State Herbarium of South Australia Research Prospectus 2008–09

The State's key institution for advancing and disseminating knowledge of plants, algae and fungi

Government of South Australia
Department for Environment and Heritage

Board *of the* Botanic Gardens *and* State Herbarium

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Overview

This research prospectus describes our business and encompasses the history, past research achievements, available infrastructures, in-house expertise, current scientific projects and future directions of the State Herbarium of SA (AD).

Background

Reporting

The State Herbarium of South Australia has two administrative reporting lines.

It reports to the Board of the Botanic Gardens of Adelaide and State Herbarium, where the Board is responsible under the Botanic Gardens of Adelaide and State Herbarium Act (South Australian Government). It is also part of the Science Resource Centre in the Information, Science and Technology Directorate of the Department for Environment and Heritage.

The activities of the State Herbarium are embodied in the following strategic plans:

- The State's Strategic Plan
- The Department for Environment & Heritage Corporate Plan 2007 – 2010.
- Botanic Gardens & State Herbarium Strategic Plan (2007 – 2009, and forthcoming plan)
- the Nature Conservation Program (2008 - 2012) reflected in the 'No Species Loss' Program in the DEH
- The State Herbarium and Bioknowledge SA Strategic Direction (2008-2013)

The role of the Board of the Botanic Gardens and State Herbarium in relation to the State Herbarium of South Australia is embodied in the *Botanic Gardens and State Herbarium Act 1978* [and a letter of Direction from the Minister, revised 20 March 2000]. Functions of the Board set out in section 13 of the Act include:

a) to establish and maintain a herbarium and, subject to this Act, to retain original specimens included in the herbarium;
b) to accumulate and care for specimens (whether living or preserved), objects and things of interest in the fields of botany, horticulture, biology, conservation of the natural environment or history;
c) to accumulate and classify data in regard to any such matters;
d) to carry out or promote research into matters of interest in the fields of botany, horticulture, biology, conservation of the natural environment or history;
e) to disseminate information of interest in the fields of botany, horticulture, biology, conservation of the natural environment or history;
f) to undertake commercial exploitation of knowledge acquired by the Board in the course of conducting research;
g) to provide consultant services;
h) to perform any other functions of scientific, educational or historical significance that may be assigned to the Board by Regulation.

History

The State Herbarium collection was first brought together under the roof of the administration building of the Botanic Gardens of Adelaide in the mid 1950s and was based on dispersed personal and institutional collections (e.g. those of Prof. J.B. Cleland, the SA Museum and the University of Adelaide). The State Herbarium was given its own custom-built home in 1966, followed by two building extensions. This site has now made way for the University of Adelaide's National Wine Centre. The herbarium moved to its new home in the Plant Biodiversity Centre, a redeveloped "Tram Barn" on Hackney Road in August 1999.

Governance and key collaborations. The original link between the State Herbarium and Botanic Gardens of Adelaide has continued since its inception through the Board and Director of the Botanic Gardens & State Herbarium. Its links to DEH were established in the 1970s. Broader collaborations at the State, national and international levels have been built on a long tradition of collaboration between plant taxonomists in herbaria and museums going back centuries.

Profile. The State Herbarium of South Australia is an internationally recognised institution, dedicated to undertaking research and an advisory role in plant systematics for South Australia. It has, since its inception, had a strong State, national and international profile. In South Australia it has played a key role in undertaking botanical surveys since the 1960s, instrumental in the foundation of conservation parks across the State, and established strong links with the University of Adelaide through postgraduate research students in plant systematics, who have taken up significant positions in the field across Australia[1].

Through its team of biosystematists and rich herbarium collection, the State Herbarium continues to be the foremost South Australian scientific and advisory authority on the plant and macro-fungal diversity and has extended this role to the macro-algae and weeds, with the acquisition of the Womersley phycological collection from the University of Adelaide and collections of naturalised plants from the Department of Agriculture and with the acquisition of the herbarium of the Waite Agricultural Research Institute. It is a joint facility of the Department for Environment & Heritage and the Board of the Botanic Gardens and State Herbarium. It is more than a centre for the deposition and curation of plants, macroalgae and macrofungi for biological and ecological studies, but rather forms a key centre in the network of Australian biological collection and research institutes, whose collective aim is to further the development of the taxonomic and spatial inventory of Australian biodiversity.

South Australia has a long jurisdictional tradition of State floras and censuses, which date from 1875[2]. The State Herbarium's research staff and associates bring scientific methodologies, including modern cutting-edge technologies in molecular biology, microscopy and information technology, to bear on a wide range of botanical areas in order to generate information at different levels of biological organisation (genes, populations, species, higher taxa, communities and ecosystems). This biodiversity information is an imperative factor in today's conservation biology, environmental management, design of natural reserves and informed decision making for South Australia and its Governmental agencies.

The State Herbarium is also part of a large global network of scientific institutions with the common aim of advancing knowledge of regional and global biodiversity. It has a long tradition of contribution to the global research and documentation in plant systematics, evolution and biogeography of plants, algae and fungi, and maintains an expanding collection of global significance. It operates nationally through its core and foundational membership of the Council of Heads of Australasian Herbaria, which has promoted recent major national initiatives such as *Australia's Virtual Herbarium* (see link on www.eflora.gov.sa.au) and the *Census of Australian Plants* (http://www.chah.gov.au). In collaboration with other herbaria, museums, universities and research institutions, the State Herbarium also participates in national and international initiatives such as the *Consortium for Barcoding of Life* (CoBoL), *Census of Coral Reefs Life* (www.creefs.org), the Australian Centre for Evolutionary Biology and Biodiversity (ACEBB,

[1] Postgraduate students from the 1960s to 1980s taking significant roles in biosystematics included: Richard Schodde (Australian National Herbarium and Head of Collections, CSIRO Wildlife), Paul Wilson (WA Herbarium), Judy West (Australian National Herbarium), Tony Orchard (Auckland Museum, Tasmanian Herbarium and Executive Editor Flora of Australia), Barry Conn (National Herbarium of Victoria and NSW National Herbarium), Bill Barker (PNG National Herbarium and State Herbarium of SA), Munir Ahmad Abid (State Herbarium of SA), Philip Short (National Herbarium of Victoria and Northern Territory Herbarium), Peter Copley and Peter Lang (Department for Environment & Heritage). Supervision included Hansjoerg Eichler (Keeper of the State Herbarium) and Constance Eardley and David Christophel (Lecturers in plant systematics of the Botany Department, University of Adelaide).

[2] Preceded only by Ferdinand von Mueller in Victoria

www.adelaide.edu.au/acebb/) and the University of Adelaide's Environment Institute (www.adelaide.edu.au/environment/).

Such partnerships have over the last 10 years realised over A$10 million of successful grant applications awarded from the Commonwealth (Department for Environment, ABRS, ARC) and NGO sources. For example, it has been one of the core participants in the Natural Heritage Trust-sponsored *Australia's Virtual Herbarium* data capture project which has provided over $10 million of Commonwealth and State funding leading to the access of data associated with the millions of herbarium records held in Australia's principal herbaria, and had a leading role in establishing on-line access to these data in 1999 (a world first for integrating a distributed biodiversity data set). Data from nearly 700,000 of the State Herbarium's approximately 1 million herbarium specimens have been digitised and are now accessible on-line.

The State Herbarium has a major role in storing herbarium specimens of plants forming the basis of scientific research. This is critical to enabling research to keep its currency against the ever-changing framework of plant species names that reflects improvement in the understanding of the circumscription of species resulting from taxonomic research. The Biological Survey of South Australia is exemplary in this: its floristic inventories and analyses that provide vegetation maps and opportunities for monitoring environmental change are based on the presence or absence of species in numerous sites across the state. Almost 100,000 herbarium specimens provide a solid foundation for keeping pace with taxonomic change that is often more complex than a simple name change.

Knowledge of our plants underpins all plant sciences and is crucial in environmental management. Through study of its collections and the information contained in them, the State Herbarium collates accurate information about the State's flora including a State and regional census and the geographic occurrence of each species. Its publications provide a variety of information such as variation, habitat, biology, illustrations and a means to identify plants. The State Herbarium is therefore an essential resource for carrying out flora surveys, vegetation mapping programs, native vegetation conservation (e.g. National Parks and Reserves, Urban Forest Biodiversity Program), weed identification (Quarantine, Animal & Plant Control Commission) and community management and rehabilitation programs.

As the key plant biodiversity knowledge and advisory agency in South Australia, we encourage and foster new research and science partnerships, State, country and worldwide. We foster an ethos of true collaborations to encourage research interaction between our staff and those in other institutes/agencies. To assist in developing these partnerships and determining new strategic directions, we have developed this research prospectus.[3]

Vision & Mission

- To excel as South Australia's leading resource for the advancement of botanical biodiversity information and knowledge.
- Make updated scientific botanical knowledge accessible to the general public, the research community and the South Australian Government.
- Promote and perform internationally renowned research in botany to assist the South Australian Government in its custodian role as protector and manager of the State's environmental heritage.

[3] Available through the Department for Environment & Heritage web pages

Research expertise, strengths and opportunities

Background

Taxonomic research on the Australian flora

The most productive avenue for advancing knowledge is through a long-term project traditionally called a taxonomic revision. Plant groups for such focussed research are selected on the perception that their current classification provides a flawed view of the species and their relationships as they exist in nature. Such works are long-term, but highly effective in bringing knowledge closer to reality. They entail the examination of the bulk of collections and historic literature of the group, extensive field work, particularly in infraspecific complexity, avenues of research relevant to establishing limits of species and races within species, analysis of data and the application of existing botanical names using international rules of botanical nomenclature. The result is a fresh classification of the group reflecting the evolutionary and genetic relationships of the component taxa (species and infraspecific variants). To gain the best results such studies are undertaken across the geographic range of the group. While State governments maintain separate herbaria, there has been a general understanding of the benefits of such study and a long history of collaboration in taxonomic studies.

The incomplete taxonomic view of the Australian plants, algae and fungi.

South Australia has produced a rich array of authoritative handbooks documenting the diversity of plants, algae, lichens and fungi. Most recent works in these groups are:

- *Flora of South Australia*, edn 4 (1986). J.P. Jessop & H.R. Toelken (eds).
  The four volumes cover vascular plants – the flowering and coniferous plants and ferns. Compilation of a fifth edition is currently taking place. The last edition, published in 1986, is out-of-print, but available on-line at www.flora.sa.gov.au.
- *Acacias of South Australia* (1980, 1992). D.J.E. Whibley & D.E. Symon.
- *Orchids of South Australia* (1990). R.J. Bates & J.Z. Weber.
- *Mosses of South Australia* (1980). D.G. Catcheside.
- *Lichens of South Austra*lia (1979). R.B. Filson & R.W. Rogers.
- *Larger fungi of South Australia* (1997). C.A. Grgurinovic.
- *The marine benthic flora of southern Australia* (1984–2003). 6 volumes/parts. H.B.S. Womersley.
- *Census of South Australian Vascular Plants*, edn 5.00 (2005). W.R. Barker et al.

There has been a tendency to assume that these handbooks indicate a near-complete knowledge of these groups. However, the reality is to the contrary. Our knowledge is quite incomplete. Even in the flowering plants our knowledge is constantly increasing (Table 1, Fig 1).

Table 1. The advancing knowledge of the South Australian vascular plant flora based on numbers of native and naturalised taxa (species, subspecies, varieties and forms) recognised in a chronology of key comprehensive historic taxonomic publications. (Extension of Barker et al. 2005)

Publication event	No. of taxa Total	Native	Naturalised
Brown Prodromus (incomplete) 1810	250	250	0
Colonisation of SA 1836	0	0	0
Bentham Flora Australiensis 1863-78	1100		
Tate Flora 1890	1706		
Black Weed Flora 1909			368
Black Flora 1922-29	2500	2139	361
Black & Robertson Flora 1943-57	3250		
State Herbarium Census SA 1983	3550		
State Herbarium Flora SA 1986	3639	2671	968
State Herbarium Census SA 1993	4275	3109	1166
State Herbarium Census SA Feb 2005	4666	3378	1288
State Herbarium Census database 2008	4750	3430	1320

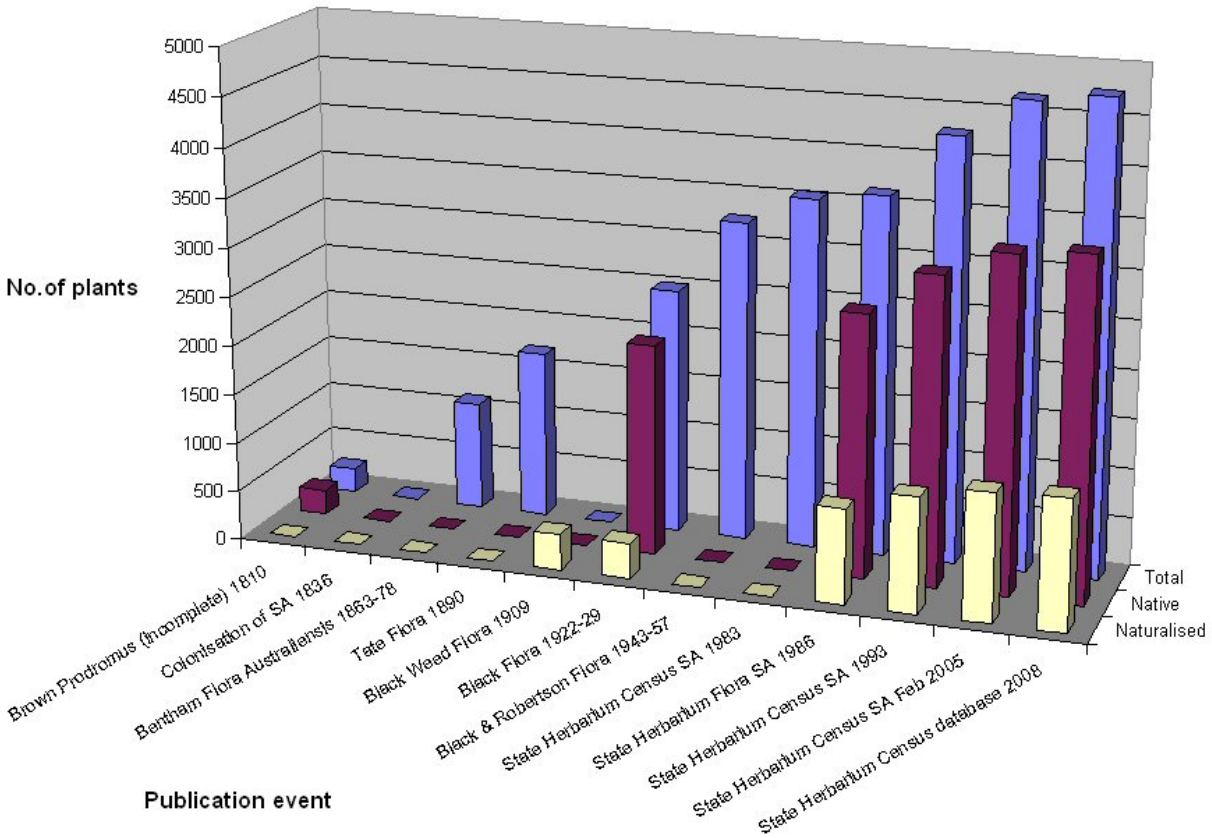

Fig. 1. The advancing knowledge of the South Australian vascular plant flora based on numbers of native and naturalised taxa (species, subspecies, varieties and forms) recognised in key comprehensive historic taxonomic publications. Based on data in Table 1.

The reasons for the change are

- The number of species new to science continues to grow due to the work of taxonomists. Even prominent genera such as *Eucalyptus* and *Acacia* and the popular Orchidaceae continue to provide many new species.
- The number of species found within South Australia continues to grow with increased sampling effort, particularly in remote regions of the state. The distributional range of species is also likely to shift due to climate change, bringing new species into the state.
- The steady increase in species naturalised in South Australia arises in two ways, one resulting from newly established introductions, the other from improvements in knowledge of the species complexes to which the plant belongs.

Current strengths

The results of taxonomic revisional research on our knowledge of the Australian flora are astounding. Table 1 indicates the results of published and ongoing research by State Herbarium specialists. South Australia has benefited in turn from taxonomic revisional studies by botanists from other States. In prominent groups the State may have its own specialist, knowledgeable in the local species and intimate with particular problems, but the benefits to such people of a committed long-term specialist covering the whole group are widely acknowledged.

Examples of prominent groups: highlighted in bold are workers in taxonomic groups throughout range (across Australia) which made the major advances.

- *Acacia* (DJE Whibley, DE Symon of State Herbarium for SA; then major work by **L Pedley,** Qld Herbarium, and **BR Maslin,** WA Herbarium, with others from across Australia including MC O'Leary of State Herbarium)
- *Grevillea* (**D MacGillivray** & **RO Makinson,** NSW National Herbarium; **Olde** & **Marriot,** nurserymen; **RO Makinson,** NSW National Herbarium)
- *Eucalyptus* (CD Boomsma, Woods & Forests SA, assisted by State Herbarium, but major thrusts with **LAS Johnson** & **K Hill,** NSW National Herbarium**; I Brooker** with **D Kleinig,** Australian National Herbarium and CSIRO Forestry, **SD Hopper,** WA Conservation and Land Management, PJ Lang, BioKnowledge SA and others; D Nicolle, Flinders University
- Orchidaceae (JZ Weber and RJ Bates, State Herbarium of SA; **M Clements** and **D Jones,** Australian National Herbarium; **SD Hopper** and **A Brown,** WA Conservation and Land Management).

Taxonomic expertise

The Biosystematics Research team of the State Herbarium is a group of taxonomic botanists who have considerable experience in undertaking taxonomic revisions of Australian plant groups. They have an often unique in-depth knowledge of the taxonomy, biology and ecological and geographical distribution across their specialist range of groups and have the capacity, as a result, to interpret available evidence in other groups.

Their studies have made and are making major advances in knowledge of the species and infraspecific variation of the groups they specialise in. Such work has been the result of:

- detailed examination of existing collections,
- directed field work across much of the range of the group,
- morphological study and analysis,
- development of new classifications reflecting evolutionary relationships.

Examples of advances that have been made are shown in Table 2.

Table 2. Examples of advances in knowledge of vascular plant groups revised taxonomically by botanists and research associates of the State Herbarium of South Australia. The increases in numbers of taxa from such long-term group-wide studies by members of State institutions in Australia and overseas is enormous and benefits all Australia.

Specialist taxonomist	Group	Range	Species and infraspecies before worker first published in group	New species or infraspecies in key publication if there was one	Species and infraspecies formally recognised in key publication, if there was one	Additional species and infraspecies (combinations) formally published after key work or, if no key work, now recognised	Additional species and infraspecies (combinations) to be described and named formally)	% overall change
Published revisions								
Barker R.M.	Acanthaceae	Australia	35	7	53	28	5	+145%
Chinnock R.J.	Myoporaceae	World	110	130	250	-	10	+136%
Barker R.M., Barker W.R. & Haegi L.	*Hakea* (Proteaceae)	Australia (world)	150	13	160	1	-	+7%
Kellerman J., et al.	Rhamnaceae	Australia	160		250	-	10	+162%
Barker W.R.	*Euphrasia* (Scrophulariaceae)	Australia	14	8	56	6	9	+407%
Symon D.E.	*Solanum* (Solanaceae)	Australia	79	14	94	2	-	+22%
Barker W.R.	Stackhousiaceae	World	18	1	15	28	10	+194%
Barker W.R.	Theaceae (excl. lowland *Eurya*)	New Guinea	22	18	31	-	-	+40%
Publication pending								
Toelken H.R.	*Hibbertia* (Dilleniaceae)	Eastern Australia	80		-	-	240	+200%
Barker R.M.	*Sida*, *Abutilon* (Malvaceae)	Australia	73		-	146	-	+100%
Barker W.R.	*Lindernia* (Scrophulariaceae)	Australia	9		-	20	36	+622%
Barker W.R.	*Mimulus* group (Scrophulariaceae)	Australia NZ	11		-	24	12	+227%
Barker W.R.	*Stemodia* (Scrophulariaceae)	Australia	9		-	12	13	+278%

Key groups

Taxonomic and phylogenetic expertise. We have a botanical staff with expertise in taxonomic principles and traditional morphological methodology to which has been added new expertise in molecular genetics and phylogenetic methodology. They are well-versed in the International Code of Botanical Nomenclature, taxonomic publication and phylogenetics.

Plant groups with associated taxonomic expertise are:

Vascular plants

- Acanthaceae (Robyn Barker)
- *Carpobrotus, Sarcozona* (Aizoaceae: Hellmut Toelken)
- Cactaceae (invasive, cultivated: Bob Chinnock)
- Celastraceae subfam. Stackhousioideae (Bill Barker)
- Chenopodiaceae (Bob Chinnock)
- *Crassula* (Crassulaceae: Hellmut Toelken)
- Cucurbitaceae (Hugh Cross)
- Gramineae (John Jessop)
- *Hibbertia* (Dilleniaceae: Hellmut Toelken)
- *Acacia* (Leguminosae: Martin O'Leary)
- Malvaceae (Robyn Barker, John Conran, Bill Barker)
- *Hakea* (Proteaceae: Robyn Barker, Bill Barker)

- Rhamnaceae (Juergen Kellermann, Bill Barker)
- *Rubus* and other naturalised Rosaceae (David Symon, Robyn Barker)
- Scrophulariaceae *s.lat.*, including *Eremophila, Myoporum, Mimulus, Lindernia, Josephinia, Stemodia, Euphrasia, Orobanche* (Bob Chinnock, Bill Barker)
- Solanaceae (David Symon, Robyn Barker)
- Zygophyllaceae (Robyn Barker)
- Pteridophyta (Bob Chinnock, Graham Bell)

Musci
- Bartramiaceae (Graham Bell)
- Pottiaceae (Graham Bell)

Macroalgae
- General taxonomy across the flora (Bryan Womersley, Gerry Kraft, Fred Gurgel)
- *Gracilariales* (Fred Gurgel)
- Tribes Griffithsieae and Bornetieae (Rhodophyta: Bob Baldock)

Macrofungi
- General taxonomy (Pam Catcheside)

Genetic expertise in:
- Population genetics, speciation and hybridisation, evolution and origin of weeds, molecular ecology (Andy Lowe)
- Marine plant phylogeography (Fred Gurgel)

Phylogenetic analysis & DNA analytical expertise in:
- Extracting and reconstituting fragmented DNA from sediments (Hugh Cross)
- General molecular analysis (Andy Lowe, Hugh Cross, Fred Gurgel, Juergen Kellermann)
- Cladistic techniques interpreting past climates or adaptive transformations (Hugh Cross, Fred Gurgel, Bill Barker, Juergen Kellermann)

Opportunities

The State Herbarium provides opportunities for undertaking taxonomic research on the Australian flora in its widest sense, incorporating:

- Morphological analysis
- Classical taxonomy, nomenclature and classification
- Historical biogeography and macroevolution
- Phylogenetics, character evolution and morpho-anatomical analysis
- Phylogeography and population genetics
- Climate and biodiversity changes
- Phylogenetic diversity and community phylogenetics

The State Herbarium is actively seeking opportunities to extend its research programme in three major areas:

- the Orchidaceae
- the macro fungi
- weeds and the naturalised flora

Orchidaceae

South Australia is currently investing much in the management of individual threatened orchid species. Nearly one hundred phrase names are listed currently by the State Herbarium under strict rules of deposition of a voucher specimen. However, these proposed new species or infraspecific taxa are urgently in need of measured evaluation through taxonomic revisional study. There is also a need to compare the genetic heterogeneity of orchid species and subspecies with that in other

plant, algal and fungal groups. There is a danger that the investment in orchids is out of balance with the proportion of the overall plant genetic diversity being conserved.

The taxonomy of the Orchidaceae in Australia is in a state of flux. Compounding the major advances in taxonomic knowledge in recent years has been controversy on the recognition of new genera and the recognition of species that might better be treated as part of the complexity of variation within an existing species. In 2002, the Council of Heads of Australasian Herbaria ran a workshop on developing standards for classification of the Australian orchids, but the momentum of change at the generic and species level has continued unchecked. Considering the diversity of the family in this State with so many new species proposed, and the investment by this State in conservation management of orchid species, including proposed new species, it is critical that the State Herbarium develop expertise in the family. New work on this group would service a revisional study of critical genera and generic groups and the progressive testing of newly proposed species, taking into account genetic diversity and principles used in the taxonomy of the flora in general.

Macro fungi

The fungi comprise the most diverse group of organisms in the South Australian and Australian flora. They have huge impact on the environment: truffles are a food source for small Australian mammals, many of which are classified as threatened; mycorrhiza are critical to nutrition of Australian plants, for example the orchids. There is also a strong public interest and not just on the question of edibility. We have a strong group of members of the public who are assisting Honorary Research Associate Pam Catcheside study fungi in her regular “fungal forays”, there are similar groups in other States, and there is a coordinated national *FungiMap* project arising from this interest. However, we have no long history of anecdotal evidence of poisonings to provide an authoritative list of edible species and without direct evidence of poisonings this is impossible to redress with our native fungi.

For all their importance in the natural and cultivated environment, fungi suffer from having the least number of taxonomists researching and documenting their diversity. Very few taxonomists are employed specifically in Australian herbaria (Tom May and Teresa Lebel, both at the National Herbarium of Victoria; Neale Bougher, based at WA Herbarium). Other taxonomists are employed voluntarily (Honorary Research Associate Pam Catcheside in the State Herbarium of South Australia; Heino Lepp at Australian National Herbarium and Tony Young in Queensland Herbarium) or with other duties (Nigel Fechner, Queensland Herbarium), while others deal with conservation or biological issues rather than taxonomic (e.g. the mycorrhizal research group at the Waite Institute, University of Adelaide; fire response by Richard Robinson at WA Department of Environment and Conservation).

The State Herbarium has an asset of national and global significance in the mycological herbarium collected by Professor Sir J.B. Cleland. Comprising about 16,000 specimens, it contains approximately 400 type specimens (the specimens to which the name of each of his more than 200 new species is permanently associated). Cleland’s major work “Mushrooms and Toadstools of South Australia”, and his many published papers, document new species not just in South Australia but elsewhere, particularly New South Wales. His collection was researched over a three year period in the 1990s by Cheryl Grgurinovic, culminating effectively in a second revised edition of the work, which included a number of new species. Grgurinovic also contributed to the re-organisation of this herbarium, which has proved invaluable for the international demand for loans to advance revisional studies in particular groups of fungi. This collection makes the State Herbarium the logical place in Australia to give impetus to fungal taxonomic research.

Weeds: the naturalised and potentially naturalised flora

The State’s flora is one third naturalised (i.e. non-native in origin). Many genera have multiple numbers of both natives and naturalised species. For example, a recent survey of *Erica* in the Mount Lofty Ranges, where it is a serious weed, extended the number of recognised species from four to almost 20. However, the State Herbarium collection, as a generalisation, is poorly represented by naturalised plants (weeds). The only groups well-represented have been the

subject of research in recent times and have benefited tremendously from focussed field work. Blackberry (*Rubus*) and the Cactaceae are two lone examples.

As a result of this, our knowledge of the taxonomy of our naturalised plants is probably at the same level as was the native flora at the time of the second edition of the Flora of South Australia, published in the 1950s. Since then the State Herbarium collection has grown from a few 10s of thousands of specimens to over 800,000 mainly South Australian collections.

There is a general attitude amongst practitioners in weed documentation, management, risk assessment, etc., that what is identified from current flora handbooks is adequately known taxonomically. This is a flawed view. Many introductions are garden plants, grown for aesthetic or food. The genetic and taxonomic relationships of cultivars are often complex and poorly researched. *Rubus* (blackberry) and Cactaceae are two examples where considerable work has been required to clarify exactly what we have in this State.

Revisional studies of groups of weeds in Australia will give a much-improved view of their taxonomy and identification, promoting better management. However good revisions need to be based on good collections and observations. South Australia's biosecurity is flawed if it does not establish a capacity to assess the taxonomy of new introductions to the State when establishing the nature of a new potential threat. The State Herbarium has promoted the need for taxonomic review as an important first step in the "diagnostic" process being established as part of the new Biosecurity Strategy for South Australia, currently being drafted. The branched broomrape (*Orobanche ramosa* subsp. *incert*.) has been the subject of a hugely expensive control programme. However, no effort has gone into an assessment of the genetic and taxonomic relationships of the South Australian populations with closely related species in Europe, the Middle East and other parts of the world where it has become naturalised, despite indications of taxonomic uncertainty.

Establishing the correct identity of invasives is important evidence for assessing the nature of the threat and the control methods that might be available or need to be researched. In the case of the work done by the State Herbarium on blackberry, huge changes were made to the classification and understanding of the taxonomy. These changes assisted in directing genetic studies and establishing a control programme using host-specific rust fungi.

The role of a weed taxonomist would need to be resourced not only to undertake taxonomic revisions of weed groups, but also to encourage collection of naturalised species to significantly expand the State Herbarium collection as a foundation for rapid assessment of new threats to the State. National projects such as Weed Spotters (CRC for Australian Weed Management, pilot study in Queensland Herbarium) and the AVH Weed Tracker (Council of Heads of Australasian Herbaria and CRC for Australian Weed Management), involve voucher herbarium specimens as authoritative evidence of the distribution of weeds.

Research Framework

In developing a strategic approach for science and research, we have reported our lines of business against four key research themes:

- **Systematics and bioidentity** – The use of classical and modern taxonomic tools to find out what types of plants, macrofungi and macroalgae occur in SA and where they are located in the land/seascapes. The State Herbarium provides taxonomic identification and survey services, and is developing DNA methodologies (e.g. DNA barcoding) to enable more rapid identification of morphologically compromised samples (i.e. forensic taxonomy).
- **Species and Populations** – Understanding the distribution of genetic variation across populations within species, used to understand the genetic health of species and population and promote conservation management options. This area of research involves

collecting detailed information on the size, distribution, abundance, growth, seasonality, birth rates and mortality in species and populations of marine and terrestrial plants. This work covers threatened and non-threatened native species, as well as exotic pests, including taxa that are likely to pose a biosecurity threat.

- **Biogeography and landscapes** – Biogeography is a broad field that seeks to explain the distribution of species in relation to environmental variation and historical dynamics. A change in the habitat connectivity of contemporary populations may lead to a change in gene flow dynamics and therefore the future survival of a species. Studies of classical biogeography, phytogeography, phylogeography and population genetics form the basis for this work in the State Herbarium.
- **Climate change.** This area of research includes biological and physical systems affected by the current concept and predictions of global climate change. In many ways climate change cuts across all of the above categories, although it is clear that specific action and planning now needs to be developed in order to start managing environmental assets in this direction appropriately. The need for a monitoring network to understand the changes that have happened in recent times and to track future changes is clear. In many cases predictive science and modelling are the only ways to gain early warning of potential future catastrophic impacts, including sea level rise and acidification, coastal and wetland inundation, species range shifts and changes to the ecology and interdependencies of species due to developmental shifts.

Research Infrastructure.

In-house

Facilities. The State Herbarium provides facilities for traditional taxonomic work as well as modern analytic methods servicing systematics research.

The State Herbarium collection: a resource for research on the Australian flora

The State Herbarium collection is housed in compactus and herbarium shelves spread over 5 vaults. Our ever-growing plant collection currently accommodates about 800,000 Higher Plants, 15,000 Ferns, 35,000 Bryophytes, 80,000 algae, 20,000 fungi and 16,000 lichens. The collection also includes some important historical collections from J.M. Black (terrestrial plants), J.B. Cleland (fungi and plants), H.B.S. Womersley (temperate Australian algae), D.G. Catcheside (mosses) and also includes some of the first specimens collected from the State by Robert Brown.

Our holdings encompass pressed dried specimens, spirit/wet (e.g. formalin, glycerine, alcohol, FAA), silica gel, and microscope-slide collections. Since 2001 our collection has been bar-coded, databased and is accessible via the web through the Australia's Virtual Herbarium and SA eFlora project portals (www.avh2.au and www.eflora.sa.gov.au, respectively). The vaults are specially constructed to minimise temperature extremes and insect attack and are provided with a state-of-art, environmentally friendly Inergen gas fire-suppression system. The collection is valued at $43 million.

Research equipment

A range of research equipment is available in our in-house laboratories: networked PC computers, a suite of analytical software, CO_2–freezing microtome, fume hoods, microscopes, histological kits, fan-assisted commercial-sized drying ovens, and walk-in decontamination freezer. Recently, the State Herbarium acquired a brand new state-of-the-art computer-assisted Nikon Image Treatment Digital Photo-Microscope System (image-analysis software included) and Electron Microscope (NeoScope).

Ancient DNA Lab

A specialized ancient DNA laboratory with positive air-pressure and UV light sterilization that is operated by to the Australian Centre for Ancient DNA (www.adelaide.edu.au/acad) is also housed

in the Plant Biodiversity Centre. The Ancient DNA Laboratory is a new research initiative between the University of Adelaide, Department for Environment and Heritage and the Board of the Botanic Gardens and State Herbarium aiming to study evolution and environmental change through time using preserved genetic records not only of plants but also human, animal and sedimentary material. Key interests include molecular studies of evolutionary processes in population genetics, phylogenetics and phylogeography, molecular clocks, and a variety of uses of temporally distributed DNA sequences. The facilities include freezer rooms, sample decontamination and preparation areas, and specialist still-air working areas for ancient human DNA, vertebrates and sedimentary and microbial DNA studies.

Library
The Botanic Gardens of Adelaide and State Herbarium Library represents approximately 145 years of development, though some of its material is much older than that. The first books to be purchased were bought by our first Directors, used as working tools, and subsequently lodged in the growing collection of works which was to become the Library proper. The Library now has roughly 24,000 individual items in its collection. The oldest volume in the collection was published in 1516 (a Greek herbal). The ABG/SH library collection is constantly acquiring new books and journals and currently receives about 300 individual journal titles either through subscription, donation or exchange with other institutions.

South Australian Plant Biodiversity Information System
Label data associated with the rich collections of the State Herbarium, the *Census of South Australian Plants, Algae and Fungi*, and the (Vascular) *Flora of South Australia* have been digitised and are progressively being made accessible for use in research and publications both within the State (via the Electronic Flora of South Australia website www.flora.sa.gov.au) and nationally (through *Australia's Virtual Herbarium* and the forthcoming *Atlas of Living Australia*) and ultimately, through these national systems, globally (the Global Biodiversity Information System and the Encyclopaedia of Life). Over one million dollars has been spent to date on digitising over 650,000 herbarium collections, focused on the vascular plants and the algae.

Opportunities for collaboration

The State Herbarium is located near the centre of Adelaide, close to a number of research-intensive institutions that house state-of-the-art laboratories and facilities such as:

- Adelaide Botanic Gardens: Seed bank. Seed physiology and plant tissue culture laboratories.
- Evolutionary Biology Unit (SA Museum/University of Adelaide): state-of-the-art molecular biology laboratories, through a collaborative partnership through the Australian Centre for Evolutionary Biology and Biodiversity and State Herbarium.
- SARDI - Aquatic Sciences (PIRSA, Primary Industries & Resources of SA): multi-aquaria facilities, growth chambers, boats, marine labs.
- Australian Genome Research Facility: automated high-throughput molecular and DNA sequencing facilities.
- University of Adelaide's Australian Centre for Plant Functional Genomics and Proteomics Centre: including state of the art facilities for analysing phenome variation, gene expression (e.g. micro-arrays) and protein variation.
- Adelaide Microscopy, the Centre for Electron Microscopy and Microstructure Analysis (CEMMSA): Scanning and transmitted electron microscopes, Confocal-Laser microscopes.

Research Expertise

A range of in-house staff undertake scientific activities to support South Australian and Australian environmental management decisions. The scope of our research includes classical taxonomy, molecular systematics, conservation biology, threatened species ecology, population demography, invasive and abundant species, seed biology, disturbance ecology, marine ecology, landscape modelling, restoration ecology and conservation planning.

Staff and Honorary Research Associates	Biosystematics (incl. morphological, molecular and nomenclatural studies	Barcoding	Species and populations (morphological and genetic variation)	Biogeography and landscapes	Climate Change
Baldock, Bob			✓		
Barker, W.R. (Bill)	✓		✓	✓	✓
Barker, Robyn	✓		✓	✓	✓
Bell, Graham	✓		✓		
Catcheside, Pam	✓		✓		
Chinnock, Bob	✓		✓	✓	
Cross, Hugh	✓	✓	✓	✓	✓
Gurgel, Fred	✓	✓	✓	✓	✓
Jessop, John	✓				
Kellermann, Juegen	✓	✓	✓	✓	
Kraft, Gerry	✓				
Lang, Peter	✓		✓	✓	
Lowe, Andrew	✓	✓	✓	✓	✓
O'Leary, Martin	✓			✓	
Symon, David	✓				
Toelken, Helmut	✓			✓	✓
Womersley, Bryan	✓				

Research in the State Herbarium is not confined to South Australia's borders. In particular, taxonomic studies in Australian plant groups are generally most productive when undertaken throughout the range of the group, many therefore entailing Australia-wide studies. Like their colleagues in other states, the State Herbarium's botanical staff adopts this approach for the majority of their work, creating a rich Australian collaboration in advancing knowledge of the State's plants. The 4th Edition of the *Flora of South Australia* (1986) indicates the benefits to the State of this approach: over 80 specialist systematists compiled this Flora: of these 24 were based in South Australia, 10 being staff or associates of the State Herbarium, while 51 were based in institutions elsewhere in Australia and 7 from overseas.

Research Highlights

Biosystematics

Fungi on Kangaroo Island. Pam Catcheside and David Catcheside (Flinders University) have been surveying the larger fungi in parks on Kangaroo Island since 2002. They have found Flinders Chase National Park to have the greatest number and most diverse fungi of any area so far surveyed in South Australia. Of particular note are the pretty little blue Pixie's Parasol *Mycena interrupta* (Fig. 1), at the western limits of its known range, and the tiny, almost subterranean, whitish-truffle-like *Torrendia arenaria* (Fig. 2), which has only been recorded previously in Western Australia. The number of fungi recorded each year continues to rise steadily (Fig. 3).

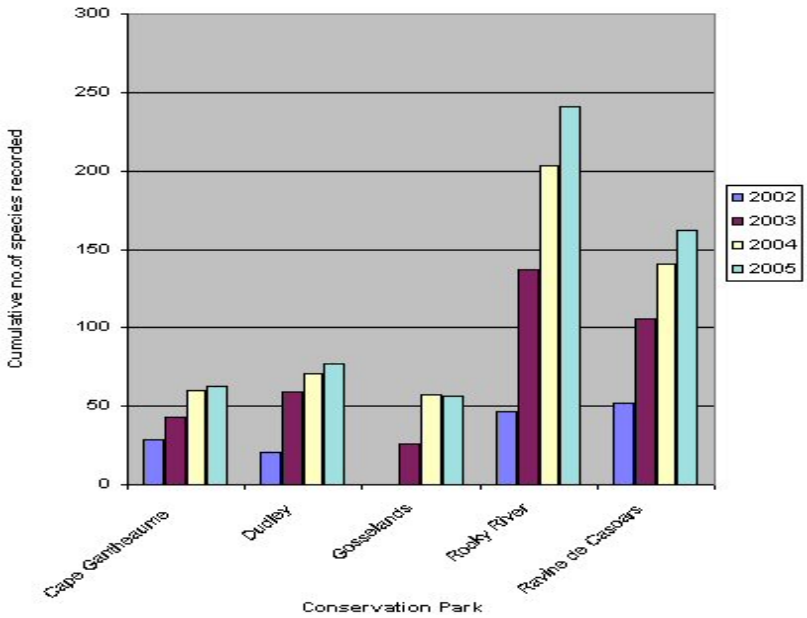

Fig 3. Pixie's Parasol *Mycena interrupta* (above left) and the whitish-truffle-like *Torrendia arenaria* (above right). Photos by David Catcheside. Chart (below) showing need for multiple surveys of fungi and the high diversity of fungi in Flinders Chase on the western end of Kangaroo Island (the last two Parks) compared with other Parks on the island (from Catcheside & Catcheside 2005).

DNA Barcoding Program

The State Herbarium of SA started its DNA barcode program in association with the Evolutionary Biology Unit, the University of Adelaide and South Australian Museum. A Lowe, H Cross and F Gurgel are engaged in building a molecular barcode dataset for Southern Australian plants and macroalgae. Potential markers have been selected and the production of DNA sequences have

started. Primary target groups include grasses (GrassBOL), trees (TreeBOL) and benthic brown algae (Fucales, Fig. 6). The macroalgal component also encompasses the flora of Australian coral reefs, in partnership with the Census of Coral Reefs (www.creefs.org).

Fig. 4-5. Example of SA Fucales being barcoded at the SHSA. Fig. 4. *Cystophora botryocystis*, Fig. 5. *Cystophora racemosa*.

Populations

Intraspecific genetic diversity of SA threatened species.

Andrew Lowe and Kym Ottewell (Postdoc, University of Adelaide), in conjunction with DEH's threatened flora ecologist, Doug Bickerton, are investigating the conservation genetics of rare and threatened South Australian plant species. The project encompasses 20 species from eight genera of 5 distinct families. Comparisons will be made with each species' common congeners in order to understand the genetic consequences of population size and isolation and thus help guide the State's threatened species management programs. Their research has found that low genetic diversity is not an explanation for the low levels of seed set in the Monarto population of *Prostanthera eurybioides* (Fig. 6 and 7), suggesting that seed set may be constrained by other factors such as resource and/or pollinator availability.

Fig. 5. Habitat of *Prostanthera eurybioides* in Monarto Reserve and plant habit.

Fig. 6. Details of flowers of *P. eurybioides*.

Climate Change

Climate change science cuts across several disciplines from genes to ecosystems, from deep sea to the highest mountains. Researchers at the SH are involved in several research projects aiming at predicting future patterns of marine and terrestrial plant distribution in Australia (biogeography) and testing the adaptation and change in plant systems due to climate change. This research includes leaderships and participations in two ARC-NZ Vegetation Function Network projects (working groups 58 and 54) and granted State and ARC Linkages.

Recent work by a PhD student, Fran MacGillivray, has examined the potential of the State's herbarium record to highlight flowering time shifts due to climatic changes. Work on a number of target orchid species, *Diuris*, has demonstrated a significant flowering time shift over the last 20 years, where, on average, plants are now flowering 20 days earlier than they used to (Figs 8 and 9).

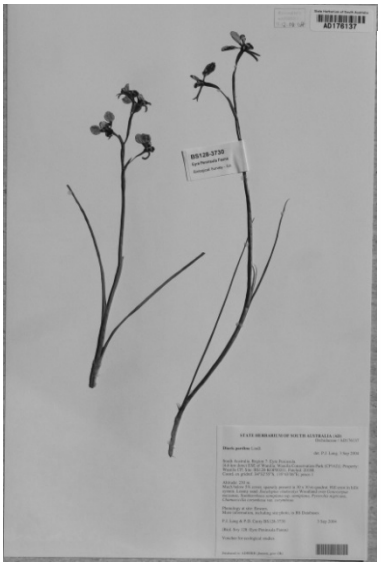

Fig. 8. Herbarium sheet of Diuris orchid

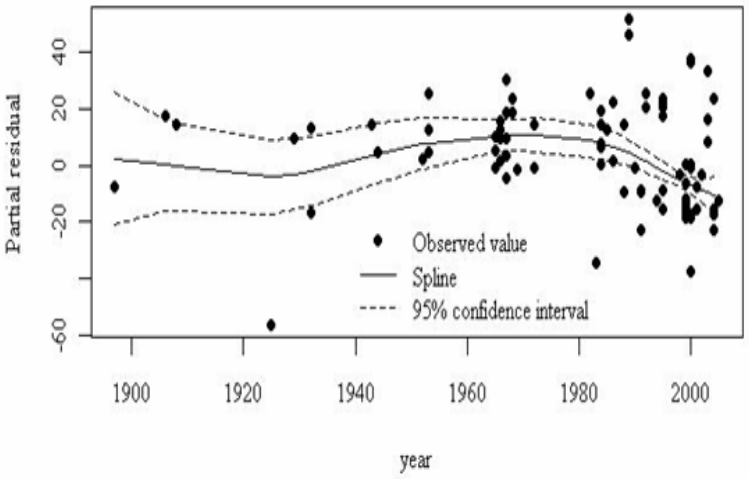

Fig. 9. Plot of change in flowering time over time from the herbarium record of Diuris

Staff Research Profiles (and recent selected publications)

Mr Bob Baldock - Honorary Research Associate. SA marine biology and ecology, marine benthic consultant, marine biological education Taxonomic expertise: SA marine flora, the tribes Griffithsieae and Bornetieae (Rhodophyta),

Baldock RN, Womersley HBS (2005) Marine benthic algae of the Althorpe Islands, South Australia. *Transactions Royal Society South Australia* 129(2): 116-127.

Baldock RN (2000-2008) Illustrated algal fact sheets for incorporation into the Australian Virtual Herbarium, Vols I-XVI.

Womersley HBS, **Baldock RN** (2003) The Encounter 2002 expedition to the Isles of St Francis, South Australia: Marine benthic algae. *Transactions Royal Society South Australia* 127(2): 141-151.

Dr William (Bill) Barker - Chief Botanist. Taxonomy, cladistics and biogeography of Australian flora with particular emphasis on the families traditionally known as Scrophulariaceae and Stackhousiaceae and the genera *Hakea* (Proteaceae: collaboratively), *Orobanche* (Orobanchaceae) and *Lawrencia* (Malvaceae). Development and management of institutional and national IT systems to serve herbarium collections, census and descriptive data and information (Electronic Flora of South Australia, Australia's Virtual Herbarium).

Barker WR (in press). The taxonomy of Subfamily Stackhousioideae (Celastraceae). I. A conspectus, keys, typifications, and progress towards a resolution of several species complexes. *Journal Adelaide Botanic Gardens*.

Beardsley PM, **Barker WR** (2005) Patterns of evolution in Australian *Mimulus* and related genera (Phrymaceae ~ Scrophulariaceae): a molecular phylogeny using chloroplast and nuclear sequence data. *Australian Systematic Botany* 18: 61–73

Mrs Robyn Barker – Honorary Research Associate/Senior Botanist (part-time). Systematics and biology of members of the families Acanthaceae, Zygophyllaceae and genera *Hakea* (Proteaceae), *Sida* and *Abutilon* (Malvaceae) and *Rubus* (Rosaceae) Australia-wide. Building Lucid keys (Solanaceae, Blackberry, *Hakea*). Information from and history of older herbarium specimens and their collectors. Maintenance of SA Census and information to be gained from it.

Caley P, Groves RH, **Barker RM** (2008) Estimating the invasion success of introduced plants. *Diversity and Distributions* 14(2): 196-203.

Barker RM (2007) The botanical legacy of 1802. South Australian plants collected by Robert Brown and Peter Good on Matthew Flinders *Investigator* and by the French scientists on Baudin's *Geographe* and *Naturaliste*. *Journal Adelaide Botanic Gardens* 21: 5- 44.

Barker RM (2007) Two newly described species and a draft key to the species of *Sida s.lat.* from Western Australia. *Nuytsia* 17: 13–30.

Mr Graham Bell – Senior Botanist. Primary research interest in bryophytes, particularly morphology and taxonomy of mosses of arid environments. Main group of interest is the moss family Pottiaceae and the genus *Bartramia* (Bartramiaceae). Secondary interests and curatorial involvement with lichens, fungi and pteridophytes.

Bell GH, Catcheside DG (2006a) Meesiaceae [Musci]. In: Flora of Australia 51: 182-6.

Bell GH, Catcheside DG (2006b) Aulacomniaceae [Musci]. In: Flora of Australia 51: 245-7.

Bell GH (2006) *Bartramia* [Musci]. In: Flora of Australia 51: 249-56.

Mrs. Pamela Catcheside – Honorary Research Associate. Current research on macrofungi, their taxonomy/ecology, habitat, phenology and their interactions with other organisms and their habitats. Major taxonomic interests: Ascomycetes, truffles (both ascomycete and basidiomycete) and desert fungi.

Catcheside PS, Catcheside DEA (2006) *The Macrofungi of South Australia, 2005*. Report on project supported by a grant from the Wildlife Conservation Fund in 2005. 178 pp

Catcheside, PS (2006) Eucalyptus or Guava rust, *Puccinia psidii* – a serious threat to our forests and plantations. *Australian Systematic Botany Society Newsletter*, 127:2-4.

Catcheside PS, Catcheside DEA (2005) Surveys of Fungi in South Australia. *Australian Plant Conservation*. Vol.14, Number 1, June-August 2005, p 6-7.

Dr Robert (Bob) Chinnock – Honorary Research Associate. *Eremophila* complex and its relationship to the environment (e.g. ecology, fire response, reproduction, pollination biology, etc). The SA weedy Cactaceae: their biology, dispersal methods and control.

Chinnock RJ (2007) *Eremophila tietkensii* F. Muell & Tate, a misinterpreted species. *Journal of the Adelaide Botanic Gardens* 21: 1-3.

Chinnock RJ (1996) To the limits of *Disphyma* and beyond. *Aloe* 32 (2 & 3): 59-61.

Richmond, GS & **Chinnock RJ** (1994) Seed germination of the Australian desert shrub *Eremophila* (Myoporaceae). *Botanical Review* 60: 483-503.

Dr Hugh Cross. Molecular Biologist. Plant molecular biology and systematics, evolution and biogeography of the Cucurbitaceae, ancient DNA, paleoecology, Historical DNA from museum and herbarium specimens, ecology and evolution of invasive species of fungi (*Amanita* spp.).

van Geel B, Aptroot A, Baittinger C, Birks HH, Bull ID, Kompanje EJO, **Cross HB**, Evershed RP, Gravendeel B, Kuperus P, Nierop KGJ, Mol D, Pals JP, Tikhonov AN, van Reenen G, van Tienderen PH (2008) The ecological implications of a Yakutian mammoth's last meal. *Quaternary Research* 69: 361-376

Erkens RHJ, **Cross HB,** Maas JW, Hoenselaar K, Chartrou LW (2008) Assessment of age and greenness of herbarium specimens as predictor for successful extraction and amplification of DNA. *Blumea*, IN PRESS.

Cross HB, Lira Saade R, Motley TJ (2006) Origin and Genetic Diversity in Chayote. pp. 171-194 In: *Darwin's Harvest : New Approaches to the Origins, Evolution, and Conservation of Crops* (Motley, Zerega, and **Cross** eds.). Columbia University Press.

Dr Frederico Gurgel - Botanist. Taxonomy, biogeography, molecular systematics and molecular ecology of marine macroalgae.

Gurgel CFD, Fredericq S, Norris JN, Yoneshigue-Valentin Y (2008) Two new flat species of *Gracilaria* (Gracilariales, Rhodophyta) from Brazil: *G. abyssalis* sp. nov. and *G. brasiliensis* sp. nov. *Phycologia* 47:249-264.

Gurgel CFD, Fredericq S, Norris JN (2004) Phylogeography of *Gracilaria tikvahiae* (Gracilariaceae, Rhodophyta): a study of genetic discontinuity in a continuously distributed species. *Journal of Phycology* 40:748-758.

Gurgel CFD, Fredericq S, Norris JN (2004). Molecular systematics and taxonomy of flattened species of *Gracilaria* Greville (Gracilariaceae, Gracilariales, Rhodophyta) from the Western Atlantic. In: Abbott, I. A. & McDermid, K. J. (Eds.), Taxonomy of Economic Seaweeds, with Reference to the Pacific and other Locations. Vol. IX, pp. 159-199. Honolulu: University of Hawaii Sea Grant College Program.

Dr John Jessop - Honorary Research Associate. Principal research interests in monocot groups, especially grasses, and significant involvement with flora treatments and plant censuses.

Barker WR, Barker RM, **Jessop JP,** Vonow HP (2005). *Census of South Australian Vascular Plants*. (Ed. 5). *Journal Adelaide Botanic Gardens, Supplement* 1: 1-396.

Dashorst GRM and **Jessop JP** (2006) Plants of the Adelaide Plains and Hills (3rd edition). 224 pp. Board of the Botanic Gardens and State Herbarium, Adelaide.

Jessop JP, Dashorst GRM and James FM (2006) Grasses of South Australia. An illustrated guide to the native and naturalised species. 554 pp. Wakefield Press, Kent Town.

Dr Jürgen Kellermann – Senior Botanist, Flora of SA Coordinator. Research focused on the taxonomy and nomenclature of vascular plants, in particular of the family Rhamnaceae, the relationships of the Australian endemic species with plants from other regions and establishing whether there is a Gondwanan connection to New Zealand and South America. These questions

are approached with both morphological and molecular methods in collaboration with colleagues from Australia and overseas. Current research projects include the preparation of the *Flora of Australia* treatment for Rhamnaceae, and the revision of several families for the *Flora of South Australia* and the *Flora of Tasmania*. Secondary interest in the history of Botany.

Kellermann J, Rye BL, Thiele KR (2006) *Polianthion*, a new genus of Rhamnaceae (Pomaderreae) from Western Australia and Queensland. *Australian Systematic Botany* 19: 169-181.

Kellermann J, Udovicic F, Ladiges PY (2005) Phylogenetic analysis and generic limits of the tribe Pomaderreae (Rhamnaceae) using internal transcribed spacer DNA sequences. *Taxon* 54: 619-631.

Aagesen L, Medan D, **Kellermann J**, Hilger HH (2005) Phylogeny of the tribe Colletieae (Rhamnaceae) – a sensitivity analysis of the plastid region *trn*L-*trn*F combined with morphology. *Plant Systematics and Evolution* 250: 197-214.

Dr Gerry Kraft - Honorary Research Associate. Taxonomy and biogeography of marine macroalgae, worldwide.

Kraft GT (2007) Algae of Australia. Marine Benthic Algae of the Lord Howe Island and the Southern Great Barrier Reef. 1. Green Algae. CSIRO Publishing, Collingwood, Victoria, Australia. 347 pp.

Prof Andrew Lowe - Head of Science. Plant ecological and evolutionary genetics, conservation genetics, molecular ecology and systematics. Micro-evolutionary consequences of hybridization between introduced weeds and natives species. Influence of gene flow and selection pressure changes across a range of fragmented and human-impacted landscapes. Application of molecular markers, spatial modelling and genomic assessments of adaptive genes to answer how do plants survive and adapt to anthropomorphized landscapes.

Prentis P, Dormontt E, Wilson A, Richardson D, **Lowe AJ** (2008) Genetic and epigenetic correlations of invasion. *Trends in Plant Sciences.* Accepted.

Bacles CFE, **Lowe AJ**, Ennos RA (2006) Seed dispersal across a fragmented landscape. *Science* 311: 628.

Lowe AJ, Harris SA, Ashton P (2004). *Ecological Genetics: Design, Analysis and Application*. Blackwells, Oxford. 326 pp.

Mr. Martin O'Leary - Senior Technical Officer. Taxonomy, phylogenetics, biogeography, biology, cultivation and ethnobotany in general, with particular emphasis on the genus *Acacia* and the family Myrtaceae. Rare and endangered species and their propagation through seed germination, cuttings and tissue culture. Community engagement and education.

O'Leary MC (2008) A new subspecies of *Acacia beckleri* from the Flinders Ranges, South Australia. (Leguminosae: Mimosoideae). *Journal of the Adelaide Botanic Gardens* 22: Accepted.

O'Leary MC (2007) Review of *Acacia retinodes* and closely related species*, A. uncifolia* and *A. provincialis* (Leguminosae: Mimosoideae: sect. Phyllodineae), a new species from Eyre Peninsula, South Australia. *Journal of the Adelaide Botanic Gardens* 21: 95-109.

O'Leary MC (2002) *Acacia toondulya* (Leguminosae: Mimosoideae: sect. Phyllodineae), a new species from Eyre Peninsula, South Australia. *Journal of the Adelaide Botanic Gardens* 20: 17-20.

Dr David Symon - Honorary Research Associate. Taxonomy of the Australian flora with particular emphasis on the families Rosaceae and Solanaceae, systematics and organismal biology of the genus *Rubus*, an account of the botanical legacy of J. Ednie-Brown, an account of *Dracaena draco* in Adelaide and the anthology of the Flora of Australia in verse.

Evans KE, **Symon DE**, Whalen MA, Hosking JR, Barker RM & Oliver, JA (2007). Systematics of the *Rubus fruticosus* aggregate (Rosaceae) and other exotic *Rubus* taxa in Australia. *Australian Systematic Botany* 20:1-66.

Symon DE, Jusaitis M (2007) Sturt Pea, a most splendid plant. 151 pp. Board of the Adelaide Botanic Gardens and State Herbarium.

Brennan K, Martine C, **Symon DE** (2006) Solanum sejunctum (Solanaceae) a new dioecious species from Kakadu National Park, Northern Territory, Australia. The Beagle 22:1-7.

Dr Hellmut Toelken – Honorary Research Associate. Taxonomy, systematics and biology of: *Kunzea* (Myrtaceae), eastern Australian species of *Hibbertia* (Dilleniaceae), Crassulaceae specifically *Crassula, Carpobrotus* and *Sarcozona* (Aizoaceae).

de Lange PJ, Datson PM, Murray BG, **Toelken HR** (2005) Hybridism in the *Kunzea ericoides* complex (Myrtaceae): an analysis of artificial crosses. *Australian Systematic Botany* 18: 117-131.

Toelken HR (2002) Notes on *Hibbertia* (Dilleniaceae). 4. The identity of *H. enervia*. *Journal of the Adelaide Botanic Gardens* 20: 1-4.

Toelken HR (2000) Notes on *Hibbertia*. 3. *H. sericea* and associated species. *Journal of the Adelaide Botanic Gardens* 19: 1-54.

Prof Bryan Womersley - Honorary Research Associate. Taxonomy and biogeography of marine macroalgae, with emphasis on Australian taxa.

Womersley HBS (1983, 1987, 1991, 1994, 1998, 2003). The Marine Benthic Flora of Southern Australia Series. Parts I, II, IIIA, IIIB, IIIC, IIID.

Research projects and participants

Barker RM 1999, 2004 ABRS: Solanaceae of Australia (completion of Lucid key) – for projection on the flora.sa.gov.au website.

Barker RM 2006-2007. ABRS: *Hakea* (Proteaceae) (completion of Lucid key) – for projection on the flora.sa.gov.au website.

Barker RM 2006-8. Flora treatment of *Sida* and *Abutilon* for the Darwin region (in ms)

Barker RM 2007. Correction of *Flora of Australia* Zygophyllaceae ms – edited by ABRS. The original work which produced the flora of Australia ms was funded by ABRS in 1995 and for 3 months in 1997.

Barker RM 1986-ongoing. Continuing updating of *Flora of Australia* Acanthaceae ms with new records for Australia, as required

Barker RM 2007-ongoing. Provision of species lists for research groups for the Australian Plant Census

Barker RM Ongoing. Preparation of historical papers on Ednie Brown (with **David Symon**), Ellis Rowan and Robert Brown specimens in AD.

Barker WR. Ongoing. The taxonomy of Euphrasia (Scrophulariaceae) in Australia.

Barker WR. Ongoing. A taxonomic revision of Euphrasia (Scrophulariaceae) in Australia. (New Zealand Foundation for Research, Science and Technology grant for completion in 2009).

Barker WR. Ongoing. Taxonomy, evolution and biogeography of the Stackhousiaceae.

Barker WR. Ongoing. Taxonomy, evolution and biogeography of *Mimulus* and allied genera.

D. Estes, **Barker WR**. 2005 – ongoing. A taxonomic revision of *Gratiola*.

Barker WR. Ongoing. Taxonomy, evolution and biogeography of Lindernia.

Barker WR. Ongoing. A revision of the Lawrencia glomerata complex (Malvaceae).

Barker WR. Ongoing. A taxonomic revision of Lasiopetalum schulzenii complex (Malvaceae).

Barker WR. Ongoing. A taxonomic review of Orobanche in Australia.

Bell G Ongoing. (ABRS Participatory Program Grants Scheme). Taxonomic treatments of Australian genera in the family Pottiaceae.

Bell G Ongoing. Revisional study of the genus *Bartramia* (Bartramiaceae: Musci) in Australia.

Catcheside PS On-going. The truffles of South Australia; Conservation Status of fungal taxa; arid land fungi; new fungal species; interactions of fungi and invertebrates; fungi and fire.

Catcheside PS On-going. The genus *Cribbea* in Australia. With Dr Teresa Lebel, National Herbarium, Melbourne.

Catcheside PS (Wildlife Conservation Fund, Native Vegetation Council) 2008. Fungimap: a project to survey the larger fungi in Flinders Chase National Park and Kangaroo Island, SA.

Marty O'Leary. On-going. Australian *Acacia* spp.

Chinnock RJ On-going. Myoporaceae: Preparation of description of post monograph new species.

Chinnock RJ On-going. Flora treatment of Cactaceae for South Australia

Chinnock RJ On-going. Booklet for field identification of *Opuntia, Cylindropuntia* and *Austrocylindropuntia*.

Cross HB (DEH, State Herbarium, Australian Centre for Ancient DNA, ACAD). Ancient DNA from hull timber of the 16th century warship the *Mary Rose*.

Cross HB (DEH, State Herbarium, Australian Centre for Plant Functional Genomics, ACPFG and ACAD). Adaptation, evolution, and paleogenomics of native Australian grasses.

Cross HB (DEH, State Herbarium, ACPFG). DNA barcoding of native Australian grasses.

Cross HB TreeBOL: DNA barcoding of Australia's trees.

Gurgel F (DEH and the Field Naturalists Society of South Australia Inc./ Lirabenda Endowment Fund) 2008-2009. DNA Barcode of selected SA marine benthic algae.

Gurgel F (CReefs - Census of Coral Reefs Life, www.creefs.org) 2008-2010. Survey of marine algal flora of Australian coral reefs using a DNA barcoding approach.

Gurgel F (Alinytjara Wilurara NRM Board) 2008. *Sargassum* spp. and associated flora from the Great Australian Bight.

Gurgel F (ARC Linkage Grant) 2008-2010. Forecasting Change in Intertidal Habitats: Connecting Local Pollution with Global Climate Change in Temperate Australia. In collaboration with Drs. Connell SD & Russell B (University of Adelaide).

Kellermann J (Australian Biological Resources Study, ABRS) 2005-2007. Resolution of generic limits in Rhamnaceae and revision of the family in Australia; treatments of Rhamnaceae for *Flora of Australia*. In collaboration with Drs KR Thiele & BL Rye (Western Australian Herbarium), Udovicic F & Walsh NG (National Herbarium of Victoria).

Kellermann J (DEH Operating Budget) 2007. Editing & coordinating the new (5th) edition of the "Flora of South Australia".

Kellermann J (DEH Operating Budget) 2007. Editing the annual "Journal of the Adelaide Botanic Gardens".

Kellermann J (DEH Operating Budget) 2007. Preparation of flora-accounts for the "Flora of South Australia" for a variety of families (e.g. Rhamnaceae, Boraginaceae, Leguminosae-Caesalpinioideae).

Lowe AJ (ARC Environmental Futures Network) 2007-2009. Habitat reconstruction and restoration: securing biodiversity assets in the face of climate change. In collaboration with Drs. Paton D & Hill R (University of Adelaide).

Ottewell K, Bickerton D, **Lowe AJ** (DEH) 2007-2008. Genetic delimitation and health assessment of threatened flora.

Lowe AJ, Keppel G (Australian and Pacific Science Foundation) 2007-2010. Genetic dynamics of lowland rainforest trees on islands in the tropical Southwest Pacific

Lowe AJ (Working for Water Programme, South African Government) 2007-On-going. Research for integrated management of invasive alien species: using genetic techniques to improve understanding and management of invasive alien plant species in South Africa. In collaboration with Drs. Richardson DM, Wilson JR, Hedderson TAJ, Hoffman JH, Sheppard AW, Witt ABR, Foxcroft LC

Lowe AJ (ARC Discovery) 2006-2010. Why do some exotics become invasive? Using ecological and genomic approaches to test alternative hypotheses in an Australian weed, fireweed. In collaboration with Drs Clarke AR, Schenk PM, Rieseberg LH, Abbott RJ.

Lowe AJ (ARC Discovery) 2006-2010. Developing biogeographic know-how: Improving species divergence and dispersal estimations to examine geological and climatic evolutionary drivers. In collaboration with Drs Rossetto M, Crayne D, Pole M, Lambert D, Hollingsworth P.

Lowe AJ (EU) 2005-2009. Developing best practice for seed sourcing for planting and natural regeneration in the neotropics, **SEEDSOURCE**. In collaboration with Drs Boshier D, Kremer A, Degen B, Finegan B, Vendremin G, Gribel R, Margis R, Navarrete H, Dick C, Parolin P.

Toelken HR On-going. Finalise revision of genus *Kunzea* (Myrtaceae).

Toelken HR On-going. Finalise description of *Crassula* species and prepare manuscript for Flora of Australia.

Toelken HR On-going. Complete revision of *Hibbertia* in eastern Australia.

Students

Honours

Veronika Bandara (2007-2008, Flinders University). Yellow staining mushrooms in the Agaricus xanthodermus (Agaricaceae) complex in South Australia. Advisor/co-advisor: **Catcheside P**

Chris Spain (2005-2006, University of Queensland). The impacts of sub-tropical rainforest fragmentation on *Macadamia tetraphylla* populations at the genetic and habitat scales. Advisor/co-advisor: **Lowe AJ**

PhD

Rainbo Dixon (2008-2010, Murdoch University). The marine flora of Ningaloo Reef with emphasis on the systematics of the genus Sargassum (Phaeophyceae). Co-advisor: **Gurgel CFD**

Greg Guerin (2002-2007, University of Adelaide). Systematics of Hemigenia and Microcorys (Lamiaceae). Advisor/co-advisor: **Barker WR**

Margaret Heslewood (2006-2009, University of Adelaide). Biogeography of the Cunoniaceae. Advisor/co-advisor: **Lowe AJ**

Craig Costion (2008-ongoing, University of Adelaide). The great Australasian floral interchange: developing novel phylogenetic methods for biogeography and conservation. Advisor/co-advisor: **Lowe AJ**

Jolene Scoble (2008-ongoing, University of Adelaide). Novel approaches for assessing historical and contemporary vegetation condition in Australian rangelands. Advisor/co-advisor: **Lowe AJ**.

Fran MacGilvary (2008-ongoing, University of Adelaide). Tracking phonological shifts and evolutionary impacts due to climate change. Advisor/co-advisor: **Lowe AJ**.

Rohan Melick (2008-ongoing, University of Adelaide). Investigating the influence of past climate change on the distribution of Podocarpus: Evidence from fossil and molecular data. Advisor/co-advisor: **Lowe AJ**.

Margaret Heslewood (2007-ongoing, University of Adelaide). Phylogeography and biogeography of genera in the family Cunoniaceae in Australia. Advisor/co-advisor: **Lowe AJ**.

Ellie Dormontt (2007-ongoing, University of Adelaide). Why do only some exotics become inasive? Combining ecological and genomic approaches t oaddress alternative hypotheses in a recent Australian weed. Advisor/co-advisor: **Lowe AJ**.

David Pavlacky (2003-2008, University of Queensland) Avian patch occupancy and historic population dynamics of logrunners (Orthonyx temminckii) in heterogeneous subtropical rainforests of Australia. Advisor/co-advisor: **Lowe AJ**.

Gunnar Keppel (2004-ongoing, University of Queensland) Rarity, ecology and biogeography of lowland tropical rainforest along a natural diversity gradient in the Southwest Pacific. Advisor/co-advisor: **Lowe AJ**.

Adam Dinsdale (2005-ongoing, University of Queensland) Phylogeography and landscape genetics of whitefly. Advisor/co-advisor: **Lowe AJ**.

James Hereward (2006-ongoing, University of Queensland) Host association, coevolution and gene flow in mirids. Advisor/co-advisor: **Lowe AJ**.

Jessie Wells (2001-ongoing, University of Queensland) Spatial ecology of plant regeneration in secondary rainforests of the wet tropics. Advisor/co-advisor: **Lowe AJ**.

Postdoctoral and Visiting Academics

Dr Kym Ottewell (2008-2009, DEH grant). Genetic delimitation and health assessment of threatened flora. Supervisor: **Lowe AJ**.

Dr Mike Gardner (2006-2010). Developing best practice for seed sourcing for planting and natural regeneration in the tropics. Supervisor: **Lowe AJ**.

Dr Peter Prentis (2005-2010; SET, QNRM&W and ARC discovery). Why do some exotics become invasive? Using ecological and genomic approaches to test alternative hypotheses in an Australian weed. Supervisor: **Lowe AJ**.

Dr Ed Biffin (2007-2010, ARC discovery). Developing biogeographic know-how: Improving species divergence and dispersal estimations to examine geological and climatic evolutionary drivers. Supervisor: **Lowe AJ**.

Dr Sam Davies (2007, EU grant - SEEDSOURCE). Developing best practice for seed sourcing for planting and natural regeneration in the neotropics. Supervisor: **Lowe AJ**.

Dr Trish McCelland (2006, Royal Society of New Zealand Marsden grant). Does gene flow limit species' ranges? Supervisor: **Lowe AJ**.

Ms Sam Davies (2006, EU grant - SEEDSOURCE). Developing best practice for seed sourcing for planting and natural regeneration in the neotropics. Supervisor: **Lowe AJ**.

Ms Heidy Villalobos (2005 & 2007, Costa Rican government). Population genetics of neotropical trees. Supervisor: **Lowe AJ**..

Dr Ming Kang (2006-2007, Chinese Academy of Sciences Fellowship). Testing the role of genetic factors across multiple independent invasions of the shrub Scotch broom (*Cytisus scoparius*). Supervisor: **Lowe AJ**.

Dr Carlos Navarro (2005 & 2007, visiting scientist from Costa Rica). Developing best practice for seed sourcing for planting and natural regeneration in the neotropics. Supervisor: **Lowe AJ**.

Dr Cecile Bacles (2005-2006, EU Marie Curie Fellowship). Ecological Genomics of Sub-tropical Eucalypt Woodlands: Comparing the Structure and Dynamics of Neutral and Adaptive Genes across a Sharp Environmental Cline in Queensland Eucalyptus. Supervisor: **Lowe AJ**.

Publications (2003-present)

Refereed/peer-reviewed journals

Aagesen L, Medan D, **Kellermann J**, Hilger HH (2005) Phylogeny of the tribe Colletieae (Rhamnaceae) – a sensitivity analysis of the plastid region *trn*L-*trn*F combined with morphology. *Plant Systematics and Evolution* 250: 197–214.

Abbott RJ, **Lowe AJ** (2004) Origins, establishment and evolution of two new polyploid species of Senecio in the British Isles. *Biological Journal of the Linnean Society*. 82: 467-474.

Bacles CFE, Burczyk J, **Lowe AJ**, Ennos RA (2005) Historical and contemporary mating patterns in remnant populations of the forest tree *Fraxinus excelsior* L. *Evolution* 59: 979-990.

Bacles CFE, **Lowe AJ**, Ennos RA (2004) Genetic effects of chronic habitat fragmentation on tree species: the case of *Sorbus aucuparia* in a deforested Scottish landscape. *Molecular Ecology* 13:573-584.

Bacles CFE, **Lowe AJ**, Ennos RA (2006) Seed dispersal across a fragmented landscape. *Science* 311: 628.

Barker RM, Conran JG (2007). *Malva preissiana* Miq., an overlooked name for *Lavatera plebeia* Sims (Malvaceae), with a note on variation within the species. *Journal Adelaide Botanic Gardens* 21: 71- 72.

Barker RM, George AS (2007). *Calycopleplus* (Euphorbiaceae) not in South Australia. *Journal Adelaide Botanic Gardens* 21: 73 – 74.

Barker RM (2007). The botanical legacy of 1802. South Australian plants collected by Robert Brown and Peter Good on Matthew Flinders *Investigator* and by the French scientists on Baudin's *Geographe* and *Naturaliste*. *Journal Adelaide Botanic Gardens* 21: 5- 44.

Barker RM (2007). Two newly described species and a draft key to the species of *Sida s.lat.* from Western Australia. *Nuytsia* 17 : 13–30.

Barker WR (2007) *Stackhousia subterranea*, a new name and revised circumscription for *S. gunnii* Hook.f. (Stackhousiaceae-Celastraceae). *Journal of the Adelaide Botanic Gardens* 21: 90-91.

Beardsley PM, **Barker WR** (2004) Patterns of evolution in Australian *Mimulus* and related genera (Phrymaceae~Scrophulariaceae): a molecular phylogeny using chloroplast and nuclear sequence data. *Australian Systematic Botany* 18(1) 61–73.

Caley P, Groves RH, **Barker RM** (2008). Estimating the invasion success of introduced plants. *Diversity and Distributions* 14(2): 196-203.

Cavers S, Degen B, Caron H, Hardy O, Lemes M, Gribel R, Margis R, Salgueiro F, **Lowe AJ** (2005) Optimal sampling strategy for estimation of spatial genetic structure in tree populations. *Heredity* 95: 281-289.

Cavers S, Navarro C, Hopkins P, Ennos RA, **Lowe AJ** (2005) Regional and population-scale influences on genetic diversity partitioning within Costa Rican populations of the pioneer tree *Vochysia ferruginea* Mart. *Silvae Genetica* 54: 258-264.

Cavers S, Navarro C, **Lowe AJ** (2003) A combination of molecular markers (cpDNA PCR-RFLP, AFLP) identifies evolutionarily significant units in *Cedrela odorata* L. (Meliaceae) in Costa Rica. *Conservation Genetics* 4:571-580.

Cavers S, Navarro C, **Lowe AJ** (2003) Chloroplast DNA phylogeography reveals colonisation history of a Neotropical tree, *Cedrela odorata* L., in Mesoamerica. *Molecular Ecology* 12:1451-1460.

Cavers S, Navarro C, **Lowe AJ** (2004) Targeting genetic resource conservation in widespread species: a case study of Cedrela odorata L. *Forest Ecology and Management*. 197:285-294.

Chinnock R (2007) *Eremophila tietkensii* F. Muell & Tate, a misinterpreted species. *Journal Adelaide Botanic Gardens* 21: 1-3.

Colpaert N, Cavers S, Bandou E, Caron H, Gheysen G, **Lowe AJ** (2005) Sampling tissue for DNA analysis of trees: trunk cambium as an alternative to canopy leaves. *Silvae Genetica* 54: 265-269.

Cottrell JE, Munro RC, Tabbener HE, Milner AD, Forrest GI, **Lowe AJ** (2003) Comparison of fine-scale genetic structure within two British oakwoods using microsatellites; consequences of recolonsiation dynamics and past management. *Forest Ecology and Management* 176:287-303.

Davies S, White A, **Lowe AJ** (2004) An investigation into effects of long-distance seed dispersal on organelle population genetic structure and colonization rate: a model analysis. *Heredity*. 93:566-576.

Erkens RHJ, **Cross HB,** Maas JW, Hoenselaar K, Chartrou LW (2008) Assessment of age and greenness of herbarium specimens as predictor for successful extraction and amplification of DNA. *Blumea*, IN PRESS.

Evans KE, **Symon DE**, Whalen MA, Hosking JR, **Barker RM**, Oliver JA (2007). Systematics of the *Rubus fruticosus* aggregate (Rosaceae) and other exotic *Rubus* taxa in Australia. *Australian Systematic Botany* 20: 187-251.

Fuji MT, Guimarães SMPB, **Gurgel CFD**, Fredericq S (2006) Characterization and phylogenetic affinities of the red alga *Chondrophycus flagellifera* (Rhodomelaceae, Ceramiales) from Brazil based on morphological and molecular evidence. *Phycologia* 45: 432-441.

George AS, **Barker RM** (2007). *Hakea chromatropa* (Proteaceae: Grevilleoideae), an apparently rare new species from Western Australia. *Nuytsia* 17: 159–164.

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Gurgel CFD, Fredericq S, Norris JN (2004) *Gracilaria flabelliformis* and *G. apiculata* (Gracilariaceae, Rhodophyta): restoring old names for common tropical Western Atlantic species, including the recognition of three new subspecies, and a replacement name for "*G. lacinulata.*" *Cryptogamie Algologie* 25: 367-396.

Gurgel CFD, Liao LM, Fredericq S, Hommersand MH (2003) Systematics of *Gracilariopsis* (Gracilariaceae, Rhodophyta) based on morphological and molecular evidence. *Journal of Phycology* 39: 154-171.

Hannan-Jones MA, **Lowe AJ**, Scott KD, Graham GC, Playford JP, Zalucki MP (2005) Isolation and characterisation of microsatellite loci from mother-of-millions, *Bryophyllum delagoense* (Crassulaceae), and its hybrid with *B. daigremontianum* "Houghton's hybrid". *Molecular Ecology Notes* 5: 770-773.

Hardner C, Peace C, **Lowe AJ,** Neal J, Pisanu P, Powell M, Schmidt A, Spain C, Williams K. (2008) Genetic Resources and Domestication of *Macadamia*. *Horticultural Reviews*

Jensen JS, Olrik DC, Siegismund HR, **Lowe AJ** (2003) Population genetics and spatial autocorrelation in an unmanaged stand of *Quercus petraea* (Matt.) Liebl. in Denmark. *Scandinavia Journal of Forestry* 18:295-304.

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Kang M, Xu F, **Lowe AJ**, Huang H (2007) Protecting evolutionary significant units for the remnant populations of *Berchemiella wilsonii var. pubipetiolata* (Rhamnaceae). *Conservation Genetics* 8: 465-473.

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Kellermann J, Thiele KR (2008) Lectotypifications and nomenclaturial notes on Rhamnaceae from northern Australia. *Journal of the Adelaide Botanic Gardens*: IN PRESS.

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Kellermann J (2004) Robert Brown's contributions to Rhamnaceae systematics. *Telopea* 10: 515–524. [Proceedings of the *Robert Brown 200* conference, Sydney].

Kellermann J (2006) A range extension for *Cryptandra pogonoloba* (Rhamnaceae: Pomaderreae) and recognition of a new subspecies. *Muelleria* 24: 45–50.

Kellermann J (2006) *Cryptandra triplex* K.R.Thiele ex Kellermann, a new species of Rhamnaceae (Pomaderreae) from Arnhem Land, Northern Territory. *Austrobaileya* 7: 299–303.

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Kellermann J (2007) Re-instatement of *Spyridium waterhousei* from Kangaroo Island, South Australia, with a short history of the tribe Pomaderreae (Rhamnaceae). *Journal of the Adelaide Botanic Gardens* 21: 55–62.

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Kellermann J, Rye BL, Thiele KR (2007) *Blackallia*, *Serichonus* and *Papistylus*: three closely related genera of Rhamnaceae (Pomaderreae) from south-western Australia. *Nuytsia* 16: 299-315.

Kellermann J, Rye BL, Thiele KR (2008) Name changes, nomenclatural notes and typifications in *Trymalium* (Rhamnaceae: Pomaderreae). *Transactions of the Royal Society of South Australia* 132: 18-28.

Kellermann J, Udovicic F, Ladiges PY (2005) Phylogenetic analysis and generic limits of the tribe Pomaderreae (Rhamnaceae) using internal transcribed spacer DNA sequences. *Taxon* 54: 619–631.

Kremer A, Caron H, Cavers S, Colpaert N, Gheysen L, Gribel R, Lemes M, **Lowe A**, Margis R, Navarro C, Salgueiro F (2005) Monitoring genetic diversity in tropical trees with multilocus dominant markers. *Heredity* 95: 274-280.

Ladiges PY, **Kellermann J**, Nelson G, Humphries CJ, Udovicic F (2005) Historical biogeography of Australian Rhamnaceae, tribe Pomaderreae. *Journal of Biogeography* 32: 1909–1919.

Lowe A (2005) Population genetics of neotropical trees focus issue. *Heredity* 95: 243-245.

Lowe AJ, Abbott RJ (2003) A new British species, *Senecio eboracensis* (Asteraceae), another hybrid derivative of *S. vulgaris* L. and *S. squalidus* L. *Watsonia* 24:375-388.

Lowe AJ, Abbott RJ (2004) Reproductive isolation of a new hybrid species, *Senecio eboracensis*. *Heredity*. 92:386-395.

Lowe AJ, Boshier D, Ward M, Bacles CFE, Navarro C (2005) Genetic resource loss following habitat fragmentation and degradation; reconciling predicted theory with empirical evidence. *Heredity* 95: 255-273.

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Lowe AJ, Jourde B, Breyne P, Colpaert N, Navarro C, Wilson J, Cavers S (2003) Fine scale genetic structure and gene flow within Costa Rican populations of mahogany (*Swietenia macrophylla*). *Heredity* 90:268-275.

Lowe AJ, Moule C, Trick M, Edwards KJ (2004) Efficient large-scale development of microsatellites for marker and mapping applications in Brassica crop species. *Theoretical and Applied Genetics*. 108:1103-1112.

Lowe AJ, Munro RC, Samuel S, Cottrell J (2004) The utility and drawbacks of chloroplast DNA for identifying native British oak stands. *Forestry*. 77: 335-347.

Lowe AJ, Thorpe W, Teale A & Hanson J (2003) Characterisation of germplasm accessions of Napier grass (*Pennisetum purpureum* and *P. purpureum x P. glaucum* hybrids) and comparison with farm clones using RAPD. *Genetic Resources and Crop Evolution* 50: 121-132.

Lowe AJ, Unsworth C, Gerber S, Davies S, Munro RC, Kelleher C, King A, Brewer S, White A, Cottrell J (2006) The route, speed and mode of oak postglacial colonisation across the British Isles; Integrating molecular ecology, palaeoecology and modelling approaches. *Botanical Journal of Scotland* 57:59-82.

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Muir C, **Lowe AJ**, Fleming CC, Vogl C (2004) High nuclear genetic diversity, high levels of outcrossing and low differentiation among remnant populations of *Quercus petraea* at the margin of its range in Ireland. *Annals of Botany*. 93:691-697.

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Staff and Associates of the State Herbarium of SA

Andrew J. Lowe – Head of Science / Researcher
Piers Brissenden – Manager of State Herbarium and Bioknowledge

Abi Saxon– Personal Assistant

W.R. (Bill) Barker - Chief Botanist and Manager Biosystematics and Genetic Research
Robyn Barker - Senior Botanist (part-time)/Honorary Research Associate
Graham Bell – Senior Botanist
Hugh Cross – Molecular Botanist
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