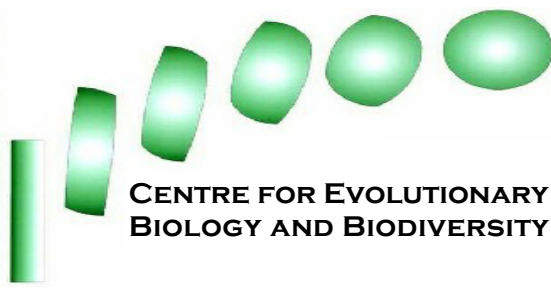
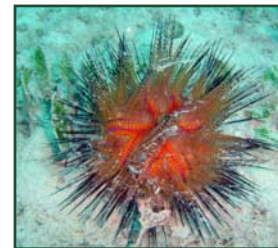


CEBB



CENTRE FOR EVOLUTIONARY
BIOLOGY AND BIODIVERSITY



ANNUAL REPORT 2005



THE UNIVERSITY
OF ADELAIDE
AUSTRALIA



South Australian Museum

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REPORT FROM THE CHAIR OF THE ADVISORY BOARD

REPORT FROM THE DIRECTOR

The Centre for Evolutionary Biology & Biodiversity (CEBB) is a University designated research centre that brings together expertise from two key organisations: The University of Adelaide and the South Australian Museum. In addition, a number of other groups are involved in CEBB, including the Plant Biodiversity Centre in the South Australian Department for Environment & Heritage. The Centre started operation in October 2000 and is entering its sixth year.

The **mission** of the CEBB is to be a leading national and international centre for research and training in evolutionary biology and biodiversity studies, with an emphasis on the fauna and flora of Australia. It aims to 1) provide a focus and recognition for the high-calibre research already being undertaken by researchers in Adelaide, 2) provide more secure funding and first-class infrastructure through collaboration among its members and with colleagues externally, 3) attract high-quality postgraduates, 4) attract national and international visitors, and 5) foster communication and ideas among members through seminars, discussion groups, workshops and conferences.

This report covers the activities of the Centre during 2005, a year which has seen the continued success of the CEBB as a major centre for evolutionary-based research in Australia. There have been numerous successes during the year, the highlights of which have been:

A new ARC infrastructure grant to fund the expansion of the *South Australian Regional Facility for Molecular Ecology and Evolution* and the completion of the *Australian Centre Ancient DNA*;

The ARC-funded *Environmental Futures Network* becoming fully operational and awarding its first program and early-career researcher grants;

The arrival of Dr Jeremy Austin as Manager of the *Ancient DNA Laboratory*, and a new postdoctoral fellow, Dr Laughlin Farrington;

Further expansion of the Centre's postgraduate program and,

New ARC and ABRS grants on speciation in stygofauna systems, orchid population genetics in fragmented environments, and the systematics of spider-hunting wasps.

This report summarises the work and activities undertaken by members and students in the Centre, and provides details on research projects, grants, publications, conference presentations, awards, new staff, and national and international collaborations. The report also includes, for the first time, a section on *Research News*, which describes a few of the Centre's current research programs in more detail.

Acknowledgements

On behalf of the members of the Centre, I would like to thank the following people for their help with the successful operation of CEBB: Professor Peter Rathjen (Executive Dean, Faculty of Sciences), Ms Janet Dibb-Smith (Director, Research, Policy & Support), the members of the Advisory Board, Professor Steve Hopper (University of Western Australia) and Dr Steve Morton (Group Executive, CSIRO Environment & Natural Resources), and Ms Maria Lekis, Gail Edwards and Trish Catford for administrative support.

I would also like to especially thank Professor Bob Hill, School of Earth & Environmental Sciences for financial support towards the printing of this report.



Professor Andrew Austin
CEBB Director
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RESEARCH NEWS

Population genetics and dynamics of orchids and their pollinators in fragmented landscapes of South Australia (Dr Lachlan Farrington)



Caladenia tentaculata (Photo by Renate Faast)

Habitat fragmentation, through land clearing, has been attributed to the demise of many species of flora and fauna throughout the world. Not surprisingly, much research effort has been devoted toward understanding the dynamics of populations subject to fragmentation. Molecular genetic techniques have proven useful in understanding the interactions between population size, isolation and genetic diversity and have helped identify a trend whereby species composed of populations with high genetic diversity are evolutionarily more stable than those with low genetic diversity. Understanding the biological attributes that promote the retention of genetic diversity in fragmented populations is therefore fundamental to the management of effected species. However the interactions

driving these responses are often complex and management regimes require a thorough understanding of key processes if they are to be successful.

A CEBB research initiative, funded through the ARC Linkage program aims to explore the dynamics of habitat fragmentation in several species of orchids and their pollinators. A variety of orchid species found in the Mt Lofty Ranges and Fleurieu Peninsula regions of South Australia presently occur as fragmented colonies, however they express wide diversity in other aspects of their biology including contrasts between both historical and contemporary distribution and pollination specificity. For example, some species have discrete habitat preferences and would have historically occurred in isolated colonies whereas others are thought to have been distributed continuously throughout their range prior to land clearing. Similarly several species of *Caladenia* are thought to express pollinator specificity such that gene flow between fragmented populations would be dependant on the presence of certain insects and the presence of habitat necessary for pollinator persistence. Other species, typically of the genus *Pterostylis*, are less specific and gene flow through pollination would presumably be less vulnerable to the loss of certain habitat types. Orchids found in the Adelaide Hills region therefore provide a unique opportunity to advance our understanding of the complexity of the interactions between habitat fragmentation, species ecology and genetic diversity.

An exploration of the role these biological traits play in determining response to fragmentation will be achieved using molecular genetic analyses. Highly variable microsatellite markers are being developed at the South Australian Regional Facility for Molecular Evolution & Ecology. These markers will aid estimation of the genetic diversity contained within several populations across the spectrum of biological aspects. It is anticipated that this information will provide further understanding of the dynamic interactions between habitat fragmentation and species persistence as well as contribute to the development of effective management plans for orchid species in South Australia.

The Stygofauna of Western Australia's Groundwater Calcretes (Dr Steve Cooper)

In 1998 a unique and diverse subterranean invertebrate aquatic fauna was discovered from numerous isolated groundwater calcretes of the arid Yilgarn region of central Western Australia (Fig. 1.). The calcrete fauna comprises subterranean aquatic animals (known collectively as stygofauna) of largely unknown species in diverse invertebrate groups including water beetles (Coleoptera), and crustaceans such as Syncarida, Isopoda, Amphipoda, Copepoda and Ostracoda. Our research at CEBB aims to explore the systematics, evolution and population dynamics of this unique stygofauna.

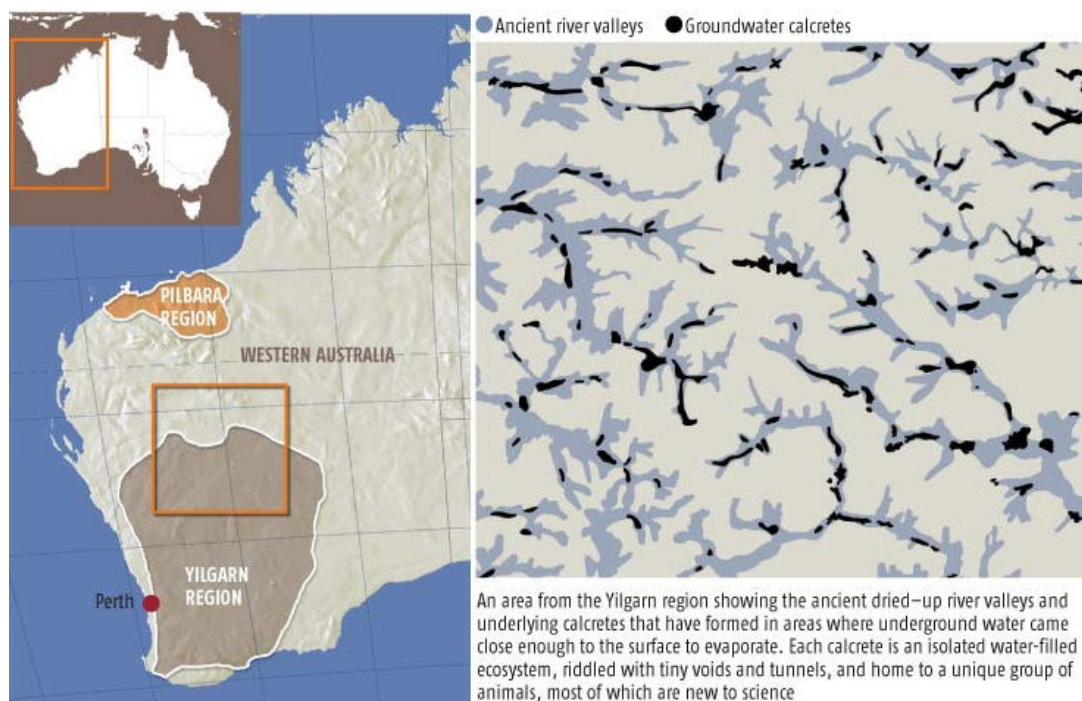


Fig. 1. Map showing the distribution of calcretes (in black) in the Yilgarn region of Western Australia. The approximate location of palaeodrainages (ancient river valleys) is shown in grey (image from New Scientist).

To date, we have identified over 100 new species of subterranean water beetle in ~47 major isolated calcretes, the world's largest and most diverse collection of such animals. There are several unique features of this fauna that have formed the basis of our current research interests. First, each beetle species is restricted in its distribution to a single calcrete and molecular clock analyses (Leys *et al.* 2003) suggest there has been no apparent geneflow between calcretes since the Pliocene (10-5 million years ago (mya)), coinciding with a major period of aridity of the Australian continent. These data suggest that the calcretes are equivalent to "subterranean islands" with the entire region resembling a subterranean island chain. Second, calcretes often contain between two to three beetle species, each showing considerable variation in morphology and size, and we have identified 15 cases of large (>3mm) /small (<2mm) sympatric sister species. Our recent analyses (Leys *et al.*, submitted) suggest it is unlikely that sympatric sister species resulted from multiple colonisations of the calcrete, indicating that speciation took place within the closed system of a calcrete body, possibly by sympatric speciation.

In 2004, with support from the mining companies Newmont and Placer Dome Asia Pacific, we received an ARC linkage grant to investigate in more detail the ecosystem and environmental variables within a number of calcrete bodies, the genetic architecture of species within calcretes and their population dynamics. Since receiving this grant we have been fortunate to discover two calcretes with large numbers of mining exploration boreholes that have enabled us to carry out detailed sampling and chemical analyses, providing a unique view into the subterranean world within a calcrete body. This ecological research is currently being conducted by Mr Adam Allford, as the main

component of his PhD project. The large number of sampling holes also has enabled us to obtain good sample sizes of beetles and other species along transects through these calcretes. Dr Michelle Guzik, a post doc in our team, has now isolated microsatellite loci from beetle species at the Sturt Meadows calcrete and has recently generated a substantial mitochondrial DNA sequence data set to investigate the population genetic structure of species, in particular addressing the question of whether there is widespread geneflow of beetles through a calcrete body or evidence for population structuring over fine spatial scales.

A further highlight in 2005 was the success of a new ARC Discovery Grant application by Cooper and Humphreys to investigate modes of speciation in the subterranean water beetles. This research will focus on comparing the trophic niches of sympatric sister species of different size classes, in order to test whether they may have evolved through a process of sympatric speciation. Comparative phylogeographic analyses will also be conducted to investigate the potential for micro-allopatric speciation within calcrete aquifers.

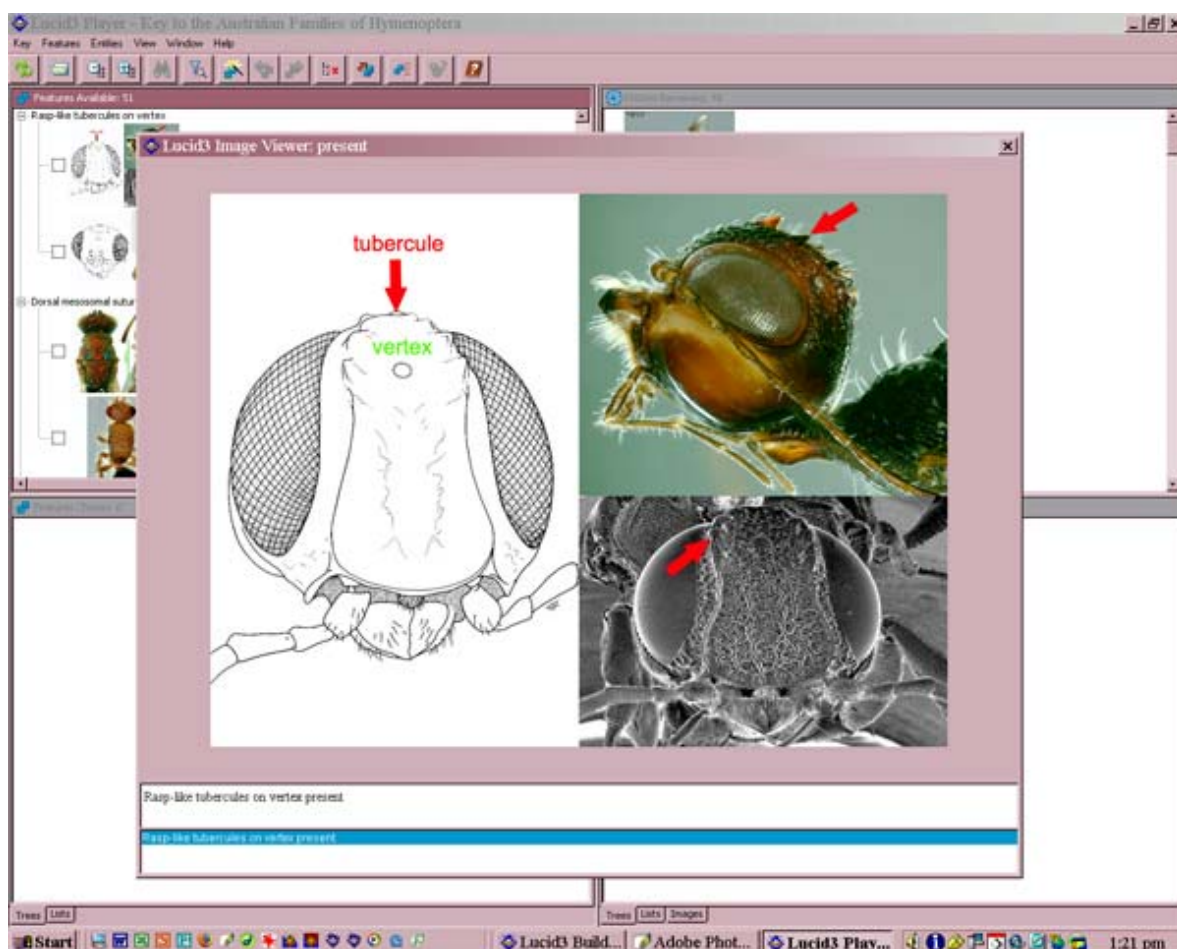
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A Lucid interactive key to Australasian Hymenoptera

(Dr Claire Stephens and Prof Andy Austin)

In 2002, the *Key to the Australian Families of Hymenoptera* was released as part of *BioEd 'An Interactive Training Tool for Taxonomy'* (Centre for Biological Information Technology, The University of Queensland). Prior to this, the traditional dichotomous key in CSIRO's *Insects of Australia* (1990) was the only readily accessible identification tool for the Australasian families of Hymenoptera. The current project has greatly expanded and completely updated the previous interactive platform using *Lucid*TM software (Version 3.3). A major addition to the new version is the expansion of the large superfamily Chalcidoidea, which can now be identified to family level. The new key provides the means to identify the 68 families of Hymenoptera that occur across Australasia.



Screen format for the new Lucid key to Australian Hymenoptera, showing how morphological structures are illustrated using line drawings, colour automontage images and electron micrographs.

Morphological character states are clearly presented in over 250 full-colour illustrations of easily seen features using basic light microscopy. In contrast to traditional printed keys, a combination of line drawings, scanning electron micrographs and colour photographs have been used to best illustrate each character. In addition, each figure is clearly annotated using simple terminology. The key also contains a comprehensive introduction on the biology, morphology and classification of the Hymenoptera and linked fact sheets with over 350 colour photographs and detailed descriptions of each family. The key is intended to provide a user-friendly foundation to the higher-level classification of the group from which users can proceed to more specific keys of each family as required.

The Hymenoptera (ants, bees, sawflies and wasps) are one of the 'mega-diverse' insect orders with 115,000 described species worldwide, and a true diversity of probably four

times this number. Likewise, Australia has 14,800 described species, however the actual number of species has been estimated at about 44,000. Species occur ubiquitously from forests and woodlands to grasslands and wetlands, freshwater and intertidal zones to urban parks and gardens. Arguably, no other insect group plays such key roles in the functioning of both native and agricultural ecosystems. Wasps regulate insect populations through predation and parasitism, bees are among the most important pollinators of flowering plants, and ants dominate many terrestrial landscapes where they are involved with vital ecological processes such as predation, seed dispersal and soil health. Accordingly, this key will become an invaluable resource for students, researchers, biological control practitioners, those involved in ecological surveys and monitoring, or simply anyone with an interest in this unique and important, yet often unnoticed, component of our native biodiversity. Developed by a team of researchers that work on the systematics and ecology of hymenoptera parasitoids comprising Nick Stevens, Claire Stephens, John Jennings, and Andrew Austin from Adelaide, and Muhammad Iqbal and John LaSalle from Canberra, the key is due for release through the Australian Biological Resources Study in late 2006.

■ **Environmental Futures Network** (Prof Bob Hill)

The ARC-funded Research Network titled "Discovering the past and present to shape the future" commenced in late 2004, but began full operation during 2005 and full funding of projects did not begin until late in 2005. The aim of the Network is to fund large, multidisciplinary groups of researchers to meet and formulate research grants that will tackle the big problems in Australian biology that will inform the debate on the origin, management and conservation of Australian biodiversity. The Research Network has a management committee chaired by Professor Bob Hill, and two other members of the CEBB, Professors Andy Austin and Steve Donnellan. The interaction between the CEBB and this ARC Research Network is very strong, and we expect to see major proposals from the CEBB funded by the Research Network in the future. We have already funded several applications from early career researchers, including postdoctoral fellow Dr Nick Murphy and PhD student Kate Muirhead from the CEBB who have been awarded travel grants to work with Dr Jim Whitfield at the University of Illinois on the evolution of microgastrine parasitic wasps.

EFN website >>> <http://nesuab.ees.adelaide.edu.au/page/default.asp?site=1>

MEMBERS OF THE CENTRE

Membership of the Centre was strengthened significantly in 2005 with the arrival of Professor Alan Cooper as a Federation Fellow in ancient DNA studies, Dr Jeremy Austin, Manager of the Ancient DNA Laboratory, and a new postdoctoral fellow, Dr Lachlan Farrington in the School of Earth & Environmental Sciences (see profiles below).

■ Key Personnel and Management Committee:

Professor Andrew Austin, School of Earth & Environmental Sciences (Director)

Professor Stephen Donnellan, South Australian Museum, and Affiliate Professor in Schools of Earth & Environmental Sciences and Molecular & Biomedical Science

Professor Robert Hill, School of Earth & Environmental Sciences, and South Australian Museum (Deputy Director)

Dr Ian Whittington, joint appointment, South Australian Museum and School of Earth & Environmental Sciences

■ Other Staff in the Centre:

Dr Jeremy Austin, School of Earth & Environmental Sciences

Dr Bill Barker, Plant Biodiversity Centre, South Australian Department of Environment & Heritage

Associate Professor William Breed, Anatomical Sciences, Faculty of Health Sciences

Dr John Conran, School of Earth & Environmental Sciences

Professor Alan Cooper, School of Earth & Environmental Sciences

Dr Steven Cooper, South Australian Museum, and Affiliate Senior Lecturer in School of Earth & Environmental Sciences

Professor Chris Daniels, School of Earth & Environmental Sciences

Dr Jack da Silva, School of Molecular & Biomedical Science

Dr Kerrie Davies, School of Agriculture & Wine

Professor Tim Flannery, South Australian Museum, and the University of Adelaide

Dr Mark Hutchinson, South Australian Museum, and Affiliate Lecturer in School of Molecular Biosciences

Dr John Jennings, School of Earth & Environmental Sciences

Associate Professor Mike Lee, South Australian Museum, and School of Earth & Environmental Sciences

Associate Professor Sandy Orgeig, School of Molecular Biosciences

Dr Greg Rouse, South Australian Museum, and School of Earth & Environmental Sciences

Dr Gary Taylor, School of Agriculture & Wine

■ Postdoctoral Fellows and Research Associates

Dr Leslie Chisholm, School of Earth & Environmental Sciences

Dr Lachlan Farrington, School of Earth & Environmental Sciences

Dr Micelle Guzik, School of Earth & Environmental Sciences

Mr Andrew Hugall, South Australian Museum, and School of Earth & Environmental Sciences

Dr Brenda Kranz, School of Earth & Environmental Sciences

Dr Remko Leijs, South Australian Museum, and School of Earth & Environmental Sciences

Dr Nicholas Murphy, School of Earth & Environmental Sciences

Ms Rosemary Paull, South Australian Museum and School of Earth & Environmental Sciences



Capsaloides sp., a monogenean fish parasite – see page 20.

PROFILES - NEW STAFF AND POSTDOCTORAL FELLOWS IN CEBB

Dr Lachlan Farrington



Lachlan has a strong interest in the application of genetic techniques to the management and conservation of natural systems. His early research has focussed on aquatic vertebrates but now extends to incorporate all systems subject to and undergoing fragmentation. Lachlan's PhD thesis, "Genetic Diversity of Brown and Rainbow Trout in Australia," explored the effects of founder events on the genetic diversity of hatchery reared and naturalised salmonids, that were introduced to Australia from Europe and North America. He has since worked at the University of Canberra exploring population genetics in freshwater and marine turtles with a view to identifying important management units in light of hydrological modification or harvesting practices. In 2004 Lachlan received a *Science and Innovation Award* for a proposal to collate fish scale collections with a view to using them as a source of DNA. The use of historical DNA can provide an important baseline upon which to assess the effects of fishing pressure on the abundance and genetic health of contemporary populations.

Lachlan is currently employed as a Research Associate funded through the ARC Linkage program. He is undertaking a study of genetic variation in orchid species found in and around the Mount Lofty Ranges near Adelaide. This project aims to investigate patterns of gene flow between orchid species with contrasting patterns of pollination and levels of fragmentation. The ensuring information will prove useful in the future management of species subject to fragmentation through anthropogenic habitat modification.

Dr Jermey Austin



Jeremy completed a PhD in ecological and evolutionary genetics at the University of Tasmania in 1994. Since then he has worked at the Natural History Museum (London), the University of Queensland (Brisbane), Museum Victoria (Melbourne) and the University of Adelaide. Jeremy has broad-based interests and expertise in molecular ecology, phylogeography, phylogenetics and systematics of extant and extinct species, particularly in island systems. His work attempts to understand how historical and recent biogeographic events, environmental change and other processes have influenced individuals, populations and species, with a strong focus on using extinct species and populations to provide a critical temporal context. His research has included ground-breaking studies of ancient DNA survival in amber-preserved insects, identifying patterns of colonisation and within archipelago speciation in extant and extinct groups of island lizards and tortoises, and comparative phylogeography of rainforest restricted birds in eastern Australia. Currently Jeremy is involved in projects investigating large-scale phylogeography and conservation genetics of extant and extinct Australian grass lizards and frogs, wildlife forensics of extinct and endangered Australian marsupials and investigating the ancient DNA potential for diverse sediment and faunal remains in Australasia to determine the roles of climate change and human impacts on the decline of Australian native fauna.

ADVISORY BOARD & ADMINISTRATION

The Advisory Board forms an important part of the overall management structure of the Centre. It comprises the four members of the Centre's Management Committee (Professors Austin, Donnellan and Hill, and Dr Whittington), the Deputy Vice-Chancellor, Research (Professor Neville Marsh), the Director of the South Australian Museum (Professor Tim Flannery), and three external members, Professor Steve Hopper (University of Western Australia), Dr Steve Morton (Group Executive, CSIRO Environment & Natural Resources), and Dr Allan Holmes (Chief Executive, Department of Environment and Heritage, South Australia).

The Management Committee has served a crucial role in advising the Director on the day-to-day running of the Centre and has been responsible for much of the activity in the Centre, particularly in developing the successful research proposal for an Australian Research Council Infrastructure grant, the ARC Network, and other competitive funding sources. Administrative support for the Centre is provided through the School of Earth & Environmental Sciences. Ms Maria Lekis acted as the administration officer in 2005, while Ms Annie Richards acted as finance officer for the Centre.



Members of the Management Committee
Left to right: Prof Bob Hill, Prof Andy Austin and
Prof Steve Donnellan

RESEARCH PROGRAMS

The major research programs in the Centre during 2005 were as follows:

Evolution and biodiversity of Australian terrestrial arthropods

(Prof Andy Austin, Dr John Jennings, Dr Nick Murphy, Dr Kerrie Davies, Dr Gary Taylor)

This program comprises a series of projects that deal with evolutionary and biodiversity aspects of terrestrial arthropods. These include:

- Evolutionary aspects of insect parasitoids, including the evolution of endoparasitism, polydnavirus associations, and host-parasitoid co-evolution
- Molecular phylogeny of the major groups of parasitic Hymenoptera using both sequence data and mitochondrial genome organisation
- Systematics of specific groups of Hymenoptera, including the Braconidae, Scelionidae, Gasteruptiidae, Aulacidae and Xiphydriidae
- Evolution and systematics of the Australian lycosid spider fauna
- Community structure of terrestrial arthropods in sclerophyll forest, semi-arid deserts, and guano cave systems
- Speciation, molecular phylogeny and co-evolution of *Fergusonina* flies and *Fergusobia* nematodes associated with galls on myrtaceous plants.

These projects have a strong systematics basis that utilize traditional comparative morphological and molecular techniques, and they are underpinned by a comprehensive field program that supports a major insect collection, the Waite Insect and Nematode Collection. During 2005, the program had two postdoctoral fellows, six PhD and two honours students.

Systematics of the Australian flora

(Dr W.R. Barker, Dr H.R. Toelken, Dr R.J. Chinnock, Mr G.H. Bell; Honorary Associates, Professor H.B.S. Womersley, Dr D.E. Symon, Ms R.M. Barker, Ms P. Catcheside)

The State Herbarium coordinates with other Australian herbaria and systematists in advancing the knowledge of the Australian flora through advancing plant classification. Its work includes recognition of new species and resolution of species complexes in South Australia to more intensive revisions of the classification of genera and families in Australia or the Australian region. The latter involve traditional morphological study but increasingly involves collaboration with molecular researchers in other institutions. Current research projects include:

- Systematics of Australian Solanaceae
- Systematics of naturalised blackberry (*Rubus*: Rosaceae) in Australia
- A taxonomic monograph of the Myoporaceae.
- Systematics and evolution of Australian Scrophulariaceae
- Systematics and evolution of Stackhousiaceae
- A taxonomic revision of *Hibbertia* (Dilleniaceae)
- A taxonomic review of Australian Cactaceae.

Evolution of mammalian sperm and eggs

(Assoc Prof Bill Breed)

Our research program mainly consists of a variety of studies on the evolution and diversity of mammalian gamete form and function. Present investigations include:

- Evolution of the sperm combining region on the glycoprotein egg coat, the zona pellucida, in marsupials and rodents
- Evolution of sperm form of muroid rodents especially that of species from the Australasian and southeast Asian regions
- Factors underlying the divergence of male gonad size and sperm numbers produced in muroid rodents
- Evolution of form, function, and molecular organisation of the sperm head cytoskeleton of Australasian rodents
- Molecular organisation and function of the marsupial sperm tail cytoskeleton.

Adaptive evolution of the Australian flora

(Dr John Conran)



Drosera androsacea

The diversity of the Australian flora is generally thought to be a result of adaptive response to environmental change and/or co-evolution with pollinators, dispersers, etc. The projects undertaken to examine these hypotheses use morphological and molecular approaches, as well as studies of reproductive biology, are as follows:

- Diversity and biology of carnivorous plants in Australia, particularly *Byblis* (Byblidaceae) and *Drosera* subgen. *Bryastrum* (Droseraceae).
- Ultraviolet floral patterning in Australian flowers in relation to pollination strategies within and between families, genera and species.
- Diversity, biology and the role of hybridisation in *Alyogyne* (Malvaceae)
- Relationships, ecology and biology of the SW WA endemic family Eremosynaceae.
- Evolution, diversity and biology of Australian petaloid monocots, especially Laxmanniaceae, Boryaceae and Hemerocallidaceae.

Ancient DNA research

(Prof Alan Cooper, Dr Jeremy Austin)

The Australian Centre for Ancient DNA (ACAD) building is now close to fully operational and apart from the normal teething problems and construction glitches we are up and running. Dr Jeremy Austin (ACAD Manager) has done a sterling job in dealing with the various buck-passing manoeuvres that seem integral to any modern construction project. We're also pleased to announce we have obtained AQIS certification and can now move all of our materials out of the various fridges and freezers they have been sequestered in for the past year. The first three PhD students have arrived, (Laura Watson, Sarah Bray and Nic Rawlence) and have started their research projects. An honours student is also underway, through the School of Molecular and Biomedical Sciences genetics program with Jack Da Silva.

of Adelaide, Dr Stefano Taiti -Italy, Dr Joo-Lae Cho - South Korea)

publicity. Contributions from 74 members of BioCity, and by 3 photographers, have made a book which is the envy of urban ecological organisations around the world.

2) The completion of the Urban Ecology volume for *Austral Ecology*. Due out in April 2006, this 15-paper collection of the latest science in Australia on urban ecology will be an excellent contribution by BioCity to the discipline.

3) The establishment and successful completion of the first courses in Urban Habitat Management. Students had the chance to interact with many members of BioCity, and important and lasting synergies were established.

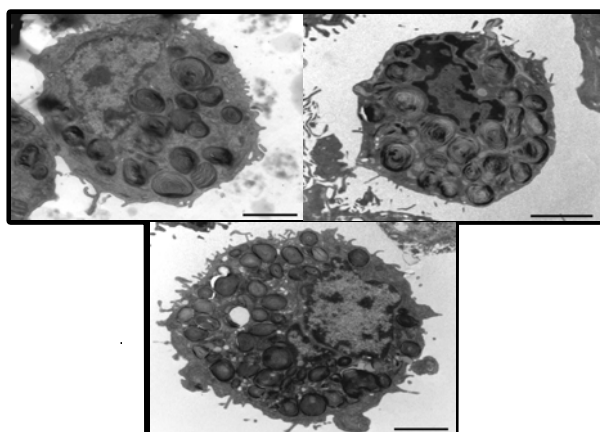
Evolution of a physiological system: The pulmonary surfactant system in diving mammals

(Prof Chris Daniels, Assoc Prof Sandra Orgeig)

Pulmonary surfactant lines the alveolar air-water interface, varying surface tension with lung volume to increase compliance and prevent adhesion of respiratory surfaces. We examined whether the surfactant system of diving mammals exhibits adaptations for more efficient lung function during diving, to complement other respiratory adaptations. We investigated adaptations at the molecular, compositional, functional and cellular levels and during development for animals beginning life on land and progressing to an aquatic environment. Molecular adaptations to diving were examined in surfactant protein C (SP-C) from terrestrial, semi-aquatic and diving mammals using phylogenetic analyses. Diving species exhibited sites under positive selection in the polar N-terminal domain. These amino acid substitutions may lead to stronger binding of SP-C to the phospholipid film and increased adsorption to the air-liquid interface. The concentration of shorter chain phospholipid molecular species was greater and SP-B levels were lower in diving than terrestrial mammals. This may lead to a greater fluidity and explain the relatively poor surface activity of diving mammal surfactant. There were no consistent differences in cholesterol between diving and terrestrial mammals. Surfactant from newborn California sea lions was similar to that of terrestrial mammals. Secretory activity of alveolar type II epithelial cells of sea lions demonstrated an insensitivity to pressure relative to sheep cells. The poor surface activity of diving mammal surfactant is consistent with the hypothesis that it has an anti-adhesive function that develops after the first entry into the water, with a surfactant film, that is better suited to repeated collapse and respreading.

Environmental control of developmental plasticity of vertebrate cardio-pulmonary systems

(Prof Chris Daniels, Assoc Prof Sandra Orgeig)



Isolated alveolar type II cells from crocodile embryos at developmental day 68 treated with a synthetic glucocorticoid (dexamethasone) or a thyroid hormone (T3), endogenous mediators of environmental variables such as hypoxia.

It is well established that developmental plasticity (i.e. ability to alter the onset, timing, progression and/or outcome of a structure or process during development) allows an organism to respond to variations in environmental conditions by altering the onset, extent, rate of change and outcome of the development of particular structures and systems, thereby ensuring survival. Hence developmental plasticity must be evident (at least to some extent) for all physiological systems within a species and environmental variables such as oxygen, temperature and pressure will exploit this plasticity. However,

for any given system, the onset and type of plasticity (i.e. the nature of the developmental window), the control mechanisms and the interactions with other developing systems will vary between organisms, and between systems within an organism. More importantly, new species can only appear once developmental programs have changed. It is possible that speciation could occur if environmental variables alter developmental trajectories for one or more systems, and the shifts in developmental windows lead to alterations in the gene frequencies of the controlling systems. Hence, repeated generations of organisms exposed to directional selection from an environmental variable will evolve into new species as a result of shifts in the developmental window. We will test the plasticity patterns in two central systems – the respiratory system (comprised of the pulmonary surfactant system and the process of lung morphogenesis) and cardiovascular system – to changes in two environmental variables – oxygen and temperature - in a wide range of oviparous and viviparous species. The patterns exposed by examining 2 systems in widely divergent species will provide a hypothetical framework for how developmental plasticity may lead to the evolution of new species. This study will greatly enhance our understanding of how the environment can influence development of one or more physiological systems in a milieu of different developing structures, organs and systems.

The Process of adaptation at the molecular level: HIV and the immune system

(Dr Jack da Silva)

Progress in understanding the process of adaptation at the molecular level has been impeded by the lack of a mature population genetic theory of adaptation and by a poor understanding of the sources and targets of selection. One way forward is to model a system that is well understood at the molecular level and then use 'simulation experiments' to test hypotheses about which factors affect the rate and limit of adaptation. This approach has two main advantages: it allows manipulations that would be impossible, too costly, or unethical with real experimental systems, and it allows a reductionist approach to modelling that does not require the unrealistic or untested simplifying assumptions often required of more tractable (analytical) mathematical models. However, a major obstacle to this approach, when applied to the protein level, is that it requires knowledge of the fitness effects of all amino acids at all sequence sites. I solve this problem by using site-specific amino acid frequencies as correlates of fitness effects, and apply this approach to model the adaptive evolution of human immunodeficiency virus type 1 (HIV-1). Simulations with this model are being used to investigate the effects of mutation rate, mutation bias, epistasis, pleiotropy, cell superinfection, and viral recombination on the rates and limits of adaptation at the molecular level.

Evolution and Palaeobiology of the Australian flora

(Prof Bob Hill, Ms Rosemary Paull)

Southern Australia is the best place in the world to study the effects of long-term climate change on vegetation. This is because Australia has moved through approximately 20° of latitude since it separated from Antarctica about 35 million years ago, and during that time this movement has had a profound impact on the global and, more specifically, Australian climate. The study of the effect of this climate change on the vegetation is made possible by the excellent preservation of Cainozoic plant fossils in central and south-eastern Australia. This has been coupled with physiological research on the nearest living relatives of the fossils so that a reconstruction of the reasons behind plant evolution and/or distributional change can be attempted. This program utilises the fossil record and the living relatives of the fossils to document the impacts of lowering temperatures and reduced water availability on the vegetation of a large region. Such data are vital to our understanding of the potential impact of future, much shorter term, climate change.

DNA fingerprinting and wildlife management

(Prof. Steve Donnellan, Prof Amanda Goodman, Prof M. Henneberg)

This program aims to develop a range of DNA fingerprinting “tools” that will assist wildlife managers to more efficiently monitor and protect wild populations of Australian and Melanesian reptiles, in particular the pythons and goannas which are much sought after by the pet trade. The research has utilised a range of genetic markers and revealed little appreciated aspects of the evolutionary dynamics of DNA fingerprinting “genes”. The results have also provided detailed insights into the systematics of the pythons and goannas, in the case of pythons rejecting and in the case of goannas confirming previous notions of their origins. We are also investigating the reliability of DNA fingerprint profiles obtained from decayed carcasses and soil as part of establishing the markers for use in a wide range of forensic and archaeological settings. During 2005, the program had three PhD students.

Evolution and systematics of living and fossil reptiles

(Assoc Prof Michael Lee, Dr Mark Hutchinson)

Anatomical, palaeontological and molecular approaches are being used to address important questions in reptile evolution, including:

- The tempo and major divergences in squamates (lizards and snakes) based on nuclear genes.
- Diversity of marine reptiles in Australia's Cretaceous inland sea.
- Systematics of Australian agamids (dragons) skinks and diplodactyline geckos.
- Evolutionary mechanisms of limb loss in the diverse scincid lizard *Lerista*.
- Molecular phylogenetics of Australian elapid snakes.
- Phylogeography of arid zone geckos
- Fossil record of Australian lizards

Plasticity of surfactant phospholipid molecular composition in mammals

(Assoc Prof Sandra Orgeig, Prof Chris Daniels)

Pulmonary surfactant, a complex mixture of lipids and proteins, lowers the surface tension in terminal air spaces and is crucial for lung function. Within an animal species, surfactant composition can be influenced by development, disease, respiratory rate and/or body temperature. We analysed the composition of surfactant in three heterothermic mammals (dunnart, bat, squirrel), displaying different torpor patterns. We discovered that like bats and dunnarts, surfactant Chol increases during torpor in squirrels. However, changes in PL saturation during torpor may not be universal. In addition, we analysed the phospholipid molecular species composition of a large range of mammals (including placental/marsupial and hetero-/homeothermic contrasts) to determine whether phylogeny or thermal behaviour determines molecular species composition in mammals. We discovered that the ‘major’ surfactant phospholipid dipalmitoylphosphatidylcholine (PC16:0/16:0) is highly variable between mammals and is not the major PL in the wombat, dunnart, shrew or Tasmanian devil. An inverse relationship exists between PC16:0/16:0 and two of the major fluidising components, PC16:0/16:1 and PC16:0/14:0. The PL molsp profile of an animal species is not determined by phylogeny or thermal behaviour. We conclude that there is no single PL molecular species composition that functions optimally in all mammals, rather surfactant from each animal is unique and tailored to the biology of that animal.

Lizard tail regeneration: a model for investigating lymphangiogenesis

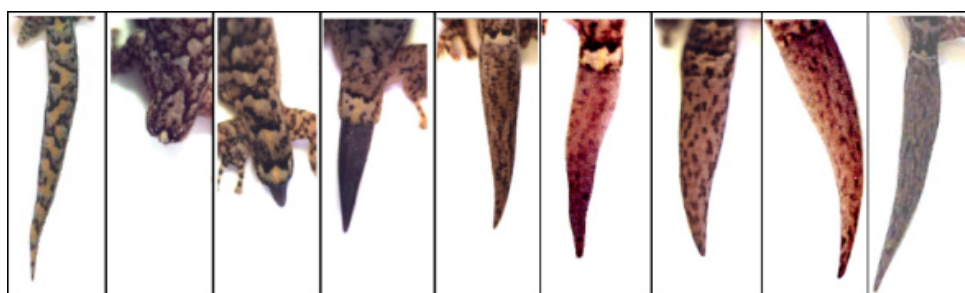
(Assoc Prof Sandra Orgeig, Prof Chris Daniels)

Marbled gecko,
Christinus moratus



This study examines the regeneration of lymphatic and blood vessels in the regenerating tails of lizards. Many species of geckos and some skinks are capable of voluntarily shedding their tail (autotomy). The tail rapidly regenerates, as a fully differentiated structure, including muscle and nervous tissue, cartilage, skin, fat, as well as blood and lymphatic vessels. However, in mammals and humans, lymphatic regeneration (termed lymphangiogenesis) occurs only transiently after surgery or radiotherapy. This

inefficient regeneration results in an accumulation of lymphatic fluid in the surrounding tissue, resulting in the debilitating condition known as lymphoedema. We are currently investigating the physiological and molecular mechanisms underlying the successful regeneration of lymphatic vessels in gecko tails after autotomy.



Tail regeneration from the blastema at 0 weeks through 3, 6, 9, 12, 15 and 18 weeks regeneration compared with an original tail (far left) and a fully regenerated tail (far right, > 24 weeks).

Systematics and evolution of marine invertebrates

(Dr Greg Rouse)

This program focuses on the systematics and reproduction in polychaete annelids. In 2005 a series of papers were published on phylogenetics and systematics of these worms. Further study was carried out on the bone devouring siboglinids *Osedax*. Greg Rouse participated in two collecting cruises funded by NSF to hydrothermal vents in the eastern and western Pacific Ocean. This resulted in a large amount of new material that is now housed at the South Australian Museum. Greg was also Guest Editor for the journal *Marine Ecology* September 2005 Vol. 26 (issues 3-4) containing 15 original papers as a tribute to the career of Kristian Fauchald.

Biology, systematics and evolution of marine parasites

(Dr Ian Whittington, Dr Leslie Chisholm)

The Monogenean Research Laboratory at The South Australian Museum and The Marine Parasitology Laboratory at The University of Adelaide focus on parasites of marine fishes. Of particular emphasis is the Monogenea, a class of flatworms with a direct life-cycle which chiefly parasitise skin, fins and gills of elasmobranch and teleost fishes. Elements of our research are especially relevant to South Australia because teleost fish reared in sea cage aquaculture in Spencer Gulf can experience parasite problems. Activities, therefore, of some Honours and PhD students continue to investigate features of the biology, epidemiology and treatment of Monogenea on kingfish, *Seriola lalandi*, in aquaculture. Currently, our research programs embrace several discrete projects investigating parasites of wild and cultivated fish species locally and also overseas. Recent studies have also involved identifying flatworm parasites using morphological and molecular

genetic methods in captivity in public display aquaria and from fish farms worldwide to determine how widespread and how host-specific some pathogens are on a global scale.

- Life cycle parameters of the monogenean parasites *Zeuxapta seriolae* and *Benedenia seriolae* from *Seriola lalandi* in South Australian finfish aquaculture
- A survey of parasites from wild and farmed carangids (*Seriola lalandi* and *S. hippos*) in southern Australia
- Efficacy of potential chemotherapeutants against Monogenea of farmed *Seriola* species
- Stock discrimination of slimy mackerel (*Scomber australasicus*) throughout Australia and New Zealand using parasites, genetics and otoliths
- The southern fiddler ray, *Trygonorrhina fasciata*, as a model host to investigate parasitism of elasmobranchs
- Sharing of parasites among the Rhinobatidae (guitarfish; shovelnose rays) in southern Australian
- Phylogeny and evolution of the Capsalidae (Monogenea), ectoparasitic on a diversity of fishes, using morphological characters, molecular genetics and host associations
- Systematics of Monogenea (Platyhelminthes) from the sharks and rays of Malaysian Borneo
- Cryptic species complexes among pathogenic Monogenea on wild and cultivated warm water fishes
- Capsaline Monogenea (Monopisthocotylea) of large, cosmopolitan, migratory pelagic fishes: revisiting species composition, diversity and distribution of the parasites

All our studies are integrated to help us build a more complete picture about the evolution, associations and interactions between marine parasites and their fish hosts. A thorough knowledge of the biology of the parasites will help to develop methods by which they can be managed and controlled on captive hosts in public display aquaria and in aquaculture. During 2005, our parasitological activities have involved 2 Research Associates, 2 Honours students and 5 PhD students.

APPOINTMENTS, AWARDS & DISTINCTIONS

Andy Austin was appointment Convenor of the Faunal Grants Subcommittee to the Advisory Board of the Australian Biological Resources Study

Andy Austin was appointment Chair of the Advisory Committee of the journal *Invertebrate Systematics*

Andy Austin was appointment as a member of the Science Review Group for the South Australian Museum

Andy Austin was appointment Associate Dean (Postgraduate) for the Faculty of Sciences, The University of Adelaide

Leslie Chisholm continued (since 2000) her appointment as Editor of the *Ichthyoparasitology Newsletter*

Leslie Chisholm was appointed to the Editorial Advisory Committee of the CSIRO journal *Invertebrate Systematics*

Chris Daniels was a finalist for the Premier's Science Excellence Award in Science Communication



Chris Daniels was promoted to full Professor (level E)

Vanessa Glennon (PhD student) won the prize for Best Student Oral Presentation at the 5th *International Symposium on Monogenea* in Guangzhou, PR China during August 2005

John Jennings was re-elected as the Chairman of the Council of Heads of Australian Entomological Collections

John Jennings was re-elected Treasurer of the Royal Society of South Australia and appointed Head of the Editorial Board of the Transactions of the Royal Society of South Australia

John Jennings was reappointed Convenor of the Management Committee of the Kangaroo Island LTER (Long-Term Ecological Research site)

Sandy Orgeig was promoted to Associate Professor



Ian Whittington was a member of the International Organising Committee for the 5th *International Symposium on Monogenea* held in Guangzhou, PR China in August 2005

Ian Whittington served the final year of his three year appointment as Councillor (State Representative for South Australia) for the Council of the Australian Society for Parasitology Inc.

Ian Whittington continued as a co-editor for *Systematic Parasitology* (Springer) and as an Editorial Adviser for *Folia Parasitologica* (Academy of Sciences of the Czech Republic) and *Journal of Natural History* (Taylor & Francis)

STUDENTS

The following students undertook research projects in the Centre during 2005.

Honours Students		
Name	Project Title	Supervisor(s)
Danielle Carey	Molecular phylogeny of baeine wasps (Scelionidae) and the evolution of wing reduction [awarded the Michael Smythe Prize]	A.D. Austin & N. Murphy
Stephen Griffiths	Influence of homopteran insects and acacias on the distribution of <i>Iridomyrmex</i> (ant) nests in the Flinders Ranges	A.D. Austin & J. Facelli
Jodie Haig	Population ecology and larval development of <i>Aporometra</i> (Crinoidea)	G.W. Rouse
Virginia Holt	Effect of bridal creeper litter on soil micro-invertebrates at Mt Billy Conservation Park	A.D. Austin
Dorothy Niumeitolu	The nature of the selective forces acting on HIV-1 during its evolution	J. Da Silva
Liberty Olds	Comparative studies on marsupial sperm tail cytoskeleton and motility in marsupials	William Breed, & Dave Taggart
Julia Lackenby	Effects of environmental parameters on development and fecundity of <i>Benedenia seriolae</i> (Monogenea: Capsalidae) parasitic on yellowtail kingfish, <i>Seriola lalandi</i>	I. Ernst & I.D. Whittington
Angela Pestell University of SA	Conservation biology of pygmy possums at Innes National Park	S. Petit (University of SA) & S. Cooper
Elizabeth Perkins	Multigene phylogenetic analyses of the Capsalidae (Platyhelminthes: Monogenea), ectoparasites of marine fish	I.D. Whittington, L.A. Chisholm & S.C. Donnellan
Sally Potter	Does mode of body temperature regulation influence the evolution of SP-C in mammals?	S. Orgeig, S. Donnellan & C. Daniels
Laura Rukys	Investigations of sarcoptic mange in southern hairy-nosed wombats (<i>Lasiiorhinus latifrons</i>) in the Murraylands of South Australia	W. Breed, & D. Taggart
Karleah Trengove	Reproductive suppression and sociality in the spinifex hopping mice (<i>Notomys alexis</i>)	W. Breed, & S. Carthew
Klara Verbyla	Covariation: statistical methods for identification and the V3 loop	J. da Silva
Becky Wade	Determination of the morphological variability of spermatozoa in the adult red veld rat (<i>Aethomys ineptus</i>)	W. Breed
Thomas Whittington	V3 loop structural properties and modelling of mutation of HIV-1	J. da Silva
Maria Zammit	Functional analysis of the neck in elasmosaurs	C. Daniels & B. Kear

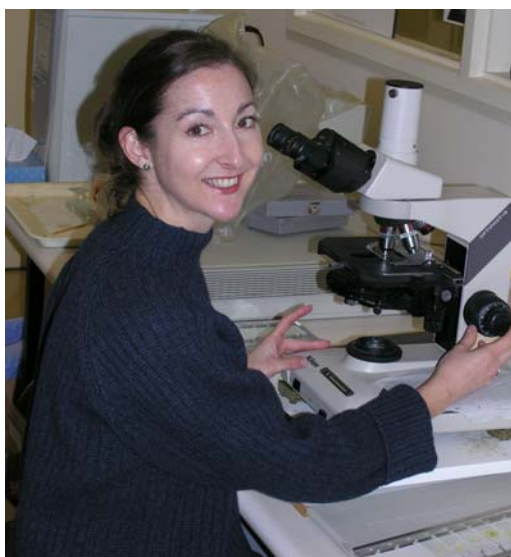
MSc Students		
Name	Project Title	Supervisor(s)
Dani Maver	Steroid hormones in peripheral blood and the control of oestrous cycle length in the long-nosed potoroo	W. Breed & D. Taggart

PhD Students		
Name	Project Title	Supervisor(s)
Adam Allford	Biology and ecology of stygofauna in the Yilgan region of Western Australia	A.D. Austin, S. Cooper & M. Guzik
Jenny Barker	Identifying the wood used in Aboriginal artifacts	R. Hill & P. Clarke
Melissa Bauer	Sperm pleiomorphism in Australian native rodents	W. Breed, M. Ricci & E. Peirce
Helen Blacker	Regenerating lizard tails: a model for understanding the process of lymphangiogenesis	S. Orgeig & C. Daniels
Andrew Breed	Are black flying foxes a possible vector of Nipa virus?	J. Meers, (Univ. of Queensland), H. Field, (Qld DPI) & S. Donnellan
Meredith Brown	The mating system, reproductive ecology and conservation status of the yellow-bellied glider (<i>Petaurus australis</i>).	S. Carthew & S. Cooper
Lyda Castro, University of Wollongong	Mitochondrial genome organisation in the insect order Hymenoptera	M. Dowton (Univ. of Wollongong) & A.D. Austin
Sylvia Clarke	Impact of management practices on invertebrate biodiversity in the Flinders Ranges, South Australia	A.D. Austin, J. Facelli & A. Andersen
Wetjens Dimmlich	Spawning in anchovies	W. Breed, T. Ward (SARDI Aquatic Sciences) & M. Geddes
Alison Fitch, Flinders University	Molecular systematics and phylogeography of Australian goannas	A. Goodman (Flinders Univ.) & S. Donnellan
Ana Glavinic, Flinders University	Systematics and phylogeography of <i>Neotrigonia</i> (Bivalvia)	G.W. Rouse
Vanessa Glennon	Monogenean parasites of the southern fiddler ray, <i>Trygonorrhina fasciata</i> : an exceptional model to investigate parasite biology, ecology, infection dynamics, microhabitat selection and speciation	I.D. Whittington & L.A. Chisholm
Travis Gotch	Population and conservation biology of mound springs spiders in South Australia	A.D. Austin & M. Keller
Greg Guerin	Revision of the <i>Hemigenia/Microcorys</i> group (Labiatae)	R. Hill & W. Barker
Debra Gum	The effect of environment on lung and surfactant development	S. Orgeig & C. Daniels
Nilanaga Gunawardana	Impact of DNA degradation on the reliability of DNA fingerprinting	M. Henneberg & S. Donnellan
Jaro Guzinski, Flinders University	Genetic population structure in parapatric ticks	M. Bull (Flinders University) & S. Donnellan
Magda Halt	Phylogeny of Cirratuliformia (Polychaeta) and assessment of the Barcode of Life program	G. Rouse
Elise Head	Biology of gall-forming <i>Fergusonina-Fergusobia</i> (Diptera, Nematoda) on eucalypt trees	I. Riley, K. Davies, G. Taylor & A.D. Austin
Kris Helgen	Rodent systematics in southeast Asia	T. Flannery & R. Hill
Kate Hutson	Parasite interactions of wild and farmed kingfish (<i>Seriola lalandi</i>) in Spencer Gulf, South Australia	I.D. Whittington & I. Ernst
Takeshi Kawakami, University of NSW	Systematics, phylogeography and speciation of chromosomally diverse Australian morabine grasshoppers	D. Paull (Univ. of NSW), Dr S. Cooper, R. Butlin

PhD Students		
Name	Project Title	Supervisor(s)
Mansoureh Malekian	Conservation biology of the sugar glider, <i>Petaurus breviceps</i>	S. Carthew & S. Cooper
Mansour Mohamadian	Stomatal wax plugs and desiccation avoidance	J. Watling & R. Hill
Dani Maver	Steroid hormones in peripheral blood and the control of oestrous cycle length in the long-nosed potoroo	W.G. Breed & D.A. Taggart
Radika Michniewicz, Flinders University	Long term monogamy in the sleepy lizard <i>Tiliqua rugosa</i> .	M. Bull (Flinders University) & S. Cooper
Natalie Miller	Evolution of a physiological system: the effect of pressure on the pulmonary surfactant system of diving mammals	C. Daniels & S. Orgeig
Ben Moretti	Development of bioinformatic tools for handling biological collections	A.D. Austin & R.S. Hill
Allan Mooney	Biology of <i>Zeuxapta seriola</i> from the gills of <i>Seriola lalandi</i> (Carangidae)	I.D. Whittington & I. Ernst
Tim Moulds	Ecology and conservation of a unique guanophilic invertebrate community	A.D. Austin & J.T. Jennings
Kate Muirhead	Biosystematics and biology of the <i>Cotesia flavipws</i> complex of wasps	A.D. Austin & S. Donnellan
Paul Oliver	Evolution in the <i>Diplodactylus vittatus</i> complex	M. Hutchinson & S. Donnellan
Kym Ottewell	Pollen mediated gene flow in woodland eucalypts	D. Paton & S.C. Donnellan
Cate Paull	Beneficial arthropods in Coonawarra vineyards	A.D. Austin & N. Schellhorn
Rosemary Paull	The plant macrofossils from the Miocene of Kiandra, N.S.W	R. Hill & J. Watling
Mario Ricci	The structure and function of the sperm cytoskeleton in marsupial mammals	W.G. Breed
David Schmarr	Stock assessment of slimy mackerel (<i>Scomber australasicus</i>) in southern Australia using parasites, genetics and otoliths	I.D. Whittington & T. Ward (SARDI Aquatic Sc.)
Adam Skinner	Systematics and evolution of <i>Lerista</i> (Scincidae, Squamata)	M. Lee and M. Hutchinson
Elisa Sparrow	Reproductive biology and genetical relationships in wombats	W. Breed & D. Taggart
Claire Stephens	The impact of weeds invasions on insect diversity and associated community structure and processes	A.D. Austin & J. Facelli
Nicholas Stevens	Systematics of Australian agathidine wasps (Insecta: Hymenoptera: Braconidae); solitary endoparasitoids of lepidopteran leaf-rolling larvae	A.D. Austin & J.T. Jennings
Christine Swann	The evolution and function of the zona pellucida in Australian rodents	W. Breed & S. Cooper
Duncan Taylor, Flinders University	Population structure and molecular evolution in pythons	A. Goodman (Flinders Univ.) & S. Donnellan
Nuttawat Tithipramote	Seasonal changes in germ cell production in bandicoot rats	W. Breed, J. Suwanjarat (Prince Songkla University, Thailand)
Fraser Vickery	The effect of fire on narrow leaf mallee (<i>Eucalyptus cneorifolia</i>) ecosystems on Kangaroo Island using ants as bio-indicators	S. Taylor & J.T. Jennings
Elaine Vytopil	Phylogeography of kelp	S.C. Donnellan & S.L. Connell
Rissa Williams	Novel treatments for Monogenea infecting commercially important finfish species in aquaculture	I. Ernst & I. Whittington

PhD Students		
Name	Project Title	Supervisor(s)
Pakawadee Worawittayawong	Dynamics of sperm production and morphogenesis of sperm form in the SE Asian rodent <i>Bandicota indica</i>	W. Breed, P. Sretagusa (Mahidol University, Thailand)
Zheng Qi Zhao	Taxonomy, biology and pathogenicity of nematodes associated with pine trees and other conifers in Australia	K. Davies, I. Riley, J. Nobbs (SARDI) & Smith (Forestry Victoria)

Student Completions		
Name	Ph.D. Thesis	Supervisor(s)
Natalie J. Miller	The evolution of a physiological system: The pulmonary surfactant system in diving mammals	C. Daniels & S. Orgeig



Above: PhD candidate Venessa Glennon, winner of a best conference presentation – see page 22.

Below: PhD candidate Takeshi Kawakami undertaking fieldwork on Kangaroo Is.



COMMUNICATION

Website

The CEBB website is at <http://www.ees.adelaide.edu.au/research/cebb/> and provides a portal into the activities of the Centre. It includes information on staff, students, research programs, funding, conferences and useful links to other sites. Unfortunately significant delays with the redesign of the School of Earth & Environmental Sciences website has prevented the final development of the CEBB site, but this should be completed by mid 2006.

CEBB Seminar Series

Date	Speaker, Title
24 May 2005	Prof. Arthur Georges , Institute for Applied Ecology, University of Canberra "Temperature-dependent sex determination in reptiles: How the physical and the physiological conspire to defeat global climate change"
8 August 2005	Prof. Craig Moritz , Director, Museum of Vertebrate Zoology, The University of California, Berkeley "The Grinnell Project: Changes in the terrestrial vertebrate fauna of Yosemite National Park over 100 years"
9 August 2005	Dr Mike Kearney , Centre for Environmental Stress and Adaptation Research, Department of Zoology, The University of Melbourne "The origin and spread of parthenogenesis in the Australian desert"
17 August 2005	Prof. Christine Janis , Department of Ecology and Evolutionary Biology, Brown University, Providence, Rhode Island "What can fossil mammal communities tell us about climatic and vegetational change? Alternative views on the evolution of the North American Miocene savannah fauna"
15 September 2005	Dr Gerry Cassis , Australian Museum, Sydney "The Planetary Biodiversity Inventory: Plantbug systematics, global cooperation and industrial taxonomy"
1 December 2005	Prof. Scott Edwards , Department of Organismic and Evolutionary Biology, Harvard University "Phylogenomics: BAC libraries as tools for phylogeny and phylogeography"

Conference Presentations

- Able, A.J., J. Randles, E. Scott, G. McDonald, C. Preston, J. Jennings, O. Schmidt & M. Keller. Development of postgraduate programs in plant health. *15th Australian Plant Pathology Society Conference, Deakin University.*
- Allford, A., S. Cooper, M. Guzik, W. Humphreys & A. Austin. The ecology of groundwater fauna from calcrete aquifers of the Yilgan region of Western Australia. *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- Austin, A.D. Funding and training of systematic science in Australia – what trends, what future? *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- Blacker, H.A., C. Tsopelas, S. Orgeig, C.B. Daniels & B.E. Chatterton. Lymphatic flow and migration of different sized colloids in regenerating lizard tails. *5th World Congress of Herpetology, Stellenbosch, South Africa.*
- Breed, W. Variation in morphology of the male accessory sex glands of New Guinea murine rodents- phylogenetic implications? *51st Australian Mammal Society meeting, Albany.*
- Carey, D., N.P. Murphy & A.D. Austin. Molecular phylogenetics and the evolution of wing reduction in a tribe of parasitoid wasps (Scelionidae: Baeini). *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- Chisholm L., T. Anderson & I. Whittington. Microhabitat selection of gill monacotylids from the giant shovelnose ray, *Rhinobatos typus*, at Heron Island, Great Barrier Reef, Australia. *Fifth International Symposium on Monogenea (ISM5), August 8-12 2005, Sun Yat-Sen University, Guangzhou, China.*
- Chisholm L. & I. Whittington. Biology and systematics of the Capsalinae (Capsalidae). *Fifth International Symposium on Monogenea (ISM5), August 8-12 2005, Sun Yat-Sen University, Guangzhou, China.*
- Collier, N., M. Gardner, M. Adams, D.A. Mackay, K. Benkendorff, A.D. Austin & S.M. Carthew. Genetic effects of landscape and habitat fragmentation on a lycaenid butterfly, *Theclinesstes albocincta* (Lepidoptera: Lycaenidae). *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- Collier, N., D.A. Mackay, K. Benkendorff, A.D. Austin & S.M. Carthew. Butterfly communities in South Australian urban reserves: Estimating diversity using the pollard walk. *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- Cooper, S., R. Leys, J. Bradbury, K. Saint, S. Taiti, M. Guzik, A. Allford, C. Watts, A. Austin, & W. Humphreys. Identifying mechanisms of speciation in subterranean cave organisms. *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- da Silva, J. Simulating realistic selection at the molecular level: A method and its implementation with HIV-1. *Molecular Biology and Evolution 05, June 19-23, 2005, Auckland, New Zealand.*
- Ernst I., C. Chambers & I. Whittington. Toward efficient management of monogenean parasites in sea cage aquaculture: parasite management strategies for established and emerging industries. *Fisheries Research & Development Corporation Aquatic Animal Health Subprogram Scientific Conference, July 26-28 2005, Cairns, Queensland, Australia.*
- Foster, W., D. Taggart, W. Breed & S. Donnellan. Reproductive biology of the red-tailed phascogale *Phascogale calura*. *The 51st Australian Mammal Society meeting Albany WA.*

- Glennon V., L. Chisholm & I. Whittington. Infection strategies of three different species of Monogenea from the southern fiddler ray, *Trygonorrhina fasciata*, off Adelaide, South Australia. *Fifth International Symposium on Monogenea (ISM5)*, August 8-12 2005, Sun Yat-Sen University, Guangzhou, China.
- Guzik, M.T., Cooper, W. Humphreys, C. Watts & A. Austin. Comparative phylogeography of stygofauna from calcrete aquifers of central Western Australia: Speciation patterns in subterranean islands. *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- Guzik, M.T., S.J.B. Cooper, W.F. Humphreys, C.H.S. Watts & A. D. Austin. Identifying mechanisms of speciation in subterranean cave organisms. *Molecular Biology & Evolution Conference, Auckland.*
- Hill, R.S. Palaeobotanical record of aridification. *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra..*
- Humphreys, W.F., W.H., Watts, C. H. S., Cooper, S. J.B., Leijes, R. & Bradbury, J. L. Groundwater estuaries of salt lakes: buried pools of endemic biodiversity on the western plateau, Australia. *9th Conference of the International Society for Salt Lake Research (26th – 30th Sept 2005) Curtin University.*
- Jennings, J.T. Entomological employment in Australia. *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- Jennings, J.T., A.D. Austin & N.B. Stevens. Systematics of Australasian Aulacidae (Hymenoptera: Evanioidea). *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- Jennings, J.T. & N. Schiff. Systematics of Australian woodwasps (Xiphydriidae). *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- Kranz B.D., Morris D.C. & Mound L.A. Facultatively ovoviviparous thrips: The coevolution of egg retention and sex allocation. *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- Lackenby J.A., I. Ernst & I.D. Whittington. Life cycle parameters of *Benedenia seriola* (Monogenea: Capsalidae) parasitic on yellowtail kingfish *Seriola lalandi*. *Twentieth International Conference of the World Association for the Advancement of Veterinary Parasitology incorporating the Annual Scientific Meeting of the Australian Society for Parasitology Inc., October 16-20 2005, Christchurch, New Zealand.*
- Leijes, R., Cooper, S.J.B., Watts C.H.S. & W.F. Humphreys. Speciation modes of diving beetles in the arid zone of Australia. *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- Leijes, R., C.H.S. Watts, S.J.B. Cooper, & W.F. Humphreys. Multiple body size classes of subterranean diving beetle species (Coleoptera: Dytiscidae: Bidessini, Hydroporini) repeated in numerous aquifers in arid Australia. *BES Conference, September.*
- Mooney A., I. Ernst & I.D. Whittington. Generation time of *Zeuxapta seriola* (Monogenea: Heteraxinidae), a gill parasite of yellowtail kingfish (*Seriola lalandi*), at different water temperatures. *Fifth International Symposium on Monogenea (ISM5)*, August 8-12 2005, Sun Yat-Sen University, Guangzhou, China.

- Mooney A., I. Ernst & I.D. Whittington. Egg-laying strategies for the monogeneans, *Heteraxine heterocerca* (Polyopisthocotylea) and *Benedenia seriola* (Monopisthocotylea), from the same fish host, *Seriola quinqueradiata*, in Japanese aquaculture. *Twentieth International Conference of the World Association for the Advancement of Veterinary Parasitology incorporating the Annual Scientific Meeting of the Australian Society for Parasitology Inc.*, October 16-20 2005, Christchurch, New Zealand
- Muirhead, K.A., A.D. Austin, M.N. Sallum & S.C. Donnellan. Genetic variation in the *Cotesia flavipes* complex of parasitic wasps: towards the effective biological control of stemborer pests in Australia. *Biology & Evolution Conference, Auckland.*
- Muirhead, K.A., A.D. Austin, M.N. Sallum & S.C. Donnellan. Resolution of the *Cotesia flavipes* complex of parasitic wasps: Towards the effective control of mothborers in Australia. *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- Murphy, N., V. Framenau, S. Donnellan, M. Harvey & A. Austin. How many times did the wolf spiders lose their webs? - A molecular phylogenetic study of web building in the Lycosidae. *Molecular Biology & Evolution Conference, Auckland.*
- Murphy, N.P., V.W. Framenau, S. Donnellan, M.S. Harvey & A.D. Austin. Molecular phylogenetic reconstruction of the wolf spiders (Araneae: Lycosidae): Implications for classification, biogeography and the evolution of web building behaviour. *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- Orgeig S. The utility of the comparative approach to understanding the surfactant system of mammals: Novel approaches, pitfalls and a new paradigm. Invited presentation in the symposium entitled "Comparative Genomics of the Lung"; *International Union of Physiological Sciences (IUPS), San Diego, USA, April 2005.*
- Paull, C., N. Schellhorn & A.D. Austin. Multispecies interactions: Wasp parasitism facilitates predation of tortricid larvae by predatory mites. *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- Perkins E., I. Whittington, L. Chisholm & S. Donnellan. A broader phylogenetic analysis of the Capsalidae (Monogenea: Monopisthocotylea) inferred from large subunit rDNA sequences. *Fifth International Symposium on Monogenea (ISM5), August 8-12 2005, Sun Yat-Sen University, Guangzhou, China.*
- Shinn A, J. Bron, C. Chambers, I. Ernst & I. Whittington. Benedeniines and the BEAST: benedeniine enumeration and segmentation techniques. *Fifth International Symposium on Monogenea (ISM5), August 8-12 2005, Sun Yat-Sen University, Guangzhou, China.*
- Sparrow, E., D. Taggart & W. Breed. Inbreeding and its effects on the reproductive parameters of male southern hairy-nosed wombats in South Australia. *The 51st Australian Mammal Society meeting, Albany WA.*
- Stephens, C.J., A.D. Austin & J.M. Facelli. The impact of weed invasion on parasitic wasp assemblages. *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- Stevens, N.B., N.P. Murphy, A.D. Austin & J.T. Jennings. An investigation of the little known agathidine (Hymenoptera: Braconidae) fauna of Australia. *Joint Conference: Australian Entomological Society's AGM and Scientific Conference, 7th Invertebrate Biodiversity and Conservation Conference, Society of Australian Systematic Biologists, Canberra.*
- Whittington I.D. The Entobdellinae (Monogenea: Capsalidae): recent research to unify the taxon. *Fifth International Symposium on Monogenea (ISM5), August 8-12 2005, Sun Yat-Sen University, Guangzhou, China. (Invited presentation).*

Whittington I.D. Fundamental knowledge of the monogenean life-cycle and how monogenean diversity in Australia can confront aquaculture. *Fifth International Symposium on Monogenea (ISM5), August 8-12 2005, Sun Yat-Sen University, Guangzhou, China.*

Whittington I.D. *Neobenedenia 'melleni'* (Monogenea: Capsalidae): what is it, where is it and what does it infect? *Fifth International Symposium on Monogenea (ISM5), August 8-12 2005, Sun Yat-Sen University, Guangzhou, China.*

Williams R., I. Ernst, C. Chambers & I.D. Whittington. Efficacy of orally-administered praziquantel against monogenean parasites infecting sea-caged yellowtail kingfish *Seriola lalandi*. *Sixth Symposium on Diseases in Asian Aquaculture (DAA VI), October 24-28 2005, Colombo, Sri Lanka.*



Dr Ian Whittington, Dr Leslie Chisholm and Vanessa Glennon examining a marlin for monogenean parasites at Port Stephens, NSW – see page 20

NATIONAL & INTERNATIONAL COLLABORATIONS

Members of the Centre have very strong links with research groups around Australia and internationally. These have resulted in several initiatives, as well as numerous joint grant applications and co-authored publications during 2005. Some of the major linkages with members of the Centre over this period are:

■ Professor Andy Austin

- Dr Mark Dowton, University of Wollongong, Project: *The molecular evolution and phylogeny of the parasitic Hymenoptera*.
- Dr Mark Harvey, Western Australian Museum, Project: *The systematics and phylogeny of Australian lycosid spiders*.
- Dr Bill Humphries, Western Australian Museum, Project: *The evolution and diversity of stygofauna associated with calcretes in the Yulgan region of Western Australia*.
- Dr John La Salle, CSIRO, Entomology, Project: *Development of an interactive platform for the identification of Australasian Hymenopteran families*.
- Dr Norman Johnson, Ohio State University, Project: *Phylogeny and higher-level classification of platygastroid wasps*.
- Dr Jim Whitfield, University of Illinois, Project: *Phylogeny of microgastroid braconid wasps*.

■ Dr W.R. (Bill) Barker

- Dr P. Beardsley, Idaho State University, USA, Project: *Molecular studies in the subtribe Mimulineae (Scrophulariaceae)*.
- Prof. Michael Kiehn, Department of Biogeography and Botanical Garden, Vienna, Project: *Chromosomal evolution of Stackhousiaceae*.

■ Dr William Breed

- Prof M Eddy - NIH, Research Triangle, North Carolina, Project: *Marsupial sperm tail cytoskeletal proteins*.
- Dr Larry Heaney - Field Museum of Natural History, Chicago, Project: *Evolution of sperm morphology of Philippine rodents*
- Prof. Tim Birkhead - Dept of Plant and Animal Sciences, University of Sheffield, Project: *Sperm cooperation and sperm motility in mammals*.
- Prof Richard Oko - Queens University, Kingston, Ontario Canada, Project: *Cytoskeletal proteins in the sperm head of murid rodents*.
- Dr. Jamie Chapman - Discipline of Anatomy and Physiology, University of Tasmania, Project: *Glycoproteins of the marsupial egg coat*.

■ Dr Jack da Silva

- Drs Kyle Summer and Tom McConnell, East Carolina University, Project: *Evolutionary Dynamics of the DAB and DXB MHC II loci in Xiphophorus fishes*.

Professor Bob Hill

- Dr Sung Soo Whang, Chonbuk National University, South Korea, Project: *Conifer morphology*.
- Dr Tim Brodribb, Harvard University, Project: *Conifer ecophysiology*.
- Assoc. Prof. Andrew Drinnan, University of Melbourne, Project: Plant macrofossil evidence for evolution of the Australian vegetation.

Dr Mark Hutchinson

- Arthur Georges, Canberra University, Project: *Conservation Biology of the broad-shelled turtle*
- Mike Bull, Flinders University, Project: *Conservation biology of endangered lizards (Tiliqua and Egernia)*
- David Chapple, Victoria University of Wellington, Project: *Evolution of the Egernia whitii complex*

Dr John Jennings

- Dr David Smith, Systematic Entomology Laboratory, National Museum of Natural History, Smithsonian Institution, Washington, D.C., Project: *Revision of miscellaneous Pseudofoenus and Gasteruption spp. (Hymenoptera: Gasteruptionidae)*.
- Dr Nathan Schiff, USDA Forest Service, Center for Bottomland Hardwoods Research, Stoneville, Project: *Revision of the Australasian wood-boring sawflies (Hymenoptera: Xiphydriidae)*.
- Dr Andy Deans, Department of Entomology, University of Illinois, Urbana, Project: *Revision of Australian hatchet wasps (Hymenoptera: Evaniidae)*.
- Dr Alexandre Aguiar, Museu de Zoologia da Universidade de São Paulo, Brazil, Project: New Caledonian Stephanidae.

Dr Brenda Kranz

- Dr David Morris, ANU, Project: *The evolution of egg retention and sex allocation in facultatively ovoviviparous thrips*
- Prof Laurance Mound, ANIC, CSIRO Entomology, Project: *The evolution of egg retention and sex allocation in facultatively ovoviviparous thrips*
- Prof Koji Tsuchida, Gifu University Japan, Project: *The evolution of egg retention and sex allocation in facultatively ovoviviparous thrips*
- Dr Arturo Goldarazena, NEIKER, Research Institute, SPAIN, Project: *The evolution of egg retention and sex allocation in facultatively ovoviviparous thrips*

Associate Professor Mike Lee

- John Scanlon, University of NSW and Outback at Isa, Project: *Early snake evolution*.
- Mike Caldwell, University of Alberta, Edmonton, Project: *Marine reptiles*
- Tod Reeder, San Diego State University, San Diego, Project: *The deep scaley project (NSF Tree of Life grant)*.

■ Dr Remko Leijds

- Dr Bill Humphries, Western Australian Museum, Project: *The evolution of subterranean waterbeetles.*
- Dr Lindell Bromham, University of Sussex, Project: *The effect of eusociality and population size on the rate of molecular evolution.*
- Dr James Wallman, University of Wollongong, Project: *Molecular Phylogeny of Australian carrion-breeding blowflies.*
- Stefan Eberhard, CALM, WA, Project: *Conservation of cave-dwelling amphipods in southwestern Western Australia.*
- Dr Michael Batley, Australian Museum, Project: *Taxonomic revision of the Australian bee species belonging to the genus Amegilla.*
- Dr Jim Mitchell, Flinders University, Project: *Development and implementation of biodiversity information for sustainable management of South Australian groundwater.*

■ Associate Professor Sandra Orgeig & Professor Chris Daniels

- Dr Steven Stacker and Dr Marc Achen, Ludwig Institute for Cancer Research, Melbourne, Project: *The role of vascular endothelial growth factors C & D (VEGF-C & -D) in lymphangiogenesis in regenerating gecko tails.*
- Dr Chris Tsopelas and Dr Barry Chatterton, Department of Nuclear Medicine, Royal Adelaide Hospital, Project: *The functional development of the lymphatic system in regenerating gecko tails.*
- Prof. Sam Schürch, University of Calgary, Prof. Fred Possmayer, University of Western Ontario, Dr Kaushik Nag, Memorial University, Newfoundland, Canada, Project: *Effects of temperature on the biophysical function of pulmonary surfactant.*
- Dr Tony Postle, University of Southampton, UK, Project: *Analysis of the molecular composition of surfactant samples of model species, to determine the effect of temperature on surfactant composition.*

■ Dr Greg Rouse

- Igor Eeckhaut, Laboratory of Marine Biology University of Mons, Project: *Systematics of Myzostomida.*
- Gonzalo Giribet, Museum of Comparative Zoology, Harvard University, Project: *Phylogeny of Metazoa.*
- Greg Edgecombe Australian Museum, Project: *Phylogeny of Metazoa.*
- Shana Goffredi, Monterey Bay Aquarium Research Institute, Project: *Taxonomy of whalefall organisms.*
- Fredrik Pleijel, Muséum national d'Histoire naturelle, Project: *Polychaete phylogeny.*
- Mark Siddall, American Museum of Natural History, Project: *Polychaete phylogeny.*
- Bob Vrijenhoek, Monterey Bay Aquarium Research Institute, Project: *Taxonomy of whalefall organisms.*

■ Dr Ian Whittington

- Dr Emma Fajer-Avila, Centro de Investigación en Alimentación y Desarrollo (CIAD), Unidad de Investigación en Acuicultura y Manejo Ambiental de CIAD, Mazatlán, Mexico, Project: *Neobenedenia 'melloni' on cultured pufferfish, Sphoeroides annulatus.*

- Roxana Inohuye Rivera and Juan Calos Pérez Urbiola, Centro de Investigaciones Biológicas del Noroeste (CIBNOR), La Paz, Mexico, Project: *Complexities in the systematics of Neobenedenia 'species' known to occur on marine fishes in the region.*
- Dr Graham Kearns, University of East Anglia, Norwich, U.K., Project: *Systematics of capsalid Monogenea from stingrays and flatfish teleosts.*
- Federico José Rotman, Kona Blue, Holuolua, Hawaii, USA, Project: *Pathogenic Monogenea in finfish aquaculture.*
- Dr Andy Shinn, Institute of Aquaculture, University of Stirling, Scotland, Project: *Image analysis and recognition of parasites using image recognition software.*

Dr Ian Whittington and Dr Leslie Chisholm

- Professor Kurt Buchmann, Royal Veterinary & Agricultural University, Frederiksberg, Denmark, Project: *Problematic parasites in aquaria and aquaculture.*
- Professor Janine Caira, University of Connecticut, Dr Kirsten Jensen, University of Kansas, Dr Gavin Naylor, Florida State University, Drs Peter Last and John Stevens, CSIRO Marine Research, Hobart, Project: *Collections of parasites from sharks and rays from Sarawak and Sabah, Malaysian Borneo.*
- Dr Kevin Christison, University of the Western Cape, South Africa, Project: *Monogenea of elasmobranchs and teleosts in public aquaria.*
- David Vaughan, Two Oceans Aquarium, Cape Town, South Africa, Project: *Monogenea of elasmobranchs and teleosts in public aquaria.*



Flowers of *Tricoryne humilis* – see research report for Dr John Conran, page 15.

BUDGET

The Centre continues to fund its core functions from its original set-up grant in 2000 and profits from a conference held in 2001. It has received no further funding from the University. Major expenses incurred by CEBB in 2005 were for travel and living expenses for invited speakers and members of the external Advisory Board, and for communication activities. The annual cost of running CEBB in 2005 was \$3,394, slightly less than in 2004 but it should be noted that this is in the absence of any new initiatives.

CEBB 2005 Financial Summary

Opening Balance 2005		\$13,684.54
Income		0.00
Expenditure		
2744	Printing	281.82
2753	Promotional and sponsorship costs	216.64
2763	Telecommunications	216.88
2781	Accommodation and meals (domestic)	558.18
2783	Airfares (domestic)	1,381.665
3014	2004 annual report	229.25
2332	Conference registration (ARC Network meeting)	509.09
Total Expenditure		3,393.52
Closing Balance		\$10,291.02

PUBLICATIONS

Refereed Papers

- Aguiar, A.P. & J.T. Jennings (2005) First record of Stephanidae (Hymenoptera) from New Caledonia, with descriptions of four new species of *Parastephanellus* Enderlein. *Zootaxa* 1001: 1-16.
- Austin, A.D. & I. Iqbal (2005) A new species of *Cyphacolus* Priesner (Hymenoptera: Scelionidae) from Australia with a discussion of generic relationships within the Baeini. *Acta Societatis Zoologicae Bohemicae* 69: 17-23.
- Austin, A.D., N.F. Johnson & M. Dowton (2005) Systematics, evolution and biology of scelionid and platygastriid wasps. *Annual Review of Entomology* 50: 553-582.
- Barker, W.R. & Barker, R.M. (2005) The census of South Australian vascular plants – a catalogue of changing knowledge. *Journal of the Adelaide Botanic Gardens, Supplement* 1: 1-17.
- Barker, W.R., Barker, R.M., Jessop, J.P. & Vonow, H.P. (2005) Census of South Australian vascular plants. (edn 5). *Journal of the Adelaide Botanic Gardens, Supplement* 1: 1-396.
- Bauer, M., C.M. Leigh, E. Peirce, & W.G. Breed (2005) Comparative study of sperm chromatin condensation in the excurrent ducts of the laboratory mouse *Mus musculus* and spinifex hopping mouse *Notomys alexis*. *Reproduction, Fertility & Development* 17: 611-616.
- Beardsley P.M. & Barker, W.R. (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.
- Breed, W.C. (2005) Evolution of the spermatozoon in muroid rodents. *Journal of Morphology* 265: 271-290.
- Brodribb, T.J., Holbrook, N.M. & Hill, R.S. (2005) Seedling growth in conifers and angiosperms: impacts of contrasting xylem structure. *Australian Journal of Botany* 53: 749-755.
- Bromham, L. & Leijes R. (2005) Sociality and the rate of molecular evolution. *Molecular Biology & Evolution* 22:1393-1402.
- Carpenter, R.J., Hill, R.S. & Jordan, G.J. (2005) Leaf cuticular morphology links Platanaceae and Proteaceae. *International Journal of Plant Science* 166: 843-855.
- Chapple, D., G., Keogh, J. S. & Hutchinson, M. N. (2005) Substantial genetic substructuring in southeastern and alpine Australia revealed by molecular phylogeography of the *Egernia whitii* (Lacertilia: Scincidae) species group. *Molecular Ecology* 14: 1279-1292.
- Chisholm L.A. & I.D. Whittington (2005) *Decacotyle cairae* n. sp. (Monogenea: Monocotylidae) from the gills of *Pastinachus* sp. (Elasmobranchii: Dasyatidae) from the South China Sea off Sarawak, Borneo, Malaysia. *Systematic Parasitology* 61: 79-84.
- Chisholm L.A. & I.D. Whittington (2005) *Dendromonocotyle lasti* n. sp. from the skin and *Monocotyle caseyae* n. sp. (Monogenea: Monocotylidae) from the gills of *Himantura* sp. (Dasyatidae) from Moreton Bay, Queensland, Australia. *Systematic Parasitology* 60: 81-89.
- Chisholm L.A. & I.D. Whittington (2005) *Empruthotrema stenophallus* n. sp. (Monogenea: Monocotylidae) from the nasal tissue of *Dasyatis kuhlii* (Dasyatidae) from Sabah, Borneo, Malaysia. *Journal of Parasitology* 91: 522-526.
- Chisholm L.A., V. Glennon & I.D. Whittington (2005) *Dendromonocotyle bradsmithi* n. sp. (Monogenea: Monocotylidae) from the skin of *Myliobatis australis* (Elasmobranchii: Myliobatidae) off Adelaide and Perth, Australia: description of adult and larva. *Zootaxa* 951: 1-15.
- Eberhard, S., Leijes, R., & Adams, M. (2005) Conservation of subterranean biodiversity in Western Australia: using molecular genetics to define spatial and temporal relationships in two species of cave dwelling Amphipoda. *Subterranean Biology* 3:13-27.
- Ernst I., I.D. Whittington, S. Corneillie & C. Talbot (2005) Effects of temperature, salinity, desiccation and chemical treatments on egg embryonation and hatching success of *Benedenia seriola* (Monogenea: Capsalidae), a parasite of farmed *Seriola* spp. *Journal of Fish Diseases* 28: 157-164.

- Glennon V., L.A. Chisholm & I.D. Whittington (2005) *Branchotenthes octohamatus* sp. n. (Monogenea: Hexabothriidae) from the gills of the southern fiddler ray, *Trygonorrhina fasciata* (Rhinobatidae) in South Australia: description of adult and larva. *Folia Parasitologica* 52: 223-230.
- Goffredi, S.K., V.J. Orphan, G.W. Rouse, L. Jahnke, T. Embaye, K. Turk, R. Lee & R.C. Vrijenhoek (2005) Evolutionary innovation: A bone-eating marine symbiosis. *Environmental Microbiology* 7: 1369-1378.
- Guerin, G. (2005) Floral biology of *Hemigenia* and *Microcorys* (Lamiaceae). *Australian Journal of Botany* 53: 147–162
- Hutchinson, M.N., Thompson, M.B. & Stewart, J.R. (2005) *Lampropholis delicata* (Delicate Skink, Rainbow Skink). Introduction to Lord Howe Island. *Herpetological Review* 36: 450-451.
- Hyman, I. T., G. W. Rouse & W. F. Ponder (2005) Systematics of *Ophicardelus* (Gastropoda: Heterobranchia: Ellobiidae). *Molluscan Research* 25: 14-26
- Jennings, J.T. & A.D. Austin (2005) *Pseudofoenus caledonicus*, a new species of hyptiogastrine wasp (Hymenoptera: Gasteruptiidae) from New Caledonia. *Journal of Australian Entomology* 44: 415-419.
- Jennings, J.T. & D.R. Smith (2005) The taxonomic placement of several New World and Oriental gasteruptiid wasps (Hymenoptera: Gasteruptiidae). *Proceedings of the Entomological Society of Washington* 107: 686-692.
- Kearn G.C. & I.D. Whittington (2005) *Neoentobdella* gen. nov. for species of *Entobdella* Blainville in Lamarck, 1818 (Monogenea, Capsalidae, Entobdellinae) from stingray hosts, with descriptions of two new species. *Acta Parasitologica* 50: 32-48.
- Kranz, B.D. (2005) Egg size and reproductive allocation in eusocial thrips. *Behavioral Ecology* 16: 779-787.
- Lang, C.J., A.D. Postle, S. Orgeig, F. Possmayer, W. Bernhard, A.K. Panda, K.D. Jürgens, W.K. Milsom, K. Nag & C.B. Daniels (2005) Dipalmitoylphosphatidylcholine is not the major surfactant phospholipid species in all mammals. *American Journal of Physiology* 289: R1426–R1439.
- Lee, M. S. Y. (2005) Choosing stable reference taxa in phylogenetic nomenclature. *Zoologica Scripta* 34: 313-318.
- Lee, M.S.Y. (2005) Squamate phylogeny revisited: taxon sampling, character analysis, and data congruence. *Organisms Diversity and Evolution* 5: 25-45.
- Lee, M.S.Y. (2005) Molecular evidence and snake origins. *Biology Letters of the Royal Society of London* 1: 227-230.
- Leijds, R., Steven J. B. Cooper, U. Strecker & H. Wilkens (2005) Regressive evolution of an eye pigment gene in independently evolved eyeless subterranean diving beetles. *Biology Letters of the Royal Society of London* 1: 496-499
- Mackie, A.S.Y., Pleijel, F. & Rouse, G.W. (2005) Revision of *Aberranta* (Aberrantidae: Annelida), with descriptions of new species from the Mediterranean and Hong Kong. *Marine Ecology* 26: 197-208.
- Miller, N.J., A.D. Postle, S. Schürch, W.M. Schoel, C.B. Daniels & S. Orgeig (2005) The development of the pulmonary surfactant system in California sea lions. *Comparative Biochemistry & Physiology A* 141:191-199.
- Miller, N.J., C.B. Daniels, S. Schürch, W.M. Schoel, S. Orgeig (2005) The surface activity of pulmonary surfactant from diving mammals. *Respiratory Physiology & Neurobiology* 150: 220-232.
- Pleijel, F. & G.W. Rouse (2005) *Lizardia hirschi*, a new hesionid polychaete with external genital organs from the Great Barrier Reef. *The Biological Bulletin* 208: 69-76
- Pleijel, F. & G.W. Rouse (2005) A revision of *Micropodarke* (Psamathini, Hesionidae, Polychaeta). *Journal of Natural History* 39: 1313-1325.
- Read, J., Hope, G.S. & Hill, R.S. (2005) Phytogeography and climate analysis of *Nothofagus* subgenus *Brassospora* in New Guinea and New Caledonia. *Australian Journal of Botany* 53: 297-312.
- Reed, E. H. & Hutchinson, M. N. (2005) First record of a giant varanid (*Megalania*, Squamata) from the Pleistocene of Naracoorte, South Australia. *Memoirs of the Queensland Museum* 51: 203-213.

- Ricci, M. & W.G. Breed (2005) Morphogenesis of the fibrous sheath in the marsupial spermatozoon. *Journal of Anatomy* 207: 155-164.
- Rouse, G.W. (2005) Annelid sperm and fertilization biology. *Hydrobiologia* 535: 167-178.
- Rouse, G.W. & M.J. Grygier (2005) *Myzostoma seymourcollegiorum* n.sp. (Myzostomida) from southern Australia, with a description of its larval development. *Zootaxa* 1010: 53-64.
- Santos, C.S.G., F. Pleijel, P. Lana & G.W. Rouse (2005) Phylogenetic relationships within Nereididae (Annelida, Polychaeta). *Invertebrate Systematics* 19: 557-576.
- Simon, C.A. & G.W. Rouse (2005) Sperm ultrastructure, spermiogenesis and spermathecal structure in *Terebrasabella heterouncinata* (Polychaeta: Sabellidae: Sabellinae). *Invertebrate Biology* 125: 39-49.
- Tait C., C.B. Daniels & R. Hill (2005) Changes in species assemblages within the city of Adelaide, South Australia, 1836 to 2002. An urban ecological study. *Ecological Applications* 15: 346-359
- Wallman, J. F., Leijds, R. & Hogendoorn, K. (2005) Molecular systematics of Australian carrion-breeding blowflies (Diptera: Calliphoridae) based on mitochondrial DNA. *Invertebrate Systematics* 19:1-15.
- Watts, C.H.S. & Leijds R. (2005) Review of the epigeal species of Australian *Limbodessus* Guignot (Insecta: Coleoptera: Dytiscidae). *Transactions of the Royal Society of South Australia*. 129:1-13.
- Whittington I.D. & G.C. Kearn (2005) The precocious oncomiracidium of *Neoentobdella parvitesticulata* (Monogenea: Capsalidae: Entobdellinae). *Parasitology Research* 96: 331-334.
- Worawittayawong, P., C.M. Leigh, G. Cozens, E.J. Peirce, B.P. Setchell, P. Sretarugsa, A. Dharmarajan, & W.G. Breed (2005) Unusual germ cell organisation in the seminiferous epithelium of a murid rodent from Southern Asia, the greater bandicoot rat, *Bandicota indica*. *International Journal of Andrology* 28: 180-188.
- Worsaae, K., A. Nygren, G.W. Rouse, G. Giribet, J. Persson, P. Sundberg & F. Pleijel (2005) Phylogenetic position of Nerillidae and *Aberranta* (Polychaeta, Annelida), analyzed by direct optimization of combined molecular and morphological data. *Zoologica Scripta* 34: 313-328

■ Books and Symposia Chapters

- Daniels, C.B. (2005) Future predictions: Adelaide in 2036. pp. 525-551. In: C.B. Daniels and Tait C (Eds) *Adelaide. Nature of a City: The Ecology of a Dynamic City from 1836 to 2036*. BioCity, Adelaide.
- Daniels, C.B. & Tait C. (2005) Editors of *Adelaide. Nature of a City: The Ecology of a Dynamic City from 1836 to 2036*. BioCity, Adelaide. 609 pp.
- Hopper, S.D., Dixon, K.W. & Hill, R.S. (2005) Australian seeds – an evolutionary perspective. In Sweedman, L. & Merritt, D. (eds) *Australian Seeds*. CSIRO, Melbourne.
- Lang, C.J., S. Orgeig & C.B. Daniels (2005) New Insights into thermal dynamics of the surfactant system from warm and cold animals. Chapter 2, pp. 17-57, In: Nag, K. (Ed.). *Lung Surfactant Function and Disorder. Lung Biology in Health and Disease Series, Volume 201*. Taylor & Francis Group, Boca Raton.
- Rouse, G.W. (2005) Fossil parasites. pp. 172-174, In K. Rohde (ed.) *Marine Parasites*, CSIRO Publishing, Melbourne.
- Rouse, G.W. (2005) Myzostomida. pp. 189-193. In K. Rohde (ed.) *Marine Parasites*, CSIRO Publishing, Melbourne.
- Rouse, G.W. (2005) Polychaeta. pp. 193-196. In K. Rohde (ed.) *Marine Parasites*, CSIRO Publishing, Melbourne.
- Rouse, G.W. (2005) Echinodermata. pp. 248-250. In K. Rohde (ed.) *Marine Parasites*, CSIRO Publishing, Melbourne.
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Other Publications

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- Rouse, G.W. (2005) Is our view of animal phylogeny fundamentally wrong? Book review: *The Origins of Larvae*. Williamson, D.I. *BioScience* 55: 81-82.
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RESEARCH GRANT FUNDING

2005

(members of CEBB in bold)				
Date	Investigators	Agency	Amount \$	Project Title
05-08	A.D. Austin	ABRS	110,000	Systematics of the Australian spider-hunting wasps
03-06	A.D. Austin, S.J. Cooper & W.F. Humphreys	ARC Linkage	228,000	Assessment of the diversity, distribution and uniqueness of subterranean animals from calcrete aquifers in central western Australia
03-06	A.D. Austin & S. Donnellan	ARC Linkage APAI	71,000	Genetic variation in the <i>Cotesia flavipes</i> complex of parasitic wasps: towards the effective biological control of stem-borer pests
02-05	A.D. Austin & J.T. Jennings	ARC Linkage APAI	71,000	Ecology and conservation of a unique threatened guanophilic invertebrate community
02-05	A.D. Austin & N.A. Schellhorn	ARC Linkage APAI	71,000	Beneficial arthropods in Coonawarra vineyards and sustainable grape production
04-06	A.D. Austin , J.B. Whitfield & K. Maeto	ARC Discovery	210,000	Evolution of microgastroid parasitic wasps and their symbiotic viruses - a major group of biological control agents
04-05	J. Blake, J. Williams, G.W. Rouse , <i>et al.</i>	NSF	15,000	PEET: Systematic and Phylogenetic Analysis of the Polychaeta: The Families Cirratulidae, Orbiniidae, Oweniidae, Paraonidae, Scalibregmatidae, and Spionidae.
05	W.G. Breed & M. Ricci	Faculty of Health Sciences, Research Development Award	9000	Sperm tail cytoskeleton proteins
05	M. Bull & S. Donnellan	ARC Discovery	126,000	Lizard social behaviour and the influence of parasites.
05-08	A. Cooper & T. Flannery	ARC Discovery	470,000	Using ancient DNA to investigate the environmental impacts of climate change and humans through time
05	A. Cooper, S. Donnellan & M. Schwarz	ARC LIEF	115,000	Expansion and enhancement of the South Australian Regional Facility for Molecular Ecology and Evolution and the Australian Centre Ancient DNA
02-05	S. Cooper , W. Humphries & J. Bradbury	ABRS	150,000	Taxonomy and distribution of subterranean amphipods from calcrete aquifers in central Western Australia
03-05	C. Daniels	Adelaide City Council	300,000	BioCity - Centre for Urban Ecology
03-05	C. Daniels, S. Orgeig , S. Schürch & S. Hooper	ARC Discovery	300,000	Environmental control of genetic/phenotypic interactions in lung development: An evolutionary perspective
05-07	M. Dowton & A.D. Austin	ARC Discovery	183,000	Structural reorganization of the hymenopteran mitochondrial genome
05-07	A.N. Drinnan, R. Hill & S. McLoughlin	ARC Discovery	60,000	Fossil evidence for the evolution of Australia's modern vegetation

Date	Investigators	Agency	Amount \$	Project Title
03-05	I. Ernst, C.B. Chambers, B.M. Gillanders & I.D. Whittington	PIRSA	70,000	Wild kingfish populations in Spencer Gulf: seasonal migration and potential for parasite interactions with farmed fish
03-06	I. Ernst, I.D. Whittington , B.M. Gillanders, K. Hutson & C.B. Chambers	FRDC	136,650	Wild kingfish populations in Spencer Gulf: potential for parasite interactions with farmed fish, discrimination of farmed and wild fish and assessment of migratory behaviour
05-07	J.M. Facelli, A.D. Austin & S.C. Donnellan	ARC Linkage	212,000	Population genetics and dynamics of orchids and their pollinators in fragmented landscapes of South Australia
05	B.M. Gillanders, I.D. Whittington & S.C. Donnellan	Wildlife Conservation Fund	4,495	An assessment of the utility of parasites as indicators of population structure in the giant Australian cuttlefish, <i>Sepia apama</i>
04-05	G. Giribet, G.W. Rouse et al.	NSF	49,480	Assembling the Tree of Life: An integrated approach to the origin and diversification of Protostomes
05	V. Glennon & I.D. Whittington	Sir Mark Mitchell Foundation	4,999	Monogenean flatworms of the southern fiddler ray, <i>Trygonorrhina fasciata</i> , in South Australia: providing insight into life history evolution
02-05	M.S. Harvey & A.D. Austin	ABRS	150,000	Systematics of Australian wolf spiders (Araneae: Lycosidae)
04-08	R. Hill, A.D. Austin, S.C. Donnellan et al.	ARC Network	1,500,000	Understanding the Australian ecosystem: integrating contemporary and historical perspectives on the evolution, ecology and management of Australia's living resources
05-09	R. Hill , T. Brodribb & G. Jordan	ARC Discovery	140,000	Global differentiation of the conifer flora
05-06	M. Hutchinson & S.J. Cooper	Sir Mark Mitchell Foundation	5,400	Biodiversity of stone geckos in southern Australia
05-06	M. Hutchinson & S.J. Cooper	ABRS	13,200	Speciation in the gekkonid lizards of the <i>Diplodactylus vittatus</i> group
04-06	M. Hutchinson & M. Lee	Herman-Slade Foundation	29,000	Evolution and limb loss in the diverse Australian lizard <i>Lerista</i>
02-06	J.T. Jennings	APPD Contract	155,300	Databasing the WINC collection
05-06	J.T. Jennings & N. Schiff	ABRS	8,800	Taxonomy of Australian xiphydriid woodwasps (Hymenoptera: Xiphydriidae)
04-07	J.T. Jennings & N. Stevens	ABRS	34,000	Systematics of Australian agathidine wasps (Insecta: Hymenoptera: Braconidae); solitary endoparasitoids of lepidopteran larvae
04-06	B. Kear & M. Lee	ARC Linkage	336,000	Australian Mesozoic Marine reptiles
04-06	B. Kranz & D. Morris	ARC Discovery	285,000.	The evolution of egg retention and sex allocation: a phylogenetic contrasts study using ovoviviparous thrips

Date	Investigators	Agency	Amount \$	Project Title
05	B. Kranz.	Faculty of Sciences, Strategic Research Scheme	5,000.	The evolution of egg retention and sex allocation in facultatively ovoviviparous thrips
03-07	M. Lee & M. Hutchinson	ARC Professorial Fellowship	625,000	Major evolutionary events in reptiles
03-05	R. Leys	ARC Discovery	246,000	Regressive evolution of eyelessness in subterranean diving beetles
03-05	D. Mackay, A.D. Austin & S. Carthew	ARC Linkage APAI	71,000	Conservation biology of butterflies in South Australia
02- 05	S. Orgeig , R. Cooter, C. Daniels, C. Tsopelas, & B. Chatterton	Breast Cancer Research Association	97,790	Testing novel growth factors for lymphangiogenic activity to aid in the treatment of lymphoedema
04-06	S. Orgeig , S. Koblar, C. Tsopelas, B. Chatterton & R.D. Cooter	ARC Discovery	240,000	Regenerating lizard tails: A model for understanding the process of lymphangiogenesis
05	S. Orgeig	Faculty of Sciences Strategic Research Scheme	7,800	A new paradigm for pulmonary surfactant composition and function
05	S. Orgeig	Faculty of Health Sciences, Research Development Award	12,000	A new paradigm for pulmonary surfactant composition and function
04-06	G.W. Rouse & L. Jermiin	ARC Discovery	210,00	Retracing the early evolution of Metazoa using novel methods and strategies
04-06	G.W. Rouse & G. Messing	ABRS	57,000	Crinoidea (Echinodermata) of Australia: Taxonomy, 'species' and illustrated guides
05-07	G. W. Rouse	ARC Discovery	250,000	The puzzle of metazoan evolution: are feeding larvae always primitive?
03-05	M. Schwarz, S. Cooper , B. J. Crespi & T. Chapman	ARC Discovery	360,000	Co-evolution of sociality and sex allocation: phylogenetic comparative approaches using insects
04-09	N.C. Smith <i>et al.</i> including I.D. Whittington	ARC and NH&MRC Network	1,500,000	ARC/NH&MRC Network for Parasitology
04-05	G.S.Taylor & K.A.Davies	ABRS	8,000	Tritrophic radiations: taxonomy, distribution, and host and nematode associations of Australian Fergusoninidae (Diptera)
02-05	I.D. Whittington & I. Ernst	ARC Linkage	474,559	Integrated management of pathogenic monogenean (flatworm) parasite infections in warm water finfish aquaculture
05-07	I.D. Whittington & S.C. Donnellan	ARC Discovery	220,000	Phylogeny and radiation of flatworm ectoparasites from marine fish using morphology and genetics, with novel approaches to identify pathogenic species

Date	Investigators	Agency	Amount \$	Project Title
05-07	I.D. Whittington	ARC Discovery	188,000	Marine flatworm parasites of elasmobranchs: a unique model for experiments exploring invasion strategies, biology and specificity to help understand parasitism
05-06	I.D. Whittington	Scientific Visits Program, Australian Academy of Science	10,600	<i>Neobenedenia</i> (Platyhelminthes: Monogenea: Capsalidae), a genus of ectoparasitic flatworms of wild and cultivated fishes with special diversity in México: identification, systematics & biology