

ANNUAL REPORT

Scientific Report of the
Science and Public Programs Branch

2008 – 2009



Inspiring the appreciation and conservation of plants
through exciting, innovative and relevant research
www.rbgsyd.nsw.gov.au/publications



Botanic Gardens Trust
SYDNEY

Access Directory

Science and Public Programs Branch
Botanic Gardens Trust
Royal Botanic Gardens & Domain
Mrs Macquaries Road, Sydney NSW 2000
Tel (02) 9231 8111 Fax (02) 9241 3892
Gardens Offices hours:
8.30 am to 5 pm, Monday to Friday

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

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

National Herbarium of NSW
Mrs Macquaries Road, Sydney NSW 2000
Tel (02) 9231 8111 Fax (02) 9241 3892

Copyright: Botanic Gardens Trust, Sydney 2009
Mrs Macquaries Road, Sydney NSW 2000
The Botanic Gardens Trust is part of the Department of Environment and Climate Change (NSW)

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

Annual report - Scientific Report of the Science and Public Programs Branch, 2008-2009:
Compiled and formatted by Sheryl Saban
Edited by Brett Summerell

Cover photograph: *Homoranthus thomasi* –

Photograph by: Andrew Orme

Contents

Part 1: Introduction	3
Part 2: Plant Diversity Section	11
Part 3: Evolutionary Ecology Section	23
Part 4: Horticultural Research Section	31
Part 5: Plant Pathology and Mycology Section	37
Part 6: Collection Section	43
Part 7: Centre for Plant Conservation	53
Part 8: Appendices	55
A Staff List, Volunteers & Students	56
B Representation on external committees	63
C Research grants	65
D Overseas Travel	67
E Cooperative research	69
F Publications	74
G Performance Indicators	82

INTRODUCTION



Angophora costata after bushfires in Royal National Park, McKell Ave, near Waterfall, NSW

Photo: Chris Allen

2009

Part 1: Introduction

Our Environment

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

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

Vision for Science at the Botanic Gardens Trust

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

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

Objectives for Science at the Botanic Gardens Trust

- To undertake original research on the plants of New South Wales and neighbouring areas.
- To effectively disseminate the results of research through publications, products and services.
- To play a leading role in the conservation of biodiversity in New South Wales and neighbouring areas.
- To be the primary source of plant diversity information in New South Wales.
- To lead and contribute to the understanding and appreciation of plant diversity.
- To assist in the sustainable management of the botanic gardens and the horticultural industry.
- To contribute to the development of State, national and international policies and legislation.

Priority-setting Criteria

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

The program or project should:

1. Be consistent with the implicit and explicit directions and policies of the State Government of New South Wales
2. Be of scientific merit: i.e. methodologically sound and scientific in approach.
The research should 'change the way we do or think about things'
3. Contribute to a sense of wonder and excitement about plants and their biology
4. Be innovative and/or use the best available methodology
5. Result in better conservation and management of biodiversity
6. Provide a service or knowledge not readily available elsewhere (may be part of a coordinated interagency program)
7. Make best use of our resources, including people, facilities, and preserved and living collections
8. Contribute to, complement, or initiate other programs in the Trust
9. Effectively communicate outcomes to the appropriate audience
10. Raise or maintain the profile of the Trust
11. Preferably attract external funding or result in income to the Trust
12. If consistent with the above criteria, be targeted to meet the greatest needs of the identified stakeholders.

Science Promotion

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

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

Teaching

The number of Honours and higher degree students supervised was 32 this year. Apart from the involvement in the biosystematics course at the University of New England (see below) staff also delivered guest lectures at various universities, sometimes presenting blocks of key lectures (e.g. Dr Cathy Offord and Dr Edward Liew at The University of Sydney). Dr Maurizio Rossetto has continued his involvement in the Biological Conservation course at the School of Rural Sciences and Natural Resources (University of New England), coordinated by Associate Professor Caroline Gross. Various staff members have adjunct appointments at a number of universities.

Plant Science Internship Program

2009 saw the third 7 week Internship Program offered by the Herbarium, running from 8 January to 23 February. This program offers undergraduates and recent graduates in the plant sciences advanced full-time working experience, with training in a broad suite of science and workforce skills. In return the Interns assist staff, particularly in the Herbarium curation area, yielding a significant nett gain for us. The program helps with BGT profile on university and TAFE campuses, and yields some media opportunities.

The Friends of the Gardens provided crucial financial support for the program. Twelve interns were recruited: Karen Bartle (UNSW), Anne Baumann (University of Sydney) Joelle Catherine (University of Mauritius) Theresa Choi (UNSW), Daniel Clarke (University of Sydney and TAFE), Eliza Fagan (Completed University of New England Bachelor Environ Sc, 2008), Peter Fallon (UNE and Macquarie University), Jennifer Hens (University of Western Sydney and Sydney Water internship), Alison Jaggard (UNSW), Rebecca Johnson (Southern Cross University), Jo Miller (University of Queensland), and Margaret Stimpson (UNE).

Core staff of the program was Bob Makinson, Louisa Murray, Kathi Downs, Barry Conn, Doug Benson, Peter Wilson and Peta Hinton. Many staff from other parts of BGT, DECC and beyond volunteered time in task preparation and teaching.

Biosystematics course

The Trust continued its strong involvement in the two Biosystematics units for tertiary students run in conjunction with the University of New England and the Australian Museum. It has been decided to run the course-specific unit every year, which staff helped to teach and to run this year. The 5-day residential school was held at the Botanic Gardens Trust, Sydney in April 2009.

Honorary research associates and volunteers

The Honorary Research Associates continued to be major contributors to our research program and their key research achievements are included within the relevant programs below. Patricia Meagher and Joy Everett were appointed as Honorary Research Associates in this period.

Our volunteers continued to play an important role in the herbarium, particularly in the mounting room program, where they painstakingly care for and mount the plant specimens of the herbarium collections. The herbarium could not function without their important contribution. Volunteer contributions in the library and various scientific programs have also been enormously beneficial.



Peter Hinton, Scientific Volunteer Coordinator (standing) and Gillian Towler, Technical Officer (front) with some of our valued Mounting Room volunteers.

Scientific Committee of the Trust

The external members of the committee are Professor Lesley Hughes (Macquarie University) (Chair from 2 February 2009); Professor Sue Serjeantson (Australian

Academy of Science) (Chair till 20 December 2008), and Associate Professor Jeremy Bruhl (University of New England), Dr Dan Faith (Australian Museum), Dr Jane Tarran (University of Technology, Sydney) (till 27 April 2009), Dr Klaus Koop (Scientific Services Division, Department of Environment and Climate Change) and Dr Murray Henwood (University of Sydney). The Scientific Committee of the Trust, together with Professor Mark Burgman, University of Melbourne, and Dr Derek VanDyk, Office of Science and Medical Research, NSW Government reviewed the science programs of the Trust on the tenth anniversary of the previous review of science in 1998. The review team provided a report to the Trust highlighting that the science programs continued to be relevant, innovative and of high quality but also providing some recommendation for future directions and appointments.

In addition the committee met three times during 2008/09, usually coinciding with the Trust meetings. Through the provision of general advice and feedback, and the review of scientific projects and programs, the committee continued to have a critical role in the management of the Science Program.

PLANT DIVERSITY



LHI Seaweeds - *Caulerpa racemosa* (green), *Dilophus intermedius* (brown) and *Asparagopsis taxiformis* (red) on the reef toward the southern end near the base of Mt Lidgbird, Lord Howe Island.
Photo: Elizabeth Brown

2009

Lamiaceae & Urticaceae

Systematics and phylogeny of Lamiaceae

The phylogenetic relationships of the genera within the Australian endemic tribe Chloantheae of the Lamiaceae family were evaluated using chloroplast 3'*ndhF* and nuclear ITS nucleotide sequence data. Several important problems with the current taxonomic classification and presumed relationships were revealed. The major conclusions of this study are that the current sectional classification of *Dicrastylis* requires revision and the generic circumscriptions of *Newcastelia*, *Physopsis* and *Lachnostachys* requires further investigation. The relationship between species of the large genus *Pityrodia* suggests the genus is not monophyletic and that several previously published generic concepts should be re-instated. This is a joint project between Barry Conn and Murray Henwood, Nicola Streiber (both University of Sydney), Elizabeth Brown (Botanic Gardens Trust) and Richard Olmstead (University of Washington, USA).



Prostanthera lasianthos being visited by a native bee, Blue Mountains, New South Wales
Photo: Trevor Wilson

Systematics and phylogeny of Urticaceae

As part of a long-term research effort into the systematics and phylogeny of the Urticaceae (*sensu lato*) using DNA data considerable changes have been recommended. One of the major changes suggested by this research is that the family Cecropiaceae, at least in part, should be included within Urticaceae. In particular, the genus *Poikilospermum* should be included within the tribe Urticeae, a tribe that was previously defined by all members having stinging hairs. The tribal placement of *Cecropia* and *Coussapoa* (both previously in the Cecropiaceae) remains unclear but their affinities are with the tribes Forsskaoleeae, Parietarieae and Boehmerieae of the Urticaceae. The genus *Myriocarpa*

was previously classified in the tribe Boehmerieae. This genus is endemic to Central and South America; however, it exhibits a strong relationship with the members of the tribe Elatostemateae, a group that has members in the Americas as well as the Old World tropics. The intra-tribal structure of the Elatostemateae is unclear; however, there is a strong suggestion that the tribe consists of two sister taxa, one including *Elatostema* and *Procris*, and the other consisting of *Lecanthus* and *Pilea*. Although the genus *Pellionia* is recognised as a distinct genus in China, it is here reconfirmed that *Pellionia* should not be recognised as a distinct genus but is here regarded as a synonym of *Procris*. *Boehmeria*, *Cypholophus* and *Laportea* as currently circumscribed are all paraphyletic and required additional study to resolve the systematics of these genera. There are three evolutionary lineages in the Urticaceae revealed by our study, namely (1) Boehmerieae–Cecropieae–Forsskaoleeae–Parietarieae, (2) Urticeae and (3) Elatostemateae. This is a collaborative project between B.J. Conn and J.T. Hadiah (Kebun Raya Bogor, Indonesia) and C.J. Quinn (National Herbarium of New South Wales).

Dr Barry Conn – Principal Research Scientist

Indigofera

Revision of the genus *Indigofera* (Fabaceae) in Australia

As part of an on-going study of the genus *Indigofera*, two further papers have been published. The first of these papers describes three species from Cape York Peninsula. Two of these species have been known for some time but the third has only recently been discovered, in June 2004, east of Musgrave, by Dr Bruce Wannan of the Queensland Environmental Protection Agency. The plant, which is named after its discoverer, has more-or-less prostrate stems that arise from a perennial rootstock and is found in the understorey of open eucalypt woodland. At present, the species is only known from a single location, which is on a site threatened by gravel extraction.



Indigofera wannanii showing its prostrate habit and erect inflorescences
Photo: Bruce Wannan

The second paper deals with a number of species that fall into two broad groups: those with consistently trifoliate leaves and those with leaflets alternate on the rachis. There are four species in the trifoliate leaflet group; these are all native and one of them is endemic. This endemic species, *Indigofera polygaloides*, is clearly related to *I. trita*, one of the native species that has a wide distribution outside Australia. The alternate leaflet group is made up of six species. Five of these are introduced to Australia and are considered to be weeds or to have weed potential; one species is considered to be native but has a wide geographic range outside Australia (extending as far as Vietnam and Pakistan). This species, *I. linnaei*, has spread within Australia since European settlement to such an extent that it is now also considered a weed.

Apart from their economic importance as weeds, some of these species have also been implicated in animal poisoning. Horses that have grazed on plants of *Indigofera linnaei* are afflicted with a condition known as Birdsville Disease, the symptoms of which include weight loss, general weakness and progressive loss of coordination. The specific cause of the poisoning is unknown.



Indigofera spicata showing its taproot, habit and red flowers.

Photo: John Hosking

The two species, *Indigofera hendecaphylla* and *I. spicata* are also horse poisons. In this case, the poisonous principle is known to be indospicine, which is an analogue of the amino acid arginine.

This is Flora of Australia project carried out with the assistance of Ross Rowe (at present with Department of the Environment, Water, Heritage and the Arts, Canberra).

Dr Peter Wilson – Senior Research Scientist

Phylogenetic biome conservatism on a global scale

The habitats that organisms occupy and why they are limited to them have long intrigued evolutionary biologists. The tendency for species to retain ancestral ecological traits and environmental distributions ('niche conservatism') has been discussed by ecologists in recent years but has been demonstrated only on local and regional scales. The extent of ecological conservatism over tens of millions of years and across continents had not been rigorously assessed until a research group including Senior Principal Research Scientist Peter Weston published the results of such a study in 2009 in the general science journal, *Nature*.

Dr Weston and his colleagues assembled a data set comprising 11,064 species of vascular plants in 45 taxa from extratropical Africa, Madagascar, Australia–New Guinea, New Caledonia, New Zealand and South America, equivalent to an estimated 15% of the total flora of these regions. They used the results of phylogenetic analyses to reconstruct ancestral distributions and, by dating divergences, inferred which disjunctions were likely to be the result of long-distance dispersal and establishment (colonization) across oceans. Each plant species was assigned to one or more of seven biomes (wet forest, sclerophyll, alpine, bog, temperate grassland, savannah and arid) and transitions among biomes were recorded.

Biomes are broad vegetation types defined by climate, life-form and ecophysiology and, hence, are useful units for investigating the large-scale pattern of ecological conservatism. Biome conservatism might

be a major determinant of the global distribution of biodiversity, such as the latitudinal gradient, which could have arisen because relatively few ancestrally tropical taxa were able to colonize temperate biomes. Global comparisons across multiple lineages were needed to investigate the generality of conservatism and how much it has influenced the assembly of biomes.

Dr Weston and his colleagues found strong support for the hypothesis of phylogenetic biome conservatism because biome shifts were rare, being associated with only 396 (3.6%) of the approximately 11,000 evolutionary divergences. Of these shifts, 356 occurred within landmasses and 40 were linked to transoceanic colonizations. Investigating taxa individually, a consistent pattern was found in which closely related species were more ecologically similar than would be expected by chance, irrespective of whether the taxa have been considered Gondwanan relics (for example *Araucariaceae*, *Casuarinaceae*, *Nothofagus*) or otherwise (for example eucalypts, grasses and some legume tribes). The results of this study are relevant to the understanding of conservation for plants and plant habitats under climate change. Conservationists cannot expect plants to dramatically change their ecological preferences and evolve to fit new habitats as the boundaries of these biomes change in response to climate change.



Catalepidia heyana from north east Queensland (**above**); and its closest living relative, *Malagasia alticola* from Madagascar (**left**) provide one of many examples of biome conservatism in the Proteaceae. Both are descended from a unique common ancestor that lived over 15 million years ago, yet both still occupy the same biome, tropical cloud forest.

Photos: Peter Weston

Dr Peter Weston – Senior Principal Research Scientist

Marine Algae

It is now a well accepted fact that anthropogenic instigated global warming is real and having an affect on our climate. Research by Dr Alan Millar is finding disturbing changes to the marine environment as a result of increasing sea surface temperatures. At the International Phycological Congress in Tokyo, Dr Millar gave a paper on the changing distributions of four iconic large brown algae along the New South Wales coast. Based on herbarium records, published accounts and anecdotal evidence, it has been shown that the large Bull



The giant Bull kelp, *Durvillaea potatorum*.

Photo by Dr Alan Millar

kelp, *Durvillaea potatorum*, has retracted south from Bermagui (where it grew in the 1920s) to Tathra (where its northern-most limit is today). The common shallow water kelp, *Ecklonia radiata*, has undergone a much larger retraction south from Caloundra to Byron Bay in northern New South Wales, although reports suggest it can survive at 30m depths off Moreton Island. The intertidal brown alga *Hormosira banksii* (Neptune's necklace) has also retracted south from Caloundra to Ballina and what is most disturbing, has become locally extinct on Lord Howe Island. Even our local Sydney kelp, *Phyllospora comosa*, has disappeared from the Sydney metropolitan area where it used to grow in the 1920s-1940s. CSIRO have detailed and accurate records of sea surface temperatures along the eastern seaboard of Australia and have recorded temperature increases within the East Australian Current of 3-5°C. Dr Millar is starting a project in collaboration with the Sydney Institute of Marine Science (SIMS) and Macquarie University to grow gametophytes of some of these kelps to ascertain the upper temperature tolerance of their gametes. It is these microscopic algal gametes that

most likely are not surviving the increased water temperatures and thus not germinating to recruit the larger kelp sporophytes.

Research by Yola Metti, Dr Millar's PhD student, is clearing up major taxonomic confusion with the red algal group known as the Laurencia complex. Using molecular gene sequences, Yola has shown there are four clear genera involved with a fifth new and undescribed genus from Norfolk Island.

Dr Alan J.K. Millar, Principal Research Scientist and Yola Metti

Lejeuneaceae

Three years of hard work culminated in the submission of PhD student Matt Renner's thesis, titled 'Morphological variation informs evolutionary relationships within the *Lejeunea tumida* aggregate (Lejeuneaceae: Marchantiophyta)'. Matt was jointly supervised by Elizabeth Brown and Dr Glenda Wardle (University of Sydney).

The Lejeuneaceae is characterised by the lateral leaves having the lower margin curled back under the leaf to form a lobule (Fig. 1); teeth patterns and lobule shape are of critical importance in taxonomic placements in the family. The Lejeuneaceae is a large family of often very small taxa, many known from only one or a few collections. This places a number of limitations on the interpretation of characters, not least being the inability to assess what constitutes infraspecific variation as opposed to inter species variation. Members of the family are commonly assumed to be highly variable and phenotypically plastic.



PhD students Endymion Cooper and Matt Renner (to right) on Mount Sprent, Tasmania. The paper packets being folded give the clue to their profession!

Photo: Elizabeth Brown

Matt used a range of innovative techniques to measure and analyse variation, focussing considerable attention on how the morphology of the lobule has been interpreted. He investigated groupings within the *Lejeunea tumida* aggregate, how variation within the gametophyte may obscure species boundaries, how species can be interpreted when there are too few observations (the single specimen problem) and looked at the bias that certain types of characters may introduce to cladistic datasets. He then compared his results with those obtained from molecular work. Matt rejected the view that morphology as a data source, and a "morphological approach" must be treated as being of

lesser weight than molecular data. 'All data must be treated with care, and it is only the interpretation of data, not the data itself which is potentially dangerous.'

One paper has already been published, one is in page proofs and several others have been submitted for publication in scientific journals.

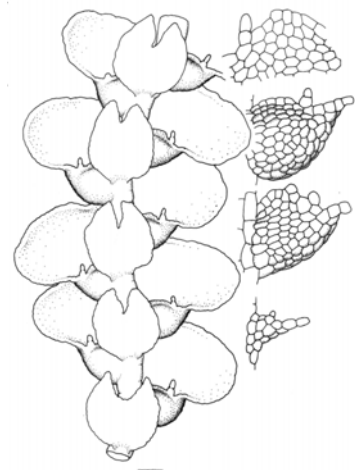


Fig. 1 Species of *Lejeunea* showing underside of plant (to left) with lateral leaves, lobules and underleaves and variation observed in lobule (line drawings to right). Scale bar = 80 μ m for plant and 33 μ m for lobule details. Drawn by Matt Renner

Dr Elizabeth Brown – Botanist

Pollination studies in *Prostanthera*

Part of the research program towards the degree of Doctor of Philosophy by Trevor Wilson (University of Sydney) is to test if pollinators and phylogenetic relationships can be correctly inferred from the design of flowers. It is hoped that it will be possible to infer the evolutionary history of pollination characteristics within *Prostanthera* and to suggest how pollination has developed within this genus. During the year, the pollination of *Prostanthera sieberi*, *P. rotundifolia* and *P. lasianthos* (all thought to be insect-pollinated), and *P. monticola* and *P. porcata* (both presumed to be bird-pollinated) were analysed. It was observed that all of these species attract their expected pollinators, but *P. lasianthos* also attracts birds, such as silvereyes (*Zosterops lateralis*) and spinebills (*Ancanthorhynchus tenuirostris*).



Trevor Wilson 'bagging' flowers of *Prostanthera rotundifolia* on Mt Buffalo, Victoria
Photo: B.J. Conn



Prostanthera porcata, an example of a typical bird-pollinated species of *Prostanthera*, Budawang Ranges, South Coast, New South Wales
Photo: B.J. Conn

These results are being considered within the framework of a molecular phylogeny, based on ETS nuclear and *trnT*-F chloroplast data. The monophyly of the bird-pollinated *Prostantheras* (section *Klanderia*) and the bird-pollinated group (section *Prostanthera*) has not received strong support so other genetic markers are being considered. Trevor is co-supervised by Dr Barry Conn of Botanic Gardens Trust, and Murray Henwood (University of Sydney).

Dr Barry Conn – Principal Research Scientist and Trevor Wilson – PhD student

Cyperaceae

The family Cyperaceae is a large cosmopolitan family of 90 genera and 4000 species worldwide, with 50 genera and 650 species (many endemic) in Australia. They are commonly called 'sedges'.

One of the larger genera is *Schoenus*, with about 120 species. A few species are spread widely around the world, but the greatest diversity by far is in Australia (about 80 species), particularly in the heathlands of the southwest and southeast of the continent. However, the genus has species all over Australia, in habitats ranging from tropical to arid and alpine. There is a secondary area of diversity in Malesia (13 species, mostly in higher altitude areas).



Schoenus species are among the many sedges that grow in the heaths on the Blue Mountains.
Photos: Karen Wilson

Karen Wilson has had a long-standing interest in the genus and has described several new species, including one in the Blue Mountains, *Schoenus evansianus*, which she named after Mr Obed Evans who had a long career in Botany at the University of Sydney and subsequently was honorary curator of Cyperaceae and other monocots at the National Herbarium of NSW. She did a preliminary survey in the 1990s, funded by ABRS, establishing the value of anatomical characters in distinguishing taxa.

Associate Professor Jeremy Bruhl (University of New England), Mrs Wilson and an ABRS-funded postdoctoral fellow, Dr Adele Gibbs, are examining generic and specific limits in the genus using molecular, morphological, developmental and anatomical methods. Initial results from molecular studies suggest that there are several distinct clades in what has been known as *Schoenus*. The '*Schoenus* team' has been joined this

year by a PhD student at University of New England, Mr Paul Mutuku Musili, who will investigate one major clade in more detail. Mr Russell Barrett (Kings Park and Botanic Garden, Perth) is also contributing molecular data.

This study fits within a broader project, involving also cyperologists in South Africa and England, examining the phylogeny of the tribe Schoeneae, which is mainly Gondwanan in distribution but with some taxa extending to northern regions. Preliminary results were presented at the *Monocots IV* conference held in Copenhagen in August 2008, in which both Prof Bruhl and Mrs Wilson participated.



Even small *Schoenus* species supply food to Western Australia's parasitic, yellow-flowered Christmas Tree *Nuytsia floribunda*. The whitish ball on the *Schoenus* root is the haustorium through which the *Nuytsia* draws nutrients.

Karen Wilson – Special Botanist

ECDEIOCOLEACEAE

A new close relative of the grasses — the third species of Ecdeiocolaceae

The plant family Ecdeiocolaceae was recently found, by DNA studies here at the BGT, to be one of the closest relatives of the grasses, the Poaceae,— indeed probably their closest living relatives. This has given unexpected interest in these plants of infertile soils and arid environments in the southern half of Western Australia, since grasses are the most important sources of food for humans and other animals.

As a sister-group to the grasses, Ecdeiocolaceae must have a long history. It is remarkable that it has so few species and such a limited distribution, in contrast to the thousands of species of grasses worldwide.



Barbara digging tussocks to study the rhizomes of the new species, north of Geraldton
Photo: Patricia Meagher

Only two species of Ecdeiocolaceae were known, one each in the genera *Ecdeiocola* and *Georgeantha*. Field studies by Barbara Briggs with Patricia Meagher and with Russell Barrett of Kings Park & Botanic Garden, Perth, have confirmed that there is a further species of *Ecdeiocola*. It is distinguished from the widespread species by its extensive rhizomes, rigid stems and larger size. The two species grow together with no sign of hybridization.

A description of the new species has been prepared, so that it can be formally named. In addition to collecting and describing this species, Barbara is studying the reproduction of *Ecdeiocola*. Both species are unusual in having zones of male and female flowers in the inflorescence and a pattern of synchronous flowering of either male or female flowers on the plant at any one

time. This is an effective method of promoting outcrossing between these wind-pollinated plants.



Ecdeiocola monostachya - male flowers of with yellow anthers.



E. monostachya - female flowers with feathery white stigmas

Barbara G. Briggs - Honorary Research Associate

All photographs provided by Patricia Meagher

Project Camellia:

Wild Camellias of Indochina

The Camellia is well-known as a garden ornamental, but the domestic familiarity of this plant has the danger of obscuring the great significance of this genus for biodiversity and conservation, and of the fascinating questions to be addressed concerning its evolutionary affinities and biogeographical history. The species most familiar in Australia, are *C. japonica* and *C. sasanqua*, of which hundreds of ornamental varieties have been developed over centuries of domestication. Even more familiar is *C. sinensis*, which produces tea. Another species of major economic importance is *C. oleifera*, which is an edible oil seed crop in China.



***C. dongnaiensis* Orel** - The first *Camellia* species to be found and described by Australian scientists. Also, the first yellow *Camellia* found in south Vietnam. Highly endangered, very rare, with huge 300 mm leaves. Fully tropical, it grows in the rainforest understorey in semi-darkness.

Photo: George Orel

The natural range of genus *Camellia* is in east Asia, from Korea and Japan in the north, to Indochina in the south, and Tibet in the east. The genus may contain up to about three hundred species, although authorities differ greatly in their estimates, and recognition of specific distinctions. Many of the species are very localised and rare in their natural habitats, and are seldom brought into cultivation. Very few of them are known outside of their native country, and there are probably many species that remain to be discovered and botanically described. The centre of diversity of *Camellia* appears to be in northern Indochina – so, they are primarily tropical species, despite their most familiar members being from the temperate regions.

Our project is investigating the diversity, distribution, and inter-relationships of *Camellia* species, with a particular focus on the relatively unexplored south-east Asian region. We are investigating such questions as the geographical origins of the genus *Camellia*, and attempting to unravel its sub-generic phylogenetic relationships. Numerous expeditions to the region, over the past decade, have amassed a living collection of one hundred and twenty species, and over a thousand specimens for botanical examination and molecular genetic analysis. Several new species descriptions have been published, and more are in preparation.



***C. azalea* C. F. Wei** - A multipetalled form (more than the usual 5 petals, in a single whorl) from Yunnan; a fully tropical species that flowers 12 months a year. There are only about 1 000 plants left in the wild. R. Cherry and G. Orel. were the first non-Chinese to visit the *C. azalea* site.

As well as the *ex situ* conservation contribution of our living collections (maintained in Australia as well as Vietnam), we are endeavouring to raise awareness of the vulnerability of species in their native situation.

Camellias are forest understory trees, and, as such, are threatened wherever the forests in which they live are threatened. As well as being eradicated by deforestation for agriculture, recreation (golf courses), or settlement, wild Camellias are incidentally destroyed in timber-cutting operations, and opening access into forests for this or other purposes leads to Camellia trees being cut down for fire-wood for domestic cooking.



***C. amplexicaulis* (Pitard) Cohen Stuart** – Only in cultivation, no wild population known. The white coloured petal margins fade with time. The pigmentation is not stable and does not occur on all *C. amplexicaulis* plants. Interesting genetics.

Conservation activists know that efforts to save a well-known, iconic, species – which can generate strong public and official support – have the “incidental” bonus of helping to preserve their habitats, ecosystems, and the many other species in them which may be less marketable, but are equally deserving and in need of protection. Camellias are widely known and loved as ornamental plants world-wide. Well publicised research on newly-discovered, rare, and threatened *Camellia* species in south-east Asia, together with encouragement at local and international levels for the conservation of these beautiful plants, will be a contribution to the efforts to try to save natural habitat in one of the world’s major centres of biodiversity.

Participants: George Orel (research associate); Anthony Curry (TAFE Richmond); Adam Marchant, Peter G. Wilson (RBG); Robert Cherry (Paradise Plants); Clifford Parks (Professor Emeritus of Biology, the University of North Carolina, the USA); Prof. Gao Ji-Yin (Research Institute of Subtropical Forestry, Fuzhou, The Chinese Academy of Forestry, P.R. China)

Dr Adam Marchant – Senior Technical Officer

Botanical Information Service (BIS)

Botanical Information Service Annual Report 2008-2009

The Botanical Information Service (BIS) provides plant identification information to the general public, government departments and to ecological consultants for a fee. We provide botanical advice, including poison and allergy information to veterinarians and the medical profession. We answered 2944 enquiries last year (over the counter, mail, email and telephone). We completed 81% of these within 7 days (our target is 70% in under 7 days).



Peter Hind in the field 2008 – Peter retired in 2008 and has joined our esteemed team of Honorary Research Associates.

Last year saw the retirement of our user friendly plant database Mr Peter Hind. Peter had been employed at the gardens since the 1960s and during that time acquired a wealth of information about the gardens, its history and plants native and exotic. He is now an Honorary Research Associate, so we are still able to plunder this resource from time to time.

Mr Andrew Orme commenced employment with the service in late January as Peter's replacement.

BIS staff spotted 256 significant plant specimens for incorporation into the collection as priority processing as well as a further significant number of specimens of general interest. We retained 34 specimens of endangered species and 101 of vulnerable species and 38 extensions of range. Under-collected species retained included *Ophioglossum pendulum* which is rarely seen in NSW, *Hyperba decumbens* and *Ruppia polycarpa*. New weed records for NSW included *Miconia calvescens*, a noxious weed in Queensland, *Abutilon pictum* and the native species *Acacia alata*. A client researching a very

old garden in the Southern Highlands provided us with the unusual conifers *Chamaecyparis thyoides* and *Juniperus rigida* (our only Australian collection and second overall). Potential new species and un-named species were retained in the genera *Astrotricha*, *Brachyscome*, *Craspedia*, *Cardamine*, *Teucrium*, *Logania* and *Hibbertia*. Unusual forms of *Leptospermum arachnoids*, *Eucalyptus youmanii*, *Chamaesyce maculata* and *Ozothamnus diosmifolius* were identified and may prove to be new taxa. The first fruiting specimen of *Pultenaea palacea* was donated to our collection so that its description in Flora On-line could be completed.

Ena Middleton (our volunteer) and Barbara Wiecek added a number of specimens to the Public Reference Collection. Families complete or almost complete now include Fabaceae: Caesalpinioideae, Loranaceae, Santalaceae, Olacaceae, Araliaceae and Apiaceae.

Barbara Wiecek – Botanist

EVOLUTIONARY ECOLOGY



'Snow bound' *Eucalyptus pauciflora* in Perisher, NSW Australian Alps

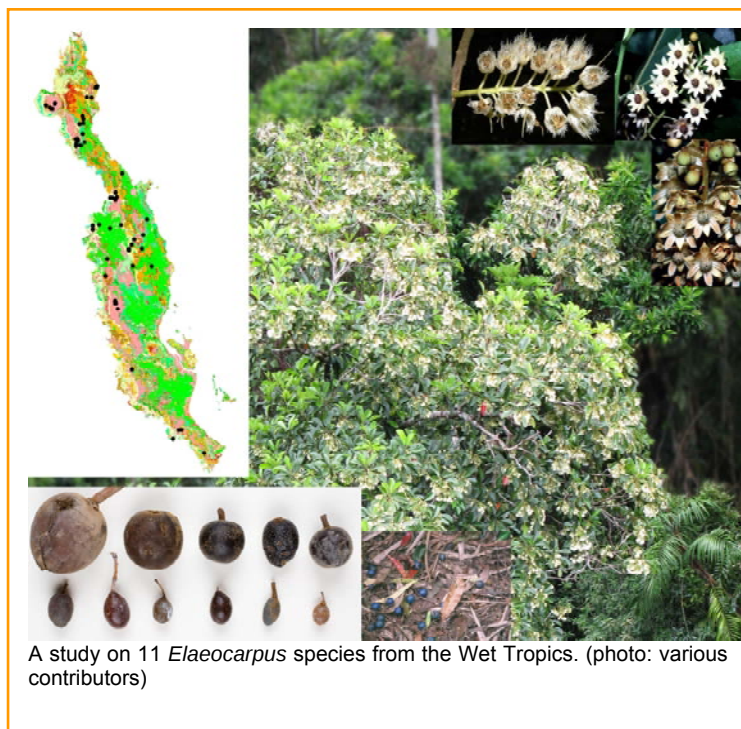
Photo: Rohan Mellick

2009

Evolution and Conservation

Australian rainforests contain considerable levels of biodiversity despite representing only a small proportion of the continental land-mass. Broad-leaved vegetation has endured considerable stress during the aridification of the continent in the last 10 Mya, with the remaining refugial areas being further strained during the climatic instability of the Quaternary. An important challenge of understanding differences in species survival is to gain an insight into the relationship between ecology and evolution. A reconstruction of temporal changes in population dynamics across diverse co-distributed taxa can yield generalities about evolutionary constraints and differential success.

In a range of separate studies (involving numerous postgraduate students and external collaborators), we gathered molecular, environmental and functional data from over 15 rainforest tree species distributed along the eastern coast of Australia. Our overall aim is to understand what makes some species more successful than others. We found some interesting trends explaining current distributions, in particular in relation to the tension between persistence and dispersal, and discovered that interacting factors can impact differently across regional communities.



Our research shows that while advanced resprouting mechanisms can stabilise family size variance and maintain genetic diversity even in small populations for some species (eg. *Eidothea hardeniana*), extensive

clonality and apomictic reproduction can significantly decrease the available genetic pool (eg. *Elaeocarpus williamsianus* and *Syzygium paniculatum*). We also found that small changes in fruit morphology can significantly affect the dispersal potential of species. For instance, in NSW



Elaeocarpus sedentarius immature fruit at BGT.

(photo: M. Rossetto)

the absence of large frugivores restricts the dispersal (and consequently distribution range and between-population connectivity) of species with large fruits (eg. *Elaeocarpus sedentarius*). Conversely, in a study on 11 local elaeocarp species, we showed that fruit size does not affect connectivity and dispersal potential in the Australian Wet Tropics, where a greater number of dispersal organisms survive.



Eidothea hardeniana in flower at BGT.

(photo: M. Rossetto)

Habitat preference also impacts differently on the distribution of species. We are finding that upland species tend to have narrower genetic diversity and greater between-population differentiation than lowland species. However, contrary to previous belief, we have increasing evidence suggesting that, in some groups at least (eg. *Elaeocarpus* and *Ceratopetalum*), competitiveness at altitude is more closely associated with adaptation to poorer soils than with adaptation to cooler climates.

Finally, in a current collaboration (R. Kooyman; Macquarie University) we are exploring how rain forest diversity gradients are influenced by evolutionary factors. We are assessing how local, regional and continental assemblages are limited by the phylo-conservatism of the southern rainforest flora and by landscape-level environmental gradients. This way, we aim to elucidate the underlying drivers of functional variation and assemblage in Australian rainforests. Exploring evolutionary interpretations of functional diversity in community assembly is a critical approach for understanding the influence of local-factor variability on biodiversity.

Such insights will help us understand how rainforest trees respond to environmental and climatic heterogeneity, and how high levels of biodiversity (that include a considerable number of unique paleo-endemics) are maintained within small remnants of a once-dominant vegetation type. In the long-term this knowledge will underpin management strategies that attempt to anticipate the likely response of ecological communities to environmental and climatic change.

Dr Maurizio Rossetto
Senior Research Scientist
Manager Evolutionary Ecology

Phylogenetic relationships of *Ceratopetalum* (*Cunoniaceae*)

Molecular data from a number of chloroplast and nuclear loci are being tested for their utility in elucidating relationships within the *Cunoniaceae*. Broad relationships within the family are well documented, but molecular assessments of finer scale relationships are lacking in many genera and Australian taxa remain poorly represented. Initial sequence data were collected to match existing datasets on GenBank and revealed very low chloroplast divergence across the family at both the *rbcl* gene and *trnL-F* intergenic spacer region, both within genera and within tribes. Initial ITS nuclear sequence data however is able to resolve intragenetic relationships. In addition to these loci a number of the

proposed barcoding loci are being assessed for variation within the family. Ultimately the molecular phylogenies generated will be calibrated with fossil data to estimate the age and evolutionary origins of taxa within the family.

On a finer scale, population dynamics are being investigated amongst *Ceratopetalum* species. A set of nuclear microsatellites have been designed to investigate relationships within and between populations of *Ceratopetalum* species. Nucleotide sequence variation in the flanking regions of these nuclear microsatellites will be examined in the future to determine levels of intra- and inter-specific genetic variation in *Ceratopetalum* and other *Cunoniaceae* which will enable detection of phylogenetic structure within species (phylogeographic structure). This data will be used to evaluate the role of long distance dispersal and vicariance in explaining present distributions of *Ceratopetalum* species



Collecting *Ceratopetalum macrophyllum*
Noah Creek tributary FNQ
(Photo: Andrew Ford)

Margaret Heslewood
Project Officer, Molecular Systematics
PhD Student

NSW Vegetation Classification and Assessment Database (NSWVCA)

Senior Plant Ecologist Dr John Benson instigated the NSWVCA database project in 1999 to meet an increasing demand for a fine-level ecological classification covering NSW for environmental assessment and ecosystem management. The NSWVCA is classifying the vegetation of NSW into plant communities based on the best existing data and extensive field checking. So far over 500 plant communities are classified but it is anticipated that about 1400 will be in the final list. During the course of 2008 the third paper on this project was published describing 135 plant communities in the 8 million hectare NSW South-western Slopes Bioregion – one of the most over-cleared and degraded bioregions in Australia.



Senior Ecologists Dr John Benson left with BGT photographer Jaime Plaza in the Pilliga forests, north of Coonabarabran. About 40 plant communities have been classified for the 450,000 ha Pilliga Scrub forests including assessments of all conservation reserves Photo: Sally Waller

10000 km of field traverse is completed for the NSW north western slopes in preparation for publication of Version 3 of the NSWVCA database that will cover another 8 million hectares of NSW and complete the NSWVCA for the Border Rivers / Gwydir and Namoi CMA areas that run westwards off the Great Dividing Range. This will add about 230 new plant communities to the NSWVCA database and is due for completion in early 2010.

The vegetation types being classified in the NSWVCA database are being incorporated into decision support tools under NSW regulations. The NSWVCA database is also being re-written for loading onto DECCW servers

allowing it to be web-enabled for use by any member of the public.

Development of Ecosystem Risk Assessment Criteria for the World Conservation Union (IUCN)

A spin-off from the NSWVCA research has been the development of risk assessment criteria for assessing the threat status of plant communities. Six risk assessment criteria are described in the NSWVCA publications. In October 2008, Senior Ecologist John Benson attended the fourth IUCN Congress in Barcelona Spain at which a resolution was passed to support this initiative. It is anticipated meetings will be held over the next four years to develop the criteria.

Dr John Benson - Senior Ecologist, Dr Chris Allen – Senior Technical Officer and Ms Sally Waller – Project Officer

Ecology of *Isopogon prostratus*

Long-term monitoring of *Isopogon prostratus* (Proteaceae), a little-known prostrate shrub

As a permanent research institution, the Botanic Gardens Trust provides the opportunity to carry out long-term projects extending over many years. Work on the ecology of rare species has been part of the ecological work program since the 1970s.

Isopogon prostratus (Proteaceae) is a little-known prostrate shrub with sporadic disjunct occurrences from Newnes Plateau near Lithgow to Victoria. It is generally localised to small populations generally in heath on plateaus and ridges.



The flowers of *Isopogon prostratus* are often almost covered in soil or leaf

Isopogon prostratus (Proteaceae) is a little-known prostrate shrub with branches spreading several metres from a central lignotuber.

Photos: Lotte von Richter

In 1978 on the recommendation of Botanic Gardens staff a small area in Newnes State Forest was set aside to protect a population. Plants were measured in 1985 (we located 58 plants) and remeasured in January 2009 when we again located 58 plants; all the observed plants were larger and had a substantial woody base or lignotuber.

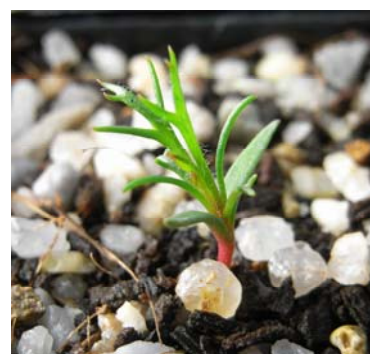
No seedlings were observed in 2009 and to find out whether viable seeds are being produced and whether this is a limiting factor for seedling establishment, seed was collected. Seed germinated in the lab over 6 months demonstrating that despite the small population size that pollination and viable seed production are occurring.

Our long-term findings are that the prostrate growth habit of *Isopogon prostratus* allows it to grow well (over at least 30 years) in full sun as well as periodically shaded conditions while its long-lived lignotuber allows it to regrow after physical disturbance (breaking, trampling) and fire. Its

survival strategy is long-term persistence at (relatively few) suitable sites, and as a result, remains a relatively rare plant.

It is conjectured that *Isopogon prostratus* may have been more abundant in the open, drier and colder conditions of previous glacial periods (e.g. the hairy seed is more likely to have dispersed further by wind in drier open conditions), and had a much more continuous distribution in southern NSW, but has become reduced to isolated populations as other shrubs have out competed it, as conditions have become warmer and wetter.

Today threatening processes to its long term survival are direct destruction (through sand extraction, infrastructure and road construction) or physical damage by trampling (e.g. trail bikes, vehicles) which break off branches.



Seedling of *Isopogon prostratus* germinated in seed lab.

Photo: Lotte von Richter

Doug Benson – Senior Ecologist and
Lotte von Richter – Technical Officer
Evolutionary Ecology

The Australian botanical collections of 19th Century German naturalist Amalie Dietrich

From December 2008 to April 2009 Hannah McPherson conducted a research and curation project at the *Herbarium Hamburgense* on the botanical collections of Amalie Dietrich (1821-1891). Amalie Dietrich is an important figure in German and Australian botanical history, who in 1863 was commissioned by the wealthy shipping merchant, Johann Cesar VI Godeffroy to voyage from Hamburg to Australia to collect specimens for the newly established Museum Godeffroy. For nine years Dietrich collected extensively around the sometimes harsh and often remote landscapes of colonial Queensland. In an era when science and exploration were dominated by well-educated, wealthy men, Dietrich - a working class woman from provincial Saxony with little formal education – was not the obvious choice for the voyage.



Hannah McPherson and Frau Baersch (volunteer)
at Amalie Dietrich museum Photo: A Perkins

Many of the earliest botanical specimens from Australia are housed in European herbaria since they were collected by European explorers. Dietrich was a prolific natural history collector with a great passion for botany. Her botanical collections (more than 20,000 in total)

which were shipped regularly to the Museum Godeffroy in Hamburg, constitute the first records of many Australian species. They provide a unique record of the Australian flora prior to land-clearing for expanding agriculture and urbanisation.



Boxes of unincorporated Amalie Dietrich collections

Photo: H McPherson

The most complete set of Dietrich's botanical specimens was sent to the Botanical Museum in Hamburg when the Godeffroy Museum was closed for financial reasons in 1868, and form the basis of the current *Herbarium Hamburgense*. Several botanists have accessed them in the past. For example, Karel Domin from Prague used the specimens to circumscribe many new taxa, resulting in the publication of some important early taxonomic works for the Australian

flora. Nevertheless, many of Amalie's specimens remained virtually untouched for a century and a half. Efforts have been made in the past to catalogue them but serious curatorial work has been intermittent. The aims of this fellowship project were to conduct a botanical and curatorial project on the collections of Amalie Dietrich, and to gain further insights into the life and botanical career of this remarkable woman.



Acacia specimen collected by Amalie Dietrich

Photo: H McPherson



Unidentified Rubiaceae specimen with Amalie Dietrich's original handwriting Photo by M Saggau Hamburg

Over three months the project focused on the unidentified material which had not yet been incorporated

into the main herbarium collection in Hamburg. This involved sorting specimens; recording collecting information and original handwriting in a new database; updating nomenclature and verifying original and duplicate specimens. By the end of the project most of the unincorporated Amalie Dietrich specimens (about 15% of her total collection) had been assessed. Taxonomy and nomenclature were updated for all and all boxes of unincorporated specimens were labeled with the stage of processing and the next steps required for their curation. The database will be used to populate the main Hamburg herbarium database and to produce labels for original and duplicate specimens. A curation plan is now in place which will allow duplicate specimens to be sent to Australia for identification and incorporation into Australian herbarium collections. Ongoing collaboration with *Herbarium Hamburgense* will ensure longevity of the collection and exchange of information between Australian and German botanists.

Many thanks to the Australia Germany Association Inc. in conjunction with the Goethe Institut and Lufthansa who funded this project.

Hannah McPherson – Biodiversity Research Officer

HORTICULTURAL RESEARCH



The remains of *Banksia serrata* fruit after cockatoos have feasted
- Muogamarra Nature Reserve, Cowan, NSW. Photo: Jude Wright

2009

Rainforest Seed Project

Conserving Rainforest Seeds

One of the key risks of projected climate change is its effect on Australian rainforests. Climate change is predicted to interact with other threats, such as weeds and habitat fragmentation, in some of the most vulnerable environments like the Gondwana Rainforests of Australian and the Wet Tropics. Seed banking is a cost effective way of conserving vulnerable species outside of their natural habitat, but not all species, especially many rainforest species, can survive the seed banking procedure that requires tolerance to seed desiccation. To contribute to the conservation of threatened species in the wild, the Royal Botanic Gardens Foundation has funded the Rainforest Seed Project for 3 years (May 2008 – May 2011) through generous donations from Allianz, Tony Maxwell and Robyn Godlee.

The Rainforest Seed Project investigates the seed biology, particularly desiccation sensitivity, of eastern Australian rainforest species with the aim of contributing to *in situ* conservation. The seed biology data will also be analysed to increase our understanding of ecological correlates of seed desiccation sensitivity for predictive use in rainforest species. For species identified to have seed desiccation sensitivity, *in situ* conservation and technology development (e.g. cryostorage) needs to be prioritised. The findings of the project will be collated



Toechima dasyrrhache

Photo: K. Hamilton

into a readily accessible database for use by scientists and restoration practitioners to inform their work (e.g. revegetation and seed banking).



Rainforest fruits of eastern Australia
Photo: S. Cottrell

The project objectives are to:

1. Screen rainforest species to determine whether they can be stored by conventional seedbanking
2. Improve understanding of germination and seedling establishment in rainforest species
3. Work in close collaboration with local (Southern Cross University), national (Environmental Futures Centre, Griffith University) and international scientists (Millennium Seed Bank, Royal Botanic Gardens Kew) for improved scientific understanding and conservation of rainforest species worldwide
4. Develop conservation technologies, including tissue culture and cryostorage for recalcitrant species.
5. Collate findings into a readily accessible database for access by scientists and restoration practitioners to inform their work (e.g. revegetation and seedbanking).



Amanda Rollason collecting fruits of *Acronychia laevis*

Photo: S. Cottrell



Rainforest fruit collection for seed biology testing

Photos: K. Hamilton



Rhysotoechia robertsonii

The Rainforest Seed Project is part of SeedQuest NSW based at Mount Annan Botanic Garden (Botanic Gardens Trust, Sydney) in partnership with Millennium Seed Bank, Royal Botanic Gardens Kew and contributes to the Global Strategy for Plant Conservation and Priority Action Statements / recovery plans for threatened

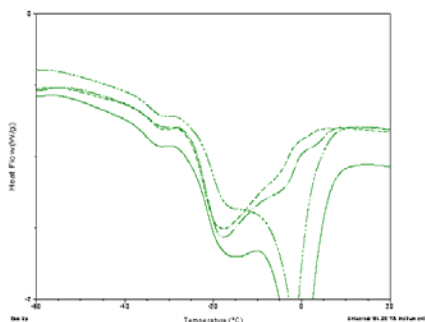


Photo: L. Butler

species. To date seed biology testing has been investigated for 75 significant and/or threatened rainforest species from 30 plant families. In addition, about 20 newspaper articles, 5 radio interviews (Dr Tim Entwisle), 2 magazine articles, 1 ABC website 'Scribbly Gum' article, 4 papers, 1 book chapter and 4 conference presentations have disseminated the objectives and acknowledged the importance of this project and sponsor contribution.

Dr Kim Hamilton – Rainforest Seed Project coordinator and postdoctoral scientist and Dr Cathy Offord – Manager Horticultural Research

Thermal analysis of phase transitions in seeds, using differential scanning calorimetry, to determine optimal moisture content for seed cryopreservation (left). Dr Kim Hamilton operating differential scanning calorimeter of the Millennium Seed Bank (Royal Botanic Gardens, Kew) in the UK (right).

Orchids

Under the Priorities Action Statement prepared by the National Parks and Wildlife Service, ex situ conservation has been listed as a priority action for a number of threatened orchid species. As orchid seeds require a fungal partner to germinate in natural environments, ex situ conservation of the orchid also demands ex situ conservation of its fungal partner. Much of our work on terrestrial orchids at Mount Annan Botanic Garden over the past four years has thus involved isolating and identifying the fungal symbiont for threatened species and researching ways to conserve the symbiont as well as the orchid.



Pterostylis saxicola flowering profusely one year after propagation by encapsulated seed and fungi.

Photo: Karen Sommerville

One technique we have been testing enables the simultaneous storage of orchid seed and fungi. This technique, known as encapsulation-dehydration, consists of mixing the seed and fungus together in a solution of sodium alginate, then pipetting the mixture drop-by-drop into a solution of calcium chloride to form individual beads (Wood *et al.* 2000). The beads are soaked in a sucrose solution and are then dehydrated before storage.

We have chiefly been testing this technique on two threatened species – *Pterostylis saxicola* and *Diuris arenaria* – and so far have successfully germinated beads held for two years at -18 °C and -196 °C for *P. saxicola*, and for two years at -196 °C for *D. arenaria*. Preliminary testing on *D. flavescens* and *D. bracteata* has also been successful following storage at -18 °C for 3 months.

Seedlings produced in this way have proven to be quite robust and have been successfully transferred directly to pot culture (Fig.1, Sommerville *et al.*, 2008). Future work on the project will focus on incorporating additional species and optimising the procedure to enable direct germination in pots.

Sommerville KD, Siemon JP, Wood CB and Offord CA (2008) Simultaneous encapsulation of seed and mycorrhizal fungi for long-term storage and propagation of terrestrial orchids. *Australian Journal of Botany*, 56: 609 - 615.

Wood CB, Pritchard HW and Miller AP (2000) Simultaneous preservation of orchid seed and its fungal symbiont using encapsulation-dehydration is dependent on moisture content and storage temperature. *Cryoletters* 21, 125-136.

Dr Karen Sommerville – Technical Officer

SEED BIOLOGY

The seed research program is integral to the SeedQuest NSW project, and has provided strong collaborative links to other Millennium Seed Bank partners via projects such as seed longevity testing. Seeds of many Australian species are expected to be long-lived in storage, with groups such as acacias, eucalypts, and casuarinas topping the list. However, the longevity of seeds of most species is unknown. In order to address this, we are collaborating with Australian partners of the Millennium Seed Bank Project to rank a wide range of species according to the longevity of their seeds. The ranking is useful for prioritising which species must be cleaned and stored first – a key task at the end of a busy collection season. The ranking will determine which species' seeds are likely to survive for long periods in storage, help us set appropriate re-testing schedules for banked seeds and work out which species will need to be regenerated or replenished regularly with fresh seed. Experimental work for this project will conclude in late 2009, with data analysis and a draft publication produced by early 2010.



Seed Research Officer, Dr Amelia Martyn removing seed germination tests from new incubators at the NSW Seedbank.

Photo: Simone Cottrell, Botanic Gardens Trust.

Research also informs the germination testing program within the NSW Seedbank. More than 900 germination tests have been

conducted during the SeedQuest NSW project, with more than 680 tests exceeding 75% germination. A review of seed quality, viability and germination has been conducted on NSW Seedbank collections in the family Rutaceae, confirming that these parameters are highly variable and reinforcing the need to take these issues into account to ensure optimal regeneration of plants from conservation seed banks. Threatened species in the family Rutaceae were more likely to have low seed fill than common species, while viability and germination were similar. This suggests that poor seed fill is a contributing factor to threat status and is an important parameter to measure. The review has been submitted for publication in *Cunninghamia*. In addition, two short publications describing seed collection methods in *Zieria arborescens* and seed quality in *Geijera* spp. have been submitted to a restoration-focussed journal.

Significant efforts have been made to educate students and seed bank practitioners in best-practice techniques for seed handling, storage and germination. This extension was made through seminars, formal training, community talks and seedbank tours, and the drafting of updated guidelines for "Plant Germplasm Conservation in Australia" (through ANPC).

Dr Amelia Martyn – Seed Research Officer and Dr Cathy Offord – Senior Research Scientist

PLANT PATHOLOGY AND MYCOLOGY



'Salinity' – a dead tree beside the road in the Murray Darling area. Photo: Cathy Offord

2009

Plant Pathology and Mycology

On-going research in the plant pathology and mycology section includes documenting and describing foliar diseases of members of the Proteaceae and Myrtaceae, describing new species of the fungal genus *Fusarium*, understanding the biogeography and evolution of soil inhabiting and endophytic species of *Fusarium*, studying movement and distribution of economically significant *Fusarium* pathogens and investigating disease management strategies for a range of diseases incited by the water mould *Phytophthora*, including root rot of Wollemi Pine.

Research Highlight

Members of the *Fusarium oxysporum* species complex are some of the most economically significant soil borne plant pathogens, causing crop disease epidemics in over 150 plant species worldwide. *F. oxysporum* f.sp. *vanillae* causes vanilla stem and root rot, a devastating disease and a major constraint to vanilla cultivation in vanilla producing countries, including Indonesia.



Fig 1. Vanilla vines growing on Glyricidia shade trees.

The Botanic Gardens Trust's pathology and mycology team have been an integral part of an international development program in building plant disease diagnostic and research capacity in North Sulawesi, Indonesia since 2001. With the foundational work of establishing laboratory and greenhouse facilities, conducting disease surveys and facilitating training workshops completed in the initial part of the program, in recent years the team have been focussing on research related to key diseases, one of which is vanilla stem and root rot.

Understanding the origins, movement and variations of the pathogen population is essential in ultimately establishing sustainable long term disease management strategies. To facilitate population analysis of this pathogen, we obtained a large collection of *F. oxysporum* f.sp. *vanillae* isolates, representing subpopulations of this pathogen from major vanilla growing regions throughout Indonesia.



Fig 3. A culture of the vanilla stem and root rot pathogen, *Fusarium oxysporum* f.sp. *vanillae*, growing on a Petri dish.

Our DNA fingerprinting analysis based on Randomly Amplified Microsatellites (RAMS) revealed a total of 16 haplotypes in the whole population. A large proportion of the individuals were clonal, i.e. genetically identical belonging to just two haplotypes, a common scenario for an asexual haploid fungus. The total number of 16 haplotypes was still unexpectedly high, indicating a significant amount of genetic diversity present. Analysis of the spatial dynamics of this pathogen indicated a high level of gene flow between subpopulations, although one geographical

subpopulation was genetically well differentiated. These findings give a good indication of how the pathogen is spread throughout the different growing regions, the potential for further spread, and the type of control strategies needed.



Fig 2. Symptoms of vanilla stem and root rot include yellow and brown stem lesions progressing along the vine

On the other hand, these findings led us to wonder about the origin of the pathogen in Indonesia where vanilla is not native but a recently introduced crop. We then

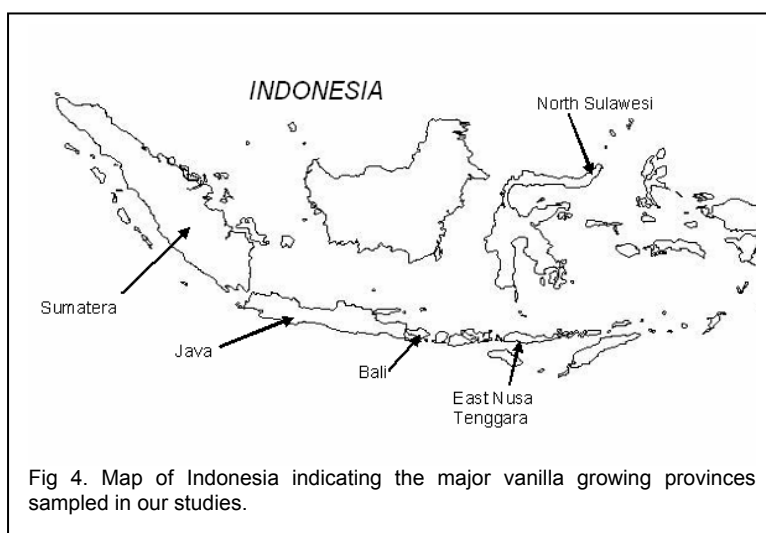


Fig 4. Map of Indonesia indicating the major vanilla growing provinces sampled in our studies.

compared our isolates of *F. oxysporum* f.sp. *vanillae* with those from the Reunion and Comoro Islands, two well-established vanilla producing countries where the same disease has been observed, as well as from Mexico, where vanilla is believed to have originated. We found that most of the Indonesian haplotypes, including the large clonal ones, shared the same lineage as the isolates from Mexico and the Indian Ocean Islands. Three haplotypes, however, were shown to have derived from two separate lineages distinct from the main lineage. These distinct lineages coincided with lineages thought to be ancestral within the overall *F. oxysporum* species complex by other research groups and generally believed to be associated with the South East Asian region.

We demonstrated that the vanilla stem and root rot pathogen in Indonesia evolved from multiple unrelated lineages. It was most probably brought into Indonesia together with the introduction of the host plant or the various germplasms imported over the years. We also have evidence to suggest that a secondary source of the pathogen could be from the surrounding region or even evolved from within Indonesia.

Dr. Edward Liew - Manager Plant Pathology and Arthur Pinaria - PhD Student

Figs 1-3 - Arthur Pinaria
Fig 4 - Dr Edward Liew

Ten years of Fusarium workshops

The genus *Fusarium* contains numerous species of economic importance due to their ability to cause plant disease and to produce mycotoxins. In the past 100 years the number of species recognized in *Fusarium* has ranged from nine to over 1000, with the number of recognized species now again approaching 100. The economic importance of these fungi, their distribution from subantarctic and arctic regions to the tropics, and the ability of some member of the genus to colonize virtually any green plant means that most plant pathologists and mycologists at some time must grapple with the problem of correctly identifying a strain of *Fusarium*.



In 2000, the tradition of holding laboratory workshops to teach identification techniques was revived at Kansas State University and co-convened by Professor John Leslie KSU and Brett Summerell from the BGT. These workshops differed from those held in the 1980s and 1990s in that participants work with cultures from at least 40 different species during the week and extract and sequence DNA and learn to use vegetative compatibility and sexual crosses for strain identification purposes. This broad base provides an entrée to all of the areas of active research with *Fusarium*.

Instruction at the workshops is by a team of instructors rather than a single person, reflecting the diversity of approaches and philosophies found in current research studies (see Summerell *et al.*, 2003). Additional instructors have included researchers from the US, Canada, Italy, Norway, Australia, Malaysia and South Korea. There are three texts available to support the instructional effort – an edited text that summarizes the status of the field *Fusarium: Paul E. Nelson Memorial Symposium* (Summerell *et al.*, 2001), a text summarizing the work the last 20 years of research in mycotoxicology,

Fusarium Mycotoxins: Chemistry Genetics and Biology (Desjardins, 2006), and an identification manual, *The Fusarium Laboratory Manual* (Leslie and Summerell, 2006).

Workshop participants are diverse in terms of their interests – plant pathology, medical mycology, air quality, plant breeding and mycotoxicology, amongst others. They also are diverse geographically coming from all continents and representing countries as diverse as Argentina, Australia, Austria, Botswana, Brazil, Burkina Faso, Canada, Egypt, Ghana, Greece, India, Israel, Italy, Jamaica, Kenya, Korea, Malaysia, Mexico, the Netherlands, New Zealand, Nicaragua, Nigeria, Norway, South Africa, Spain, Syria, Thailand, Tunisia, Uganda, Vietnam and Zambia in addition to the United States. The workshops currently are based in Kansas and are held at Kansas State University in odd years (most recently in 2009). In even years the location rotates to enable more international participation and have included Sydney (2002), Pretoria, South Africa (2004), Bari, Italy (2006) and Penang Malaysia with future locations in Argentina (2010), Italy (2012) and Korea (2014).

Dr Brett Summerell – Director
Science and Public Programs

Matthew Laurence

Plant Pathology Diagnostic and Facilities Coordinator Profile

Growing up in Fremantle, Western Australia I developed a keen love of the ocean and also spent a great deal of time in the Southwest Botanic Province; ideal surroundings to spark a curiosity in unique plants and biodiversity!

With a general interest in biology I was uncertain which particular course I should take at University. To help decide I took a 'gap' year (or two or three), which was spent productively, surfing throughout the East Nusa Tenggara Islands of Indonesia! These travels initiated a fascination with not only island biology but, after an intimate run in with *Plasmodium falciparum*, parasitology! After travelling in Europe, I decided to commit to serious study. With a family background in medicine I was always interested in disease, however with a total aversion to all things red, decided green was a more appropriate colour, so I started a degree in plant science at the University of Western Australia.

Indecision about my life's work continued and I switched my studies to Imperial College in the UK (fuelled, amongst other things, by meeting an English lass whom I later married). Here I was introduced to plant pathology

by Prof. John Mansfield, through his inspirational 'home garden' tutorials. I am sure he was a better gardener than he seemed and the myriad of plant diseases in his garden was purely for their educational benefit! I went on to complete an undergraduate Honours degree in Biology at the University of London. During this time I spent two weeks on a botanical field trip in the Canary Islands. This incredible trip stimulated an interest in plant evolution and biogeography. My Honours project - the taxonomy and the role of fungi in the germination of



Matt Laurence "Enjoying the unique tyre busting geology of the Millstream-Chichester National Park, Western Australia, while collecting soil samples for isolating fungi"
Photo: Emma Laurence

Gentianella anglica (one of England's few endemic plants) introduced me to the fascinating world of the fifth kingdom, the fungi. I had finally arrived at a field(s) of study; botany, ecology, evolution, biogeography and fungi! But... where to find such a unique niche? -



Matt Laurence collecting soil samples for isolating fungi

Photo: Emma Laurence

After much searching and discussion with supervisors, the Royal Botanic Gardens in Sydney looked like providing the perfect opportunity. Through the advice of Prof. Brett Summerell, I contacted Prof. Lester Burgess and Dr Edward Liew of the Sydney University, and embarked on my PhD project in 2006 characterizing the diversity, phylogenetic composition and evolutionary potential of the fungal plant pathogen *Fusarium oxysporum* from natural soils in Australia. To ensure a representative sample of this fungal species I travelled to many of the National Parks on the West and East coasts of Australia collecting. What a hardship - a 20,000km drive through some of the most beautiful and isolated National Parks in Australia - on a transect from the Kimberley to the edge of the Great Australian Bight in Western Australia, to the coastal heath of Wilson's Promontory and up to the spinifex country in northern QLD. Unfortunately, all good things must come to end and the last two years have been spent in the laboratory trying to make sense of the amazing diversity of *Fusarium* and unravel the phylogeographic patterns of this species complex. The results to date suggest that Australia represents an important centre of diversity for the *Fusarium oxysporum* complex and has uncovered a couple (and counting) of novel species.

My time at the RBG Plant Disease Diagnostic Unit (PDDU) rekindled my interest in plant pathology and I have been fortunate to gain experience with many exotic horticultural plant pathogens, not usually included in agricultural-focused undergraduate training programs. Edward Liew and Sue Bullock provided major encouragement and support for the development of my

clinical plant pathology skills and on Sue's retirement I was successful in my application for the part-time position of Diagnostics and Facilities Coordinator at the PDDU. This unique position allows involvement in 'real' plant pathology while providing opportunities for new projects and the continuation of my studies on *Fusarium*. So if you ever find your favourite plants are drooping and have leaf spot or two, don't hesitate to send a sample to the PDDU and we will do our best to find the cause - if not the cure!

COLLECTIONS



Lilly pilly - *Syzygium paniculatum* Photo: Cathy Offord

2009

PlantBank

The Trust, as part of the 'Botanic Bicentenary' celebrations, has commenced planning for a capital investment program that will equip it for its leading role in protecting plant diversity in a world of growing environmental challenges. *PlantBank* is proposed for Mount Annan Botanic Garden in Sydney's south-western growth centre. This centre will be a world leader in conservation research and education on the remarkable plant (includes plant, fungi and algae) species found in Australia. 6000 vascular plants occur in NSW alone, and 600 of these are in immediate danger of extinction unless we take immediate action. Many more will be pushed to the brink within a few short years unless a holistic approach is taken to understanding species, species interactions, plant communities and the processes that threaten ecosystems.

PlantBank will be:

- a secure repository for Australian species (including germplasm, seeds and tissue cultures);
- a regional hub for innovative and applied change research;
- a collaborative venture with major universities in Sydney; and
- a public and student education facility.

At the heart of *PlantBank* will be the NSW Seedbank which



currently holds, in temporary facilities, the largest collection of Australian native seed in Australia. The valuable collection currently holds almost 10,000 collections from across Australia including 37% of NSW seed bearing plants and 30% of NSW threatened plant species. The collection has an indicative value of \$18 million based on an estimate of the costs of re-collecting the seeds. Research laboratories, teaching laboratories and climate controlled research glasshouses will also be essential components of *PlantBank*. The facility will address significant staff accommodation, collections and data storage deficiencies particularly at Mount Annan Botanic Garden.

PlantBank will primarily seek to address NSW State Plan Priority E4: 'Better environmental outcomes for native vegetation, biodiversity, land, rivers, and coastal waterways'

and ensure the Trust is able to meet its statutory objectives and ensure plant diversity and plant habitats are understood, protected and restored.

Quantity surveyor studies have estimated the cost to design and construct *PlantBank* at \$19.786M. The Trust intends to seek State and Federal funding as well as targeting foundations and corporate sponsors. Should funding be forthcoming it is anticipated construction of *PlantBank* will commence in the second half of the 2010/11 financial year and be operational by 2012/13. However, in the current tough economic climate, raising of significant capital may not be achievable in the short term.

PlantBank will address some unique issues within NSW and Australia. Some component parts proposed are not currently available in NSW while others are not within the one location to undertake the tasks required. Importantly *PlantBank* will allow the community to engage with the Trust's scientists both passively, through glass viewing windows, and actively through tours and education programs targeted at school, university and community groups.

Failure to implement *PlantBank* would significantly impair the information the community and the Government require to determine future planning decisions for NSW and Australia.

John Siemon - Science Facilities Coordinator

PlantNET

PlantNET is our website, created and maintained by Herbarium staff, delivering information about plants.

Work on PlantNET has had a boost this year with two funded positions from Domain Carpark money. Currently there are 2 temporarily funded positions: Louisa Murray - *Flora Botanist*, working on updating the taxonomy and distribution data of plant information on the website; and Wayne Cherry - *Plant Information Network Officer*, working on the all aspects of how the site works enabling easy use for our customers. Other positions with main input to PlantNET are: Gary Chapple (*Database Manager*); Lesley Elkan and Catherine Wardrop (on maternity leave) - *Illustrators*; all curators; 2 volunteers; Fred Langshaw and Harry O'Brien who are actively photographing the collections.

PlantNET acts as a “banner” or “brand” under which the following Web services are aggregated:

HerbLink: Provides details and photographs of type specimens held at NSW.

WeedAlert: Early Alert system for new occurrences within New South Wales of naturalised non-native plants.

Cycad Pages: Provides a comprehensive treatment of the world's cycads.



Styphelia angustifolia

Photo: Elizabeth Brown

Eucalink: Provides specialised information on eucalypts (*Angophora*, *Corymbia*, and *Eucalyptus*).

Aussie Algae: Provides search interfaces to the Herbarium's seaweed collections, to several overseas institutions.

Australian Freshwater Algae: Provides information about freshwater algae in Australia.

WattleWeb: Provides specialised information on wattles of New South Wales.

Casuarinaceae: a database containing information on the distribution and nomenclature of all names used in the plant family *Casuarinaceae*.

PNGPlants: is not part of PlantNET, but is hosted on the plantnet webserver. It provides information about the plants of Papua New Guinea - it was developed and is maintained by herbarium staff at NSW.

FloraOnline: Provides an electronic Flora of the vascular plants of New South Wales based on the printed Flora of New South Wales volumes (UNSW Press). Additional information is presented (distribution maps, botanical illustrations, photographs, weed status, TSCA status) from electronic sources maintained at the Herbarium. Despite the disclaimer in the introduction to FloraOnline that it is “not fully up-to-date” and is not to be regarded “necessarily as an authoritative resource” the intent is that it should be both of these. FloraOnline is the centrepiece of PlantNET.

Work is ongoing to keep PlantNET as up-to-date, informative and user friendly as possible. Targets will be decided by a PlantNET Committee.

Louisa Murray – Flora Botanist and
Wayne Cherry – Plant Information
Network Officer

Library

Foundation Night

The Library and Foundation held a fund-raising evening in August 2008, with an extensive display of many of the Library's treasures. The project to raise \$1.2 million for the Library's development was launched just as the global financial crisis hit in earnest. Despite this \$44,000 has been raised so far, spread over 5 years.



Part of Display for Foundation donors.

Photo: Pauline Markwell

Rare Book Cataloguing Project



Ferns of Great Britain and Ireland – by Thomas Moore

The Ferns of Great Britain and Ireland by Thomas Moore. A fine example of innovative 'nature printing' where a plant is impressed upon a soft lead plate and hand-coloured for printing. The first rare book to be catalogued online as part of the Rare Book Cataloguing Project, funded by The Foundation.

Photo: Judy Blood

With Foundation funds, the Library has started the Rare Book Cataloguing Project, employing a part-time cataloguer. Already some very interesting stories about

the publication, annotations and provenance of many volumes have been discovered. The catalogue records will record many of these stories. Also recorded will be binding and conservation information, identifying priorities for conservation treatment and possible digitisation projects should funds become available. Each book is being covered in protective acid-free plastic.

Pteridological Display

The Library was visited by the International Pteridological Society, as part of their tour of the Gardens. They expressed admiration of the Library's display of rare fern books and albums, particularly Sir William Hooker's *Genera Filicum*.

Hooker project & Catalyst program

Items from the Library's collections and interviews with Miguel Garcia were filmed by both the ABC's Catalyst program (broadcast in August) and by Peter Donaldson for his 2-part documentary on Sir Joseph Hooker.

PhD on the Gardens

Historian Jodi Frawley has been researching the resources of the Library and the Herbarium in recent years for her PhD *Botanical Knowledge, Settling Australia. Sydney Botanic Gardens, 1896-1924*. She has produced 2 prize-winning historical articles about Wattle and Prickly Pear and a number of articles relating to the Sydney Botanic Gardens.

They continue the work of her Honours thesis *Information, People Place. Global botanical information networks and local nineteenth century Australian Botanic Gardens*.

DVD Collection

The Library has started a DVD collection including documentaries on Darwin, the Kew Gardens, the Eden Project, the David Attenborough series, Around the World in 80 Gardens and the gardens of Heligan, Alnwick and Longwood.

Photographic Milestone

Stalwart volunteer Evelyn Shervington has finished the indexing of 73 folders and boxes of historic photographs, continuing the work of the photographic team. Later these can be converted into online catalogue records with images (when public-access server and funding is available).

Florilegium Society Display

A major display of contemporary and historical works of botanical illustration and art was laid out for the artist members of the *Florilegium Society at the Royal Botanic Gardens Sydney*. These artists have contributed artworks to the Gardens, to be held in the Library's collection. The first stunning artworks produced by the Florilegium Society were exhibited in the Red Box Gallery from September to November 2008.



Florilegium artists viewing some of our library's treasures Photo: Judy Blood

Extra IT resources

The two multimedia workstation now have wide-screen, high-end monitors for image processing (courtesy of the Friends), both now have scanners and one has OCR (optical character recognition). This will directly benefit the Library's ongoing digitisation projects. The three staff

workstations now have dual screens, making handling high volumes of complex work much more efficient.

Judy Blood – Senior Librarian

Internship Program 2009



Interns: Jennifer Hens, Theresa Choi and Joelle Catherine, taking ecological measurements in salt-marsh vegetation at Patonga Creek, with Bob Makinson (BGT).
Photo: Peta Hinton

The third annual Plant Science Internship program was held over seven weeks in January and February. The program involves the competitive selection of students from the vegetation sciences at tertiary campuses, or recent graduates, and their placement for seven weeks as full-time volunteers assisting staff in the science units, especially the Herbarium. In return for their time, Interns receive advanced training on current issues in botany, plant conservation and related fields, and in workforce skills such as seminar presentation, job applications and interviews. Several interns from past years have already returned to work for DECC or the Trust, and others have returned as post-graduate students.

Specimens numbered, sorted and incorporated	2500
Specimens numbered and sorted only	667
Specimens accessioned, electronic data checked	567
Donated specimens checked, cleaned, sorted and prepared for mounting	400
Sheets mounted	508
Genera re-organised according to new taxonomy	3
Plant Pathology: soil samples taken	65
Plant Pathology: soil samples processed	122
Plant Pathology: plates processed	384
Bryophyte collections mounted	141
Bryophyte specimens sorted geographically	1800
Morphological measurements taken from 260 specimens across 2 species	6316
Printed journals reorganised in store	150 cartons (30 issues)
DNA samples packaged for storage	100
Seedbank: germination tests	34
Seedbank: collections incorporated	44
Seedbank: collections packaged/repackaged	64
Interns' own collections prepared, databased and incorporated	17 sheets
Disaster recovery and clean-up	1 flood (minor)

Interns are trained and supervised by science staff, and deployed to support mainly curatorial activities: an area for

which there are no grant programs to support additional paid staff. All intern work supports, directly or indirectly, our research and information-provision activities. Interns are deployed in teams to maximise efficiency and accuracy of work. Staff benefit both from the assistance and from honing their training and presentational skills. Lectures and seminars are given to the interns by Trust staff and by invited guest speakers from other institutions and fields. The program is strongly supported by academics around NSW.

Seven campuses were represented in the 2009 program: the Universities of NSW, New England, Sydney, and Western Sydney, Southern Cross and Macquarie Universities, and the University of Mauritius. The twelve students selected showed great enthusiasm and capacity to benefit from the program. As in previous years they provided a valuable net gain of assistance to the Herbarium, the Seedbank, and the Plant Pathology unit. Work outputs this year are shown in the accompanying table.

Bob Makinson – Conservation Botanist; and Kathi Downs – Curator

My time as an intern

Thoughts from Rebecca Johnson

On the Internship Program 2009

In Rebecca's application she stated that:

"I chose to pursue a career in the field of environmental resource management simply because of my passion for the environment and a desire to find solutions to the negative impacts the revolution in technology that humans have experienced is having on the natural world."

I was unsure about the Internship program until I spoke with Louisa Murray on the phone - I had often felt at university that my passion was a little over the top or misplace, and my conversation with Louisa confirmed, that in this case, that was a quality which was desirable! Of course I was immediately compelled to come to Sydney. Louisa also described the type of workshops and work we would be doing which dispelled my preconceptions about entering such a formidable institution as the National Herbarium of New South Wales - I had thought that the Internship may be a bit dry and rigid or perhaps linear, and that I would have to dress up in dress pants and suits, and look scientific - with lab coats - a task I was unsure I would be capable of pulling off! I discovered the opposite to be true.



Rebecca Johnson (Intern 2009) mounting specimens as part of her work experience in the 2009 internship program at the National Herbarium of New South Wales
Photo: Louisa Murray

After the first few weeks I was amazed at the passion and openness in this institution [Botanic Gardens Trust].

It promotes knowledge sharing, and almost everyone that I came into contact with was willing to spend time with me. Even with the tedium of some of the work, the atmosphere of learning and friendliness and constant involvement of us in the lives of the scientists was a mind blowing experience.

The most enjoyable part was the on week of fieldwork. I was amazed that we had 5 days gifted to us at Pearl Beach in a real research station and where we were looked after. I appreciated working with the experts; Doug Benson and Barry Conn (*Lamiaceae* expert) to name just two. I knew the scientists names from their publications, and then to meet them and work with them and be taken under the wing of many of them was amazing. I at times felt a little like a Botany groupie on tour with the band.

During the Internship Program I was able to discuss my future with the scientists and many of them spent a lot of time talking with me. Having the ability to talk to Elizabeth Brown and Maurizio Rossetto about research projects was great and the fact that they had research projects ready to talk

about with a graduation of time scales to match the projects was really useful.

After a 3 month break I came back to work on how leaf character traits may be used to find trends in variation within species and possible correlations to environment with Maurizio.

I have to comment that if the whole scientific community worldwide behaved like those individuals at the Royal Botanic Gardens we would have attained a harmonious global equilibrium and understanding with the natural world by now - ha-ha!

But what I want to do next is to take a year off from botany and do a Masters in Humanities and then a PhD in Science/Philosophy at Armidale UNE, as while I don't see myself doing taxonomy for the rest of my life, I will certainly always take a systematic approach to everything I do.

I would like to work in the broader environmental arena, as I feel that the global environmental situation is so dire that the changes required that we may have any hope of turning this situation around must be enacted now. But also the future of taxonomic research seems rocky at best, as governments around the globe take the focus more and more away from biodiversity and the health of natural ecosystems. Taxonomy is an essential discipline and should be a strong part of any biological study, but at present future job prospects seem limited. Science and botany will always be there underpinning my knowledge and the basis for my passion for learning.

but also reaffirmed the value and importance of what each of us wanted to do and the confidence to follow that path.



Rebecca, collecting in Bouddi National Park during the intern field-trip January 2009
Photo: Louisa Murray

I highly recommend the Internship program, and feel it would be a valuable experience for any environmental science student or similar. The program not only gave us practical and meaningful experience in a specific area,

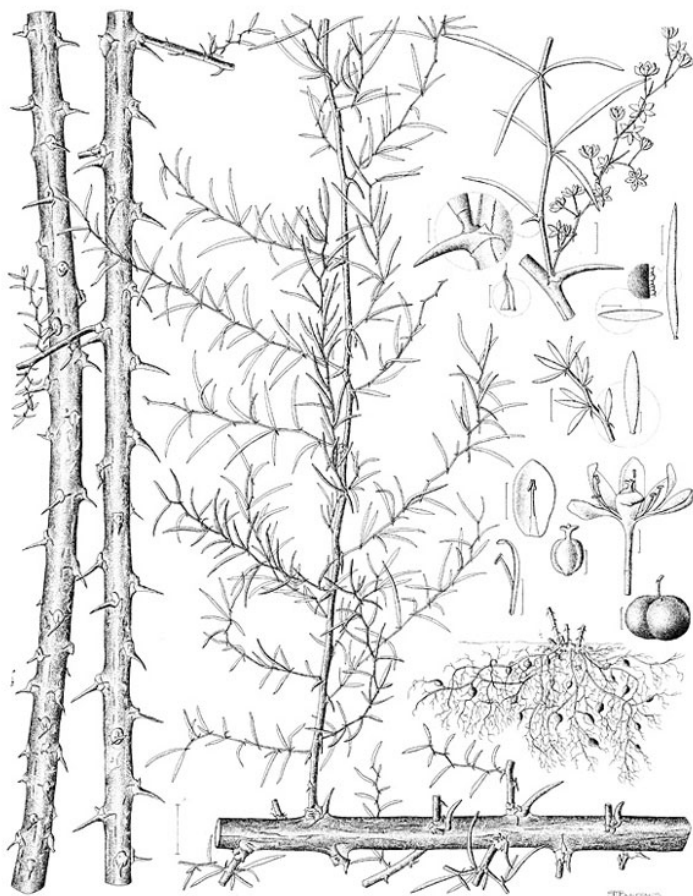
FLOCKTON AWARD

The Friends of the Botanic Gardens sponsored the 2009 Margaret Flockton Award for Botanical Illustration (exhibited from 10 April to Friday 17 July 2009) with the generous support of the Maple-Brown Family. This year 27 artists submitted with 40 works, 12 of which were from overseas.

The winners of the 2009 Award were announced at the opening of the Margaret Flockton Award Exhibition on 9 April in the Red Box Gallery at the Royal Botanic Gardens in Sydney. The works were judged on botanical accuracy, technical and artistic merit and reproducibility.

2009 Winners

First Prize of \$5000: Sandra Burrows, a freelance botanical illustrator and field botanist from South Africa, for her pen and ink illustration of *Asparagus elephantinus*. This is the first time Sandra has entered the award.



First Prize – Margaret Flockton 2009

Second prize of \$2000: Klei Rodrigo Sousa, a freelance botanical illustrator from Brazil, for his pen and ink rendering of *Orthophytum heleniceae*.

Highly commended:

Sandra Burrows, freelance botanical illustrator and field botanist, South Africa: *Acacia latispina*.

Highly commended:

Rosemary Wise, University of Oxford, UK:

Four species of *Pouteria* (*P. coriacea*, *P. bangii*, *P. stimulans*, *P. bracteata*)

Highly commended:

Rosemary Wise, University of Oxford, UK:

Four species of *Pouteria* (*P. sapota*, *P. baehniiana*, *P. polysepala*, *P. buenaventurensis*)

Highly commended:

Mali Moir, botanical, scientific and natural history artist, Victoria:

Doryanthes palmeri

Highly commended:

Prof Rod Seppelt, Principal Research Scientist and Botanist with the Australian Antarctic Division, Tasmania:

Calyptopogon mnioides.

The award honours the enormous contribution made by Margaret Flockton (1861-1953) to early botanical illustration for taxonomic research, and it is unique in that it promotes botanical illustration, as opposed to botanical art.

Louisa Murray – Acting Manager, Collections



Centre for Plant Conservation

The Centre for Plant Conservation is a nexus for coordination and facilitation of some of the Trust's activity in support of the conservation of species and ecological communities, and of capacity building in the conservation sector.

A major project during 2008-9 was the completion of a new book, *Plant Germplasm Conservation in Australia*. This comprehensive technical manual will effectively set national standards for the capture, long-term storage, and use of wild-plant germplasm, especially seed. Developed in collaboration with other members of AuSCaR, the Australian partners of the Millennium Seed Bank, the book represents a significant pooling of research results and practical experience from around the country. Staff of the Horticultural Research Unit at Mount Annan, and the CPC Coordinator, have been key contributors and drivers of this project. *Plant Germplasm Conservation in Australia* will be published by the Australian Network for Plant Conservation in September 2009.

The CPC was represented in several DECC forums for discussion and coordination of conservation policy, such as regular meetings of the Biodiversity Conservation Managers group, and more project-oriented meetings including a series aimed at developing a DECC policy on translocation of plant and animal species. The Coordinator also represented the Trust at several external meetings, including the 'Fungal Initiative' group which aims to promote the importance of fungal studies and conservation, and (jointly with the Mount Annan Seedbank Manager) on the Steering Committee of AuSCaR (Australian Seed Conservation and Research, link group for the Australian partners of the Millennium Seed Bank).

The CPC Coordinator Bob Makinson, is an appointed member of the New South Wales Scientific Committee, the body that assesses terrestrial species and ecological communities nominated for listing under the *Threatened Species Conservation Act 1995*. The Scientific Committee meets monthly to progress the many nominations made under the Act, and assessment and drafting of Committee determinations is a substantial part of the Coordinator's activity.

The nine Australian jurisdictions all follow different legislation, processes, and criteria for assessing the extinction risk of species and ecological communities. In December 2008 the first national directory of the procedures followed by the various jurisdictions for listing of plant species, ecological communities, and key threatening processes was published by Bob Makinson.

Several Trust staff are active members of the Australian Network for Plant Conservation Inc., a national linkage

body that includes among its members all the major Botanic Gardens and conservation agencies, as well as community groups and individuals. Staff contributed several articles or abstracts to *Australasian Plant Conservation* during the year, and assisted in its production.



Editors Cathy Offord and Patricia Meagher cut the seed-cake at the launch of the new book *Germplasm Conservation in Australia*

Photo: Leahwyn Seed

The CPC Coordinator participated in the Victorian-based Box-Ironbark Ecology Course in September 2008, a one-week residential focussing on management of this important inland biome. The Coordinator also delivered an annual lecture to third-year ecology students at Macquarie University, gave several lecture and seminar sessions to participants in the Plant Science Internship Program, and gave a talk on 'Provenance issues in bushland restoration' to a packed audience in the Blue Mountains.

Bob Makinson – Conservation Botanist

APPENDICES



Doryanthes excelsa after bushfires in Waterfall, NSW
Photo: Chris Allen

2009

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

Director Science and Public Programs

Brett Summerell BScAgr(Hons), PhD(Syd)

Executive Assistant

Sheryl Saban

Technical Officers

Kristina McColl BSc(Hons)(NSW), BushRegenCert(Ryde/Richmond TAFE)

Ifeanna Tooth BSc(Syd), AdvCertUrbHort(OTEN)

CENTRE FOR PLANT CONSERVATION

Coordinator

Bob Makinson BA(Biology)(Macqu)

EVOLUTIONARY ECOLOGY

Manager and Senior Research Scientist

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

NSW Vegetation

Special Botanists

Doug Benson BSc(Hons)(NSW)

John Benson BSc(Macq), PhD(Syd)

Senior Technical Officer

Chris Allen BEng, BSc(Biology)(Syd), PhD(Syd)

Technical Officer

Katie Thurlby BSc/BA(Syd) (temp)

Lotte von Richter BScAgr(Syd), MScAgr(Syd)

Scientific Officer

Hannah McPherson BSc(Hons)(UNSW) (temp)

PLANT PATHOLOGY AND MYCOLOGY

Manager and Research Scientist

Edward Liew BSc(Hons), PhD(Qld)

Senior Technical Officers

Suzanne Bullock NZCS, MSc(NSW) (LDD 9.04.09)

Matthew Laurence BSc (WA), Imperial College,London (Hons)

Technical Officers

Julie Bates, AssDipAppSc (Ultimo TAFE)

Therese Suddaby BHortSci(Hons)(USyd) (temp) (LDD 0908)

Sarah Dunstan Cert III Lab Technology (Granville TAFE) (temp)(LDD 2802)

HORTICULTURAL RESEARCH

Manager and Senior Research Scientist

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

Scientific Officer

Amelia Martyn BHortSci(Hons), PhD(Syd)

Kim Hamilton BAppSc(Hons), MTeach(QUT), PhD(Griffith)

Senior Technical Officer

John Siemon, BHortSc(Hons)(Qld)

Technical Officers

Karen Sommerville BSc(Hons), PhD(UTS); CertHortOperations(Padstow TAFE) (temp)

John Silk BScAgr(Syd) (temp)

Research Horticultural Assistant

Amanda Rollason CertIVHort(Parks&Gardens)(Yallah TAFE)

PLANT DIVERSITY**Manager**

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

Peter Weston BSc(Hons), PhD(Syd) (Acting)

Senior Principal Research Scientist

Surrey Jacobs, BScAgr; PhD(Syd)

Peter Weston BSc(Hons), PhD(Syd)

Principal Research Scientist

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

Alan Millar BSc(Hons), PhD(Melb)

Senior Research Scientist

Peter Wilson BSc(Hons), PhD(NSW)

Senior Botanist

Joy Everett BioTechCert(Syd TAFE), BSc(Hons), MSc(Syd) (LDD 0209)

Botanist & Scientific Editor (Telopea)

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

Flora Botanist

Louisa Murray BAppSc(CCAE)

Scientific Officers

Margaret Heslewood BSc(Hons)(Syd) (temp)

Marlien van de Merwe BSc(Hons)(Pretoria), MPhil, PhD(Cambridge) (temp)

Botanical Information Service**Botanist**

Barbara Wiecek BSc(Syd)

Senior Technical Officer

Seanna McCune BAppSc(Hawkes), BushRegenCert

Plant Information Network Officer

Gary Chapple BSc(Syd), DipAg(Hawkes)

Laboratory**Senior Technical Officer**

Adam Marchant BSc(Hons), PhD(ANU)

Technical Officer

Carolyn Porter BAppSc(Hons)(UTS)

COLLECTIONS**Manager**

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

Louisa Murray BAppSc(CCAE) (Acting)

Gillian Towler BSc(Macq), AssDipAppSc(HortParkMgt), TreeSurgCer (Acting)

Technical Officers

Wayne Cherry BScAgr(Syd), GradDipBioSc (NSW)

Robert Coveny HortCert

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

Clare Herscovitch BSc(Hons)(Syd)

Phillip Kodela BSc(Hons), PhD(UNSW)(temp)

Hannah McPherson BSc(Hons)(UNSW)

Leonie Stanberg BSc(Syd), DipEd(SCAE)

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

Loans Officer

Zonda Erskine AssDip in FAP(Sydney TAFE)

Herbarium Assistants

Belinda Araghi (temp)

Lisa Woods (temp)

Marnie Innes BSc(Hons)(Macqu) (temp)

Herbarium Support Officer

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

Library

Senior Librarian

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

Library Technician

Miguel Garcia AssocDipLibPrac(STC)

Botanical Illustration

Illustrators

Lesley Elkan BSc(UTS), PostGradDipIllus(Newc)

Catherine Wardrop BA(Vis)(ANU), PostGradDipIllus(Newc)

Volunteer Program

Volunteer Program Supervisors

Mary Stewart BSc(Syd)

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

Jude Wright BA(UNSW), BushRegen.Cert II (Ryde TAFE) (temp)

2009 Interns

Karen Bartle, Anne Baumann, J  el Catherine, Theresa Choi, Daniel Clarke, Eliza Fagan, Peter Fallon, Jennifer Hens, Alison Jaggard, Rebecca Johnson, Jo Miller, Margaret Stimpson.

HONORARY RESEARCH ASSOCIATES

Alan Archer PhD(City Lond), CChem, FRSC

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

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

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

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

Gwen Harden MSc(UNE)

Ken Hill BSc(Hons), MSc(UNE)

Peter Hind HortCert
Jocelyn Howell BPharm(Syd), BSc(Macq)
Robert Kooyman
Erich Lassak BSc(Hons), MSc, PhD(NSW)
Alan Leishman PhotoengravingEtchingCert
John Leslie BA(Dall), MS(UWisc), PhD(UWisc)
Lyn McDougall BushRegenCert
Anthony Martin, BioTechCert, BioTechHigherCert, BAppSc(Riverina)
Patricia Meagher BSc(Hons) Urban Horticulture(UTS)
Peter Michael BAgSc(Hons); PhD(Adel)
Peter Olde
Christopher Quinn BSc (Hons)(Tas); PhD (Auk)
Helen Ramsay MSc, PhD(Syd)
Bettye Rees BSc(Hons)(Qld), PhD(NSW)
Rod Rice Higher UrbCertHort
Geoffrey Sainty DipAgr(WAC), GradDipExt(Hawkes)
Phil Spence
Joy Thompson BScAgr, MSc(Syd)
John Thomson MSc, MAgrSc, PhD(Melb)
Mary Tindale MSc, DSc(Syd)
Edwin Wilson BSc(NSW)

VOLUNTEERS

Beverley Allen, Kathleen Allen, Lydia Bell, Margaret Bell, Pamella Bell, Chris Belshaw, Carol Bentley, Rosemary Blakeney, Wayne Brailey, Harry Brian, Ellen Brien, Louise Broadhead, Kathryn Brown, Dawn Bunce, David Buncel, Lynette Burns, Mary Cail, Diane Calder, Margaret Carrigg, Margot Child, Anne Collins, Anthony Curry, Barbara Darmanin, Jane D'Olier, David Drage, Helen Flinn, Gladys Foster, Jane Helsham, Rachel Hill, Alick Hobbes, Jim Hoffmann, Beverley Honey, Mike Isbell, Susan Jalaluddin, Trevor Kruger, Fred Langshaw, Gwenda Levy, Lorraine McCarthy, Malcolm McDonald, Ena Middleton, Jenna Nielsen, Barbara Page, Sally Paton, John Pearce, Aileen Phipps, Dorothy Pye, Beth Radford, Ann Rahaley, Daniel Robinson, Theresa Sergeant, Evelyn Shervington, Graham Shields, Carol Sinclair, Lois Stewart, Julie Taylor, Elisabeth Thilo, Betty Thurley, Ruth Toop, Shelagh Trengove, Valerie Trigg, Sybil Unsworth, Rosemary Varley, Denise Walker, Ann Wilcher, Jean Williams.

STUDENTS S&PP BRANCH 2008-2009

Student	Degree	University	Supervisors	Project Title
Melita Baum	PhD	Australian National University	+Prof. M. Crisp, Dr M. Rossetto, Dr P. Weston	Evolutionary patterns across the landscape in <i>Telopea</i> and <i>Lomatia</i>
Anne Bauman	PhD	University of Sydney	+Dr P. Martin, Dr C. Offord	Regeneration studies of the Paperbark (<i>Melaleuca quinquenervia</i>) Fringing Forest at the Myall Lakes
Jonathon Carbrera	PhD	Mainz University (Germany)	+Dr G. Kadereit, +Prof J. Kadereit, Dr S. Jacobs	Studies in Australian Camphorosmeae (Chenopodiaceae).
Endymion Cooper	PhD	University of Sydney	+Dr M. Henwood, +M. Pye, Dr E. Brown	A revision of <i>Lepidozia</i> and <i>Telaranea</i> and an assessment of the phylogeny and biogeography of Lepidoziaceae subfamily Lepidozioidae
Will Cuddy	PhD	University of NSW	+Assoc Prof B. Neilan, Dr B. Summerell	Investigate amelioration of impacts of irrigation salinity in wheat cropping using the cyanobacteria <i>Nostoc</i> and arbuscular mycorrhizal fungi
Jim Dellow	MScAgr	University of Sydney	+Prof D. Kemp, +Dr W. King, Dr S. Jacobs	Weedy Brassicaceae of NSW wheat areas
Frances Elliot	PhD	Southern Cross University	+Prof R. Henry, Dr M. Rossetto	Extent of clonality and taxonomic relationships in <i>Davidsonia</i>
Nathan Emery	Hons	University of Sydney	+Dr G. Wardle, +Dr M. Henwood, +Professor R. Overall, Dr C. Offord	Germination of <i>Actinotus helianthi</i>
Allison Frith	Hons	University of Sydney	+Professor D. Tissue (UWS), +Dr C. Warren, +Prof. M. Adams, Dr C. Offord	Ecophysiology of Wollemi pine
Jitendra Gaikwad	PhD	Macquarie University	+Prof S. Ranganathan, +Dr J. Kohen, Dr +J. Jamie, +Dr. S. Vemulpad, +P. Haynes, KL Wilson	Analysis of customary medicinal plant knowledge using a biodiversity Informatics approach
Kerry Gibbons	PhD	University of Sydney	+Dr M. Heywood, Dr B. Conn	Phylogeny and biogeography of <i>Mitrasacme</i> s. lat. (Loganiaceae)

Student	Degree	University	Supervisors	Project Title
Evan Graham	Hons	University of Sydney	+Professor D. Tissue (UWS), +Dr C. Warren, +Prof. M. Adams, Dr C. Offord	Ecophysiology of Wollemi pine
Joanne Green	PhD	Southern Cross University, Lismore	Dr S. Jacobs, + Dr A. Reichelt-Brushett	Assessing saltmarsh rehabilitation
Margaret Heslewood	PhD	University of Adelaide	Dr M. Rossetto, +Prof D. Crayn, +Prof A. Lowe	Historical biogeography and phylogeography of the family Cunoniaceae (Oxalidales) in Australasia
Peter Jobson	PhD	University of Technology	+K. Brown, Dr P. Weston	A taxonomic revision of <i>Dillwynia</i> (Fabaceae: Sydney Faboideae: Mirbelieae)
Tory Kuria	MSc	National University Taiwan;	+Dr Jer-Ming Hu, Dr B. Conn	Phylogeny of <i>Dillenia</i> (Dilleniaceae)
Matthew Laurence	PhD	University of Sydney	Dr E. Liew, Dr B. Summerell, +Prof L. Burgess	The evolutionary and pathogenic potential of <i>Fusarium oxysporum</i> from native soils in Australia
Hannah McPherson	MSc → PhD	University of New England	Dr M. Rossetto, +Prof D. Crayn, +Dr C. Gross	Biogeography of the eastern tetrathecas: Elaeocarpaceae
Rohan Mellick	PhD	University of Adelaide	Dr M. Rossetto, +Prof R. Hill, +Prof A. Lowe	Comparing and contrasting molecular and fossil data in <i>Podocarpus elatus</i>
Yola Metti	PhD	University of New South Wales	Dr A. Millar, +Prof P. Steinberg	Morphology and molecular phylogeny of the red algal <i>Laurencia</i> in NSW
Arthur Pinaria	PhD	University of Sydney	Dr E. Liew, +Prof L. Burgess	Vanilla Stem Rot In Indonesia: Host diversity and pathogen population genetics
Caroline Puente-Lelievre	PhD	James Cook University	Dr Elizabeth Brown, +Dr Darren Crayn	Systematics of the Leucopogon/Syphelia/Astroloma clade (Ericaceae subf. Syphelioideae)
Matt Renner	PhD	University of Sydney	Dr E. Brown, +Dr G. Wardell	Relationships of the Austral family Lepidoziaceae
Josie Saul	PhD	University of Sydney	+Prof D. Guest, Dr E. Liew	Diversity of Phytophthora palmivora in PNG
Lucas Shuttleworth	PhD	University of Sydney	+Prof D. Guest, Dr. E Liew	Biology and Management of nut rot of chestnut
Katie Thurlby	Honours	University of New South Wales	+Assoc Prof W. Sherwin, Dr M. Rossetto, Dr P. Wilson	The reproductive biology of the magenta Lilly Pilly (<i>Syzygium paniculatum</i>) and its implications for conservation

Student	Degree	University	Supervisors	Project Title
Nguyen Vinh Truong	PhD	University of Sydney	Dr E. Liew, +Prof L. Burgess	Biology, epidemiology and Population structure of <i>Phytophthora capsici</i> , pathogen of Black Pepper Wilt in Vietnam
Sela Tupouniua	PhD	University of Sydney	Dr E. Liew, +Assoc Prof R. McConchie	Fungicide resistance in <i>Podosphaera xanthii</i> (powdery mildew) of Squash in Tonga
Michael Whitehead	PhD	Australian National University	+Prof R. Peakall, Dr M. Rossetto	Gene flow patterns in speciating ground orchids
Trevor Wilson	PhD	University of Sydney	+Dr M. Henwood, Dr B. Conn	Systematic studies in <i>Prostanthera</i> (Lamiaceae)
Paul Wynn	PhD	University of Sydney	+Prof B. Sutton, Dr C. Offord	Water use efficiency of Australian plants
Ameera Yousiph	PhD	University of Sydney	Dr E. Liew, +A. Watson (NSW DPI), +Prof L. Burgess	Fusarium Wilt of Snow Peas

+ external supervisor

Appendix B: REPRESENTATION ON EXTERNAL COMMITTEES

Doug Benson

Member, North Head Sanctuary Scientific Committee (Sydney Harbour Federation Trust); Member, National Trust Bush Management Advisory Committee; Member, Greater Blue Mountains World Heritage Area Advisory Committee, Member, Stakeholder Working Group for Sydney Harbour National Park Plan of Management Review 2009.

John Benson

Member, NSW DECC Vegetation Mapping and Classification Type Committee; Member of IUCN Commission of Ecosystem Management; Member of Wollemi Pine Recovery Team; participant in IUCN Ad Hoc Committee on Ecosystem Risk Assessment; Member of DECC NSW Biodiversity Strategy Priorities Committee.

Dr Barbara Briggs (Honorary Research Associate)

Committee Member, NSW Division of Australian & New Zealand Association for the Advancement of Science (ANZAAS).

Dr Elizabeth Brown

Adjunct Lecturer, University of New England.

Professor Carrick Chambers (Honorary Research Associate)

Member Griffin Reserves Advisory Committee for Willoughby City Council; Patron, Walter Burley Griffin Society Inc.; Member, Florilegium Committee Royal Botanic Gardens Trust, Sydney.

Dr Barry Conn

Project Leader Pacific Region, of the European Union-sponsored African-Caribbean-Pacific (ACP_EU) Forest Network (FORENET) Program; Member of the Scientific Advisory Group for the ACP-EU project; Coordinator, Flora Malesiana Urticaceae Working Group; Member, Editorial Committee, Telopea;

Dr Tim Entwisle

Deputy Chair, Australian Academy of Science National Committee for Plant and Animal Sciences; Member, NSW Agricultural Scientific Collections Trust; Chair, Scientific Program Coordinator, International Botanical Congress 2011; Member, International Advisory Committee for Botanic Gardens Conservation International; Member, Macarthur Advisory Board (MACROC); Member, Hyde Park Master Plan Reference Committee; Member, Taxonomy Research & Information Network Steering Committee.

Peter Hind

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

Dr Surrey Jacobs

Adjunct Assoc. Professor, University of New England; Member, Wetlands Committee of Hawkesbury Nepean Catchment Management Authority.

Dr Edward Liew

Adjunct Senior Lecturer, Faculty of Agriculture, Food and Natural Resources, The University of Sydney; Member, Wollemi Pine Conservation Management (Recovery) Team; Member, *Phytophthora cinnamomi* Threat Abatement Plan Working Group; Assessor, National Association of Testing Authorities (NATA).

Bob Makinson

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

Dr Adam Marchant

President of the Workers' Educational Association (Sydney); Member of the Genetics Society of AustralAsia

Dr Amelia Martyn

Member, Australian Society of Plant Scientists; Member, Women In Science Enquiry Network Program.

Dr Peter Michael (Honorary Research Associate)
Member, National Trust Bush Management Committee.

Dr Alan Millar

Editor-in-chief, Journal of the International Phycological Society - *Phycologia*; Deputy Chair, NSW Fisheries Scientific Committee, Fisheries Management Act; Adjunct Professor of University of New South Wales, University of Melbourne and James Cook University; Professorial Research Fellow, University of Wollongong; Chair – Research Advisory Group, Sapphire Coast Marine Discovery Centre; Member, International Organising Committee, International Phycological Congresses; Member, Nominations Committee, International Phycological Society; Member - International Marine Experts Group; Algal Consultant for International Union for the Conservation of Nature (IUCN); Consultant for Conservation International, Washington DC; Chair, Research Advisory Group, Sapphire Coast Marine Discovery Centre

Dr Cathy Offord

Scientific Committee (Floriculture and Climate Change) International Horticulture Congress, 2010; Wollemi Pine Conservation Management Committee, member.

Dr Maurizio Rossetto

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

Sheryl Saban

Spokeswoman, Botanic Gardens Trust, Sydney.

Dr Brett Summerell

Chair, Council of Heads of Australian Herbaria (till 30 December 2008); Member Executive Committee, Council of Heads of Australian Herbaria (since January 1, 2009); Chair, Herbarium Information Systems Committee (since January 1, 2009); Convenor, Taxonomy Australia; Member, Australian Museum, Research and Curation Advisory Committee; Member, Australian Biological Resources Study Advisory Committee; Member, Management Committee, Atlas of Living Australia; Adjunct Professor, Faculty of Agriculture, Food and Natural Resources, University of Sydney; Adjunct Professor, Department of Plant Pathology, Kansas State University.

John Thomson (Honorary Research Associate)

Professor Emeritus, University of Sydney; Council Member, International Association of Pteridologists; Committee Member, International Bracken Group

Dr Peter Weston

Member, Editorial Advisory Board, Kew Bulletin; Corresponding Member, Editorial Advisory Committee, Australian Systematic Botany; Vice President, Australian Systematic Botany Society; Chairman, Bushland Management Advisory Committee of Lane Cove Municipal Council; Chairman, Ira Butler Trophy Committee (a joint committee of the Orchid Society of New South Wales and the Australasian Native Orchid Society); Adjunct Assoc. Professor, University of New England.

Karen Wilson

Member of Australian Academy of Science National Committee for Data in Science; Secretary General for International Botanical Congress 2011; Convener, Global Plant Checklist Committee, International Organization for Plant Information; Member of IOPI Species Plantarum Committee; Adjunct Assoc. Professor, University of New England; Council member and member of Joyce W. Vickery Research Fund Committee, Linnean Society of New South Wales; Member of Board and Team, Species 2000; Member, Species 2000 Asia-Oceania Committee, Member, Editorial Advisory committee, Australian Systematic Botany'

Dr Peter Wilson

Adjunct Senior Lecturer, University of New England; Member, Committee of the Heads of Australian Herbaria Australian Plant Census Working Group.

Appendix C: RESEARCH GRANTS

FUNDING TO TRUST

Australian Biological Resources Study (ABRS)

Karen Wilson & Prof. Jeremy Bruhl (UNE) - Phylogeny, taxonomy and biology of *Schoenus*: A Cinderella of Australian Cyperaceae \$150,000 (2nd year of a 3 year \$300,000 grant)

Dr Darren Crayn, Dr Maurizio Rossetto, Dr Peter Weston, Dr John Conran (Uni Adel), A/Prof. Santiago Madriñan (Universidad de los Andes, Bogotá, Colombia), Dr Henk van der Werff (Missouri Botanical Garden, St. Louis MI, USA) plus retirees Bernie Hyland and Bruce Gray (rainforest botanists CSIRO, Qld) - Integrating molecular and morphological data for generic delimitation and species identification in Lauraceae \$150,000 (2nd year of a 3 year \$300,000 grant)

Dr Peter Wilson and Dr Chris Quinn – Generic position of the non persistent-fruited species of *Leptospermum* (Myrtaceae) \$22,000 (3rd year of a 2 year \$44,000 grant) - delayed start

Australian Flora Foundation

Dr Peter Wilson and Dr Maurizio Rossetto - Reproductive biology of the Magenta Lilly Pilly (*Syzygium paniculatum*) \$11,600 (2nd year of a 2 year \$23,200 grant)

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

John Benson and Bob Makinson NSW Native Vegetation Classification and Assessment \$200,000 (3rd year of a 3 year \$400,000 grant)

Friends of the Royal Botanic Gardens Sydney Inc.

Research Grants

BGT NSW Herbarium Internship Program \$14,000

Dr Maurizio Rossetto - "Bicentenary Plant Diversity Project" Collect representative Australian flora, curate relevant herbarium section and conduct research on the association between climate gradients and genetic diversity \$127,000 (1st year of a 4 year \$510,000 grant)

Scientific Travel Scholarships

Dr Surrey Jacobs – To assist attendance at the Monocots 4 – International Conference in Copenhagen 11-15 Aug 2008 \$6,200

Karen Wilson - To assist attendance at the Monocots 4 – International Conference in Copenhagen 11-15 Aug 2008 and associated visits to other institutions \$4,000

Barry Conn – Appraisal of herbarium collections of the Singapore Botanic Gardens, Herbarium Bogoriense and Kebun Raya, Bogor Indonesia \$2,000

John Benson – To attend the International Union for Conservation of Nature (IUCN) World Conservation Congress, Barcelona, Spain, 5-14 October 2008 \$3,000

Margaret Flockton Award and Exhibition

\$10,000

Hermon Slade Foundation

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

Namoi Catchment Management Authority

Dr Chris Allen - Vegetation Communities of the Liverpool Plains \$50,000

Natural Resources Advisory Council of NSW

John Benson - preliminary compilation of literature on vegetation types on the NSW South Eastern highlands and Australian Alps Bioregions in preparation for assessment and

classification of the vegetation in those bioregions for data entry in the NSWVCA database in 2010 \$60,000

Matrix Plus Consulting (Rio Tinto Alcan)

Dr Maurizio Rossetto & Dr Marlien van der Merwe - To undertake a detailed population-genetic study of the Gove (NT) population of *Erythroxylum pusillum* (Erythroxylaceae) \$71,000 one off payment

Royal Botanic Gardens Foundation

Dr Cathy Offord and Dr Kim Hamilton – 'Rainforest Seed Project' – rainforest seeds research and conservation project \$130,000 (1st year of a 3 year \$390,000 grant). Project funded by donations from Allianz and two private benefactors, Tony Maxwell and Robyn Godlee

UK Millennium Commission

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

FUNDING TO PARTNER ORGANISATIONS

Australian Research Council – Discovery Grant

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

Australian Research Council - Research Networks

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

Australian – New Zealand Research Network for vegetation function (4th year of sharing in \$2,500,000 over 5 years)

Appendix D

Overseas Travel

Name & Position	Countries / Cities visited	Purpose of visit	Duration	Total Cost	Cost to Trust	Source of Other Funds
Dr Maurizio Rossetto, Senior Research Scientist	Berlin, Germany and Kew, United Kingdom	To participate and present at XX th International Congress of Genetics, and to discuss potential conservation genomics projects on Australian flora (Also availed of recreation leave from 19 – 25 July 2008)	10 – 25 July 2008	\$5,500	Nil	Grant from HSF
Dr Edward Liew, Plant Pathologist/ Mycologist	Turin and Alghero, Italy	To attend 9 th International Congress of Plant Pathology and 10 th International Fusarium Workshop	23 Aug – 3 Sept 2008	\$7,300	Nil	Friends of the Gardens, Horticulture Australia Limited and Australian Centre for International Agricultural Research
Surrey Jacobs, Principal Research Scientist	(1) Copenhagen (Denmark) (2) Mainz, Remseck/Neckar (Germany)	(1) Participate in 5th International Symposium on Grass Systematics & Evolution, presenting talks/posters (2) Give lecture; discuss joint projects with fellow researchers	9-16 August 2008 17-21 August 2008	\$9,700	3,500	Friends of the Gardens and Remseck/Neckar & Mainz University
Karen Wilson, Acting Manager Plant Diversity; Special Botanist	(1) Copenhagen (2) Lund (Sweden; day-trip from Copenhagen); Hamburg (Germany); Kew (UK)	(1) Participate in Monocots IV international conference, presenting talks/posters (2) Examine specimens in 3 herbaria; discuss joint projects with fellow researchers	10-16 August 2008 7-8, 18-22 August 2008	\$7,800	2,000	Friends of the Gardens and personal contribution
John Benson, Senior Ecologist	Spain; Barcelona	Participate and present at the IUCN 4th World Conservation Congress	1-15 October 2008	\$7,100	2,100	Friends of the Gardens, external grant funds and personal contribution

Name & Position	Countries / Cities visited	Purpose of visit	Duration	Total Cost	Cost to Trust	Source of Other Funds
Dr Kim Hamilton, Rainforest Seed Project Coordinator, Horticultural Research Section	UK, Sussex	(1) Presentation at the conference "Tree Seeds 2008 – Trees, Seeds and a Changing Climate" (2) Visit Millennium Seedbank for discussions with collaborators.	19 September - 04 October 2008	\$6,000	nil	Royal Botanic Gardens Foundation
Dr Tim Entwisle, Executive Director, BGT	New Zealand	To participate in Awards ceremony	5 to 8 November 2008	\$2,500	nil	New Zealand Horticulture Industry Training Organisation
Dr Alan Millar, Principal Research Scientist	Wellington, New Zealand	To attend Asia Pacific Phycological Forum	9 to 19 November 2008	\$1,950	nil	Allen Press, USA
Dr Elizabeth Brown, Systematic Bryologist	New Zealand	To attend workshop and fieldwork for Lepidoziaceae projects	16 November to 12 January 2009	\$3,500	nil	Personal contribution
Hannah McPherson, Technical Officer (Scientific)	Hamburg, Germany and	To research Australian collection in Hamburg Herbarium, and	22 December 2008 to 3 April 2009	\$15,000	Nil	Australia Germany Association, Goethe Institut, Lufthansa, and ARC Discovery grant
	Grenoble, France	To work with colleagues at the University Joseph Fourier	and 4 April to 18 April 2009	\$3,000	Nil	
Dr Barry Conn, Principal Research Scientist	Singapore	To conduct research at Singapore Botanic Gardens	14 June to 7 July 2009	\$9,590	nil	Friends of the Gardens and Singapore Botanic Gardens
	Indonesia	To conduct research at Herbarium Bogoriense	7 to 13 July 2009			
	Indonesia	To attend conservation symposium	13 to 19 July 2009			
Dr Alan Millar, Principal Research Scientist	Lawrence, Kansas, USA,	To attend meeting at Allen Press	21 to 28 June 2009	\$1,920	nil	Allen Press, USA
	Honolulu, Hawaii, USA	To attend Phycological Society of America Conference	18 to 25 July 2009	\$2,300	nil	
	Tokyo, Japan	To attend Phycological Congress	31 July to 9 August 2009	\$3,534	nil	

Appendix E: COOPERATIVE RESEARCH

*Dr Chris Allen

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

Dr Alan Archer

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

Doug Benson

- Assessment of 1770 native vegetation, historic Cook landing site, Kurnell with G Eldershaw (Parks & Wildlife Div. DEC)
- Vegetation of Blackwood Reserve, with D. Picone National Trust of Australia

Dr John Benson

- NSW Vegetation Classification and Assessment database project with all other DECC divisions and district offices, DPI, CMAs and individual experts.
- IUCN Ecosystem risk assessment criteria with international expert panel through the IUCN Commission of Ecosystem Management.

Dr Barbara Briggs

- Phylogeny and classification of Restionaceae with Prof. H.P. Linder, Zurich University, Switzerland.
- Phylogeny of restiid clade of Poales (Restionaceae, Centrolepidaceae, Anarthriaceae) with A.D. Marchant and A.J. Perkins, Western Australian Herbarium.
- Typification of Restionaceae species with R.L. Barrett, Kings Park and Botanic Garden, Perth.
- Reproductive morphology of Hydatellaceae with Dr P.J. Rudall, Jodrell Laboratory, Royal Botanic Gardens, Kew and Dr. D.D. Sokoloff and Dr. M.V. Remizowa, Moscow State University.
- Monocot Tree of Life Project with Prof. T.J. Givnish, University of Wisconsin and Dr. J. Leebens-Mack, University of Georgia, USA.

*Dr Elizabeth Brown

- Systematics of *Asterella* (Aytoniaceae) with Dr C. Cargill, Centre for Plant Diversity, Canberra.
- Molecular phylogeny and systematics of *Fossombronina* in NSW with W. Cuddy, H. McPherson and with Dr. C. Cargill, Centre for Plant Diversity, Canberra.
- Bryoflora of New Caledonia with Dr Jérôme Munzinger, IRD, Noumea.
- IBISCA Queensland and SANTO2006, an international project to study biodiversity.
- Horizontal gene transfer between bryophytes and *Amborella* with Prof. Jeffrey Palmer and Dr Eric Knox of Indiana University.
- Systematics of the *Leucopogon* s.lat. complex with M. Hislop, WA Herbarium and Prof. D.Crayn, Director Australian Tropical Herbarium

Professor Carrick Chambers

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

Dr Barry Conn

- Phylogeny of *Prostanthera* (Lamiaceae) with Trevor Wilson and Dr Murray Henwood (both University of Sydney).
- Phylogeny of Chloantheae (Lamiaceae) with Murray Henwood (University of Sydney) and Dr Elizabeth Brown
- Phylogeny of Urticaceae with Dr Chris Quinn, Julisasi T. Hadiah (Kebun Raya Indonesia)
- Systematics of Loganiaceae with Kerry Gibbons and Murray Henwood (both University of Sydney) • Systematics of *Drosera peltata* complex (Droseraceae) with Robert Gibson (DECCW) and Jeremy Bruhl (University of New England) • Review of *Verbena* in Australia with Dr Peter Michael

- Guide to trees of Papua New Guinea with Kipiro Damas (Papua New Guinea National Herbarium)

Dr Tim Entwisle

- Molecular systematics, biology and biogeography of freshwater red algae with Dr M. Vis (USA), Dr Alison Sherwood (USA) and Dr Orlando Necchi Jr (Brazil).

Ken Hill and Leonie Stanberg

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

Dr Surrey Jacobs

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

Dr Edward Liew

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

Bob Makinson

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

Dr Adam Marchant

- Relationship of Australian Restionaceae with Dr B. Briggs, Botanic Gardens Trust.
- Relationships of South East Asian Theaceae species, with Dr G. Orel, UWS; R. Cherry, and J. Rob, Paradise Plants wholesale nursery, Kulnura; A. Curry, TAFE Richmond; Prof. Gao. Fuyang Research Institute of Sub-Tropical Forestry, China; Prof. L. Legendre, Laboratoire de Biotechnologies Végétales Appliquées aux Plantes Aromatiques et Médicinales, Université Jean Monnet, Saint Etienne, France; Prof. C. Parks, Uni. Of North Carolina, USA; Prof. Tran, Hanoi University, Viet Nam.

Dr Amelia Martyn and Dr Cathy Offord

- Research on seed dormancy in Rutaceae species with Dr Tony Auld and Dr Mark Ooi, NSW Department of Environment and Conservation.
- Seed longevity studies for Australian species with Dr R. Probert (Millennium Seed Bank, Royal Botanic Gardens Kew) and Australian Seed Conservation and Research (AuSCaR) partners.

- Germination and dormancy breaking for Australian species with Australian Seed Conservation and Research (AuSCaR) partners.

Dr Alan Millar

- DNA research on Sporochneales with Nick Yee, Dr G.T. Kraft, University of Melbourne and Dr Adam Marchant.
- Systematics of coralline algae of the east coast of Australia with Dr Wm J. Woelkerling, La Trobe University, Victoria.
- New Zealand representatives of the red algal family Delesseriaceae with Dr W. Nelson, Museum of New Zealand, Wellington.
- Marine floristics of East African coast with Prof. E. Coppejens and Dr O. De Clerck, University of Gent, Belgium.
- Biogeographical similarities between South Africa and eastern Australia with Prof. J. Bolton, University of Cape Town.
- Invertebrate epifauna of macroalgae with Dr G. Wilson and Dr D. Faith, Australian Museum.
- DNA research on the red algal genus *Laurencia* with Yola Metti and Prof. P. Steinberg, University of New South Wales.
- DNA research on *Laurencia* from Taiwan (with Yola Metti and Showe-Mei Linn); from the Mediterranean (with Yola Metti and Professors Cormaci and Furnari, University of Catania, Sicily, Italy); and from New Zealand (with Yola Metti and Wendy Nelson, NIWA).
- Systematics of the red macroalgal family Ceramiaceae with Dr O. De Clerck, University of Gent, Belgium.

Dr Cathy Offord

- Rainforest Seed Project, with Dr Sarah Ashmore, Griffith University, Qld.
- Rockdust as a potting mix additive, with Linda Lindongi, Dr R. McConchie, University of Sydney and Dr Geoff Cresswell.
- Lipid characterization of Araucariaceae seeds with Dr C. Duke and Dr R. Duke, University of Sydney.
- Ecophysiology of Wollemi pine with Professor David Tissue, University of Western Sydney.

Dr Chris Quinn

- Systematics and biogeography of the *Vittadinia* group of Astereae (Asteraceae) with Dr T.K. Lowrey, University of New Mexico, Albuquerque, USA.
- A morphological and molecular systematic reassessment of *Monotoca* (Ericaceae: Styphelioideae) with Dr D. Albrecht, Alice Springs Herbarium, Alice Springs.
- A systematic reassessment of generic concepts among *Epacris* and its allies (Ericaceae: Styphelioideae) with Dr R.K. Crowden, University of Tasmania.

Dr Maurizio Rossetto

- Developing biogeographic know-how: improving species divergence and dispersal estimations to examine geological and climatic evolutionary drivers, with Prof. A. Lowe (University of Adelaide), Prof. D.M. Crayn (James Cook University), M.S. Pole (UQ), D. Lambert (Massey University, NZ) and P.M. Hollingsworth (Royal Botanic Garden, Edinburgh).
- Speciation in the Australian flora: testing explanatory hypotheses in waratahs and their allies, with P. Weston, M. Baum and Assoc. Prof. M. Crisp (ANU).
- Phylogeographic studies on *Elaeocarpus* in northern Queensland, with A. Ford (CSIRO Atherton) and Prof. D. Crayn (James Cook University).
- Understanding the relationship between trait variation and environmental variables in Australian rainforests, with R. Kooyman, Prof. M. Westoby (Macquarie University)
- Conservation genomics and transcriptomics – a pilot project on rainforest trees, with Prof. R. Henry and N. Rice (SCU).
- Variability theory - new applications for Shannon's index, with Assoc. Prof. W. Sherwin (UNSW).
- Speciation in native orchids, with M. Whitehead and Prof. R. Peakall (ANU).
- Genetic diversity in fragmented populations of *Davidsonia* (Cunoniaceae), with Prof. R. Henry and F. Elliot (SCU).

- Population and conservation genetics of *Elaeocarpus holopetalus* (Elaeocarpaceae), with Prof. C. Gross (UNE).
- Breeding system, diversity and fitness in a rare lilly pilly, with K. Shields and Assoc. Prof. W. Sherwin (UNSW).

Dr Brett Summerell

- Genetics and taxonomy of *Fusarium* with Professor John Leslie, Kansas State University.
- Biosystematics of fungi on Proteaceae and Myrtaceae with Professor Pedro Crous, CBS Netherlands.

Dr Peter Weston

- Systematics, biogeography and comparative biology of the Proteaceae, with Dr Cajsja Anderson, Real Jardin Botanico, Madrid, Spain, Associate Prof. N.P. Barker, Rhodes University, South Africa, Ms Melita Baum, Australian National University, Associate Prof. Peter Bernhardt, StLouis University, USA, Associate Prof. J.J. Bruhl, University of New England, Dr D.J. Cantrill, Royal Botanic Gardens Melbourne, Dr H. Citerne, Université Paris-Sud 11 (Orsay), France, Prof. M.D. Crisp, Australian National University, Mr A. Ford, CSIRO Sustainable Ecosystems, Atherton,, Dr G.J. Jordan, University of Tasmania, Dr A.R. Mast, Florida State University, USA, Dr D. Murphy, Royal Botanic Gardens Melbourne, Dr M. Rossetto (RBG&DT), Dr H. Sauquet, Université Paris-Sud 11 (Orsay), France, Ms M. Stimpson, University of New England.
- Systematics, biogeography and comparative biology of the Diurideae (Orchidaceae) with Dr M.A. Clements, CSIRO Division of Plant Industry, Dr A.J. Perkins, University of Sydney, Mr J.O. Indsto, Forensic Science Services Branch, New South Wales Police, Dr R. Peakall, Australian National University, and Prof. R.J. Whelan (University of Wollongong).
- Integrating molecular and morphological data for generic delimitation and species identification in Lauraceae, with Dr M. van der Merwe, Dr M. Rossetto (RBG&DT) and Prof. D.M. Crayn, Australian Tropical Herbarium,.
- Floral development in the Calycanthaceae, with Mr Y.M.. Staedler and Prof. P.K. Endress, University of Zurich, Switzerland.
- Phylogeny of the Winteraceae, with Associate Prof. J.J. Bruhl, University of New England, Mr A. Ford, CSIRO Sustainable Ecosystems, Atherton, Ms N. Thomas, University of New England.
- Phylogeny of the Goodeniaceae with Dr S.L. Krauss, Kings Park and Botanic Garden, Perth.
- Assembly of Southern Floras, with Working Group 18 of the ARC-NZ Research Network for Vegetation Function, Macquarie University.
- Evolutionary history of the Eastern Mesic Biome with the ARC Environmental Futures Network, University of Adelaide.

Karen Wilson

- Systematic studies in Juncaceae with Assoc.Prof. J. Bruhl, University of New England and Dr J. Hodgson, Qld National Parks & Wildlife Service.
- Systematic studies in Abildgaardieae (Cyperaceae) with Assoc. Prof. J. Bruhl, University of New England, Dr K. Clarke and Dr K. Ghamkhar, University of Western Australia.
- Systematics of *Carpha* (Cyperaceae) with Assoc. Prof. J. Bruhl, University of New England and Dr Xiufu Zhang.
- Systematics of *Lepidosperma* (Cyperaceae) with Assoc. Prof. J. Bruhl, University of New England, Dr J. Hodgson, Qld National Parks & Wildlife Service and R. Barrett, Kings Park and Botanic Garden, Perth.
- Spikelet structure in Cyperaceae, with Dr J. Richards, Florida International University, Florida and Assoc. Prof. J. Bruhl, University of New England.
- Systematics of *Schoenoplectus* sens. lat. with Dr A. Muasya, University of Cape Town, Assoc. Prof. J. Bruhl, University of New England, et al.
- Systematic studies in tribe Schoeneae with Assoc. Prof. J. Bruhl, Dr A Gibbs and P Musili, University of New England, Dr J. Hodgson, Qld National Parks & Wildlife Service, Drs A. Muasya & A.Verboom, University Cape Town.

Dr Peter Wilson

- Systematics of the *Indigofera pratensis* complex with Dr A. Kazandjian, Simon Bolivar University, Caracas, Venezuela.
- Relationships and generic concepts in the tribe Chamelaucieae, particularly *Baeckea* sens. lat. and *Micromyrtus*, with Dr B.L. Rye and Mr M. Trudgen, Western Australian Herbarium.
- Relationships and generic concepts in the *Verticordia/Darwinia/Chamelaucium* group with Dr M.D. Barrett, Kings Park and Botanic Garden; and Dr L.M. Copeland, University of New England.
- Systematics, phylogeny, and biogeographical affinities of the Indo-Pacific species of *Eugenia* (Myrtaceae) with Dr N. Snow, Bishop Museum, Hawaii.

Appendix F: Publications

Scientific Publications List 2008-09

- Archer, A.W.** (2009), Graphidaceae. *Flora of Australia* 57: 84–194.
- Archer, A.W.** & Elix, J.A. (2008) Two new species in the Australian Graphidaceae (lichenised Ascomycotina). *Australasian Lichenology* 63: 26-29.
- Archer, A.W.** & Elix, J.A. (2009) New species and new reports in the lichen genus *Pertusaria* (Ascomycota: Pertusariaceae) from Australasia. *Nova Hedwigia* 88: 1-10.
- Archer, A.W.**, Elix, J.A., Fischer, E., Killmann D. & Sérusiaux, E. (2009) The genus *Pertusaria* (Ascomycota) in Central Africa (Congo/Kivu, Rwanda and Burundi) and Western Kenya. *Nova Hedwigia* 88: 309-333.
- Barkworth, M.E., Arriaga, M.O., Smith, J.F., **Jacobs, S.W.L.**, Valdés-Reyna, J., & Bushman, B.S. (2008) Molecules and morphology in South American Stipeae (Poaceae). *Systematic Botany* 33: 719-731.
- Benson, J.S.** (2008) Classifying ecological communities and synthesizing data for natural resource management: some problems and potential solutions. Guest Editorial, *Ecological Management & Restoration* 9(2): 86-87.
- Benson, J.S.** (2008) New South Wales Vegetation Classification and Assessment: Part 2 Plant communities in the NSW South-western Slopes Bioregion and update of NSW Western Plains plant communities: Version 2 of the NSWVCA database. *Cunninghamia* 10(4): 599-673.
- Bentley, A.R., Milgroom, M.G., Leslie, J.F., **Summerell, B.A.** & Burgess, L.W. (2009) Spatial aggregation in *Fusarium pseudograminearum* populations from the Australian grain belt. *Plant Pathology* 58: 23-32.
- Bentley, A.R., **Summerell, B.A.** & Burgess, L.W. (2008) Sexual compatibility in *Fusarium pseudograminearum* (*Gibberella coronicola*). *Mycological Research* 112: 1101-1106.
- Cabrera, J.F., **Jacobs, S.W.L.**, & Kadereit, G. (2009) Phylogeny of the Australian Camphorosmeae (Chenopodiaceae) and the taxonomic significance of the fruiting perianth. *International Journal of Plant Science* 170: 505-521.
- Chambers, T.C.** (2008) *Doodia hindii* (Blechnaceae) a new species from north eastern New South Wales, Australia. *Telopea* 12(2): 257-261.
- Coleman, M.A., Kelaher, B.P., Steinberg, P.D. & **Millar, A.J.K.** (2008) Absence of a large brown macroalga on urbanized rocky reefs around Sydney, Australia, and evidence for historical decline. *Journal of Phycology* 44: 897-901.
- Crisp, M.D., Arroyo, M.T.K., Cook, L.G., Gandolfo, M.A., Jordan, G.J., McGlone, M.S., **Weston, P.H.**, Westoby, M., Wilf, P., & Linder, H.P. (2009) Phylogenetic habitat conservatism on a global scale. *Nature* (Advanced Online Publication: doi:10.1038/nature07764).

- Crous, P.W., **Summerell, B.A.**, Mostert, J.Z. & Groenewold, J.Z. (2008) Host specificity and speciation of *Mycosphaerella* and *Teratosphaeria* species associated with leaf spots of Proteaceae. *Persoonia* 20: 59-86.
- Crous, P.W., Braun, U., Wingfield, M.J. Wood, A.R., Shin, H.D., **Summerell, B.A.**, Alfenas, A.C., Cumagun, C.J.R, Groenewald, J.Z. (2009) Phylogeny and taxonomy of obscure genera of microfungi. *Persoonia* 22: 139–161
- Cuneo, P.**, Jacobson, C.R. & Leishman, M.R. (2009) Landscape-scale detection and mapping of invasive African Olive (*Olea europaea* L. ssp. *cuspidata* Wall ex G. Don Ciferri) in SW Sydney, Australia using satellite remote sensing. *Applied Vegetation Science* 12: 145-154.
- Der, J.P., **Thomson, J.A.**, Stratford, J.K. & Wolf, P.G. (2009) Global chloroplast phylogeny and biogeography of bracken (Pteridium; Dennstaedtiaceae). *Amer. J. Bot.* 96: 1041-1049.
- Elix, J.A., Jariangprasert, S. & **Archer, A.W.** (2008) New *Pertusaria* (lichenized Ascomycota) from Australia and Thailand. *Telopea* 20(2): 263-272.
- Entwistle, T.J.**, Vis, M.L., Chaisson, W., Necchi O. Jr & Sherwood, A. (2009). Systematics of the Batrachospermales (Rhodophyta) – a synthesis. *Journal of Phycology* 45: 704–715.
- Everett, J., Jacobs, S.W.L. & Nairn, L.** (2009) Tribe Stipeae. Flora of Australia, 44A: 11-70.
- Gillespie, L.J., Soreng, R.J., Bull R., **Jacobs, S.W.L.** & Refulio-Rodriguez, N.F. (2008) Phylogenetic relationships in subtribe Poinae (Poaceae, Poeae) based on nuclear ITS and chloroplast trnT-trnF sequences. *Botany* 86: 938-967.
- Govaerts, R., Sobral, M., Ashton, P., Barrie, F., Holst, B.K., Landrum, L.L., Matsumoto, K., Mazine, F.F., Nic Lughadha, E., Proença, C., Soares-Silva, L.H., **Wilson, P.G.** & Lucas, E. (2008) *World Checklist of Myrtaceae*. (Kew Publishing: Royal Botanic Gardens, Kew). 470 pp.
- Green, J., Reichelt-Brushett, A. & **Jacobs, S.W.L.** (2009) Re-establishing a saltmarsh vegetation structure in a changing climate. *Ecological Management & Restoration* 10: 20-30.
- Hadijah, J., **Conn, B.J. & Quinn, C.J.** (2008) Infra-familial phylogeny of Urticaceae, using chloroplast sequence data. *Australian Systematic. Botany.* 21: 375–385.
- Hamilton, K.** (2008) Australia's unique wild citrus diversity. *Samara* 14: 3
- Hamilton, K.N.** & Ashmore, S.E. (2008) Development of conservation technologies for Australia's rainforest and tropical native fruits. *Australasian Plant Conservation* 17(1): 1-31.
- Hamilton, K.N.**, Ashmore, S.A. & **Offord, C.A.** (2009) Development of conservation technologies for Australian rainforest fruits and CWR. *Crop Wild Relative, IUCN Crop Wild Relative Specialist Group*, Issue 7: 10-12

- Heslewood, M., Porter, C., Avino, M., & Rossetto, M.** (2009) Isolation and characterization of nuclear microsatellite loci in *Ceratopetalum apetalum* (Cunoniaceae). *Molecular Ecology Resources* 9: 566-568.
- Indsto, J.O., **Weston, P.H.** & Clements, M.A. (2009) A molecular phylogenetic analysis of Diuris (Orchidaceae) based on AFLP and ITS reveals three major clades and a basal species. *Australian Systematic Botany* 22: 1-15
- Kalb, K., **Archer, A.W.**, Sutjaritturakan, J. & Boonpragob, K. (2009) New or otherwise interesting lichens V. *Bibliotheca Lichenologica* 99: 225-246.
- Kodela P.G.** (2009) *Oryza*, Flora of Australia 44A, Poaceae 2: 361-368.
- Kodela P.G.** & Weiller, C.M. (2009) Trib. Phareae, Flora of Australia 44A, Poaceae 2: 5-9.
- Kodela P.G.** & Weiller, C.M. (2009) *Leersia*, Flora of Australia 44A, Poaceae 2: 360-361.
- Kodela P.G.** & Weiller, C.M. (2009) *Potamophila*, Flora of Australia 44A, Poaceae 2: 369.
- Kodela, P.G.**, Weiller C.M. & Thompson, I.R. (2009) *Phalaris*, Flora of Australia 44A, Poaceae 2: 145-152.
- Kodela, P.G.**, Weiller C.M. & Thompson, I.R. (2009) *Arrhenatherum*, Flora of Australia 44A, Poaceae 2: 127-129.
- Kodela, P.G.**, Weiller C.M. & Thompson, I.R. (2009) *Pentapogon*, Flora of Australia 44A, Poaceae 2: 233-235.
- Kodela, P.G.**, Weiller C.M. and Thompson, I.R. (2009) *Alopecurus*, Flora of Australia 44A, Poaceae 2: 253-256.
- Kooyman, R. & Rossetto, M.** (2008) Definition of plant functional groups for informing implementation scenarios in resource limited multi-species recovery planning. *Biodiversity Conservation* 17: 2917-2937.
- Jacobs, S.W.L.**, Gillepsie, L.J. & Soreng, R.J. (2008) New combinations in *Hookerchloa* and *Poa* (Graminae). *Telopea* 20(2): 273-278.
- Jacobs, S.W.L.**, Whalley, R.D.B. & Wheeler, D.J.B. (2009) Grasses of New South Wales ed. 4 (School of Environmental and Rural Science, University of New England: Armidale). 450 pp.
- Jacobs, S.W.L.** & Barkworth, M.E. (2009) A new species of *Elymus* (Gramineae, Triticeae) from Eastern Australia. *Novon* 19: 168-171.
- Jacobs, S.W.L.**, Weiller, C.M., & Thompson, I.R. (2009) *Rostraria*. Flora of Australia 44A, Poaceae 2: 158-160.

- Jacobs, S.W.L.** (2009) *Agrostis*, Flora of Australia 44A, Poaceae 2: 163-173.
- Jacobs, S.W.L.** & Brown, A.J. (2009) *Lachnagrostis*. Flora of Australia, 44A Poaceae 2: 174-190.
- Löhne, C., Borsch, T., **Jacobs, S.W.L.**, Hellquist, B. & Wiersema, J.H. (2008) Nuclear and plastid DNA sequences reveal complex reticulate patterns in Australian water-lilies (Nymphaea subgenus Anecphya, Nymphaeaceae). *Australian Systematic Botany* 21(4): 229–250.
- Lücking, R. **Archer A.W.** & Aptroot, A. (2009) A world-wide key to the genus *Graphis* (Ostropales: Graphidaceae) *Lichenologist* 41: 363-452.
- McPherson, H.C., Porter, C.** Rymer, P.D. & **Rossetto, M.** (2008) Isolation and characterisation of polymorphic microsatellite loci from *Tetralochea ericifolia* (Elaeocarpaceae). *Molecular Ecology Resources* 8(4): 867-869.
- Makinson R.O.** (2008) A directory of conservation-status listing processes for threatened Australian plant species and ecological communities. *Australasian Plant Conservation* 17(2): 2-33.
- Martyn, A.J.,** Larkhum, A.W.D., McConchie, R. & **Offord, C.A.** (2008) Photoinhibition and change in pigments associated with bract browning in waratahs (*Telopea* spp., Proteaceae). *Journal of Horticultural Science and Biotechnology* 83 (3): 367-373.
- Martyn, A.J., Seed, L.U. & Offord, C.** (2008) Dessication to tolerance of threatened Australian species *Myrsine richmondensis*. *Seed Science and Technology* 36: 206-209.
- Martyn, A.** (2009) Seed longevity in Australian species: a collaborative study through the AuSCaR (Australian Seed Conservation and Research) network. *Australasian Plant Conservation* 17(4): 9-10
- Maynard, D.,** Crayn, D., **Rossetto, M., Kooyman, R.** & Coode, M. (2008) *Elaeocarpus sedentarius* sp. nov., (Elaeocarpaceae) – morphometric analysis of a new, rare species from eastern Australia. *Australian Systematic Botany* 21: 192-200.
- Michael, P. W.** (2008). The misapplication of the name *Verbena bonariensis* L. and the status of *V. incompta* P.W. Michael. *Australian Systematic Botany Society Newsletter* No. 136 (Sep): 10—11.
- Morin, L., **van der Merwe, M.,** Hartley, D. & Müller, P. (2009) Putative natural hybrid between *Puccinia lagenophorae* and an unknown rust fungus on *Senecio madagascariensis* in KwaZulu-Natal. *South Africa. Mycological Research* 113: 725-736.
- Offord, C.A. & Tyler, J.L.** (2009) In vitro propagation of *Pimelea spicata* R.Br. (Thymelaceae), an endangered species of *Pimelea spicata* R.Br. (Thymelaceae), an endangered species of the Sydney region, Australia. *Plant Cell, Tissue and Organ Culture* 98: 19-23.

Pratley, J.E., Broster, J.C. & **Michael, P.** (2008). *Echinochloa* spp. in Australian ricefields—species distribution and resistance. *Australian Journal of Agricultural Research* 59 (7): 629—645.

Rees, B.J., Cracknell R., **Marchant, A.** & Orlovich, D.A. (2009) A near fatal case consistent with mushroom poisoning due to *Amanita* species. *Australasian Mycologist* 28(1): 23-28.

Remizowa, M.V., Sokoloff, D.D., **Briggs, B.G.**, Macfarlane, T.D., Beer, A.S., and Ruddall, P.J. (2008) Seedling structure, shoot architecture and morphological identity of reproductive units in Hydatellaceae (Nymphaeales). *Tver State University Series Biology and Ecology* 25: 219-223.

Renner M.A.M., Wardle G.M. & **Brown E.A.** (2008) Conflict and continuity and the logic of grouping in and out of context, with *Papilliolejeunea* (Lejeuneaceae: Jungermannopsida) as an example. In: Haji Mohamed, Baki Hj Bakar, Nasrulhaq Boyce and Patrick Lee (editors) *Bryology in the new Millenium*, pp. 477–494.

Renner, M.A.M. & Brown, E.A. (2008) *Mnioloma* (Calypogeiaceae: Jungermannopsida) in Australasia: how many species are there? *Fieldiana Botany new series* 47: 159–174.

Rossetto, M., Crayn, D., Ford, A., **Mellick, R. & Sommerville, K.** (2009) The influence of environment and life-history traits on the distribution of genes and individuals: a comparative study of 11 rainforest trees. *Molecular Ecology* 18: 1422-1438.

Royer, D.L., **Kooyman, R. M.**, Little, S. A., & Wilf, P. (2009) Ecology of leaf teeth: a multi-site analysis from an Australian subtropical rainforest. *American Journal of Botany* 96(4): 1-14.

Sage, T.L., Hristova-Sarkovski, K., Koehl, V., Lyew, J., Pontieri, V., **Bernhardt, P., Weston, P.H.**, Bagha, S. & Chiu, G. (2009) Transmitting tissue architecture in basal-relictual angiosperms: implications for transmitting tissue origins. *American Journal of Botany* 96(1): 183-206.

Sage, T.S., Hristova-Sarkovski, K., Koehl, V. Lyew, J., Pontieri, V., Bernhardt, P., Sauquet, H., **Weston, P.H.**, Anderson, C.L., Barker, N.P. Cantrill, D.J., Mast, A.R., & Savolainen, V. (2009) Contrasted patterns of hyperdiversification in Mediterranean hotspots. *Proceedings of the National Academy of Sciences of the U.S.A.* 106: 221-225.

Sherwood, A.R., Vis, M.L., **Entwisle, T.J.**, Necchi, O. Jr. & Presting, G.G. (2008) Contrasting intra versus interspecies DNA sequence variation for representatives of the Batrachospermales (Rhodophyta): insights from a DNA barcoding approach. *Phycological Research* 56: 269–279.

Siemon, J., Offord, C.A. & Sommerville, K. (2009) Storage of terrestrial orchid seed and symbiots for ex-situ conservation. *Australasian Plant Conservation* 17(4): 7-8.

Skinner, S., Fitzsimmons, N. & **Entwisle, T.J.** (2008) The moss-back alga (Cladophorophyceae, Chlorophyta) on two species of freshwater turtles in the Kimberleys. *Telopea* 20(2): 279-284.

Sommerville, K.D., Siemon, J.P., Wood, C.B. & Offord, C.A. (2008) Simultaneous encapsulation of seed and mycorrhizal fungi for long-term storage and propagation of terrestrial orchids. *Australian Journal of Botany* 56: 609-615.

Sommerville, K.D., Heslewood, M.M., Siemon, J.P. & Offord, C.A. (2009) Banking site soil for the germination of terrestrial orchid seed collections. *Seed Science and Technology* 37: 222-228.

Staedler, Y.M., **Weston, P.H.** & Endress, P.K. (2009) Comparative gynoecium structure and development in Calycanthaceae (LAURALES) *International Journal Plant Sciences* 170(1): 21–41.

Thomson, J.A., Mickel, J.T. & Mehltreter, K. (2008) Taxonomic status and relationships of bracken ferns (*Pteridium*: Dennstaedtiaceae) of Laurasian affinity in Central and North America. *Bot. J. Linn. Soc.* 157: 1-17.

Thomson, J.A. (2008) Morphotype and conflicting taxonomies in *Pteridium* (Dennstaedtiaceae: Pteridophyta). *Fern Gazette* 18: 101-109.

Truong, N.V., Burgess, L.W. & **Liew, E.C.Y.** (2008) Prevalence and aetiology of *Phytophthora* foot rot of black pepper in Vietnam. *Australasian Plant Pathology* 37: 431-442.

Van der Merwe, M.M., Kinnear, M.W., Barrett, L.G., Dodds, P.N., Ericson, L., Thrall, P.H., & Burdon, J.J. (2009) Positive selection in AvrP4 avirulence gene homologues across the genus *Melampsora*. *Proceedings Royal Society B-Biological Sciences* 276:2913-2922.

Weiller, C.M., **Jacobs, S.W.L.** & Thompson, I.R. (2009) *Amphibromus, Holcus, Hierochloa, Anthoxanthum*. Flora of Australia, 44A: 127-143.

Weiller, C.M., **Jacobs, S.W.L.** & Thompson, I.R. (2009) *Avena*. Flora of Australia, 44A: 119-122.

Weiller, C.M., **Jacobs, S.W.L.** & Thompson, I.R. (2009) *Molineriella, Avellinia*. Flora of Australia, 44A: 153-155.

Weiller, C.M., **Jacobs, S.W.L.** & Thompson, I.R. (2009). *Koeleria*, Flora of Australia, 44A: 157-158.

Weiller, C.M., **Jacobs, S.W.L.** & Thompson, I.R. (2009) *Polypogon*. Flora of Australia, 44A: 229-233.

Weiller, C.M., **Jacobs, S.W.L.** & Thompson, I.R. (2009) *Phleum*. Flora of Australia, 44A: 243-244.

Weiller C.M., **Kodala, P.G.** & Thompson, I.R. (2009) *Gaudinia*, Flora of Australia 44A, Poaceae 2: 156.

Weiller C.M., **Kodala, P.G.** & Thompson, I.R. (2009) *Trisetum*, Flora of Australia 44A, Poaceae 2: 160-163.

Weiller C.M., **Kodela, P.G.** & Thompson, I.R. (2009) *Echinopogon*, Flora of Australia 44A, Poaceae 2: 222-228.

Weiller C.M., **Kodela, P.G.** & Thompson, I.R. (2009) *Calamagrostis*, Flora of Australia 44A Poaceae 2: 235-237.

Weiller C.M., **Kodela, P.G.** & Thompson, I.R. (2009) *Gastridium*, Flora of Australia 44A, Poaceae 2: 238-240.

Weiller C.M., **Kodela, P.G.** & Thompson, I.R. (2009) *Lagurus*, Flora of Australia 44A, Poaceae 2: 240-242.

Weiller C.M., **Kodela, P.G.** & Thompson, I.R. (2009) *Deschampsia*, Flora of Australia 44A, Poaceae 2: 256-258.

Weiller C.M., **Kodela, P.G.** & Thompson, I.R. (2009) *Aira*, Flora of Australia 44A, Poaceae 2: 259-264.

Simon, B.K., Weiller, C.M. & **Kodela, P.G.** (2009) *Dichelachne*, Flora of Australia 44A, Poaceae 2: 214-221.

Weston, P., Bagha, S. & Chiu, G. (2009) Transmitting tissue architecture in basal-relictual angiosperms: Implications for transmitting tissue origins. *American Journal of Botany* 96: 183-206.

Wilson, P.G. and Rowe, R. (2008) Three new species of *Indigofera* (Fabaceae: Faboideae) from Cape York Peninsula. *Telopea* 12: 285–292.

Wilson, P.G. and Rowe, R (2008) A revision of the Indigofereae (Fabaceae) in Australia. 2. *Indigofera* species with trifoliolate and alternately pinnate leaves. *Telopea* 12: 293–307.

Wilson, P.G. (2008) Typification of *Metrosideros regelii* (Myrtaceae) and consideration of its generic position. *Kew Bulletin* 63 (2): 347–349.

Woelkerling W.J., **Millar A.J.K.**, Harvey A. & Baba, M. (2008) Recognition of *Pachyarthon* and *Bossiella* as Distinct Genera in the Corallinaceae, Subfamily Corallinoideae (Corallinales, Rhodophyta). *Phycologia* 47(3): 265–293.

General List

Entwisle, T.J. (2008) Conserving a self-destructing palm *The Gardens* 77:5

Entwisle, T.J. (2008) It is now time to act. *The Gardens* 77:3

Entwisle, T.J. (2008) Why are flamingos are pink? *The Gardens* 78:4

Entwisle, T.J. (2009) Australia's tenacious little pitcher plant *The Gardens* 80:5

Entwisle, T.J. (2009) Maiden's Palm re-discovered *The Gardens* 81:5

- Martyn, A.** (2008) Seeds take a journey to the Heavens. *Wisenet Journal* 79:9
- Martyn, A.** (2008) The Balancing Act, Pearls of Wisdom from Busy Women. *Wisenet Journal* 79:15
- Michael, P.** (2008). My early life with plants. A Good Weed—*The Newsletter of the Weed Society of New South Wales (Winter)*: 11-12
- Murray, L.** (2008) Intern program extends knowledge and skills *The Gardens* 78:3
- Rossetto, M.** (2009) The Bicentenary Plant Diversity Program: a new focus on botanical exploration *The Gardens* 81: 6-7
- Summerell, B.** (2008) Serendipitous journey in plant pathology *The Gardens* 77: 22

Appendix G: Performance Indicators

