the internet.
- Launch of Centre for Plant Conservation by Hon. Bob Debus and Professor Peter Raven, and appointment of coordinator.
- Coediting and contributing to a major international book on *Fusarium*, an economically important pathogenic fungus that attacks ornamental and agricultural plants.
- Awarding the inaugural Royal Botanic Gardens Eureka Prize for Biodiversity Research to Dr John Woinarski of the Northern Territory Parks and Wildlife Commission. This prize was funded by the Friends of the Royal Botanic Gardens.
- Completion of the first phase of WattleWeb, an interactive key to the genus *Acacia* in New South Wales, now available through the PlantNET internet site.
- Contracts from Department of Land and Water Conservation to identify plants collected in the vegetation mapping program, and to audit the mapping outputs.
- Removal of all naphthalene from the herbarium collection, and its replacement with an Integrated Pest Management system (including temperature and humidity control, monitoring and routine freezing of specimens).
- Publication of the colour booklet *'Sydney's Bushland: More than meets the Eye'* in time for the Olympics.

Part 1: INTRODUCTION

As in 1999–2000, the Plant Sciences Annual Report is structured around the Vision Document prepared in response to the 1999 Review of Plant Sciences. The following introductory material is taken from that 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.

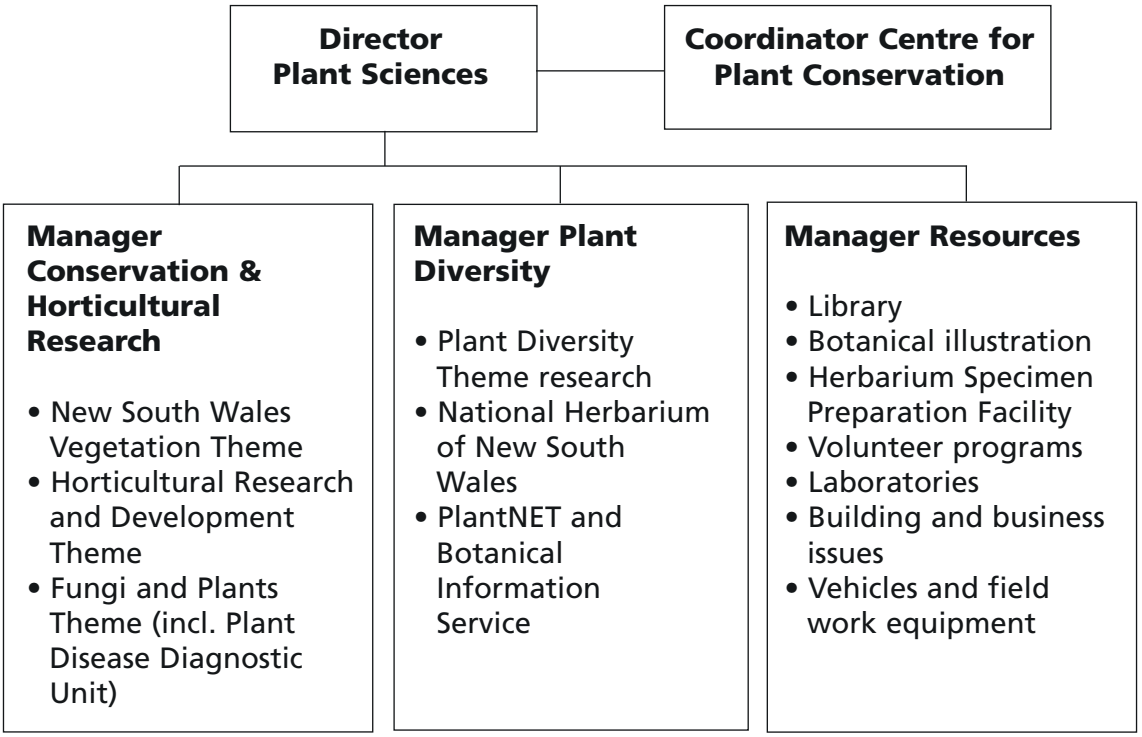
Priority-setting Criteria

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



General Promotion

The Plant Sciences Promotion Strategic Plan included a range of actions for increasing our profile in the general community (eg. media stories, Eureka Prize, signage), community groups (eg. regional presence, collaboration), government agencies (eg. committee contributions and leadership) and within the Gardens (eg. popular articles and talks).

Eureka Prize

Director Frank Howarth presented the inaugural 'Royal Botanic Gardens Sydney Eureka Prize for Biodiversity Research' to Dr John Woinarski of the Northern Territory Parks and Wildlife Commission. The prize was funded through the generous support of the Friends of the Gardens as a way to improve the promotion of science in the Gardens and more generally in the community. To an audience of some 700 scientists and science journalists, Frank Howarth announced that Dr Woinarski demonstrated an outstanding and demonstrable commitment to scientific research that led to the implementation of a systematic approach to biodiversity conservation in the Northern Territory. Dr Woinarski was later interviewed by Robyn Williams for the Eureka Prize television special that appeared later that week on the ABC.

Science Week

Science Week this year combined community education and scientific expertise as part of our contribution to the successful Science in the City program. The week was headlined with a talk to a capacity audience on 'The nightlife of plants: sex and other perversions'. The Gardens also took part in the follow-up *Science in the City*, with a display booth at the Australian Museum and various schools activities held at the Gardens in conjunction with the Museum, the University of Sydney, University of NSW and University of Technology, Sydney. This gave us exposure to all levels of school groups and to the general public. The Museum display was part of a major presentation of scientific expertise associated with the Sydney city area.

Part 3: CONSERVATION AND HORTICULTURAL RESEARCH SECTION

This section brings together a wealth of expertise in ecology, horticulture and plant pathology and creates opportunities for multidisciplinary projects and collaboration. It also facilitates our contribution to the *NSW Biodiversity Strategy*. A Conservation Ecologist will be recruited to the group in late 2001.

New South Wales Vegetation Theme

The three programs included under this theme are combined here. Firstly, an understanding of the ecology of individual species, and how they interact with other species, complements our plant diversity and community mapping programs work in providing baseline data for biodiversity management. Our species ecology work is currently focussed on the Sydney area but will be expanded to all of New South Wales as part of the PlantNET project. The new conservation ecology program, to commence midway through 2001, will focus on issues of high conservation and scientific importance. Aquatic ecology will also be expanded in coming years.

The Gardens has been a major contributor to the survey, mapping and classification of plant communities in New South Wales. A thorough knowledge of the composition and distribution of vegetation communities is critical for the management and conservation of biodiversity at paddock, catchment or bioregion level. The target and scope of projects has been driven by gaps in State coverage and the needs of stakeholders. Our new directions are yet to be resolved, but may include vegetation modelling, testing of conservation reserves, habitat fragmentation, and the inclusion of cryptogam (e.g. bryophyte and lichen) data, in addition to the ongoing vegetation community classification project.

Acacia
Dr Phillip Kodela completed a project on the identification and assessment *of Acacia melvillei* and *A. homalophylla* for the NSW Scientific Committee. This was to assist with the assessment of the distribution and conservation status of *Acacia melvillei* communities in New South Wales, particularly in view of nomination as an endangered ecological community under the *NSW Threatened Species Conservation Act*.

Aquatic 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 commencement of a student, Joanne Ling, who is comparing different assessment techniques and examining the effects of errors in sampling and identification.

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 55 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 year of the project the literature review is complete for the western plains, and partly complete for the western slopes and tablelands. John Benson has entered over 100 records into the database for the western plains vegetation. It is anticipated that the classification and assessment of the plant communities of the western plains of NSW will be completed by mid 2002 and submitted for publication as stage 1 of the vegetation classification of NSW. A paper will also be submitted that describes the project aims and methods.

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 and the NSW Fisheries Scientific Committee. The Gardens also contributed to two major implementation groups, the Biodiversity Strategy Implementation Group (as chair) and the Native Vegetation Implementation Group. The Director Plant Sciences was appointed chair of the Biological Diversity Advisory Council.

Ecology of Sydney Plant Species
Part 7b of the popular series documenting the ecology of plants in the Sydney region was published in the fourth issue of *Cunninghamia* volume 6, covering families Proteaceae to Rubiaceae (with 250 species). The largest family, Proteaceae, includes the well known Sydney species of waratah, banksias and grevilleas. An accompanying paper describes the ecology of Proteaceae 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. Monitoring of Cumberland Plain Woodland vegetation by ecologists Doug Benson and Jocelyn Howell, in permanent plots at Mount Annan Botanic Garden, begun in 1990, is continuing. This program has been extended to include monthly assessments of plant species abundance, to gain insights into seasonal changes. 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.

Floristic Surveys
Peter Jobson, Dr Phillip Kodela and Doug Benson participated in a vegetation and rare plant survey and assessment in the Picton area for Sydney Water (as a

joint consultancy between the Gardens and Australian Museum Business Services). Several Plant Diversity staff participated in field surveys of rare and threatened plants in the Riverina region and South Far Western Plains of New South Wales for the National Parks & Wildlife Service. This project involved survey planning, leading a team in the field to investigate over 15 rare plant species (data collection on localities, population numbers, habitat details, plant characteristics, possible threats), establishing permanent plots, and collating notes for a report. The aim was to increase the knowledge of these species with outcomes that may assist towards species recovery planning and management.

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 water quality. 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 2000–01 was field surveys, identification of algal species and experimental design.

A paper resulting from work with Dr Downes in the catchments near Melbourne, Victoria, was submitted to *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 affected 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 co-supervised by Dr Tim Entwisle and Associate Professor Shelly Burgin at the University of Western Sydney.

Population Genetics and Ecology

The long-term management and conservation of rare and threatened species requires an understanding of their genetic structure and population biology. The genus *Persoonia* has many rare species, most of which are fire sensitive (obligate seeders). Frequent fires are thought to have caused populations of seeders to become smaller, and even locally extinct. While this may be true, quite a few obligate seeding *Persoonia* species remain common. Postgraduate students Paul Rymer and David McKenna have been collaborating with Dr Peter Weston in trying to understand the causes of rarity in fire-sensitive *Persoonia* species by comparing the genetic structure and demography of rare and common species. Demographic attributes such as breeding systems, pollen dispersal, seed dispersal, seed longevity, seed dormancy, growth rates, time

from germination to reproductive maturity, levels of herbivory, and causes of plant mortality are being investigated in 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). One of the main aims of this project is to incorporate these demographic attributes in population viability models that would allow us to predict the combined and separate impacts of a range of threats (e.g. increased fire frequency, isolation from other populations). Such models could be used by wildlife managers to assess possible management options.

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.

***Waterhousea floribunda* Survey**
John Benson and Lisa Hill conducted a detailed survey of riparian rainforest dominated by *Waterhousea floribunda* on the lower north coast of NSW. This included the sampling of over 80 plots in order to document the flora of this community and detect variation due to environmental factors. This plant community is poorly represented in reserves and mainly occurs on private land. It is threatened by weed invasion, river bank erosion and grazing by cattle. A paper is to be compiled that will document the distribution of the community, its floristic variation, conservation status and threats, and make recommendations about management and restoration.

Wollemi Pine
John Benson assisted National Parks and Wildlife Service with the long term monitoring of the main population of the Wollemi Pine in Wollemi National Park. This involved monitoring growth rates and mortality of tagged seedlings. John Benson was also involved in documenting the environment at the several populations of the Pine. During 2001 he obtained wood material from the field to assist the Australian National University Division of Forestry in its dendrochronological and wood anatomy research on the Wollemi Pine. Early results reveal that a fallen 0.8 m wide Wollemi Pine tree was about 350 years old. It is anticipated that the dendrochronological studies will be able to correlate rainfall fluctuations to growth rates in the pine. A number of Gardens' staff continue to sit on the Wollemi Pine Recovery Team.

Horticultural Research and Development Theme

There are two driving forces behind our horticultural research programs: firstly, the need to provide horticultural solutions to conservation problems and, secondly, a desire to increase the number and variety of species available in horticulture. Techniques include: the development of biotechnological methods for mass-propagation and ex situ conservation; DNA finger-printing of rare populations and cultivars; and the selection and development of plants, both native and exotic, which are new to commercial Australian horticulture.

New programs have been initiated that encompass conservation and vegetation

management. Particular emphasis has been placed on seed physiology research, especially for rare and endangered species and ecological plant communities. The establishment of the NSW Seedbank has given impetus to this research as well as the involvement of the Gardens in a number of ongoing recovery efforts with the National Parks and Wildlife Service.

Cumberland Plain Seed Biology
Seed from the Woodland Conservation area at Mount Annan was collected and tested for viability. The focus of this new project is on the understorey species as these are the least understood. A seminar was held at Mount Annan bringing together Gardens' researchers and managers, as well as representatives of Greening Australia and National Parks and Wildlife Service, to form linkages and prioritise research programs in line with the forthcoming Cumberland Plain Endangered Ecological Communities recovery plan.

Flannel Flowers
The flannel flower was adopted as the floral emblem for the Centenary of Federation celebrations in New South Wales. The Gardens released a range of pot and garden varieties of flannel flowers developed by the horticultural research team under the label 'Federation Stars'. Additionally, a long-stemmed variety was released to the cut-flower industry. This was the culmination of seven years of research and development of this species. Cultural information has been developed and has been published in industry reports and is being prepared for publication in scientific journals. The work has moved on to developing a rapid propagation system for cut-flower production in conjunction with NSW Agriculture.

Orchid Research
There are more than 20 endangered orchid species in NSW that will be the subject of future recovery plans. A small study was supported by the Slade Orchid Fund to examine techniques for improving the storage of orchid seed. Decisions about the role of the Gardens in native orchid seed and propagation research will be made following the International Orchid Conservation Congress in 2001.

Silicon Addition to Potting Mixes
A 140-page report was prepared by Dr Sally Muir (University of Western Sydney), Dr Cathy Offord, Dr Brett Summerell and others for the Horticultural Research and Development Corporation. The study demonstrated the effect of the addition of plant-available silicon added to potting mixes in increasing plant health through resistance to fungal diseases, tolerance to stressful conditions and general yield increases. Further studies are planned to examine the role of silicon and other nutrients in a range of species.

Waratahs
Research Officer Cathy Offord received a PhD for work on horticultural improvement of the waratah through breeding. Publications are being prepared on reproductive biology, biochemical and morphological variation in natural populations and genetic analysis of horticulturally important traits. Amelia Martyn began a PhD project on the causes of bract browning in

waratahs. Localised calcium deficiency has been implicated in disorders similar to waratah bract burn, such as tip burn of lettuce and bract necrosis of poinsettia. With Honours student Cheryl Thomas, Amelia Martyn conducted experiments on potted waratahs in the 2001 season to determine the effect on bract burn of various calcium applications. Anecdotal evidence also suggests that water stress may play a role in development of bract burn. Experiments were conducted to determine the effects of a high and low frequency of irrigation on bract burn of waratahs.

Horticultural research staff played a key role in preparing waratah, flannel flower and Wollemi Pine displays and exhibitions for the Olympics and the 2001 Royal Easter Show.

Wollemi Pine
The Wollemi Pine is due for release in 2005. In preparation, an experimental program has been established to ensure that horticultural information is available at that time. Experiments are being conducted on pot and field growth with the research and development partner, Queensland Forest Research Institute.

Work on seed biology of the Wollemi pine was accepted for publication in *Australian Journal of Botany* and a number of other publications were prepared on the biology of this species. Members of the Gardens' staff continue to be active on the Wollemi Pine Conservation Management Committee, including a number of scientific visits to sites in the wild.

Technical Officer Patricia Meagher accompanied a Wollemi Pine display at the World Heritage Committee Meeting in Cairns, in November 2000, to support the successful nomination of the Greater Blue Mountains World Heritage Area.

Fungi and Plants Theme

Plant health is the major focus of this theme. The research component focuses on the nature, classification and control of fungi, both disease-causing and beneficial. Priorities are set largely by industry needs. The long-standing program on Fusarium continues to be of relevance to agriculture and horticulture in Australia and overseas. New directions will include a greater emphasis on the fungi associated with native species, linking in with other research programs in the Conservation and Horticultural Research Section. Molecular analysis and diagnosis is a growing area for research and service delivery.

***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 was accepted for *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 makeup 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 Program

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. The Conservation and Horticultural Research Section also provides advice on horticulture, vegetation management and plant disease in Australia and overseas. The section has a strong interest in the communication of botanical knowledge, particularly through the publication of Cunninghamia *and books on the vegetation of the Sydney region. Larger publication projects on the vegetation of New South Wales and rare and threatened plants will be initiated in coming years.*

Cunninghamia
Cunninghamia: a journal of plant ecology for eastern Australia, continues to be an important vehicle for the publication of ecological research in New South Wales and other eastern States. Highlights of issues 3 and 4 of volume 6 include:

- Vegetation maps of the Guyra 1:100 000 map sheet in the New England bioregion, and Booti Booti National Park and Yahoo Nature Reserve, near Forster on the New South Wales north coast
- Vegetation surveys of Barrington Tops and Mount Royal National Parks, emphasising fire management issues, Holsworthy military area near Campbelltown, and Pooncarie in the far south-western plains
- Historical studies of changes in estuarine wetlands along the Parramatta River, 1788–1940
- Soils on a sandhill remnant at 'Zara' on the riverine plain near Deniliquin
- The breeding system of *Persoonia juniperina*, in the family Proteaceae
- An assessment of the biogeographical attributes of the threatened flora of New South Wales.

Plant Disease Diagnostic Unit

The Gardens offers a comprehensive commercial service, the Plant Disease Diagnostic Unit, for the diagnosis of diseases of native, horticultural and amenity plants. Recommendations and appropriate control measures, with an emphasis on biological or environmentally safe treatments, are also provided. In 2000/2001 the Unit processed 188 samples, 145 from external clients and 43 from within the Gardens. This represents a 73% increase in samples received from external clients over the previous year, due mainly to more consultants and professional horticultural advisers accessing the service.

Soil-borne diseases again predominated in the diagnoses. *Phytophthora* spp (27%) and *Armillaria* spp (17%) were most frequently detected, with *Armillaria* continuing to be a major problem in many of the older established gardens in inner Sydney. The Unit's ability to accurately identify *Armillaria* from decaying roots or bark using a molecular-based test is the first for an Australian laboratory. A further 13% of samples involved the identification of fruiting bodies from fungi that cause secondary tree rots and decay.
As in the previous year, 10% of diagnoses were for Fusarium Wilt of palms, predominantly the Canary Island Date Palm, *Phoenix canariensis*. For the first time, the Unit detected the disease in another State, South Australia. Further molecular testing in the research section of the Diagnostic Unit will help to confirm whether this outbreak has spread from Sydney or is a new introduction into Australia.

Samples from within the three Gardens were also mainly (70%) for *Armillaria* and *Phytophthora* detection. The Unit continues to play a major role in monitoring the disease status of the living collections and ensuring new plantings are disease free. There is continuing assessment of the Wollemi Pine specimens and the development of a program in consultation with Gardens' staff to control the spread of *Armillaria* within the Sydney site.

Sydney's Bushland

As noted last year, in response to the need for a general guide to the plant-life of Sydney, *Sydney's Bushland: More than meets the eye* , a magnificently

illustrated book by Jocelyn Howell and Doug Benson, was published in September 2000. It includes a guide to the different types of vegetation around Sydney, describing some of their intriguing ecological attributes, and suggests interesting bushland places for readers to explore. The book was edited by Penny Farrant and designed by Helen Stevenson in the Design and Editorial Section of the Gardens' Communication and Marketing Branch, and staff photographer Jaime Plaza provided many of the colour illustrations.

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 programs were established under the Plant Diversity Theme, and user-friendly access to data has been identified as the major communication objective.

Flora of Australia Program

We do not know what plants, fungi and algae occur in Australia. It is hard to believe such fundamental knowledge is lacking. The biggest gap in our knowledge is the thousands of undiscovered or unnamed microscopic and flower-less plants. We spend billions seeking life on other planets, but we don't even know what grows in our backyard. Even where the gaps are not so big — the flowers and trees we know so well — a discovery like the Wollemi Pine brings us back to earth!

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.

Priorities are set by the Flora of Australia publication program, stakeholder demands for resolution of taxonomic problems, and nationally recognised knowledge gaps. In consultation with other members of the Council of Heads of Australian Herbaria, the Gardens will focus on bryophytes and algae as its contribution to the gap in cryptogam knowledge (the so-called 'forgotten flora').

Aquatic Plants
Dr Surrey Jacobs continued his molecular studies in several groups including Zosteraceae, *Vallisneria* and *Aponogeton.* Dr Jacobs is cooperating with Dr Don Les of the University of Connecticut with the first publication to be on Zosteraceae.

Bryophytes
In November, Dr Elizabeth Brown attended the John Child Bryological Workshop in Westland, New Zealand. As a result, an interesting *Zoopsis* (Lepidoziaceae) is being described in collaboration with David Glenny (Landcare Research, Christchurch). Further fieldwork was undertaken in northern Queensland with Professor Tamas Pócs (Eszterházy Károly College, Hungary), Dr Christine Cargill (Centre for Plant Biodiversity Research, Canberra) and Andi Cairns (James Cook University, Townsville). A number of interesting taxa were found, including New Caledonian and New Guinean representatives of a genus new to Australia, *Nowellia*.

Dr Helen Ramsay (Honorary Research Associate), in collaboration with J.R. Spence (Glen Canyon Nature Reserve, Page, USA) and A.J. Shaw (Duke

University, Durham USA), continued work on the Bryaceae for *Flora of Australia*. Dr Ramsay also pursued her revision of the Sematophyllaceae in collaboration with B.C. Tan (Singapore University) and W.B. Schofield (University of British Columbia).

Cyperaceae
Karen Wilson continued studies of various genera in the family Cyperaceae, in collaboration with Dr Jeremy Bruhl (University of New England) and students whom they jointly supervise. The large widespread genus *Fimbristylis* and its allies are being studied morphologically and anatomically by PhD student Ms Kerri Clarke. Studies are also being conducted from a molecular standpoint by Kioumars Ghamkhar, another PhD student, with Dr Adam Marchant as a co-supervisor. Delimitation of the genus *Carpha* is being studied by PhD student Xiufu Zhang, who is investigating morphological, anatomical and molecular characters. Sectional relationships within the genus *Schoenus* are being investigated by Honours student Linda McLaughlin using morphological and anatomical characters. Special Botanist Karen Wilson visited herbaria in London to examine types and other key specimens, and collected samples in New Caledonia in June for these studies.

Ericaceae: Epacridoideae
In collaboration with Associate Professor Chris Quinn (University of NSW), Dr Elizabeth Brown has continued revision of the systematics of subfamily Epacridoideae. A molecular analysis of relationships in *Leucopogon s.lat.* by Honours student Gabrielle Taaffe was published. *Leucopogon s.str.* has been shown to be a strong grouping but there are a number of taxonomic problems and relationships still to be resolved in the remainder of *Leucopogon, Astroloma* and *Styphelia*.

Eucalypts
Ken Hill continued systematic studies on the eucalypts, with publication of some of the work commenced with Honorary Research Associate Don Blaxell and the late Lawrie Johnson on Western Australian species. Work continued on several rare and poorly known taxa from New South Wales and on the Sydney Blue Gum group in collaboration with Don Blaxell.

Fabaceae: Faboideae
Dr Peter Weston and Peter Jobson published in *Telopea* a description of *Dillwynia rupestris*, a narrow endemic from the New England Tablelands. Specimens to be used as the type of a recently discovered species of *Dillwynia* from Barren Grounds Nature Reserve near Jamberoo were also collected during the year.

The major publication *Legumes of the World* was launched at the International Legume Conference held in Canberra in July. The book was published by Kew Gardens and co-written by a number of world renowned legume botanists. Gardens' staff contributed several generic entries. At the same conference, the prototype of a full interactive identification computer key for Australian peas was launched. The *Dillwynia* and *Swainsona* character coding will be completed by Gardens' staff by the end of 2001.

A paper co-authored by Dr Mary Tindale on the *Glycine clandesina* complex was accepted for publication. The full treatment of *Glycine* for the *Flora of Australia* is at first draft stage.

Fabaceae: Mimosoideae
Information about the more than 230 species of Acacia that occur within New South Wales is now available through the *WattleWeb* module of the *PlantNET* website (plantnet.rbgsyd.gov.au/PlantNet/wattle/index.html). The team that developed this website included Dr Barry Conn, Dr Phillip Kodela, Ken Hill and Terry Tame (Honorary Research Associate). *WattleWeb* includes an up-to-date interactive identification tool; current, authenticated distribution information for NSW; and notes on ecology, uses and cultivation. This project was funded through the New South Wales State Government Community Access to Natural Resource Information (CANRI) program.

The culmination of decades of work by a team of scientists from across the country has resulted in the publication of the *Acacia* volumes 11A & 11B of the *Flora of Australia* project, complemented by the CD-ROM *WATTLE –Acacias of Australia*. These volumes and CD present information on more than 1000 *Acacia* species, together with an interactive identification tool. Contributors from the Gardens included Dr Mary Tindale, Dr Kodela, Dr Conn and Terry Tame.

Drs Tindale and Kodela co-authored papers on two new taxa of *Acacia* in *Telopea* and *Nuytsia*: a new subspecies of *Acacia dealbata* from south-eastern Australia, and a new species from the Pilbara in Western Australia.

Flora of Lord Howe Island
Dr Elizabeth Brown, Dr Barry Conn and Katherine Downs surveyed liverworts, freshwater algae and weedy species from Lord Howe Island as part of the development of 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.

Freshwater Algae
A collaborative project between Dr Tim Entwisle and Simon Lewis at the Royal Botanic Gardens Melbourne on the taxonomy of the filamentous green algal family Zygnemataceae was completed. A manuscript for the *Algae of Australia* series was submitted to the funding agency Australian Biological Resources Study. This account includes five genera and 54 species, plus 12 vegetative groups. A paper describing a new species of *Spirogyra* was published in *Muelleria*. The Zygnemataceae is a cosmopolitan family of 12 genera and nearly 800 species, with representatives found in lakes, streams and ponds, sometimes producing weedy problem growths in farm dams.

Dr Stephen Skinner finalised four papers for *Telopea* documenting new species and new records of macroalgae from freshwater habitats in New South Wales. The previous year's research resulted in five new species to science and 27 new records for NSW. Funding has been achieved to continue this work (part-time) in 2000–01.

Dr Skinner and Dr Entwisle also achieved funding to revise the filamentous green algal genus *Oedogonium* in Australia. This three-year project commenced in January 2001. *Oedogonium* is a vegetatively simple but species-rich genus widespread throughout the world, in almost all freshwater habitats. There have been numerous, mostly unvouchered, literature records from Australia, including 80 species, but no national revision. Collections so far represent 25 confirmed species.

Two possible new genera of freshwater red algae collected from Queensland are being studied in culture (with Professor John West, University of Melbourne) and being sequenced (Dr Morgan Vis, Ohio University). 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 submitted two papers to *Telopea* documenting five new species and 79 new records of desmids (microalgae) for New South Wales.

Lamiaceae
An account of this family was prepared for *Flore de la Nouvelle-Calédonie* series by Dr David Mabberley (Honorary Research Associate) and Dr Rogier de Kok (CSIRO, Canberra).

Lichens
Honorary Research Associate Dr Alan Archer continued his work on Australian taxa in the family Graphidaceae, in particular the genera Graphis, Graphina, Phaeographis and Phaeographina in which a number of new taxa and new records for Australia were described. The remaining genera: Glyphis, Medusulina, Sarcographa, Sarcographina. and the endemic, monotypic Diplogramma and Gymnographa are currently under investigation.

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 Dr Millar 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 (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 several students from Wollongong University (NSW) and La Trobe University (Vic) complete theses under the co-supervision of Dr Millar.

Poaceae
Sampling for molecular studies was completed for the Australian native species but sequencing and analysis has shown a serious problem with the ITS sequences used. Joy Everett and Dr Surrey Jacobs uncovered the problem while analysing results and are now working on ways to overcome the setback. Some re-sampling and re-sequencing is part of the process. Scanning electron microscopy was tested on selected material to estimate variation and establish scoring systems.

Work commenced on the third edition of *Grasses of New South Wales*. There has been a change of authorship (now D.J. Wheeler, S.W.L. Jacobs and R.D.B. Whalley) with this expanded and updated treatment.

Proteaceae
In September 2000, a new species of *Eidothea*, a genus of rainforest trees that was only named in 1995, was discovered in the Nightcap Range, near Lismore in north-eastern New South Wales. *Eidothea zoexylocarya*, the only other species, is known only from Mt Bartle Frere, near Cairns in North Queensland. This was an exciting discovery because *Eidothea* is the only relic of a lineage that probably diverged from other Proteaceae over 90 million years ago and that has barely survived in the rainforests of eastern Australia. Almost 100 trees of the Nightcap *Eidothea* have been found so far, some of which are well over 30 metres high. That such a large, biologically significant plant could escape detection in a place as thoroughly botanised as the Nightcap Range underlines the fact that much remains to be discovered about our natural heritage. Dr Peter Weston is collaborating with discoverer Rob Kooyman in describing and naming the new species.

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 submitted and recommended for publication by referees.

Restionaceae and Allied Families
Study of the Restionaceae by Honorary Research Associate Dr Barbara Briggs continued, using both morphological and DNA data, the latter in collaboration with Dr Adam Marchant. Papers were published naming nine new species in the genus *Desmocladus* and five in other genera of the family. Work is continuing to formally name the many undescribed species that have been distinguished and further studies are in progress to clarify the affinities of Restionaceae to other families, relationships within the family, and aspects of evolution and biogeography.

Asia-Pacific Taxonomic Initiative Program

The Gardens has contributed for a number of years to the discovery and documentation of plants in the local region outside Australia. As part of our national

responsibilities under the United Nations Convention on Biological Diversity, we are assisting neighbouring countries to gain the knowledge to manage and conserve their vegetation. 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. Sydney, as Australia's 'gateway to the Pacific', continues to look outward to the Asia-Pacific region.

Our emphasis is on training, knowledge exchange and collaborative projects with the host countries. Priorities will be set by international programs, host country needs and our expertise. Most of our research in this area will be funded externally.

Araceae
Dr Alistair Hay and Dr Peter Boyce (Royal Botanic Gardens Kew) revised the genus *Pothos* in Malesia and the South-west Pacific, including about 50 species. This revision is a precursor to the forthcoming account of Araceae for *Flora Malesiana*. 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 Horticulturists Lorraine Perrins and Darcy Tordoff used a Friends of the Gardens' Scholarship and a grant of $12,000 from the Australia Indonesia Institute to travel to Sumatera to assess threats to this plant in the wild state. They also discussed plans for initiating propagation trials at Bogor Botanic Garden. The project, overseen by Dr Alistair Hay, seeks to demonstrate that this plant can be commercially propagated using low technology methods.

Bauer Illustrations
Professor David Mabberley (with Prof. dr. E. Pignatti-Wikus, University of Trieste, and Mag. C. Riedl-Dorn, Naturhistorisches Museum Wien, Austria) published a book on Ferdinand Bauer's plant drawings from his trips to Timor and Australia, including Norfolk Island, in 1801–1805.

Blechnum
Professor Carrick Chambers (Honorary Research Associate) 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. Field observations have been extended to Venezuela together with studies on the collections at the National Herbarium in Caracas and at the Herbarium of the Royal Botanic Gardens Kew.

Cycadophyta
Ken Hill completed three weeks field study on the cycads of the Philippines in June 2001. He was assisted by Dr Edwino Fernando of University of the Philippines Los Banos and Anders Lindstrom of Nong Nooch Tropical Garden, Thailand. This commenced the study of the cycads of the Philippines, and recorded five species, one undescribed. A further trip to finalise this study has been planned for early 2002. A short trip was also conducted to examine newly discovered populations in China in May 2001. A visit was made to the Indonesian National Herbarium in Bogor to examine specimens of Indonesian

cycads and to discuss future collaborative studies in July 2000. 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 is in preparation 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).

Eucalypts
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 visit was made to the Indonesian National Herbarium in Bogor to examine material of this group in July 2000.

Indonesia
The Gardens has continued its close collaboration with *Kebun Raya Indonesia* (Botanic Gardens of Indonesia). Outcomes from this collaboration included joint field studies of the Urticaceae (Nettle family) in Sumatra by Dr Barry Conn, accompanied by J. Hadiah and E. Ariyanti (both KRI) and site visits to Kebun Raya Bogor (by RBG horticulturists Lorraine Perrins and Darcy Tordoff) as part of the *Amorphophyllus titanum* propagation project.

Juncaceae
Karen Wilson contributed to the treatment of the family Juncaceae for the IOPI Species Plantarum *World Flora*. She also visited herbaria in London and Paris to complete a revised treatment of the genus *Juncus* for the Malesian region (the original treatment was published in 1951 and was very out of date). This paper includes an overview of related septate-leaved species native to Australasia and continental Asia. It was accepted for publication in *Telopea*, along with the description of a new species in New Zealand, *Juncus edgariae*, the name honouring Dr Elizabeth Edgar of Christchurch who has intensively studied the family Juncaceae in Australasia. 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
Reed Beaman is at the Gardens in his second year of a two-year post-doctoral fellowship from the *US National Science Foundation*. Dr Beaman is developing biological informatics tools to automate the process of mapping and modelling specimen distributions using Geographical Information System (GIS) software. He is using databased collection data from NSW and Malesia in the nettle family as a case study. His approach will improve the usefulness of the plant distribution information from botanical collections from Australia and South-east Asia.

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 the *International Union of Biological Sciences* and key international database groups (particularly, Executive Committee of the IUBS *Taxonomic Database Working Group*, Chair of the *Global Plant Checklist Committee* of *IOPI*, and the management team of *Species 2000*). 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.

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 began organising a *Biodiversity Knowledge Management Forum* to be held in November 2001, building on our expertise in the management and theory of biodiversity information.

Tropical Systematics
In conjunction with the Centre for Plant Biodiversity Research in Canberra, the Gardens is organising the *5th International Flora Malesiana Symposium* to be held in Sydney and Cairns in September 2001. Our lead role in this regionally important meeting consolidates the commitment of the Gardens to the Asia-Pacific Taxonomy Initiative program identified in the 1999 Review of Plant Sciences. The Gardens also prepared to advertise for a botanist to specialise in tropical systematics.

Origins and Evolution Program

Through the study of plant relationships the Gardens is part of an international effort 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.

Priorities are set by the scientific questions left unanswered, national priorities (such as through the Australian Research Council), and the expertise available within the Gardens and collaborating organisations. The biota is best treated as a whole, and collaboration will be sought with, for example, the Australian Museum.

In addition to telling us more about the country we inhabit, research on relationships, origins and evolution can provide an alternative way to set conservation priorities and discover new species, and a means of understanding (and managing) responses of plants to the environment (e.g. the origin of fire tolerance in the Australian flora).

Amborellaceae
Charles Darwin once called the early evolutionary history of the flowering plants 'an abominable mystery'. It remained so until 1999 when several American and European laboratories independently announced that, using DNA sequences, they had resolved the precise branching order of the earliest flowering plant lineages. Their work showed that a small rainforest tree endemic to New Caledonia, *Amborella trichopoda*, is probably the only known survivor of the first lineage that diverged from the rest of the flowering plants. This discovery represented a huge first step in reconstructing what ancestral flowering plants were like, where they lived, and how they functioned. A crucial element of the function of any plant is its reproductive biology — how fertilisation is effected, the distribution and ratio of male and female

reproductive organs, whether or not it is capable of self-fertilisation, etc. Nothing has been published about the reproductive biology of *Amborella* other than the fact that the tiny, male and female flowers are borne on separate plants.

Dr Peter Weston was invited by a team of North American botanists (Associate Professor Peter Bernhardt, St Louis University, U.S.A., Dr Tammy Sage, University of Toronto, Canada, Professor Leonard Thien, Tulane University, U.S.A.) to join them in studying the reproductive biology of *Amborella trichopoda* in New Caledonia in April 2001. Although poor weather prevented any study of natural pollination, experimental pollinations were successfully conducted, allowing the detailed study of pollen-stigma interactions, pollen tube-ovule interactions and the physiology of fertilisation.

Casuarinaceae

Karen Wilson continued a major study of the family Casuarinaceae with interstate collaborators, with ABRS 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, Prof 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 *mat*K region of the chloroplast genome confirms the family as monophyletic, highly derived and remote from its nearest relatives. As postulated from morphological data, *Gymnostoma* appears to be the most primitive of the four genera, while sister genera *Allocasuarina* and *Casuarina* are probably the most derived. We are 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 we plan to investigate nuclear 26S ribosomal DNA if funding is found. Mrs Wilson collected more samples in New Caledonia in June, both for this study and for her nearly-completed treatment of the family for the *Flore de la Nouvelle-Calédonie*.

Character Coding

Visiting Research Fellow, Associate Professor Bruce Kirchoff from University of New Carolina, USA, spent three months working with Dr Peter Weston and other staff on the coding of characters for use in discriminating taxa and reconstructing phylogenies. Using *Banksia* as a test organism, Associate Professor Kirchoff examined the different ways that characters can be divided into character states. Authors tend to be silent on why they have chosen particular ways of scoring a character, and although characters are often treated as independent they are usually not, neither biologically nor in the way we define them. Through workshops with staff, and as part of his research project on *Banksia*, Associate Professor Kirchoff helped the Plant Diversity group achieve a far greater awareness of the relativity of 'characters'.

Cosh Studentship

As inaugural recipient of the Janet Cosh Studentship, Jeffrey Drudge studied the pollen morphology of the *Baeckea* group (Myrtaceae) with Dr Peter Wilson and Associate Professor Chris Quinn (University of NSW). The pollen from

over 30 species in the *Baeckea* group was collected from herbarium specimens and examined using scanning electron microscopy. The results were correlated with the molecular phylogenetic analyses described below.

Dennstaedtiaceae

Analysis of the biogeographic and evolutionary history of the bracken ferns (*Pteridium*) world-wide by Professor John Thomson (Honorary Research Associate) continued. The emphasis is on clarifying local problems concerning the genus in South and Central America, northern and eastern Europe and in Africa that were identified in the general overview completed last year. 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. Examination in London of Linnaeus' specimens labelled *Pteris caudata* confirmed that these are tetraploid.

An informal international consortium involving bracken researchers from the United Kingdom, Sweden, Russia and Ukraine provided material for DNA fingerprinting at the Gardens, that should when completed resolve outstanding questions of relationship and status amongst controversial European bracken morphotypes such as *pinetorum*, *atlanticum*, *fulvum* and *tauricum*, especially in relation to the principal pan-boreal *latiusculum* lineage. Progress was also made during the year with cloning and sequencing of rDNA regions including ITS (with Dr Peter Weston) and IGS (with visiting scientist Dr Goro Kokubugata) directed towards establishing specific probes that can be used as markers for the several ancestral genomes represented in modern diploid brackens.

Freshwater Red Algae

The collaboration between Dr Tim Entwisle and Dr Morgan Vis of Ohio University in the USA continued with a second paper published. This study examines relationships within the red algal order Batrachospermales, identifying a distinctive Australian clade as well as some more widespread taxa. The collaboration continued with collections from New Zealand (South Island and Stewart Island) and Australia (New South Wales and Victoria) prepared for molecular sequencing.

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. A paper on relationships within the family, based on the combined analysis of morphological and molecular data, has been accepted for publication in the *American Journal of Botany*.

The results of a study by BSc.(Hons) student Marcelle O'Brien, based on sequences of two chloroplast regions, the matK gene and the atpβ-rbcL intergenic spacer, for *Leptospermum* and related genera were published. This project overturned some existing views of the relationships of this group and cast doubt on the integrity of the well-known genera *Agonis* and *Leptospermum*.

Work is continuing on a project aimed at clarifying generic concepts in *Baeckea* and related genera. This project was started by BSc.(Hons) student Nikolas Lam and is continuing with funding by the Australian Biological Resources Study (ABRS). A preliminary paper on the phylogeny of this group is in preparation.

A paper was published describing a new genus, *Anetholea*, identified as distinct during the above project. The new genus is remarkable in that it has small, dry fruits while the DNA data clearly indicate that it is a member of the otherwise fleshy-fruited Lilly Pilly group. This research has shown that the Lilly Pilly group has evolved independently from other fleshy-fruited groups in the family, such as the Guava, and it is possible that this new genus resembles an ancestor of the entire Lilly Pilly group.

Orchidaceae

Species of *Chiloglottis* (bird orchids) are known to attract specific wasp pollinators by a process known as sexual deception. The orchid flowers mimic female wasps by producing chemicals that resemble the pheromones exuded by wasps. In the course of attempting to mate with the flowers, male wasps pollinate them. In most cases, each species of orchid is uniquely pollinated by the males of one species of wasp. Postgraduate student Jim Mant and Dr Peter Weston have been investigating whether these intimate relationships between plants and animals are the result of an ancient, gradually evolving association, or a process of more recent, abrupt 'colonisations' of wasp lineages by different orchid species. They have done this by using DNA sequences to reconstruct the evolutionary family trees of wasps and orchids. The gradual model of coevolution predicts a close fit between the evolutionary histories of orchids and their pollinators, in contrast to the colonisation model, which predicts a low level of fit. The data that have been collected favour the colonisation model, although the three main groups of orchids correspond closely (but not perfectly) to the three main groups of wasps. Analysis of rates of molecular evolution in wasps and orchids suggests that the orchid groups are much younger than the corresponding wasp groups. Sampling has now shifted to a more sensitive kind of DNA marker from the orchids to test the hypothesis that male wasps are better orchid taxonomists than are human morphologists.

Sex is not the only commodity that Australian native orchids use to deceive their pollinators. Some orchids have been shown to deceive their pollinators by 'pretending' to offer food rewards. For example, at least one species of Donkey Orchid, *Diuris pardina*, is pollinated by the same species of native bee that pollinates the egg and bacon peas with which it grows in Victoria. The peas offer nectar and pollen rewards to the bees, unlike the orchid, which offers neither nectar nor edible pollen. The orchid flower does, however, superficially resemble an egg and bacon pea flower. Postgraduate student James Indsto and Dr Peter Weston have shown that this close resemblance even extends to the ultra-violet spectrum, which is visible to bees but not to humans. They have also found that *Diuris pardina* and egg and bacon peas are probably pollinated by the same bees in the Sydney region too. This work is part of a recently initiated project, the aim of which is to understand the evolution of pollination

syndromes in *Diuris*. Variation in DNA markers will be sampled to reconstruct the evolutionary family tree for *Diuris*. They hope to be able to 'decorate' this tree with data on the pollinators of different *Diuris* species. Most of these orchids do not resemble egg and bacon peas but may mimic other flowers with which they grow.

The Beardy Orchids, genus *Calochilus*, are native to Australia, New Zealand and New Caledonia. Postgraduate student Andrew Perkins and Dr Peter Weston have been investigating the phylogeny of this genus in order to test different explanations for the origins of this distributional pattern. For instance, did seeds of the non-Australian species blow across the Tasman Sea and found new populations or did they ride out into the Pacific on drifting continental fragments? Rates of molecular evolution in *Calochilus* were analysed and it was concluded that they must have flown to New Zealand and New Caledonia if currently accepted estimates for the timing of continental drift are correct. Andrew submitted his PhD thesis for examination in March 2001.

Proteaceae
Carolyn Porter and Dr Peter Weston continued their molecular phylogenetic study of the subfamily Persoonioideae, filling gaps in their sample of ITS and trnL DNA sequences from a broad range of species.

Management of Preserved Collection Program

The National Herbarium of New South Wales holds the State's reference library of nearly one 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.

Centenary of Herbarium
On 8 March 2001, the Gardens celebrated the opening 100 years ago of the first home dedicated to the National Herbarium of NSW — what is now called the R.H. Anderson Building. The actual herbarium (ie. the collection of dried specimens) effectively began with that opening. The Director at that time, J.H. Maiden, initiated an exponential growth in the herbarium collection, having been surprised to find only 'a few books of specimens' when he became Director in 1896, thanks to most of the earlier specimens having been sent to England for study there. That opening in 1901 marked the effective establishment of the Herbarium as an important part of the world's network of herbaria for botanical research.

At the celebratory afternoon tea, staff members were entertained by fellow staffer Stephen Skinner, who presented a speech (somewhat cut down) as made by J.H. Maiden 100 years before. Some of Maiden's comments have continuing relevance today. Unveiling of a centenary quilt made by a group of staff and friends followed this speech. The group included 23 present staff

members, two spouses of staff members, one former staff member, three members of The Friends of the Gardens, and one quilting friend. These people contributed in many different ways, according to their interests and available time — some, for example, contributed ideas on the design of the quilt; others displayed delightful talents in embroidery, appliqué and quilting. The motifs on the quilt reflect the integral role of the Herbarium in the Royal Botanic Gardens and its diverse activities – in the first place as one of Australia's leading centres for plant systematics, and more recently including plant ecology, breeding, pathology and conservation.

Herbarium Specimen Database

The Gardens played a lead role in securing nearly $10 million of Commonwealth, State and private funding for Australia's Virtual Herbarium project. Over five years, the preserved plant collections held by all State and Territory herbaria will be data-processed and made available to the community via the internet. Dr Tim Entwisle will be a member of the national Steering Committee, and Dr Ian Blackburne has been appointed to the Trust overseeing the Private Funds.

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

PlantNET

PlantNET (plantnet.rbgsyd.gov.au), the website that brings 200 years of collections and scientific research (ie. the National Herbarium of New South Wales) to the community, was launched. The site includes a 'live' link 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.

The *HerbLink* module of *PlantNET* was implemented in June. This module presents images of the Type herbarium specimens of *Eucalyptus* and *Corymbia* that are held at the National Herbarium of New South Wales. It is part of a longer-term project to present an image of at least one herbarium collection of each species that occurs in the State.

The Gardens, NSW National Parks & Wildlife Service and the Australian Museum have jointly developed a Biological Information Network to present biological distributional information via the Internet. This project was funded, in part, through the NSW Biodiversity Strategy.

Collection Enhancement

A five-year herbarium collection strategy for New South Wales, based on an analysis of the collection density of specimens held by the Herbarium, has been developed. The number of collections in each 10x10 km grid cell (within the State) has been calculated. Those grid cells that were not represented by specimens, and were surrounded by other cells with only 1 or 2 collections, were targeted as priority areas for collecting trips.

This year, three collecting teams collected plants from the South West Plains of the State. 1500 collections were made and processed for incorporation into the Herbarium. Of these about 50 specimens represented extensions to their known distributional range or were rare plants. About 70 specimens were also added to the Public Reference Collection of the Gardens. This work was funded by a NSW National Parks and Wildlife Service contract.

Communication and Services Program

A major recommendation of the review was to make our research results and expertise more accessible to the general community. Descriptions, illustrations and identification tools will be part of the expanded PlantNET system. Linked to the collections of all State and Territory herbaria through Australia's Virtual Herbarium, PlantNET will provide an up-to-date Flora of New South Wales and a series of interactive keys and information packages. Our commitment to teaching and student supervision is a concrete way for the Gardens to fulfil its legislative objective 'to increase and disseminate knowledge with respect to the plant life of Australia and of NSW in particular' and 'to give particular emphasis to encouraging and advancing the study of systematic botany, and to plant conservation'.

The Botanical Information Service now includes electronic delivery of information, through PlantNET, as well as a plant identification service and self-help reference collection. The hardcopy Flora of New South Wales has been updated, continuing to provide a summary of our research on the diversity and classification of the State's plant species. Through a mix of print and electronic products the Gardens will maintain its core role as provider of information on the plant diversity of New South Wales.

Accessions, Exchanges and Loans

	1999-2000	**2000-2001**
Herbarium accessions*	14,215	11,148
Specimens mounted	26,905	25,643
Records databased	20,950	20,222
Total databased to date	325,806	346,028
Outgoing loans	**(loans) specimens**	**(loans) specimens**
Dispatched to other institutions	(35) 2,430	(38) 4,876
Returned to other institutions	(47) 1909	(267) 4,876
Incoming loans:	**(loans) specimens**	**(loans) specimens**
Received from other institutions	(59) 2,758	(37) 3,092
Returned by other institutions	(159) 4,125	(59) 4,860
Exchanges:	**Specimens**	**specimens**
Donated to other institutions	2,045	2,494
Received and from other institutions	4,097	5,497

* New accessions include exchange material, donations and 2681 collections by staff.

Bachelor of Science (Biosystematics)
The Gardens continued its involvement in this course run by the University of New England in conjunction with the Gardens and the Australian Museum. Plant Sciences staff contributed to the residential schools and helped to further refine the course content. Numbers are still low but the reputation of the course is growing.

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. 486 enquires were processed through *PlantNET*, of which 183 were from Australia (130 from New South Wales subscribers, of which 58 were from State Government agencies and 29 from educational organisations).

INQUIRY STATISTICS	1999–2000	2000-2001
Inquiries by mail	1321	1082
Inquiries by telephone	2326	1997
Inquiries in person	375	322
Inquiries by Internet	471	486
Requests for Electronic Data	22	18
Specimens Identified	5211	5822

Revenue 1999–2000 $17,786; 2000-2001 $9,543

The drop in revenue is due to the Olympics shutdown, the transfer of Department of Land and Water Conservation inquiries to the specially appointed botanist (see below), and a higher number of 'charge exempt or discounted' identifications. The latter included 375 specimens for urgent processing, such as extensions of ranges, rare and threatened species, and new weed incursions. An additional 438 specimens were kept as valuable additions to the herbarium, resulting in a discount to the inquirer.

Flora of New South Wales
Flora of New South Wales volume 2 was completely revised during the year. The first edition included 218 genera and 1608 species, while this revised edition describes 235 genera and 1765 species, an increase in species number of almost 10% in the past 10 years. Editing of this volume by Gwen Harden has been completed and it will be published in late 2001.

Forensic Identification
Government analysts identified forensic material (*Cannabis*) in 29 cases for the Police Service, resulting in revenue of $1450.

Public Reference Collection
Environmental consultants, students, government agencies, and the general community spent nearly 300 hours using the Public Reference Collection to identify plants that they had collected. Volunteers continued to update and

expand the collection. The identifications of five specimens were corrected and 102 additional botanical specimens were added to the collection.

Telopea

Three issues of *Telopea* were published during the year. Volume 8, number 4 (July 2000) carried eight papers covering taxa in the Asteraceae, Cunoniaceae, Casuarinaceae, Apiaceae, Graphidaceae and Myrtaceae, with 16 new Australian species and three new subspecies; and describing two new families of Poales. A revision of *Davidsonia*, a genus of rainforest trees on the east coast of Australia, showed there are three species, rather than one, the two new species being classed as Endangered, but with conservation efforts underway.

Volume 9, number 1 (December 2000) was a special issue comprising two papers on Schismatoglottidae (Araceae) in Malesia. This issue was a precursor to the *Flora Malesiana* and heralded new directions for *Telopea*: to extend our coverage to the Asia-Pacific region, in line with the direction of the Gardens; to expand our acceptable formats so that papers can easily be modified for various uses and forums; and periodically to publish special issues reaching new audiences. The two papers by RBG botanist Alistair Hay, in collaboration with Yuzammi and Josef Bognor respectively, covered five genera (112 species) with 34 new species described, and five new combinations. They contained extensive descriptions and citations and so will be valuable tools for field studies in conservation and in herbarium curation.

Telopea volume 9, number 2 (June 2001) commemorated the centenary of the first home of the National Herbarium of New South Wales, and the work of Joseph Henry Maiden, Director of the Gardens and herbarium founder. The issue contained 16 papers by 20 authors (of these 14 are Gardens' staff or Honorary Research Associates). There were 42 new species described and eight new subspecies. Two papers were on genera in the Restionaceae, four on the Myrtaceae, four on genera of the Fabaceae, two on the Juncaceae, and one in each of Goodeniaceae and Graphidaceae. All new vascular plant species carry comments on their conservation status, about half are considered rare, vulnerable or restricted. Most of the research was on Australian plants, while the work on Juncaeae covered species in Malesia and New Zealand.

Vegetation Mapping Identifications

The Gardens and the Department of Land and Water Conservation (DLWC) signed an MoU leading to the funding by DLWC of an Identifications Botanist to assist with all DLWC plant identifications including replies, liaison with field staff, report writing, and processing specimens retained by the Gardens.

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 Resources 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.

Library

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

Banks' Florilegium
At the end of the year we received the gift of a complete set of *Banks' Florilegium*, published in 34 parts by Alecto Historical Editions between 1980 and1988. This exquisite publication records the plants collected by Banks and Solander on Cook's first voyage around the world between 1768 and 1771. In many cases these are the first scientific illustrations of Australian plants.

New Accessions
This year the library accessioned 1703 items (251 monographs, 1452 periodical issues), and arranged to have bound 115 journal volumes. Additionally, 3685 items were loaned or circulated, and 1200 reference inquiries received and acted upon.

Physical Care
Monitoring of the library's temperature and humidity continued. Some problems with high humidity levels in the library annexe were encountered during the summer months. This necessitated the use of fans and dehumidifiers to ensure the collection was housed in optimum conditions.

Botanical Illustration

The botanical illustrators provide detailed and scientifically accurate illustrations of new and renamed species to complement taxonomic descriptions. The illustrations are made from pressed and living plants from the Sydney Gardens and other collections. The drawings are published in scientific journals, including Telopea, for the revisions of Flora of New South Wales, Flora of Australia as well as field guides, popular books and displays. Illustration of endangered and vulnerable species under the Threatened Species Conservation Act is ongoing and illustrations are to be included in Plant

Sciences web-based products. The illustrators also assist botanists in the creation of computer rendered illustrations and diagrams, particularly for modules of PlantNET.

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 illustration archive also allows the illustrations to be available on request whilst being stored safely.

Rare and Threatened Plants/WattleWeb
WattleWeb, a major project, was commenced in January 2001 to illustrate all listed rare and threatened species in NSW. *Acacia* species were given first priority, to link with the WattleWeb project. Twenty-five species were illustrated, including a new species *Acacia atrox*.

Other Major Projects
- A total of 375 illustrations were executed, including:
- New and revised species for the second edition of *Flora of New South Wales, vol. 2*.
- 20 plates of the moss family Sematophyllaceae: including *Macrohymenium, Acroporium, Meiothecium, Meiotheciella, Clastobryum, Papillidiopsis, Rhapidorrynchium, Radulina, Trichostelium* and *Warburgiella*.
- Araceae species, including ongoing work on the genus *Homalomena* (7 plates completed).
- Twelve plates of desmids (freshwater algae).
- Two plates of *Eidothea* 'Nightcap Range'.
- A new species of *Eucalyptus*, *E. boliviensis.*
- Various species in the lichen genera *Phaeographis.*

Herbarium Specimen Preparation Facility

The Preparation Facility is where new plant specimens coming into the Herbarium are processed and prepared before being incorporated into the collection. Specimens collected in the field are pressed and dried in preparation for mounting and then frozen to ensure they are free from pests before they are incorporated into the collection. Incoming and out-going loans and exchanges are also frozen, to ensure that pests are not transmitted between herbaria. The facility is a checkpoint where all specimens entering and leaving the Herbarium can be recorded. The Herbarium is accredited as an approved Australian Quarantine and Inspection Service (AQIS) facility. This enables us to process specimens received from overseas, and provide a quarantine service for other Australian herbaria.

Experimental Program
During 2001 a study was started to formalise the freezing procedure for pest management. The study involved freezing the different developmental stages of *Stegobium paniceum* at -18° C for different lengths of time. The aim is to establish the most efficient length of freezing time (hours) in order to achieve

100% mortality. This study may also provide evidence that freezing can be used as an ongoing and efficient method of pest control and pest eradication.

Herbarium Beetle Infestation
In June 2000 there was a widespread infestation of *Stegobium paniceum* (herbarium beetle), a common herbarium pest. All stages of the life cycle were found within plant specimen boxes and damage was caused to a large number of preserved specimens. As part of the IPM program, the infestation was controlled by freezing the infested material at -25ºC for 7 days. The infested area was then sprayed with an insect growth regulator, and the environment maintained at between 18 and 20ºC to prevent further insect activity. No further activity has been observed and the area is being monitored continually.

Integrated Pest Management
2001 saw a further phase in the introduction of an Integrated Pest Management program (IPM) to protect the herbarium collection from insect pests. Prior to IPM, protection of the collection depended on the use of chemical deterrents such as naphthalene, which has been used in herbarium and museum collections for over 100 years. Unfortunately, naphthalene and similar chemicals are potentially hazardous and of dubious use in insect control.

IPM 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 targeted at the insect pest. The first step in the program was the installation 18 months ago of the -25ºC freezer room. This year saw the progressive removal and disposal of all naphthalene from the 75,000 herbarium boxes. Next year will see the upgrading of the air conditioning system to allow better control and monitoring of the building environment and the introduction of housekeeping procedures.

Volunteer Programs

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

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

Databasing program

Volunteers databased in excess of 5 718 specimens during the year, a sharp increase on last year's 4,300 specimens. Volunteers also assisted with the transfer of data from disks to the Herbarium database (NSWDATA) for exchange specimens for which electronic records were provided from other herbaria.

Specimen mounting program
Fifty-three regular volunteers mounted 24,300 specimens on archival paper, slightly down from last year (25,326 specimens) due to fewer volunteers (cf. 68 last year) and a shortage of mounting materials later in the year. Outgoing loans, incoming exchange and fragile or vulnerable groups within the Herbarium collection were given highest priority. A total of 1343 cryptogam specimens were also mounted, databased 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.

Electron Microscopy Laboratory

The Electron Microscopy Laboratory provides facilities for Scanning Electron Microscopy, including freeze and critical-point drying. These techniques are used in research and plant identification.

Major projects
- Studies of *Stipeae* (Poaceae) lemma and leaf epidermis to fulfil project requirements as part of an international working group.
- Jeff Drudge, the 2001 recipient of the Janet Cosh Studentship, investigated the pollen morphology of Baeckea (Myrtaceae) and allies.
- Ongoing studies of taxonomy of *Acacia* (Mimosoideae) rusts (with NSW Department of Agriculture).
- Scanning Electron Microscope demonstrations for tour groups included; High School Biology Teachers, Forensic Biology Students, Green Corp Volunteers and Botanical Illustration Course students.

Molecular Systematics Laboratory

This laboratory provides facilities and expertise for the use of molecular genetic technology in botanical research.

Major projects
- Investigation of *Persoonia* (Proteaceae) phylogenetics and population genetics, including two PhD studies (in collaboration with University of Wollongong).
- PhD study of Urticaceae systematics in Indonesia (in collaboration with University of NSW).
- PhD study on molecular systematics of the tribe Abildgaardieae in Cyperaceae (in collaboration with University of New England).
- PhD study on molecular systematics of *Carpha* and related genera in Cyperaceae (in collaboration with University of New England).

- PhD study on genetic relationships in the Juglandaceae (in collaboration with University of Western Sydney).
- PhD study of *Chiloglottis* (Orchidaceae) population genetics (in collaboration with Australian National University).
- PhD study on molecular systematics of Chloantheae (Lamiaceae) (in collaboration with University of Sydney).
- MSc study of biogeography of the brown algal order Sporochnales (in collaboration with University of Melbourne).
- Identification of *Actinotus* (Apiaceae) cultivars produced at Mount Annan, by DNA fingerprinting.
- Ongoing study of the systematics of Restionaceae and allied families.
- Major survey of worldwide genetic diversity in the fern genus *Pteridium*.

Building Infrastructure

Building Leaks

Level 4 of the Brown Building still experiences water leaks following the addition of the new level in 1997. The leaks are potentially damaging to both the collection and fabric of the building. Repeated attempts to have the leaks repaired since the completion of construction have been unsuccessful due to contractual and legal issues with the contractors and sub-contractors. Funding is being sought to have the source of the leaks investigated and repaired.

Energy Performance Contract

The air conditioning system for the Brown Building has been experiencing problems since the completion of Level 4. These problems relate mainly to poor integration of the new and old systems and was further exacerbated by the failure of the chiller system in March 2001. A temporary chiller is maintaining the building environment until a new chiller is purchased. The new chiller will be installed as part of the Energy Performance Contract (EPC) that the Trust has entered into with Tarong Energy. The EPC is a Government sponsored program where Treasury advances the funds for the installation works and the loan is repaid using the energy savings guaranteed by Tarong Energy. In addition to the air conditioning upgrade, Tarong Energy will also be replacing the building lighting system with energy efficient lighting that will result in improved lighting and reduced energy consumption.

Part 6: CENTRE FOR PLANT CONSERVATION

The Centre for Plant Conservation was launched on 17 April 2001 to create a stronger focus for the broad range of conservation programs in the Gardens, and to link them to the activities of other natural resource agencies and the wider community. The Royal Botanic Gardens Sydney has always played an important role in the conservation of biodiversity in New South Wales, providing education, research and inspiration. Over the next few years, the Centre will become the focus for plant conservation in New South Wales, and a major hub for the Australasian region.

The Centre was launched by the Minister for the Environment, the Hon. Bob Debus, with the Director of Missouri Botanic Gardens, Dr Peter Raven, as our special guest speaker. The audience included key representatives from NSW government agencies, research organisations and community groups. The Co-ordinator of the Centre for Plant Conservation, Mr Bob Makinson, commenced duties in June 2001.

The four components of the Centre are:

Conserving Biodiversity through Research
Four key areas have been selected for scientific research. They complement the existing research of the Gardens in Plant Diversity, NSW Vegetation, Horticultural Research and Development, and Fungi and Plants. All these programs link with research in other organisations through the newly formed 'NSW Biodiversity Research Network'.

Biodiversity conservation: Saving threatened vegetation in New South Wales, such as the Cumberland Plain Woodland and other endangered communities gazetted through the Threatened Species Act. Using research and scientific principles to manage natural vegetation on the Gardens' sites.

Charismatic plants: Research and interpretation of compelling or iconic species such as the Wollemi Pine in New South Wales, Amorphophallus titanum in Indonesia, and selected orchids, palms and cycads in our region.

Restoration ecology: Retention, recovery and restoration of biodiversity through projects such as the long-term storage of seed and other germplasm, propagation, conservation biology of plants in the Sydney region, and environmental weeds in natural and horticultural landscapes. This research will be largely directed by the objectives of the 'NSW Biodiversity Strategy' and actions in Recovery Plans for threatened species or communities.

The Gold List: Setting new priorities for conservation in New South Wales, moving away from a simple listing of species on the brink of extinction (the Red List). Conservation can be based on biodiversity hot-spots and evolutionary potential and should include the Forgotten Flora — mosses, fungi, lichens and algae. We need to test whether vegetation communities act as surrogates for monitoring biodiversity more generally.

Community Conservation Education
A set of new programs will be established, building on our already strong focus on conservation in community and school education. It will include:

- Interactive lessons for schools
- Conservation-based walks, talks and activities in our Gardens for the community, e.g. the Cumberland Plain Woodland area at Mount Annan
- Interpretive signage highlighting the importance of plant conservation to a sustainable future
- Working outside the 'garden walls' with schools and the Department of Housing to provide sustainable horticulture and biodiversity messages
- Ecotours highlighting the significance of the rugged Mount Tomah Botanic Garden conservation area adjoining the Blue Mountains World Heritage Area
- Taking the Wollemi Pine 'on tour'.
- Plant Collections for Conservation
- Plant collections and horticultural expertise can be used to directly conserve plants or to inspire and educate about conservation. The Gardens has a wide range of existing and new programs for inclusion in the Centre:
- Visually stimulating and interactive exhibits in our botanic gardens, such as the Rare and Threatened bed and 'Cadi Jam Ora' at Sydney Gardens, a revitalised Terrace Garden at Mount Annan, and the Gondwana Walk at Mount Tomah
- Mount Annan Seedbank and ex situ collections of rare and threatened plants
- Integrated Pest Management of home and amenity gardens
- Showcasing environmental initiatives for sustainable horticulture
- Propagation for conservation and the commercialisation of species with horticultural potential to reduce wildharvesting or damage to native populations: e.g. the flannel flower, the Wollemi Pine.

Coordinating Conservation
The Gardens will continue to provide authoritative advice on State, National and Interational conservation issues, contributing to committees and councils responsible for overseeing natural resource management. It will take a leadership role by chairing the *NSW Biological Diversity Advisory Council*.

The website (www.rbgsyd.nsw.gov.au/HTML/SCIENCE/plantcon/index.htm) will become a clearing house for plant conservation information in New South Wales, including a register of all NSW conservation programs, plant societies and research projects.

Part 7: NSW BIODIVERSITY STRATEGY REPORT

The Gardens is represented on, and chaired for most of the year, the Biodiversity Strategy Implementation Group (BSIG), which has representatives from all natural resource agencies. 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 was also appointed chair of 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. In 1998, funding of $5.3 million was allocated (over three years) by Treasury to enhance the implementation of eight of the nominated priority actions. For each of these actions a working group was formed to assist with their coordination and implementation (the Gardens is represented on five working groups). The Gardens was allocated $328,000 to implement four projects under these priority actions. 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) are 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

The Gardens was allocated $50 000 to provide a current 'master names index' for plant species in NSW. The 'master names index' for vascular plants was completed in July 2000. Further funding was achieved through the Community Access to Natural Resource Information program to extend this index to bryophytes in 2001-02.

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 $135 000 to audit the conservation status of NSW plant communities by June 2001. The project is behind schedule due to the delayed appointment of a project officer and the expanded scope of the database. In the first year of the project the literature review was completed for the western plains, and partly completed for the western slopes and tablelands, and over 100 Western Plains records were entered. Continuation funding for this project in 2001-02 was achieved through the NSW Biodiversity Strategy.

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)

The seedbank at Mount Annan was further upgraded and additional seed collected. Funding was achieved through the NSW Biodiversity Strategy to test the viability of seed in the NSW Threatened Species Seedbank in 2001-02.

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)

The NSW Biological Diversity Advisory Council was reconvened in April 2001 with Gardens' Director Plant Sciences as chair. 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 interagency working group responsible for this priority action. $200 000 was allocated to the Gardens over three financial years to research non-vascular plant groups. Two additional staff were employed, and funding was available for field work. The results of the work to June 2001 were:

Group	New species to science in NSW	New records of species for NSW	Progress towards publication
Marine algae	25 (incl. 1 genus)	42	1 ms submitted; other mss to be submitted by June 2001
Lichens	10	9	1 ms published; 1 submitted; one other paper in preparation
Bryophytes	2	2	2 mss in prep.
Freshwater microalgae	5	68	2 mss submitted; 1 ms in prep.
Freshwater macroalgae	5	27	4 mss submitted (1 previous ms withdrawn)
Fungi	11	7	2 mss submitted
Total at end of project	**58**	**155**	
No. likely without additional funding	15	15	
No. due to additional funding	43	140	

The following papers were published, submitted or are in preparation:

Fungi
Burgess, L.W. and Summerell, B.A. (2000). Taxonomy of *Fusarium: Fusarium armeniacum* stat. & comb. nov. *Mycotaxon* 75, 347-348.

Crous, P.W., Summerell, B.A., Taylor, J. and Bullock, S. (2000). Fungi occurring on Proteaceae in Australia: selected foliicolous species. *Australasian Plant Pathology* 29, 267-278.

Summerell, B.A, Burgess, L.W., Backhouse, D., Bullock, S., and Swan, L.J. (2001). Natural occurrence of perithecia of *Gibberella coronicola* on wheat plants with crown rot in Australia. *Australasian Plant Pathology* (in press).

A paper authored by Michael Priest (Department of Agriculture) will be submitted later this year.

Lichens
Archer, A.W. (2000). The lichen genus *Phaeographis* and *Phaeographina* (Graphidaceae) in Australia 1: species based on Australian type specimens. *Telopea* 8: 461-475.

Archer, A.W. (2001). The lichen genus *Graphis* (Graphidaceae) in Australia. *Australian Systematic Botany* 14: 245-271.

A third paper will be submitted later this year.

Bryophytes
Papers (2) on the new bryophyte taxa and records are still in preparation (due for submission later this year).

Freshwater Microalgae
Dingley, M. Desmids of New South Wales: new species and new records. *Telopea* (submitted).

Dingley, M. More new records of desmids of New South Wales. *Telopea* (submitted). [may be combined with previous paper]

Dingley, M. Desmids (Chlorophyta) recorded from wet rocks in Australia. *Algological Studies* (submitted)

Freshwater Macroalgae
Skinner, S. & Entwisle, T.J. Non-Marine Algae of Australia: 1. Colonial Blue-Green Macro-Algae (Cyanobacteria). *Telopea* (submitted).

Skinner, S. & Entwisle, T.J. Non-Marine Algae of Australia: 2. Some conspicuous tuft-forming Cyanobacteria. *Telopea* (submitted).

Skinner, S. & Entwisle, T.J. Non-Marine Algae of Australia: 3. *Audouinella* and *Balbiania* (Rhodophyta). *Telopea* (submitted).

Skinner, S. & Entwisle, T.J. Non-Marine Algae of Australia: 4. Colonial Green Macro-Algae (Chlorophyta). *Telopea* (submitted).

Marine Algae
Harvey, A., Woelkerling, W.J. and Millar, A.J.K. The Sporolithaceae (Corallinales, Rhodophyta) in south eastern Australia. *Phycologia* (submitted)

Kraft, G.T. (2000). Marine and estuarine benthic green algae (Chlorophyta) of Lord Howe Island, South-western Pacific. *Australian Systematic Botany* **13**: 509-648.

Millar, A.J.K. (2000). *Spirophycus acicularis*, a new red algal genus and species in the Lophothalieae (Rhodomelaceae, Ceramiales) from eastern Australia. *Phycologia* **39**: 87-95.

Millar, A.J.K. and Xia, Bangmei (2000). The genera *Gracilaria* and *Gracilariopsis* from Norfolk island, south western Pacific. In: *Taxonomy of Economic Seaweeds*, I.A.Abbott Ed. pp. 113-119.

Millar, A.J.K. and Kraft, G.T. (2001). Monograph of the green macoalgal genus *Rhipilia* (Udoteaceae, Halimedales), with a description of R. crassa sp. nov. from Australia and the Philippines. *Phycologia* **40**: 21-34.

Three further papers in preparation.

Funding has been achieved for 2001-02 to continue this work for another year, focussing on freshwater algae, fungi and bryophytes.

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)

No progress on Action by Gardens without funding.

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

The Gardens contributed to an inter-agency working group for this priority action and helped develop a consultancy briefing to include non-vascular plants in biodiversity surveys. The consultancy has not been let.

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, 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. The network will contribute to priority-setting for the revised biodiversity strategy, and a project officer, funded through the NSW Biodiversity Strategy, will commence in December 2001.

Part 8: APPENDICES

Appendix A
STAFF

PLANT SCIENCES BRANCH
(including the National Herbarium of New South Wales)

Director Plant Sciences
Tim Entwisle BSc(Hons)(Melb)PhD(La Trobe)

Executive Assistant
Lynne Munnich BA(Syd)

Administrative Assistant
Kristina McColl BSc(Hons)(UNSW), BushRegenCert (on leave 28.11.00)
Hannah McPherson BSc(Hons)(UNSW) (29.11.00) (temp)

CENTRE FOR PLANT CONSERVATION

Coordinator
Bob Makinson BA(Biology)Macq (4.6.01)

CONSERVATION AND HORTICULTURAL RESEARCH

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

NSW Vegetation

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

Special Botanists
Doug Benson BSc(Hons)(UNSW)
John Benson BSc(Macq) (Special Botanist)
Gwen Harden MSc(UNE) (LDD 31.8.00)

Senior Technical Officers
Jocelyn Howell BPharm(Syd), BSc(Macq)
Liz Ashby BSc(Syd) (LDD 31.1.00)
Lisa Hill BAppSc, GradDipEd (CSturt) (temp) (LDD 21.5.01)

Technical Officer
Chris Togher BEnvSc(Wollongong) (temp)

Technical Assistant
Lyn McDougall BushRegenCert

Fungi and Plants

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

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

Technical Officers
Julie Bates, AssDipAppSc(Ultimo TAFE) (17.7.00
Alex Newman CertAmenHort(SA), AdvCertHort(SA), BScAg(Hons)(Adel), BMus(Adel)
Jillian Smith-White BSc(Hons)(Macq)

Horticultural Research and Development

Horticultural Research Officer
Catherine Offord MScAgr(Syd)

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

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

Senior Research Scientists
Alistair Hay MA, DPhil(Oxon)
Ken Hill BSc(Hons), MSc(UNE)
Alan Millar BSc(Hons), PhD(Melb)
Peter Weston BSc(Hons), PhD(Syd)

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

Peter Jobson BSc(Hons) (La Trobe), MSc (James Cook) (1.3.01) (temp)
Phillip Kodela BSc(Hons), PhD(UNSW) (temp)

Cosh Studentship

Jeffrey Drudge BSc (Macq) (15.1.01 – 9.3.01)

Postdoctoral Fellow
Reed Beaman BS(Univ. of Michigan), MS(Univ. of Florida), PhD(Univ. of Florida) (1.1.00 – 1.1.02)

Senior Technical Officer
Katherine Downs, BA(UNSW), BSc(Hons)(Syd) (Acting)

Technical Officers
Wayne Cherry BScAgr(Syd), GradDipBioSc(UNSW)
Darren Crayn BSc(Hons), PhD (UNSW) (13.9.00) (temp)
Jane Dalby BA(Hons), CBLT(QIT)
Dianne Godden, BSc(Hons)(UNSW) (LDD 27.11.00)
Clare Herscovitch BSc(Hons)(Syd)
Natasha Leist BSc(UNSW) (temp) (LDD 27.10.00)
Leonie Stanberg BSc(Syd), DipEd(SCAE)
Rachel Wakefield, BSc(Hons)(La Trobe) (LDD 15.8.00)
Nick Yee BSc (Hons)(Melb) (temp)

Herbarium Assistant
Zonda Erskine AssDip in FAP(Sydney TAFE)

Botanical Information Service

Botanist
Barbara Wiecek BSc(Syd)

Senior Technical Officers
Seanna McCune BAppSc(Hawkes), BushRegenCert (Acting) (on leave 9.4.01)
Louisa Murray BAppSc(CCAE)

Technical Officers
Gary Chapple BSc(Syd), DipAg(Hawkes)
Robert Coveny HortCert
Gillian Towler BSc(Macq), AssDipAppSc (HortParkMgt), TreeSurgCert (temp)

PlantNET Officer
Peter Hind HortCert

RESOURCES

Manager
Anthony Martin, BioTechCert, BioTechHigherCert, BAppSc(Riverina)

Technical Assistant
Rosie Arnold (31.7.00)

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)

HONORARY RESEARCH ASSOCIATES

Alan Archer PhD(City Lond), CChem, FRSC

Peter Bernhardt BA, MA(SUNY), PhD(Melb)

Don Blaxell BSc(UNSW), DipAgr(Vic)

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

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

Mike Dingley BioTechCert (STC)

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

Norman Hall BForSc

Peter Michael BAgSc(Hons)PhD(Adel)

David Mabberley MA, PhD(Cambridge), DPhil(Oxon)

Helen Ramsay MSc, PhD(Syd)

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

Geoffrey Sainty DipAgr(WAC), GradDipExt(Hawkes)

Terry Tame DipIndArts(STC), DipEd(Syd)

Joy Thompson BScAgr, MSc(Syd)

Professor John Thomson MSc, MAgrSc, PhD(Melb)

Mary Tindale MSc, DSc(Syd)
Elsie Webster Hon. D Litt(Melb)

Appendix B
VOLUNTEERS

Volunteer Program Supervisor
Alan Leishman PhotoengravingEtchingCert

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

Appendix C
REPRESENTATION ON EXTERNAL COMMITTEES

Tracey Armstrong Member, Australian Network for Plant Conservation Inc. Committee; Regional Coordinator (Sydney), Australian Network for Plant Conservation.
Doug Benson Member, NSW Scientific Committee, Threatened Species Conservation Act; Member, Institute of Wildlife Research, University of Sydney;
John Benson Member, Native Vegetation Advisory Council, Native Vegetation Conservation Act; 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 Steering Committee, Grassy White Box Woodland Protection Area Network; Member, Wollemi Pine Conservation Team.
Dr Barbara Briggs (Honorary Research Associate)
Member, Editorial Committee *Taxon*; Member; Editorial Advisory Nordic Journal of Botany; Member, Research Scientist Classification Committee of NSW Public Sector Management Office.
Professor Carrick Chambers (Honorary Research Associate)
Member, Research Committees of Australia and Pacific Science Foundation; Member, Willoughby City Council Group – Reserves Advisory Group; Member, Standards Association of Australia – Tree Evolution Committee.
Dr Barry Conn Editor, Handbooks of the Flora of Papua New Guinea; 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; Committee Member, The Friends of the Royal Botanic Gardens, Sydney.
Dr Tim Entwisle Chair, 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; Chair, NSW Biodiversity Research Network; Chair, Biological Diversity Advisory Council.
Joy Everett Member, Animal Care and Ethics Committee, Australian Museum.
Gwen Harden Member, Council of the Linnean Society of New South Wales; Trustee, Friends of the Royal Botanic Gardens Sydney Trust Fund.
Dr Alistair Hay Member, Board of the Flora Malesiana Foundation; Coordinator, Australian Flora Malesiana Contributors Working Group; Member, National Living Collections Policy Working Group; Co-chair, Organising Committee of 5th International Flora Malesiana Symposium 2001.
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, Steering Committee for Wetland Rehabilitation, Department of Land and Water Conservation; Member, Steering Committee and Technical Committee for implementation of wetland assessment, Hawkesbury Nepean Catchment Management Trust; Member, Expert Panels for Woronora and Bega Rivers, Healthy Rivers Commission; Member, State Technical Advisory Committee for Integrated Monitoring of Environmental Flows, Department of Land and Water Conservation; 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.
R.O. (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).
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*; Judging panel for International Phycological Prize; Member, Intra-agency Work Group for NSW Aquatic Biodiversity Strategy.
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; Research representative, Waratah Industry Network Committee.
Dr Brett Summerell 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* species recovery team; 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 Organization for Plant Information; Vice-President, Linnean Society of New South Wales; Convener, Special Committee on Electronic Publishing, International Association for Plant Taxonomy; Convener, Global Plant Checklist Network Task Group, CODATA; Member, STABD Commission, CODATA; Member, CODATA Commission on Data Access; Member, National Committee for Scientific Information, Australian Academy of Science; Member, Board of Management, Johnstone Centre Herbarium, Charles Sturt University at Albury; Systematics Agenda 2000 International Steering Committee Diversitas; Member, Executive Committee, International Union of Biological Sciences; Member, National Committee for Animal Sciences, Australian Academy of Science; Vice-Chair, Species 2000.
Dr Peter Wilson Member, International Advisory Board, *Candollea* (Geneva) and *Boissiera*.

Appendix D
SCIENTIFIC PUBLICATIONS AVAILABLE FROM THE GARDENS

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

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

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

Flora of New South Wales: supplement to vol 1 (2000); vol 1 (2000)(revised edition with supplement); vol 2 (1991) (being reprinted), vol 3 (1992), vol 4 (1993), edited by Gwen Harden (NSW University Press).

Collection, Preparation and Preservation of Plant Specimens (Royal Botanic Gardens Sydney 2nd edition, 1995) $6.55.

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

Rare Bushland Plants of Western Sydney (1999) Revised edition, by Teresa James,

Lyn McDougall and Doug Benson (Royal Botanic Gardens Sydney) $13.15.

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

Taken for Granted: the Bushland of Sydney and its Suburbs by D. Benson and J. Howell (Kangaroo Press, 1995) $27.95.

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

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

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

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

Appendix E
RESEARCH GRANTS

Australian Biological Resources Study
Dr Tim Entwisle and Simon Lewis — Taxonomic revision of Zygnemataceae (Chlorophyta) $35,000 (3rd year of a 3 year $106,000 grant)

Dr Tim Entwisle and Stephen Skinner — Taxonomic revision of Oedogonium (Chlorophyta) $30,000

Australian Centre for International Agricultural Research
with the University of Sydney
Dr Brett Summerell — Diagnosis and control of soilborne diseases in Indonesia $133,333 (1st year of a 3 year $400,000 grant)

Australian Research Council
Dr Alan Millar (with LaTrobe University) — Non-geniculate coralline algae $50,000 (1st year of a 3 year $150,000 grant)

Community Access to Natural Resources Information
Dr Barry Conn & Dr Phillip Kodela — Wattleweb, NSW Flora on-line $$80,000
Dr Barry Conn & Louisa Murray — Herblink $10,000
Dr Barry Conn — Digital imaging $25,000

Department of Land and Water Conservation
Dr Barry Conn & Barbara Wiecek - Plant ID Contract for native veg. Mapping
$50,000 (1st year of a 3 year $150,000 grant)
Dr Brett Summerell — Mapping validation $112,000 (1st year of a 3 year $336,000 grant)

Fisheries Scientific Committee
Dr Alan Millar — Studies on the rare brown algae **$1,800**

Hermon Slade Foundation
Ken Hill — Cycad project $25,000

Dr Alan Millar — Marine algae of southern NSW $30,000 (3rd year of a 3 year $90,000 grant)
Dr Peter Weston & Jim Mant — Chiloglottis Project: Comparative biology of Chiloglottis (Orchidaceae) and it's thynnine wasp pollinators $25,000 (2nd year of a 3 year $75,000 grant

Ian Potter Foundation
Nick Yee — Travel grant $1,850

New South Wales Biodiversity Strategy
Dr Alan Millar — New marine algae in NSW $40,000 (3rd year of a 3 year $100,000 grant)

New South Wales Fisheries
Dr Alan Millar - Marine algae of Port Kembla $3,200

New South Wales National Parks and Wildlife Service
Dr Barry Conn & Barbara Wiecek — SWNSW rare plant survey $ 43,281

New South Wales Centenary of Federation
Dr Elizabeth Brown — W.W. Watts collection $ 24,831

Australian Museum Business Services
Dr Phillip Kodela & Peter Jobson — Additional Flora assessment for the Oakes and Oakleyvale and Belimbla Park Sewerage System EIS $ 7,000

Hawkesbury Nepean Catchment Management Trust
Ken Hill — Plant Fact Sheets and Searchable Database/Key Identification guide to plants of their region $6,400

United States National Science Foundation
Dr Reed Beaman - Malesian Urticaceae Biogeomatics $90,909 (2nd year of a 2 year $181,818 grant)

Dr Barry Conn —Malesian Urticaceae Biogeomatics $16,308

Royal Botanic Gardens Scientific Research Fund
Dr Alan Millar — Molecular genetics of the brown algal order Sporochnales $4,000

Appendix F
OVERSEAS TRAVEL

Name and Position	Countries/ Cities visited	Purpose of visit	Duration	Cost	Source of Funds
John Benson, Special Botanist	Amman, Jordan	IUCN Second World Conservation Conference	2–11 October	$4500	Consolidated fund
Tim Entwisle, Director Plant Sciences	South Island, New Zealand	Fresh Perspectives Conference; algal collecting for biogeography project	17–25 November 2000	$2,400	Consolidated fund
Ken Hill, Senior Research Scientist	China	Research project on Cycads	26 June–19 July 2000	$14000	Externally funded
Ken Hill, Senior Research Scientist	China, Philippines	Research project on Cycads	12–29 June 2001	$7000	Externally funded
Alan Millar, Senior Research Scientist	Capetown, South Africa	International Seaweed Symposium	Feb 2001	$4833	Externally funded
Alan Millar, Senior Research Scientist	Japan	DIWPA workshop	June 2001	$3500	Externally funded
Brett Summerell Manager, Conservation and Horticultural Research	Manhattan, Kansas, USA	Teaching at Fusarium Workshop/ Research at Kansas State University	May 31–19 June 2000	$4500	Externally funded
Peter Weston, Principal Research Scientist	New Caledonia (Noumea and Sarramea)	To participate in an international expedition to investigate the reproductive biology of the New Caledonian endemic plant *Amborella trichopoda*	6–12 April 2001	$2251	Consolidated fund

Name and Position	Countries/ Cities visited	Purpose of visit	Duration	Cost	Source of Funds
Karen Wilson, Special Botanist	Italy (Stresa, Naples), Germany (Frankfurt) & UK (London)	Species 2000 Team meeting; CODATA symposium, general assembly and working group workshop; IUBS Executive Committee meeting, conference and general assembly; IOPI AGM and Council meeting, Global Plant Checklist Committee meeting; research work in herbarium RBG Kew and BM (Cyperaceae and Juncaceae)	12–21 October, 3–16 November 2000	$7,049	Consolidated fund and externally funded
Karen Wilson, Special Botanist	Tokyo, Japan	Species 2000 Asia-Oceania forum and meeting	Jan 2001	$2,750	Consolidated fund and externally funded
Karen Wilson, Special Botanist	Paris and London	Species 2000 Symposium, Team Meeting and Taxonomy Group meeting; research work in herbarium (Juncaceae, Cyperaceae and Casuarinaceae) Paris and RBG Kew	31 March–12 April 2001	$3,874	Consolidated fund and externally funded
Karen Wilson, Special Botanist	New Caledonia	Preparatory trip for Friends tour; field and herbarium study of Casuarinaceae	June 2001	$3,863	Consolidated fund
Nick Yee, Technical Officer	Capetown, South Africa	International Seaweed Symposium	Feb 2001	$1850	Consolidated fund and externally funded

Appendix G
COOPERATIVE RESEARCH

Dr Alan Archer

- Chemotaxonomy of species of the lichen genus *Pertusaria* 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

- Systematics of Australian Veroniceae with Prof. F. Ehrendorfer, University of Vienna, Austria.
- Phylogeny of Restionaceae with Dr H.P. Linder, University of Cape Town, South Africa.

Dr Elizabeth Brown

- Molecular phylogeny and systematics of Epacridaceae with Assoc. Prof. C.J. Quinn, University of New South Wales.
- Systematics of *Epacris* (Epacridaceae) in New South Wales with Dr Yvonne Menadue, University of Tasmania.

Suzanne Bullock

- Development of mycorrhizae of Wollemia nobilis with Brett Summerell of Royal Botanic Gardens, Sydney and P. McGee of Sydney University.

Dr Barry Conn

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

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.
- Taxonomic revision of Zygnemataceae (Chlorophyta) in Australia with Simon Lewis of the Royal Botanic Gardens, Melbourne.

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.

Gwen Harden

- Revision of *Davidsonia* with John Williams, University of New England, Armidale.

Dr Alistair Hay

- Coordinator, Flora Malesiana Araceae Project with P.C. Boyce (Royal Botanic Gardens, Kew), J. Bogner (Munich Botanic Garden), Prof. N. Jacobsen (Royal Agricultural and Veterinary University, Copenhagen), W.L.A. Hetterscheid (Hortus Botanicus, Leiden), Prof. J. Murata (Makino Herbarium, Tokyo Metropolitan University), Dr D.H. Nicolson (Smithsonian Institution, Washington D.C.), Dr M. Sivadasan (University of Calicut), Dr E.A. Widjaja (Herbarium Bogoriense).
- Commentary on Aroids in Curtis's Botanical Magazine with P.C. Boyce (Kew).
- Taxonomy of Alocasia in Thailand with D. Sookchaloem, Forest Herbarium, Bangkok.

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.
- Ecological comparisons of Chinese and Australian cycads with Liu Nian, South China Botanical Institute, Guandong province, China.

Jocelyn Howell

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

Dr Surrey Jacobs

- Effects of fire on managing small reserves with Dr J. Pickard, Macquarie University.
- 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.

Professor David Mabberley

- Molecular systematics of Labiatae (Viticoideae, Teucrioideae), with Dr. R.J.P. de Kok (CSIRO, Canberra), Dr D.L. Steane (Dept. Plant Science, University of Tasmania), Dr A. Paton (Royal Botanic Gardens, Kew), Dr S.J. Wagstaff and Dr R.G. Olmstead (University of Colorado).
- Revision of Labiatae of New Caledonia, with Dr R.J.P. de Kok (CSIRO, Canberra)
- Ecology and systematics of Vitex (Labiatae) in Sri Lanka with Dr B.M.P. Singhakumara (Univerisity of Jayawardenepura, 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).
- Catalogue of the Australian plant drawings and cognate materials in the Natural History Museum, London, with D.T. Moore (formerly 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.

R.O. (Bob) Makinson

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

Dr Peter Michael

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

Dr Alan Millar

- DNA research on sporochnales with Dr G. Saunders and Dr G.T. Kraft, University of Melbourne.
- Taxonomy and ecotoxity of *Caulerpa taxifolia* with Prof. A. Meinesz and O. Jousson.
- Systematics of coralline algae of the east coast of Australia with Dr Wm J. Woelkerling, La Trobe University, Victoria.
- Isolation and extraction of secondary metabolites of marine algae towards antifouling compounds with Dr Rocky de Nys, University of NSW.
- New Zealand representatives of the red algal family Delesseriaceae with Dr Wendy Nelson, Museum of New Zealand, Wellington.
- Marine floristics of Papua New Guinea and East African coast with Prof. Eric Coppejens, University of Gent, Belgium.

Dr 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 *Telopea* with Prof. Don Marshall and Dr Peter Sharp of the University of Sydney.
- Bud anatomy of the Wollemi Pine with Dr Geoff Burrows, Charles Sturt University.
- Pollination and seed set in *Wollemia nobilis* (Araucariaceae) with Prof. N. Prakash, University of New England.
- Causes of bract browning in *Telopea* species with Dr Robyn McConkie 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 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 Crow, University of Stellenborch.

Dr Mary Tindale

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

Dr Peter Weston

- Cladistic analysis and classification of the Mirbelieae (Fabaceae) with Dr M.D. Crisp, Australian National University, Canberra.
- Molecular systematics of Bracken (*Pteridium*) with Prof. J.A. Thomson and Dr M.-K. Tan (Elizabeth McArthur Agricultural Research Institute, Camden).
- Taxonomic revision of *Macadamia* (Proteaceae) with Dr C.L. Gross, University of New England.
- Phylogeny of the Proteaceae with Dr Nigel Barker, Rhodes University, South Africa, Dr Andrew Douglas, Field Museum of Natural History, USA, and Dr Sarah Hoot, University of Wisconsin, USA.
- A taxonomic revision of *Dillwynia* (Fabaceae: Mirbelieae) with Mr Peter Jobson and Dr David Morrison, University of Technology, Sydney.
- Ecology and genetics of fire-sensitive *Persoonia* species: threatened species recovery and management with Mr David McKenna, Mr Paul Rymer, Prof. Robert Whelan, Assoc. Prof. David Ayre, the University of Wollongong and Dr Tony Auld, NSW National Parks and Wildlife Service.
- Reproductive biology of some *Persoonia* species with Mr Christopher Nancarrow, Prof. Robert Whelan and Assoc. Prof. David Ayre, the University of Wollongong.
- Character Description in Systematics with Dr Bruce Kirchoff, University of North Carolina, Greensboro, North Carolina, USA
- Species relationships and pollination ecology of Diuris (Orchidaceae) of the Sydney region, with James Indsto Westmead Millenium Institute, Prof. Robert Whelan University of Wollongong, and Dr Mark Clements, Centre for Plant Biodiversity Research, CSIRO Division of Plant Industry.
- Comparative biology of *Chiloglottis* (Orchidaceae) and its thynnine wasp pollinators (Tiphiidae) with Mr Jim Mant and Dr Rod Peakall, Australian National University.
- Phylogenetic systematics of the genus Calochilus (Orchidaceae) with Mr Andrew Perkins and Dr Murray Henwood, University of Sydney.

Karen Wilson

- Survey of fungi of Cyperaceae with Mr J. Walker, NSW Agriculture.
- 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. Hodgon, 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 Assoc. Prof. C.J. Quinn, University of New South Wales.
- Molecular phylogeny of the Baeckea suballiance with Assoc. Prof. C.J. Quinn, University of New South Wales.

- Mycorrhizal associations of Myrtaceae with Dr A.E. Ashford, University of New South Wales and Dr W. Allaway, University of Sydney.

Appendix H
STUDENT SUPERVISION*

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

Student	Degree	University	Supervisors	Project Title
Abdul Asir Abubaker	MscAgr	University of Sydney	+Professor L. Burgess, Dr B. Summerell	Biology of fungi causing crown rot
Kerri Clarke	PhD	University of New England	+Dr J. Bruhl, +Dr N. Prakash, K. Wilson	Systematic studies in Abildgaardieae (Cyperaceae)
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 G. Vaughton, Dr B. Conn	Systematics of *Drosera peltata* complex
Tran Nget Ha	PhD	University of Sydney	Brett Summerell	Populations of *Fusarium* on maize
Julisasi Hadiah	PhD	University of New South Wales	+Assoc. Prof.C.Quinn, Dr B. Conn	Systematics of Elatostema in Indonesian Archipelago
Adele Harvey	PhD	La Trobe University	+Dr Wm J. Woelkerling, Dr A. Millar	The crustose coralline algae of NSW
Ken Hill	PhD	University of Technology	+Dr D. Morrison, Dr P. Weston	Phylogeny and biogeography Technology of the genus *Cycas*
John Hodgon	BSc (Hons)	University of New England	+Dr J. Bruhl, Mrs K. Wilson	Systematics of *Lepidosperma laterale* complex (Cyperaceae)
James Indsto	MSc	Uni of Wollongong	Dr P. Weston Species	relationships and pollination ecology of Diuris (Orchidaceae) of the Sydney region
Peter Jobson	PhD	University of Technology	+Dr D. Morrison, Dr P. Weston	A taxonomic revision of *Dillwynia* (Fabaceae: Sydney Faboideae: Mirbelieae)
Aniuska A. Kazandjian	PhD	James Cook University	+Assoc. Prof. B. Jackes Dr P. Wilson	Systematics of the Indigofera Pratensis complex (Fabaceae): A Morphological and Molecular Approach
Ruth Kharis	BSc	Undergraduate research project Macquarie University	Dr. S. Jacobs	Snowy River data analysis
Joanne Ling	PhD	University of Western Sydney	+Dr John Bauor, Dr S. Jacobs	Development of a wetland. Assessment protocol using biological techniques

Student	Degree	University	Supervisors	Project Title
Rachelle McConville	BSc (Hons)	University of Wollongong	Dr A. Millar	Macro-algal distribution of southern NSW lakes
David McKenna	PhD	University of Wollongong	+ Professor R. Whelan, +Assoc. Prof. D. Ayre, +Dr T. Auld, Dr P. Weston	Ecology of fire-sensitive *Persoonia* species: threatened Species recovery and Management
Linda McLaughlin	Honours	University of New England	Karen Wilson	Systematic studies in *Schoenus* (Cyperaceae)
Jim Mant	PhD	Australian National University	+Dr R. Peakall, Dr P. Weston	Comparative biology of *Chiloglottis* (Orchidaceae) and its thynnine wasp pollinators (Tiphiidae)
Amelia Martyn	PhD	University of Sydney	+Dr R. McConchie, Dr S. Jacobs, C.Offord, J. Tyler	Causes of bract browning in *Telopea* species
Lucy Nairn	PhD	University of Melbourne	+Dr B. Downes, Dr T. Entwisle	Ecology of stream algae
Chris Nancarrow	PhD	University of Wollongong	+ Professor R. Whelan, +Assoc. Prof. D. Ayre, Dr P. Weston, C.Offord	Reproductive character Displacement and adaptation of three co-occurring *Persoonia* species
Jennie Nelson	MSc (Hons)	University of Western Sydney	+Assoc. Prof.Shelly 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
Andrew Perkins	PhD	University of Sydney	+Dr M. Henwood, Dr P. Weston	Phylogenetics of the genus *Calochilus* (Orchidaceae)
Tijana Petrovic	PhD	University of Sydney	+Professor L. Burgess, Dr B. Summerell	Populations of *Fusarium* on sorghum
Catherine Smith	BScAg	Undergraduate research project University of Sydney	+Professor L. Burgess, Dr B. Summerell	*Phytophthora cinnamomi* in New South Wales
Karin Rutten	PhD	University of Wollongong	Dr A. Millar	Macro-algal blooms and Management
Paul Rymer	PhD	University of Wollongong	+ Professor R. Whelan, +Assoc. Prof. D. Ayre, +Dr T. Auld, Dr P. Weston	Genetics of fire-sensitive *Persoonia* species threatened species recovery and management
Jillian Smith-White	PhD	University of Sydney	+Professor 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 Chloantheae (Lamiaceae)

Student	Degree	University	Supervisors	Project Title
Cheryl Thomas	BscAgr	Undergraduate research project University of Sydney	+Dr R. McConchie, C. Offord	Effect of calcium on bract browning severity in *Telopea* species
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
Song Wang	PhD	University of Sydney	+Dr M. Henwood, Dr S. Jacobs	Taxonomic studies in Australian species of *Elymus* (Gramineae)
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 New South Wales	Dr A. Millar	Molecular phylogeny of the algal order Sporochnales
Xiufu Zhang	PhD	University of New England	+Dr J. Bruhl, +Dr. N. Prakash, K. Wilson	Systematic studies in Schoeneae (Cyperaceae)

Appendix I
PLANT SCIENCES PUBLICATION LIST

***Archer, A.W.** (2000) The lichen genera *Phaeographis* and *Phaegraphina* (Graphidaceae) in Australia 1: Species based on Australian type specimens. *Telopea* 8: 461-476.

***Archer, A.W.** (2001) The lichen genera *Phaeographis* and *Phaegraphina* (Graphidaceae) in Australia 2: *Phaeographina* – New reports and new species. *Telopea* 9: 329-344.

+Backhouse, D., +Burgess, L.W. & Summerell, B.A. (2001) Biogeography of *Fusarium*. Pp. 124-139 in Summerell, B.A., Leslie, J.F., Backhouse, D., Bryden, W. L. & Burgess, L.W. (eds.). *Fusarium*: Paul E. Nelson Memorial Symposium. American Phytopathological Society Press, St. Paul Minnesota.

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***Briggs, B.G. & *Johnson, L.A.S.** (2001) The genus *Desmocladus* (Restionaceae) and new species from the south of Western Australia and South Australia. *Telopea* 9: 227-245.

***Briggs, B.G. & *Johnson, L.A.S.** (2001) New species of *Harperia*, *Loxocarya*, *Onychosepalum*, *Platychorda* and *Tremulina* (Restionaceae) in Western Australia. Telopea 9: 247-257.

Bullock, S., Summerell, B.A. & Gunn, L.V. (2000) Pathogens of the Wollemi Pine, *Wollemia nobilis. Australasia Plant Pathology*. 29: 211-214.

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+Savolainen, V., +Fay, M.F., +Albach, D.C., +Backlund, A., +van der Bank, M., +Cameron, K.M., +Johnson, +S.A., Lledo, +M.D., Pintaud, J.C., +Powell, M., +Sheahan, M.C., +Soltis, D.E., +Soltis, P.S., Weston, P., +Whitten, W.M., +Wurdack, K.J., & +Chase, M.W., (2000) Phylogeny of the eudicots: a nearly complete familial analysis based on rbcL gene sequences. *Kew Bulletin* 55: 257-309.

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#Smith-White, J.L., Summerell, B.A. & +Burgess, L.W. (2001) Molecular detection and identification of *Armillaria* species in eastern Australia. P.23 in Porter, I.J. et al. (eds). Proceedings of the Second Australasian Soilborne Disease Symposium, Lorne, Victoria, 5-8 March, 2001.

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Appendix J
PERFORMANCE INDICATORS