

# Australian Museum

## Report from RACAC to the Australian Museum Trust on the implementation of the Science Research Strategy, 2007-2012

for the period: 1 July 2007- April 2008

nature culture **discover**



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## Abbreviations

SF: Senior Fellow

RA: Research Associate

VCF: Visiting Collections Fellow

VRF: Visiting Research Fellow

PGA: Postgraduate Award recipient

CHSI: Cultural Heritage & Science Initiatives  
Branch

## Definitions

**Taxonomy/ Alpha Taxonomy** is the science of finding, describing and categorising organisms, thus giving rise to taxonomic groups or taxa (singular: *taxon*), which may then be named.

**Phylogeography** is the study of the historical processes that may be responsible for the contemporary geographic distributions of genetic diversity.

A **geographic information system (GIS)** is an information system for capturing, storing, analyzing, managing and presenting data which are spatially referenced.

# Executive Summary

This is the first annual report on research undertaken at the Australian Museum following the adoption of the Australian Museum's Science Research Strategy, 2007-2012. The purpose of this Strategy being to set out the priorities for research aligned with the Museum's vision, purpose, context, research strengths and capabilities taking into account both state and national priorities.

The Strategy provides a framework for research, balancing existing research and collection strengths with emerging issues and priorities. The Strategy recognises the drivers, both internal and external, which shape and influence the Museum's research activities; of note, the loss of biodiversity, climate change, the impact of invasive species and better outcomes for native vegetation and fauna, land, rivers and coastal waterways all of which have been identified as significant issues both for New South Wales and nationally. The depth and scope of the Museum's collections and its specialist research scientists and collection managers place the Museum in a unique position to make a significant contribution to these scientific challenges. Key drivers of each research program are noted in the following section of this summary.

This report was considered by the Research and Collections Advisory Committee (RACAC) at a meeting on 20 May, 2008 which was preceded by a meeting with senior research and collection staff who had coordinated the preparation of this report. RACAC commends this report to the Australian Museum Trust noting that while the implementation of this Strategy and reporting on its implementation are evolutionary processes, the report highlights good progress in meeting the goals of the Research Strategy. Research activities and outcomes are aligned with government priorities and projects undertaken generally address well the external and internal drivers identified in the Strategic Plan. RACAC is pleased with the productivity of the researchers.

The reporting process was also useful in bridging silos since it brought the researchers' work together as part of the programs.

Research and Collections Advisory Committee

28<sup>th</sup> July 2008

## Key Drivers

### **Program 1: Addressing knowledge gaps and problems in understanding the biota in Australasian marine environments.**

The research undertaken primarily addressed issues such as documenting biodiversity, invasive species and other environmental impacts in marine environments. It aligned with both State and Commonwealth initiatives designed to achieve an environmentally sustainable country with well managed marine ecosystems. Commonwealth Government, international and charitable research funding was awarded to undertake many of the projects.

Species groups studied drew on the specialist expertise of the research and collection staff, to provide an improved understanding of current species diversity and distributions, and were used to inform marine planning. For example, amphipods, which are noted for their diverse ecological roles and as indicators of biogeographic and environmental change, were a key group investigated. Similarly, research on larval fish dispersal increases our understanding of the spatial scale at which marine populations operate, and is fundamental to management of them both for fishery purposes, and also for the design and operation of marine protected areas.

Many of these projects involve national and international collaborations to develop interdisciplinary teams. Some of the studies have been collection-based, using existing collection data and also further building the collections.

Museum facilities which have been integral to research in this program include Lizard Island Research Station, and the DNA and Scanning Electron Microscope laboratories.

**Program 2: Addressing knowledge gaps and problems in understanding the biota in Australian terrestrial and freshwater environments.**

It is not possible to measure human impact on biodiversity, or understand the significance of this loss unless there is knowledge of what species are present in the NSW and Australian environments, and what their relationships are to each other. Taxonomic and systematic research in this program has provided keystone information required to identify, manage and ameliorate loss of biodiversity.

This program has also used taxonomic knowledge, collection-based distributional data and community/species-specific ecological and genetic data to assist land managers and policy makers in making informed conservation and management decisions, at both a landscape, and on a species-specific scale.

This research also provides the rigorous and relevant framework required to identify potential and detect actual invasive species, as well as providing baseline data enabling the ongoing impact of climate change to be monitored, modelled and predicted.

This program is thus contributing to the achievement of a key goal of the NSW Government (as identified in the State Plan *'Better environmental outcomes'*) as well as a National Research Priorities for *'An environmentally sustainable Australia'* and *'Safeguarding Australia'*.

Most of the research in Program 2 involves collaboration between Museum staff and external (often international) researchers and/or institutions and is largely funded from external sources.

Most projects are collection/specimen based, bring together interdisciplinary teams including

morphologists, ecologists, geneticists and information technologists and utilize key AM research infrastructure (e.g., bioinformatics, geographic information system (GIS), scanning electron microscope (SEM), DNA lab).

**Program 3: Increasing our understanding of the genetic variation in key taxa (species) of the Australasian and Indo-Pacific biota.**

The research undertaken involved collaborations with external researchers and institutions, nationally and internationally. As genetic research is expensive, it has largely been funded by external funding sources.

Research addressed significant New South Wales issues such as the loss of biodiversity and the early identification of invasive species, and the National Research Priorities *'An environmentally sustainable Australia'* and *'Safeguarding Australia'*.

The Museum contributed to building international resources by joining the *'International Barcode of Life'* project that aims to systematize genetic identifications by collecting sequence information from the same gene in all animals.

Genetic approaches to monitoring biodiversity and assisting resource-use planning for biodiversity conservation have focussed on Australian taxa. Studies have drawn on the Museum's expertise in particular species groups to investigate how genetics can aid the conservation of endangered species, to provide baseline information on natural geographic boundaries to monitor changes in species distribution caused by climate change.

Genetic research by its nature has a strong collection focus and can be used to enhance the value of the museum's collections for understanding and solving emerging issues. Problems related to individual species or whole ecosystems have been addressed in this year's research, generally by bringing interdisciplinary teams together including morphologists and geneticists.

The research for this program is mostly conducted in the Museum's DNA Laboratory and is strongly supported by the Museum's frozen tissue collection.

**Program 4: Origin, evolution and biogeography of the Indo-Pacific and Australasian region.**

Elucidating the origin, evolution and biogeography of the biota of Australia provides information about how successfully or poorly different species groups are likely to adapt to environmental changes. The research undertaken in this program therefore informs environmental management policies and plans to protect biodiversity and mitigate climate change impacts, key goals of both NSW and Commonwealth Governments. In recognition of this, a number of projects received Commonwealth Government grant funding.

Taxa chosen for investigation reflected the areas of expertise of researchers. Many projects involved collaboration with state, federal and overseas institutions, directly as fellow researchers on projects and indirectly supervising students. Many scientists were involved in interdisciplinary teams to address key issues.

The value of collections was enhanced through a range of research activities and the addition of specimens collected in the field.

**Program 5: Understanding human impacts on the Australian biota.**

The research undertaken in this Program addressed a number of significant environmental issues identified as key state and national priority areas. These include, the impact of invasive species, (NSW State of the Environment Report; the National Research Priorities *Safeguarding Australia and An Environmentally Sustainable Australia*) and the impacts of climate changes and loss of biodiversity (NSW Biodiversity and Climate Change Adaptation Framework, 2006-2008; NSW State Plan *'Better environmental outcomes'*). Grant funding from NSW and Commonwealth funding agencies as well as charitable organisations was received to undertake a number of these research projects.

Research activities in this program enabled input to reports which were developed to assist conservation management and environmental planning. The expertise of researchers was applied to provide baseline data against which changes resulting from human activity can be measured.

**Program 6: Investigating human cultures and communities over time in the diverse and changing environments of Australia and the Pacific Region.**

Research in this Program has broadly contributed to a number of areas identified as priorities by the NSW Government, including:

- contributing to building harmonious communities and strengthening Aboriginal communities, under the State Plan;
- supporting and affirming Aboriginal people's culture and heritage under the *Two Ways Together 2003-2012* policy; and
- contributing to the creation of a stronger multi-cultural society, which is relevant to policies set out in the Green Paper, *Cultural Harmony: the Next Decade 2002-2012* and the White Paper *Building on our Cultural Diversity: Ethnic Affairs Action Plan 2000*.

For example, studies added significantly to the knowledge held by the Museum about its anthropological collections and well as providing Indigenous communities, researchers and the wider public with information about the diverse human societies that live and lived in the Australia-Pacific Region. Research in western NSW resulted in the acquisition of several important art-works by a contemporary Aboriginal artist.

Research has also contributed to answering fundamental questions about past and present human societies, and the diversity of their material culture and technologies. It has added to our knowledge about the way in which climate change and natural disasters impacted upon people and how they responded. In addition, it has investigated indigenous people's relationships with their environment and with neighbouring communities.

Research outcomes from this program are an integral part of the information that contributed to a variety of Museum public programs, including the 2008 photographic exhibition *Frank Hurley - Journeys into Papua*, the Museum's website and *Explore* magazine.

**Program 7: Linking intangible and tangible heritage.**

The research in this program has encouraged a wide variety of collaborations, methods and theoretical approaches. The research responded in direct ways to a number of key priorities at state, national and international levels, for instance:

- *NSW Two Ways Together Policy* (supporting Indigenous Australian culture and heritage);
- The Green and White papers on cultural diversity;
- the National Research Priority of 'Frontier Technologies'; and
- the international research issue of the loss of cultural diversity in the Australian-Pacific region.

This has included projects which were collection-based, and which enhanced our understanding of objects in the ethnographic collections. Results also contributed to the development a film, *One Man his Art and his Country*, led to important new acquisitions, and will support an upcoming exhibition about contemporary Indigenous culture.

**Program 8: Investigating extant and extinct faunas and environments in the context of recent geological history to better forecast future changes.**

The research focus has been to provide information on the origins of Australia's environment, as well as climate change.

One collaborative project, investigating insect species and atmospheric gases trapped in Cape York fossil amber, will provide new information on changes in Australia's climate. Identification of new insect species in the amber will fill in gaps

about the biodiversity of Australia's recent past. This project has attracted ARC research funding.

A conodont (tooth-like microfossils from extinct marine organisms) project is providing better Ordovician stratigraphic correlation for reconstruction of past biogeography and biodiversity. This is a significant International issue. This collection-based project involves several Australian and overseas institutions.

A project on Jenolan Caves minerals also has a strong collection focus. Project results gave crucial support to the case for World Heritage status for Jenolan Caves and the Blue Mountains. Input was provided into cave management and conservation as well as environmental studies in NSW. This project has enhanced the promotion of tourism to Jenolan Caves within Australia and overseas.

All projects have used key Museum research infrastructure, including SEM, optical microscopy, and X-ray diffraction. Results were integrated into public programs, including the Museum's website and *Explore* magazine.

# Introduction

## *Structure of Report*

1. The **narrative information** provided represents the collective achievements and activities of research scientists across the Research & Collections Division, and is not a report of individual performance. Rather than presenting a comprehensive description of all research undertaken, the narrative aims to highlight key achievements and progress against each of the research programs and key research goals, as set out in the Science Research Strategy.
2. The qualitative narrative information is supplemented by **quantitative indicators** of performance, including **publications (Appendix 3) and grant funding (Appendix 2)**.
3. A list of staff, Senior Fellows, Research Associates and Visiting Fellows and Postgraduate Award recipients who have contributed to a Program is listed under each Program and in Appendix 1.
4. The **list of research areas/projects** in each of the Research Strategy Programs, previously submitted to RACAC in October 2007 for the research “stocktake” has been updated. It lists research project titles and staff involved, including Senior Fellows.

## *Methodology*

Two researchers from across the three branches of the Division were nominated to coordinate the input for each Research Strategy Program, as follows:

**Prog 1:** Biota in Australasian marine environments

- Jeff Leis (Research);
- Steve Keable (Collections)

**Prog 2:** Biota in Australian terrestrial and freshwater environments

- Mark Eldridge (Research);

- Dave Britton (Collections)

**Prog 3:** Genetic variation in key taxa of Australasian and Indo-Pacific biota

- Don Colgan (Research);
- Rebecca Johnson (CHSI)

**Prog 4:** Origin, evolution and biogeography of the biota of Indo-Pacific and Australasian region

- Chris Reid (Research);
- Walter Boles (Collections)

**Prog 5:** Understanding human impacts on Australian biota

- Pat Hutchings (Research);
- Richard Major (Research)

**Prog 6:** Investigating human cultures and communities over time... in Australia and the Pacific

- Phil Gordon (CHSI)
- Val Attenbrow (Research)

**Prog 7:** Linking intangible and tangible heritage

- Robin Torrence (Research);
- Paul Monaghan (CHSI)

**Prog 8:** Investigating extant and extinct faunas and environmental systems in context of recent geological history ...

- Ross Pogson (Collections)
- Dan Bickel (Research)

The coordinators determined how the narrative information would be gathered for their respective Programs. Some chose to convene face to face meetings of researchers contributing the Program area; others requested written contributions. All contributions were then compiled and edited by the coordinators into the narrative format.

Individual researchers provided details of publications, grants awarded and students supervised.

This report does not include the research output of Lizard Island Research Station (LIRS) except



where it has been undertaken by staff, fellows and students of the Australian Museum.

This report does not cover a full financial year. It is proposed that the research report for the following year be aligned with other reporting activities for the Museum, in particular, the Annual Report.

# Program 1

## Addressing knowledge gaps and problems in understanding the biota in Australasian marine environments.

This program recognises that a key requirement for conserving and managing marine environments is a better understanding of the organisms comprising marine biological communities. Species groups studied included adult and larval fishes, gastropod (snails or univalves) and nudibranch (sea slugs) molluscs, polychaetes (segmented marine worms), crustacean amphipods (scuds and beach hoppers) and isopods (sea slaters), and asteroids (sea stars).

### Key Drivers

The research undertaken primarily addressed issues such as documenting biodiversity, invasive species and other environmental impacts in marine environments. It aligned with both State and Commonwealth initiatives designed to achieve an environmentally sustainable country with well managed marine ecosystems. Commonwealth Government, international and charitable research funding was awarded to undertake many of the projects.

Species groups studied drew on the specialist expertise of the research and collection staff, to provide an improved understanding of current species diversity and distributions, and were used to inform marine planning. For example, amphipods, which are noted for their diverse ecological roles and as indicators of biogeographic and environmental change, were a key group investigated. Similarly, research on larval fish dispersal increases our understanding of the spatial scale at which marine populations operate, and is fundamental to management of them both for fishery purposes, and also for the design and operation of marine protected areas.

Many of these projects involved national and international collaborations to develop interdisciplinary teams. Some of the studies were collection-based, using existing collection data and also further building the collections.

Museum facilities which were integral to research in this program included Lizard Island Research Station, and the DNA and Scanning Electron Microscope laboratories.

### Research Goal a) Understanding Australia's marine biodiversity, emphasising species with key ecological roles and high sensitivity to human impact.

Two reports detailing the distribution of over 200 species of amphipods from Queensland and NSW were prepared for the Department of the Environment and Water Resources. This information will be used to indicate areas of species richness and endemism for future management, therefore providing direct input into the planning process to develop a national system of Marine Protected Areas and positioning the museum collections to inform processes at the State level.

A survey of Nannoniscidae specimens in the Museum's collection resulted in a fundamental revision of these isopods. Because they are one of the most diverse and abundant components of deep sea environments this study provides a basis for better characterisations of offshore environments and allows the Australian fauna to be assessed on a global basis.

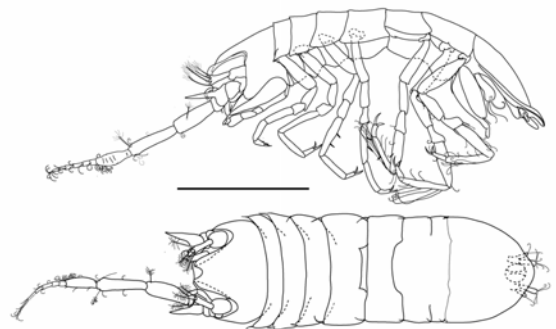
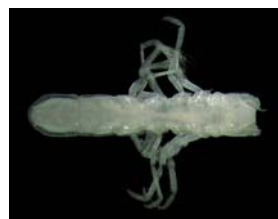


Photo and diagrams by Buz Wilson.

In collaboration with the International Institute for Species Exploration, Arizona State University, the relationships of the Lobotidae (tripletail fishes) have been assessed using both adult and larval characters. As a result, three families will be combined. This represents a significant taxonomic contribution to understanding diversity and distributions in this important group. This research was supported by a Museum Research Fellowship.

Research on the phylogeny of Sabellida (fan worms) resulted in a major restructuring of the group. This was a collaborative project with the Universidad Autonoma do Madrid. These polychaetes include a large number of introduced marine pests which can easily be confused with native species, some of which are undescribed. This project therefore provides baseline information from which environmental change and anthropogenic impacts may be determined.

Research on midwater deepsea fishes provided new insight into the biota of the poorly understood deep sea environment. The study by a Senior Fellow in collaboration with the Smithsonian Institution revealed that what had previously been regarded as three separate families were actually the larvae, females and males, respectively of a single family, Cetomimidae.

Research by a Senior Fellow in collaboration with the University of Auckland provided new feeding information for 137 chromodorid nudibranch species and re-evaluated data for an additional 63 species. These sea slugs accumulate secondary metabolites from their sponge prey which they use for their own defence. The first evidence of a link between food specificity and evolutionary relationships of these species was shown.

A project identifying amphipod collections from the Great Barrier Reef was undertaken in collaboration with the National University of Ireland. As a result, the known species of this region was increased from 50 to about 240. The majority of these records are new for Australia

and more than 50% are previously undescribed species. A particularly significant discovery was the recognition of a new species of one of the rarest families (the Bolttsiidae) at Lizard Island. It is otherwise known only from a species occurring in saline lakes in South Africa. The collections forming the basis of this study are deposited at the museum.

Work continued to increase the accessibility of information about Australia's marine biota. This included management and development of the following two websites by Senior Fellows:

*Seashells of NSW* catalogue

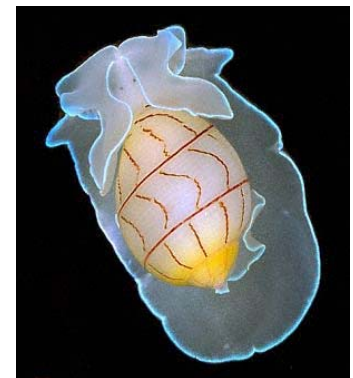
[www.seashellsofnsw.org.au](http://www.seashellsofnsw.org.au), the most authoritative publication on the larger molluscan fauna of NSW. Information for 51 species in seven families was added.



*The Sea Slug Forum* website,

[www.seaslugforum.net](http://www.seaslugforum.net),

made an immense contribution to knowledge available for these molluscs with over 5,000 visitors a day accessing the peer reviewed information provided.



Additionally, four new interactive identification systems were developed for amphipod families Amaryllididae, Ampithoidae, Caprellidae and Urohaustoriidae, two of which were added to the *Crustacea.net* website ([www.crustacea.net](http://www.crustacea.net)).

#### **Research Goal b) Understanding the connectivity of marine populations.**

Research on connectivity focused on phylogeography of molluscs and larval dispersal of demersal fishes with field work undertaken in

South East Australia and the Great Barrier Reef.

Phylogeographic studies of marine and estuarine molluscs in South East Australia were undertaken to provide the basis for the conservation of the most fundamental biological process – evolution. (see Prog 4).

Research on the ontogeny of fish behaviour has shown that larval dispersal is a biophysical process in which behaviour plays a key role, unlike traditional assumptions that only currents need to be considered. The development of behaviour in larval fishes was applied to the construction of a biophysical dispersal model for fish larvae on the Great Barrier Reef. This project was undertaken in collaboration with the Australian Maritime College, with Marine and Tropical Science Research Facility (MTSRF) support, and input from a French MSc Intern.



Similarly, research on larval fish dispersal increases our understanding of the spatial scale at which marine populations operate, and is fundamental to management of them both for fishery purposes, and also for the design and operation of marine protected areas.

Photo by Lyle Vail.

In collaboration with the University of Miami an innovative device was used to study orientation behaviour of fish larvae in the sea at Lizard Island. This research was supported by a Hermon Slade Grant and a Museum research fellowship.

In July, a Museum researcher delivered the invited opening plenary talk on his larval-fish

behaviour work to the International Larval Fish Conference at St John's Newfoundland.

Postgraduate students supervised by AM research staff have contributed to our understanding of the development of sensory abilities in marine fish larvae as well as the influence of Pleistocene sea-level changes and Pre-Pleistocene isolation in South East Australian bryozoans.

### **Research Goal c) Understanding the biodiversity of coral reefs.**

Research on coral-reef biodiversity focused on the systematics of fishes, polychaete worms and crustacean amphipods.

A Senior Fellow continued his studies on the taxonomy and systematics of gobiid fishes that live on coral reefs. Gobies are the most speciose fish family, and dominate coral-reef fish communities.

Research continued on the description of the larvae of the tropical snappers, Family Lutjanidae, with the dual goals of documenting their larval development, and ultimately using ontogenetic data for assessing relationships. A large proportion of lutjanid species live on coral reefs, and support artesinal, recreational and commercial fisheries throughout the world's warm waters.

Work was undertaken on dispersal of larvae of coral reef fishes (see goal b) and is fundamental to understanding the biogeography and biodiversity of reef fishes. Dispersal processes are also important to understanding how invasive species spread.

Data from work previously undertaken on polychaete bioerosion were reviewed to document the mechanism of boring and the importance of polychaetes in the early stage of colonisation of newly available substrates in coral-reef systems. This will provide a baseline of natural processes in coral reef ecosystems against which change can be measured.

A PhD (UNE) research project is underway investigating marine interstitial amphipods on

the east coast of Australia: it is describing 15 new species of interstitial amphipod including one new genus. Several of the new taxa are from Lizard Island coral reef habitat.

#### Contributing Staff

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(by Jeff Leis)

Ms Lexie Walker, MSc, Southern Cross Uni,

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Dr Kelly Wright, PhD, UNSW

(by Jeff Leis) completed.

Ms Michelle Yerman, PhD, Uni of New England,

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## Program 2

### Addressing knowledge gaps and problems in understanding the biota in Australian terrestrial and freshwater environments

Contributions to this program encompassed a broad range of research methodologies and topics, from field-based ecological studies of interactions between species and their environment, to computer-based syntheses utilising over 200 years of accumulated taxonomic and collection data to analyse large scale patterns in biodiversity. In most cases projects in Program 2 has strong overlaps with other Programs in the Research Strategy (esp 3, 4, 5). Systematic studies, using morphological and genetic approaches, were the core strengths of this Program. As part of this research, field work was conducted in localities throughout Australia and overseas. Visits were made to significant natural history collections in other museums, while the vital detailed work of sorting, databasing, identifying and examining specimens, as well as analysing data continued apace.



Photo by Carl Bento.

#### Key Drivers

It is not possible to measure human impact on biodiversity, or understand the significance of this loss unless there is knowledge of what species are present in the NSW and Australian environments, and what their relationships are to each other. Taxonomic and systematic research in this program provided keystone information

required to identify, manage and ameliorate loss of biodiversity.

This program also used taxonomic knowledge, collection-based distributional data and community/species-specific ecological and genetic data to assist land managers and policy makers in making informed conservation and management decisions, at both a landscape, and on a species-specific scale.

Research also provided the rigorous and relevant framework required to identify potential and detect actual invasive species, as well as providing baseline data to enable the ongoing impact of climate change to be monitored, modelled and predicted.

This program thus contributed to the achievement of a key goal of the NSW Government (as identified in the State Plan *'Better environmental outcomes'*) as well as a National Research Priorities for *'An environmentally sustainable Australia and Safeguarding Australia'*

Most of the research in Program 2 involved collaboration between Museum staff and external (often international) researchers and/or institutions and was largely funded from external sources.

Most projects were collection/specimen based, bring together interdisciplinary teams including morphologists, ecologists, geneticists and information technologists and utilised key Museum research infrastructure (e.g., bioinformatics, GIS, SEM, DNA lab).

#### Research Goal a). Understanding the species and places of high biodiversity significance in Australia

A major issue for biodiversity conservation in Australia is our poor knowledge of basic taxonomy in most groups and in many significant environments.

In the last 12 months there has been significant progress in the key area of taxonomic descriptions. Many new species were discovered and taxonomic relationships clarified in a wide variety of groups including insects, arachnids, molluscs, crustaceans and vertebrates.

Understanding the relationships between already described species and their environment has allowed researchers to open windows into evolutionary and ecological events in Australia's history, as well as begin to understand the impact of current climate change.

Although there is a huge continuing need for alpha level taxonomy in Australia, the relationships between already described species and their environment is often lacking. Understanding these relationships has allowed researchers to open windows into evolutionary and ecological events in Australia's history, as well as begin to understand the impact of current climate change.

Studies of communities of organisms and their role in ecosystem assessment were also a strong feature of this goal. Again, the results of many of these studies will enable legislators and planners to make better decisions for conservation of Australian habitats. One prime example is the phylogenetic diversity measure devised by museum staff and co-workers which has been taken up by researchers worldwide as an analytical tool for measuring patterns in diversity and identifying biodiversity "hot spots", and is a key part of a Global Biodiversity Information Facility (GBIF) campaign for significantly reducing loss in biodiversity by 2010.

Also notable in this goal are the innovative applications of techniques by Museum staff associated with many of the studies. Research such as the successful extraction of DNA from land-snail shells and the molecular characterisation of Tasmanian Devil Facial Tumour Disease used new and sophisticated molecular techniques to address issues of conservation significance in key Australian taxa. Similarly, there were significant advances in the

Museum's capability and skills in the analysis and modelling of biodiversity data and environmental variables.

### **Research Goal b) Understanding the distribution, interaction and evolution of key species in arid Australia**

Most projects listed under Goal 2b have substantial overlap with those in 2a. This reflects the biological reality that taxa from the wetter areas of Australia often have representatives in the arid zone. Part of understanding how they have colonised and radiated into arid habitats comes from an investigation of the overall patterns of biodiversity in Australia. Notable progress towards this goal was made by collecting in arid areas such as the WA Goldfields, inland springs linked to the Great Artesian Basin, and from other fieldwork in central and northern Australia. Studies of distribution patterns in arthropods in the Pilbara, an integrated study of biotic radiations in songbirds, and a molecular phylogenetic study of bush cockroaches shed light on how animals have evolved and adapted to arid zones in Australia. Other studies revised taxonomic groups which have a strong arid zone component (e.g. beetles and mantids).

### **Other projects addressing knowledge gaps in Australian terrestrial and freshwater environments.**

The features of the catching webs of spiders were used to develop a spider identification guide. This was applied as a rapid and cost-effective biodiversity assessment method. An advantage of this method is that it can be used by non-specialist groups such as conservation volunteers who want to monitor the effects of habitat restoration. The learning unit at the Museum has further adapted the guide for their school-based activities.



Orb web. Photo by Mike Gray.

The linkages between insect taxa and their host plants often reflect evolutionary and biogeographic history. This can also be useful in applied conservation to better understand the requirements of insect herbivores and the ability of their plant hosts to cope with herbivory. Research identified a moth which damages an endangered and undescribed plant in northern NSW, and the insect community found damaging fruit of endangered lilly pillies in coastal NSW.

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## Program 3

### Increasing our understanding of the genetic variation in key taxa (species) of the Australasian and Indo-Pacific biota.

The research reported for this program covered a broad range of taxa from Australian and the Indo-Pacific and comprised two distinct research goals as outlined below.

The collection and analysis of genetic information by staff made significant contributions to many of the Museum's research projects in 2007/08. The use of such information is now a critical component of most evolutionary, biogeographic and bio-systematic studies (Program 4).

Genetic data are very often central to the understanding of how species are responding to the environmental challenges associated with increasing human impacts. Details of the pattern of genetic diversity across the range of a species inform decisions about what areas need to be managed to maintain the species' full evolutionary potential.

The Museum is leading a long-term project on evolutionary and conservation genetics of marsupials, which includes comprehensive population genetics analysis. One such study was completed for 15 populations of the endangered brush-tailed rock-wallaby sampled throughout the species' range. (photo by R.L. Close)



Genetic information assists species identification. This may be necessary because only part of the animal is available (eg. with forensic specimens), or because it is difficult to correlate different life history stages such as larvae, pupae and adults, or

because identity cannot be established solely from morphology.

#### Key Drivers

The research undertaken involved collaborations with external researchers and institutions, nationally and internationally. As genetic research is expensive, it was largely funded by external funding sources.

Research addressed significant New South Wales issues such as the loss of biodiversity and the early identification of invasive species, and the National Research Priorities '*An environmentally sustainable Australia*' and '*Safeguarding Australia*'.

The Museum contributed to building international resources by joining the 'International Barcode of Life' project that aims to systematize genetic identifications by collecting sequence information from the same gene in all animals.

Genetic approaches to monitoring biodiversity and assisting resource-use planning for biodiversity conservation focussed on Australian taxa. Studies drew on the Museum's expertise in particular species groups to investigate how genetics can aid the conservation of endangered species, to provide baseline information on natural geographic boundaries to monitor changes in species distribution caused by climate change.

Genetic research by its nature has a strong collection focus and can be used to enhance the value of the museum's collections for understanding and solving emerging issues. Problems related to individual species or whole ecosystems were addressed in this year's research, generally by bringing together interdisciplinary teams including morphologists and geneticists.

The research for this program was mostly conducted in the Museum's DNA Laboratory and was strongly supported by the Museum's frozen tissue collection.

**Research goal a) DNA Barcoding of taxonomic groups that are of economic, social or environmental concern.**

The Museum made considerable progress both experimentally and organisationally in its contribution to this research goal this year. Two workshops on applications of DNA Barcoding at the National Taxonomy Forum (held at the Australian Museum in October 2007) were chaired by AM's Head of Research and Collections who also presented an invited address at the 2<sup>nd</sup> International Barcoding Symposium held in Taiwan in September 2007.

The Australia Museum is co-ordinating, through the Australian Barcode Network, Australia's involvement in the International Barcode of Life Project. This involvement was firmly established this year by the signing of an MoU at the official launch of Australia's participation in the \$150 million International Barcode of Life Project at the Australian Museum in February 2008.

On the experimental side, approximately 50 samples of New Caledonian skinks and geckos were barcoded using the mitochondrial ND2 gene to support the project on "A DNA library for the New Caledonian Lizard Fauna." This enlarged the extensive sequence library for lizards from this region to approximately 500. A gene phylogeny for the narrow-range endemic genus *Kanakysaurus* was produced. This was used in the description of a new species in a recently submitted paper.

Much of the Museum's contribution to barcoding will be by the provision of tissue specimens from vouchered and identified specimens to the central processing facility at the University of Guelph. To date, several hundred tissues from the AM fish collection have been contributed to this barcoding effort. A comprehensive DNA Barcoding project of all Australian termites is also underway.

**Research goal b) Genetic approaches to monitoring biodiversity and assisting resource-use planning for biodiversity conservation.**

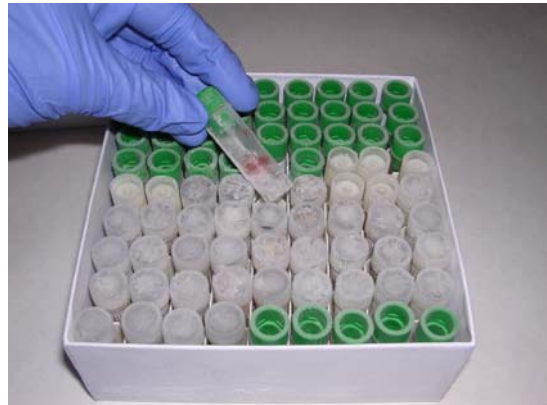


Photo by Rebecca Johnson.

Using its own resources and expertise, and in conjunction with external collaborators, the museum made substantial contributions toward this goal. Genetic analyses at both micro- and macro-levels were conducted on a range of species including Australian birds, isopods, marsupials, molluscs and reptiles.

In collaboration with NSW Department of Environment and Climate Change, museum staff conducted genetic analysis of several populations of the Bush Stone-curlew, which is endangered in Southern Australia but which has large and healthy populations in Northern Australia. This work was undertaken to determine what geographical constraints existed on the release of captive bred Stone-curlews. Samples from casualties and dropped feathers of live birds from across the range were analysed and compared. Although there is a low level of population structuring, this does not preclude release of the captive birds in the desired areas. This is now underway.

The Museum is leading a long-term project on evolutionary and conservation genetics of marsupials, which includes comprehensive population genetics analysis. One such study was completed for 15 populations of the endangered brush-tailed rock-wallaby sampled throughout the species' range. A second such population genetics study was conducted using six populations of the abundant short-eared rock-wallaby, sampled over an hierarchical spatial scale in the Northern Territory.

The Museum continued to contribute to the ongoing search for an increased range of genetic markers and molecular biological approaches to support biodiversity research and conservation management. A particularly promising class of genes is the immunity-related multi-histocompatibility (MHC) locus. In collaboration with staff of the University of Sydney and the Sanger Centre (UK), Museum personnel have been characterising the MHC gene region of the tamar wallaby. Markers were developed which will be valuable tools in macropod genetic research.

New and sophisticated molecular techniques were used to better understand the Tasmanian Devil Facial Tumour Disease. The devil's immune system is failing to recognise the tumour as "foreign" because of a lack of diversity in the immunity-related multi-histocompatibility (MHC) genes.



Photo by D. Greig.

Significant contributions were made to phylogenetic studies of a species flock of freshwater Isopods from Kakadu National Park and three families of freshwater molluscs. The freshwater Isopod (genus *Eophreatoicus*) project which used extensive morphological, ecological and molecular data, effectively demonstrated that morphological data are critical to properly understanding the major lineages in this species flock.

Genetic analysis of molluscs from the families Viviparidae, Planorbiidae and Hydrobiidae was

conducted by Museum staff and associates at the Justus Liebig University (Giessen, Germany), the Museum of Natural History (Berlin, Germany) and the University of Sydney. DNA sequences and morphological data have been used in all three analyses. For more details of individual components see Program 2.

Phylogeographic boundaries are discontinuities between the spatial distribution of members of different groups within a taxon. This discontinuity has immediate operational implications for conservation genetic management as populations on both sides of the boundary require management if the full evolutionary potential of the species is to be conserved. The concordance of boundaries in different species is particularly significant as it suggests that there may be a causal relationship to an historical and/or contemporary habitat or geographic barrier.

Museum staff have identified such a concordant boundary in the three reptiles (*Ctenotus robustus*, *C. taeniolatus* and *Oedura lesueurii*) from the Northern Tablelands of New South Wales. The boundary runs generally northwest and southeast from the Armidale area. The genetic distance between the groups on either side of the boundary differs (up to threefold) between the three species. This might be due to species-specific variation or the concordance may reflect events from multiple historical periods, possibly range expansion from refugia formed at different times.

Phylogeographic studies of marine and estuarine molluscs examined biogeographic boundaries along the south east mainland and Tasmania. Results showed that distinct morphological species of the estuarine hydrobiid genus *Tatea* cannot be distinguished by mitochondrial DNA due to low levels of genetic variability, and neither does mtDNA show any evidence of the clear phylogeographic boundary at the NSW/Victorian border that had previously been shown by protein electrophoresis in one of the species. The delineation of such areas is an important aspect of bioregionalisation and management practices in marine environments

under both State and Commonwealth programs currently being put into place.

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## Program 4

### Origin, evolution and biogeography of the biota of the Indo-Pacific and Australasian region.

Many of the Museum's research projects directly or indirectly contributed to this programme. Both terrestrial and aquatic (freshwater and marine) organisms were studied. The origins of the Australian biota are often intimately connected with the evolution of the Indo-Pacific, especially in the marine environment. Work undertaken in this interrelated aspect of the programme included studies of the early Palaeozoic fossil conodonts of the region, biogeography and origins of marine hoppers (amphipoda) of the Great Barrier Reef, fiery leaf-beetles, molecular phylogeny of macropod genera present in both Australia and New Guinea (pademelons and tree kangaroos), emballonurid bat biogeography, involving Australia and the west pacific, and the systematics and biogeography of birds of the region.

#### Key Drivers

Elucidating the origin, evolution and biogeography of the biota of Australia provides information about how successfully or poorly different species groups are likely to adapt to environmental changes. Research undertaken in this program therefore informs environmental management policies and plans to protect biodiversity and mitigate climate change impacts, key goals of both NSW and Commonwealth Governments. In recognition of this, a number of projects received Commonwealth Government grant funding.

Taxa chosen for investigation reflected the areas of expertise of researchers. Many projects involved collaboration with state, federal and overseas institutions, directly as fellow researchers on projects and indirectly supervising students. Many scientists were involved in interdisciplinary teams to address key issues.

The value of collections was enhanced through a range of research activities and the addition of specimens collected in the field.

#### Research goal a) Understanding the origins of the Australian fauna.

A wide range of organisms was studied, using both morphological and molecular attributes, often in combination.

In the marine arena, a major research programme on the biogeography and diversity of Great Barrier Reef Amphipoda continued (see Program 1).

Work progressed on several basal clades of spiders with posited 'Gondwanan' origins, including revision of the Australian endemic genus *Storenosoma*, a new subfamily of spiders in the family Stiphidiidae, the genus *Toxopsoides*, and comb-footed spiders in the subfamily Hadrotarsinae. The Australian region may be a key centre of diversity for this group.

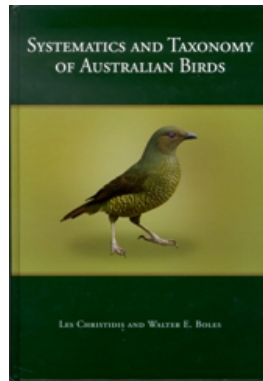
The Australian endemic mantid genus *Rhodomantis*, which commonly inhabits grasses in the arid and semi arid regions, was revised.

The systematics and taxonomy of the kangaroo beetles revealed them to be more speciose than previously considered and less closely related to their supposed nearest relatives in Madagascar and Argentina. Several unsuspected new species were found amongst the fiery leaf-beetles, all in rainforests. Both of these primarily Australian subfamilies are relatively basal clades in the family of leaf-beetles and signify an early Australian relationship between Chrysomelidae and flowering plants. A PhD project continued on the phylogeny of the Australian chrysomeline leaf-beetles and a PhD project was started on the phylogeny of the leaf-beetle genus *Paropsis*, with 80 Australian species.

Agamid lizards are diverse in Australia but the genera are poorly defined. Progress was made in determining molecular phylogenies to better determine the genera. Scincid lizards of the speciose genus *Egernia* continued to be sampled for DNA, to determine the species in this difficult group.

Phylogenies of two primarily or entirely Australian clades of birds, whistlers, cuckoo-shrikes and allies, and grass-wrens, have been determined, with re-organisation of their classification and recognition of new species.

A detailed book, *Systematics and Taxonomy of Australian Birds*, was published which will serve as the baseline for research and legislative nomenclature for some time.



The avian component of a new Pleistocene vertebrate fauna discovered in Nullarbor caves was described and work continues on this fauna. Research continued on fossil cormorants and two student projects on fossil birds were supervised.

The relationships between the Australian and New Guinean representatives of *Thylogale* (pademelons) and *Dendrolagus* (tree-kangaroos) were studied, using DNA from representatives of most currently recognised taxa within the two genera.

The Australian members of the diverse freshwater group of Isopoda, Phreaticoidea, were surveyed using SEM and data recorded in a morphological database.

A project aimed at tracing the origin of wood-burrowing and soil-burrowing cockroaches (subfamilies Panesthiinae and Geoscapheinae) was progressed. A project aimed at understanding the biogeographical origins of various Australian termite genera (in conjunction with a DNA-Barcoding project) commenced.

#### **Research goal b) Understanding the biogeography and evolution of the Indo-Pacific fauna**

Knowledge of the Indo-Pacific fauna, in the seas and on land masses neighbouring Australia, is fundamental to understanding the origin and diversity of the Australian fauna. To this end, Australian Museum scientists worked on the faunas of Fiji, New Caledonia, New Guinea, New Zealand, the Solomon Islands, the Pacific and Indian Oceans.

An understanding of some of the earliest land relationships between what is now Australia and elsewhere has been provided by the study of Ordovician conodonts, a group of fossil organisms

of great stratigraphic significance. Work continued on this subject, completing a survey of the New South Wales sites (See Program 8).

Molecular and morphological studies of caenogastropod molluscan phylogeny were completed. This group includes the majority of marine snails in the Australasian region.

Research on phylogeny of groundwater isopods revealed the age of the New Zealand freshwater fauna, based on tectonic plate timing. A dataset including both morphological and DNA characters on the phylogeny of all isopods is being assembled and the subterranean connections of Australian phreatoicidan isopods to India and New Zealand were studied.

A study of the biogeography of Indo-West Pacific tropical amphipods (marine hoppers) was completed, with particular reference to Australia

Participation in major project, "Terrestrial Arthropods of Fiji", continued at the museum, together with its partner, the Bishop Museum, Honolulu. This project is to undertake biological surveys and build local capacity in developing, biodiversity rich countries. Fijian and southwest Pacific dolichopodid flies of the genus *Krakatauia* were revised, including 25 new species. Taxonomic revisions of the Dolichopodidae of New Caledonia were completed.

Work continued on the global faunas of kangaroo beetles and fiery leaf-beetles, showing their relationships to South America, Madagascar, New Guinea and New Caledonia. Conference talks were given on the leaf-beetles of New Caledonia and the extinction of beetles of Lord Howe Island, including loss of 3 genera endemic to that small island. An Austro-papuan genus of leaf-beetle, *Menippus*, was revised.

Research continued on larval development of tropical snappers (Lutjanidae), an important commercial group throughout the tropics, tripletails (Lobotidae), and a number of other fish species. Dispersal of fish larvae was studied, which is fundamental to the understanding of species dispersal and biogeography of Indo-Pacific fishes.

A review of the lizard genus *Kanakysaurus*, endemic to New Caledonia, was produced with description of a new species.

Research was completed on the phylogeny and biogeography of Australasian whistlers, cuckoo-shrikes and their allies. It was shown that the ability to ingest toxic beetles, secrete these toxins through the uropygial gland and then coat feathers with the toxin, evolved several times in New Guinean corvid birds. Morphological studies provided additional information for molecular phylogenetic studies on Australasian birds. These placed the unusual New Zealand Stitchbird *Notiomystis cinctus* into a monotypic family near the New Zealand wattlebirds. Family and species accounts were provided for four Australasian passerine families in volume 12 of Handbook of Birds of the World. This is the first time that several of these families have been presented and illustrated as a group across their entire distribution.

Studies of species radiations of four macropodid mammal genera (*Dendrolagus*, *Thylogale*, *Dorcopsis*, *Dorcopsulus*) in New Guinea continued. Species boundaries and evolutionary relationships within these genera are poorly known and in dispute.



A DNA study of phylogeny of Indo-West Pacific bats of the family Emballonuridae was completed. The results suggested that emballonurids can establish populations across seas or oceans but because they do this infrequently, water barriers have a major role in genetic structuring within these species.

Miniopterus bat. Photo by G. Little.

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## Program 5

### Understanding human impacts on the Australian biota.

Research was undertaken in twenty three research projects, including eight major ones, investigating human impacts on Australian biota. This research contributed to three main goals directed towards understanding our impacts on freshwater and estuarine ecosystems, effects of climate change on the Australian fauna, and human impacts in the Sydney region.

#### Key Drivers

The research addressed a number of significant environmental issues identified as key state and national priority areas. These included, the impact of invasive species, (NSW State of the Environment Report; the National Research Priorities *Safeguarding Australia and An Environmentally Sustainable Australia*) and the impacts of climate changes and loss of biodiversity (NSW Biodiversity and Climate Change Adaptation Framework, 2006-2008; NSW State Plan *'Better environmental outcomes'*). Grant funding from NSW and Commonwealth funding agencies as well as charitable organisations was received to undertake a number of these research projects.

Research activities in this program enabled input to reports which were developed to assist conservation management and environmental planning. The expertise of researchers was applied to provide baseline data against which changes resulting from human activity can be measured.

#### Research goal a) Assessment of the vulnerability of Australia's freshwater and estuarine ecosystems to human impacts

A major study on the freshwater isopods from Kakadu National Park showed that all these animals were characterized as being at risk from water extraction by humans and was included in a review of the global diversity of this group in freshwater. Another major component of Australia's freshwater systems are fish (with 57% of these species being endemic). Many are restricted to only one or two major drainage systems. While increases in permanent water for irrigation has provided increased habitat for some temperate

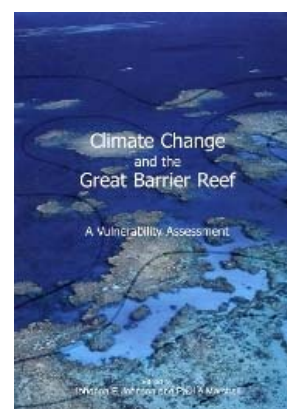
species, disturbance to natural habitats has resulted in significant hybridization between closely related species. In northern Australia, some species thought to be widely distributed species are being found to consist of cryptic species.

The Australian Museum contributed to an international review of the tools and methods used to assess water quality and ecological integrity of estuarine and coastal systems. The Australian component of this study highlighted the value of using biological components to complement the traditionally used chemical and physical parameters.

#### Research goal b) Investigating the effects of climate change on the Australian fauna.

Studies were progressed to document changes in distributions and connectivity of a range of marine and estuarine mollusc populations along the South East Australian coast during recent decades, using a variety of techniques including genetic and shell elemental concentrations. One cold water species appears to be retreating southwards with increasing sea temperatures. Another study investigated the effects of changes to currents and temperature related changes on the dispersal of fish larvae especially on the Great Barrier Reef (GBR). Changes in dispersal will influence the spatial scale and magnitude of population connectivity in reef fish populations.

A major review of the vulnerability of benthic invertebrates of the Great Barrier Reef to climate change was undertaken and formed part of a comprehensive regional assessment of the likely impacts. A series of recommendations for future studies was made.



Another project investigated how biodiversity planning corridors at a continental scale can help conserve biodiversity in the face of threats especially climate change. The project is linked to the NSW Government Alps-Atherton



Conservation Corridor and involves researchers from several institutions. The research entails biodiversity and environmental modeling, along with landscape genetic studies of plants and birds.

On a smaller scale, a detailed study of narrow range endemic forest species of spiders was progressed. It is thought they may be limited by environmental conditions and may respond relatively rapidly to climate change. One genus, which contains many undescribed Australian species, is currently being documented. Many of these spiders are narrow-ranged endemics and will provide a useful tool with which to document the effects of climate change in these habitats.

### Research goal c) Understanding human impacts in the Sydney environs.

A collaborative program documented changes in urban bird diversity and to understand the factors responsible for these changes and how these can be reversed. An important component of this study is engaging people living in these urban environments to determine ways in which they can help in the conservation of this fauna. One bird species that has increased considerably in urban areas, while declining in its natural homeland, the wetlands of the Murray Darling Basin, is the Australian White Ibis. Populations of these birds in Sydney were banded or fitted with radio transmitters to monitor their movements and structure of these populations. Recent new funding will enable another cohort of birds to be banded and the research to continue for another year.



Australian White Ibis. Photo: Richard Major, Australian Museum.

Hill tops are important sites for reproductive behaviour in many butterflies and other insects. Increasing urbanisation is leading to the loss and/or degradation of these hill top sites. Museum researchers worked with community groups and held workshops in butterfly identification and botanical site assessment to identify which hill tops are important for future conservation.



Photo: The Bronze Flat *Netrocoryme repanda repanda*, a hill-topping skipper, by Dave Britton.

Humans can also have an impact on the Australian biota through poaching and smuggling. DNA based identifications of wildlife which has been mutilated, such as seized shark fins or smuggled bird eggs, was carried out for various government agencies and used in a number of court cases to prosecute people attempting to bring biota into Australia illegally.

Another study investigated the burning of vegetation over time by Aborigines as a land management tool. When this practice began is not known, but at the time of British colonization it was in place. The study has shown that climate change was the dominant factor affecting fire frequency and intensity in the Sydney Basin during the Holocene, suggesting it was used within a climatic framework.

### Other human impacts on Australian biota

Incorporation of material collected during port surveys of Australia's international ports has allowed an analysis of the distribution of invasive species around Australia and how factors such as the environmental conditions within a port are crucial. In the resultant paper, the importance of the deposition of vouchers in museums and the

role of taxonomists to ensure the correct identification of any introduced species was highlighted and recommendations were given for the conduct of any future port surveys.

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## Program 6

### Investigating human cultures and communities over time in the diverse and changing environments of Australia and the Pacific Region.

A number of ethnographic, anthropological and archaeological research projects have contributed to Program 6 over the last year and the significant achievements of the major projects over the last nine months are briefly described below.

Research programs and projects have involved fieldwork in Australia (NSW), Torres Strait Islands (TSI), Papua New Guinea (PNG) as well as Russia. They also involved ethnographic and archaeological objects as well as human remains held in the Australian Museum Anthropology Collection from different parts of Australia, TSI and PNG, as well as material collected during recent excavations in PNG and Russia.

#### Key Drivers

Research in this Program has broadly contributed to a number of areas identified as priorities by the NSW Government, including:

- contributing to building harmonious communities and strengthening Aboriginal communities, under the State Plan;
- supporting and affirming Aboriginal people's culture and heritage under the *Two Ways Together 2003-2012* policy; and
- contributing to the creation of a stronger multi-cultural society, which is relevant to policies set out in the Green Paper, *Cultural Harmony: the Next Decade 2002-2012* and the White Paper *Building on our Cultural Diversity: Ethnic Affairs Action Plan 2000*.

For example, studies added significantly to the knowledge held by the Museum about its anthropological collections and well as providing Indigenous communities, researchers and the wider public with information about the diverse human societies that live and lived in the Australia-Pacific Region. Research in western NSW resulted in the acquisition of several important art-works by a contemporary Aboriginal artist.

Research has also contributed to answering fundamental questions about past and present human societies, and the diversity of their material culture and technologies. It has added to our knowledge about the way in which climate change and natural disasters impacted upon people and how they responded. In addition, it has investigated indigenous people's relationships with their environment and with neighbouring communities.

Research outcomes from this program are an integral part of the information that contributed to a variety of Museum public programs, including the 2008 photographic exhibition *Frank Hurley - Journeys into Papua*, the Museum's website and *Explore* magazine.

#### Research goal a) Understanding the diversity of Indigenous material culture over time

Research projects employed a range of methodological approaches to identify significant changes across space and time in production, use and meanings of material culture from Australia and PNG. Ethnographic and historical research with modern Aboriginal groups in Queensland, Northern Territory and NSW added useful information about the variety of contexts and ways in which significant Australian Museum collections of paintings and objects were made and used, today as well as in the past.

Research with Aboriginal people from far-western NSW explored the re-contextualisation of incised designs on historical wooden weapon in their re-use on art-works by contemporary Barkindji artists.



No More Catfish, by artist Badger Bates© 2004.

In contrast, archival research added greatly to knowledge about the history of the important Papunya permanent collection of paintings.

Research on the Australian Museum grass skirt collections from Central Province PNG identified changes in manufacturing techniques linked to exchange processes during the colonial period.

Microscopic examination of backed artefacts, a key Australian prehistoric stone tool type, has identified a range of use-wear and residues from which their past uses in the Sydney Basin have been inferred to include a range of domestic tasks such as cutting, incising and scraping in association with wood, soft plant, bone and skin materials, and not simply being projectiles/spears as claimed by many past researchers. Their variable distribution and abundance across the Sydney Basin appears linked to the history of site use as well as environment.

Studies of a wide variety of simple stone artefacts have revealed a surprising lack of change in tool use in prehistoric New Britain PNG despite the introduction of pottery. A major analysis of the history and distribution of prehistoric ceramics in New Britain proposed that several key archaeological sites were primarily used for ritual purposes and also confirmed an extensive system of land-use during the time of Lapita pottery.

**Research goal b) Tracking the history of human interaction with the natural environment including the effects of urbanisation, industrialization, tourism, environmental changes and disasters**

Collaborative research with international and Australian scholars assessed the impacts of slow long-term environmental changes and rapid onset natural disasters on human societies in Australia and Papua New Guinea, that involved responses mediated through stone technologies and use of fire. Cases ranged from earliest colonization of PNG (c. 45,000 years ago) up to the present day. Certain items in the Australian Aboriginal tool kit, such as backed artefacts in the Sydney Basin, proliferate during the mid-late Holocene colder, drier period indicating their possible involvement in adapting life to changed climatic conditions.

Using detailed analyses of charcoal in sediment cores from swamps, it has been shown that Holocene fire histories in the Sydney Basin were profoundly influenced by global climatic factors, suggesting in turn that climate may also have influenced Aboriginal firing practices.



Photo: J Fields

No convincing evidence was found in the stratigraphic or archaeological records for impacts by an alleged Holocene mega-tsunami along the Australian east coast. In New Britain, PNG, however, the presence of relatively frequent and severe volcanic eruptions was shown to have been a key factor in shaping the long-term human history of that region, particularly in terms of slow population growth, high mobility and the maintenance of social networks.

Ethnographic research explored how contemporary Barkindji people of NSW express their diverse relationships with the Darling River in their artworks.

**Research goal c) Understanding the origin and functions of social exchange**

Inter-disciplinary research on ancient and modern economic systems in Australia, the south Pacific (particularly Melanesia) and the north Pacific Rim in Far East Russia contributed to a better understanding of the general processes of social exchange. Studies of stone tools made from obsidian traced social networks in Melanesia and Russia by linking artefacts back to their geological sources on the basis of their chemical composition measured by established geochemical techniques (PIXE-PIGME, neutron activation, LA-ICPMS, and relative density) and through the innovative application of Raman spectroscopy. New findings

confirmed and extended the presence of a regional exchange system dating to the early to mid-Holocene. In this case large obsidian artefacts made by craft specialists circulated across 2200 km in Melanesia. Studies of ground stone artefacts from New Britain, Papua New Guinea also provided new evidence about the timing and scale of social networks. Excavations at an obsidian quarry in Primorye, Russia dating to the late Pleistocene uncovered tool manufacturing strategies that demonstrate the existence of highly flexible, risk-adverse strategies for provisioning essential resources in this time period.

A research project, undertaken as part of the Aboriginal repatriation program has found that several skulls from the Torres Strait, presumed Indigenous, have physical properties radically different from Australian Aboriginal and Melanesian examples. The Torres Strait's community has agreed to further scientific research being undertaken to determine the country of origin of these skulls. The results may have major significance for Australian history and Torres Strait Islander and European contact.

Finally, an anthropological study investigated changes in identity and employment among Aboriginal people in western NSW since the 1950s.

### **Other research into human cultures**

Marine reservoir variability in molluscan shells along the NSW Coast was investigated in a collaborative project with the University of Queensland and ANSTO. This work will enable more reliable chronologies for investigating high resolution geomorphological and archaeological sequences, as the currently recommended regional DeltaR value for this region is problematic, being based on only one living <AD 1950 specimen.

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## Program 7

### Linking intangible and tangible heritage

Studies of the cultural contexts in which collections were made showed how contemporary attitudes and scientific theories shaped the way scientists, explorers, missionaries, government officials and tourists obtained objects from communities in Australia and Papua New Guinea and also identified how Indigenous choices influenced the kinds of artefacts offered for exchange or sale.

Researchers collaborated with contemporary Aboriginal groups in NSW and the Northern Territory to study traditional material culture, contemporary art, and attitudes to museum collections.

Visitors from Fiji, and the Solomon Islands provided invaluable information and insights about functions and meanings of objects in the AM collections. Our collaborators also provided valuable insights on conceptions held by Pacific communities about museum collections. Following consultation with them, new projects were devised to return information about the collections to local communities overseas and to diaspora groups in NSW and to assist communities do their own recording of intangible information about items in the Australian Museum collections.

#### Key Drivers

The research in this program has encouraged a wide variety of collaborations, methods and theoretical approaches. The research responded in direct ways to a number of key priorities at state, national and international levels, for instance:

- *NSW Two Ways Together Policy* (supporting Indigenous Australian culture and heritage);
- The Green and White papers on cultural diversity;
- the National Research Priority of 'Frontier Technologies'; and
- the international research issue of the loss of cultural diversity in the Australian-Pacific region.

This has included projects which were collection-based, and which enhanced our understanding of objects in the ethnographic collections. Results also contributed to the development a film, *One Man his Art and his Country*, led to important new acquisitions, and will support an upcoming exhibition about contemporary Indigenous culture.

#### Research goal a) Investigating the history of creativity in human cultures and communities in Australian and the Pacific.

Based on case studies of communities from the south coast of Papua New Guinea, ongoing projects investigated how Indigenous people have actively contributed to the formation of ethnographic collections. The research provides new information about how Papuans have viewed and responded to social changes since first European contact. The innovative methodology complements traditional historical approaches and uncovers new information not available through documentary research.

Most research on museum collections has overly stressed the role of collectors, but this pioneering research shows that Papuans made strategic choices in the kinds of artefacts offered for trade and also that their selection of objects played an important role in their negotiations with European and Australian explorers, missionaries, traders, government officials and tourists.

This very unusual ornament collected in Central province, PNG late in the 19<sup>th</sup> century and now in the Australian



Museum ethnographic collection is a very poor copy of a traditional item. It serves to illustrate that even in this very early period, Indigenous people were making items for sale especially to European traders.

Photo by Robin Torrence.

Documentary research in the Australian Museum archives and the Mitchell Library, together with detailed analyses of collections in the Australian

Museum and the Macleay Museum, has reconstructed the history of social contexts in which trade took place and ultimately structured which items entered museum collections.

For example, items commonly used within indigenous trading networks were frequently also exchanged with outsiders, but objects highly valued within these societies were very rarely offered for trade with outsiders.

Detailed studies of specific artefact types, including grass skirts and ornaments used in rituals, demonstrated that creativity was expressed by Papuans in the ways that objects were manufactured and decorated.

#### **Research goal b) Understanding knowledges and social imperatives which produce and shape material culture.**

Several projects led to a deeper appreciation of contemporary roles of material culture in Indigenous cultures and have involved the capture of new knowledge documented in digital audio and video recordings, digital photography and data base entries. The Fijian collections were activated to increase our understanding of both the contemporary social roles of pottery and the ritual exchange and other functions of *tabua* (whale's teeth). These projects involved both home and diaspora communities.

Research also value added to NSW Indigenous collections through a short film documenting Badger Bates, a Barkindji man, talking about his Indigenous culture and how it informs his artwork.

Collaborative research with Roy Barker (Snr) led to the first inland river canoe being produced in the last 70 years in the Brewarrina area. Importantly, digital video of the canoe's production, including interviews with Roy Barker (Snr), documented traditional knowledge surrounding this aspect of material culture and will be available for future researchers and local Indigenous communities.



Roy Barker Snr, Muruwari Elder with his two sons, Tom and Roy Barker, remove bark from a tree on the banks of the Cato River, Brewarrina, NSW. Photo by Barrina South.

The innovative methodology of digital access and generation of contemporary data relating to the objects held at the museum was tested in a number of projects (Yirrkala, Solomon Islands, Fiji *tabua*) and involved the development of standards and protocols for better management of the objects and associated traditional knowledge.

#### **Research goal c) Understanding the collecting process**

A detailed attribute analysis of the ethnographic objects presented in British auction catalogues from the late 19<sup>th</sup> and early 20<sup>th</sup> century and their prices evaluated theories about why particular artefacts were attractive to collectors during a key period when significant collections of ethnographic material were obtained by the Australian Museum and other institutions. The research also compared consumer tastes in objects, as reflected by the popular market, with the kinds of material accessioned by museums.

Research on collecting and recording practices used in the American-Australian Scientific Expedition to Arnhem Land in 1948 provided important insights on the resulting Australian Museum collections. Although not integrated into a specific research project, basic documentary research on individual

artefacts or material derived from a specific collector is also an important ongoing component of collection management.

**Research goal d) Engaging with creator communities to better understand the significance of our collections**

The broad aim has been to develop innovative approaches for providing digital access to the museum's cultural objects to the creator communities as well as providing mechanisms for gathering intangible cultural heritage information associated with the objects. This engagement has involved fieldwork (at sites such as Brewarrina, Wilcannia, Yirrkala), collection research visits to the museum under the Visiting Cultural Leaders program (Lawrence Foana'ota, Director of the Solomon Islands National Museum), and consultations with research partners (including Indigenous community members and organisations). In close consultation with Lawrence Foana'ota, the museum received a grant to build specialized audio-visual equipment for the digital repatriation of images and film of key cultural objects held at the museum to villages in the Solomon Islands (an MoU was signed with the Solomon Islands National Museum in January 2008 to facilitate this).

Another innovative research approach has been pursued in partnership with Wollongong University. A competitive research partnership grant from the university was awarded to the project "The application of concept lattices to digital museum collection management and access". The project tested new methods for mapping, annotating and accessing cultural collection databases, including capturing intangible cultural heritage material. The focus of the project was the South Pacific collections held at the Australian Museum. This project involved several collections and materials conservation staff who contributed towards defining parameters for visual rather than keyword searching.

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## Program 8

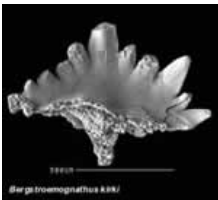
### Investigating extant and extinct faunas and environmental systems in the context of recent geological history to better forecast future changes.

#### Key drivers

The research focus has been to provide information on the origins of Australia's environment, as well as climate change.

One collaborative project, investigating insect species and atmospheric gases trapped in Cape York fossil amber, will provide new information on changes in Australia's climate. Identification of new insect species in the amber will fill in gaps about the biodiversity of Australia's recent past. This project has attracted ARC research funding.

A conodont project is providing better Ordovician stratigraphic correlation for reconstruction of past biogeography and biodiversity. This is a significant International issue. This collection-based project involves several Australian and overseas institutions.



Conodonts are tooth-like micro fossils - mouth parts of extinct marine organisms.

A project on Jenolan Caves minerals also has a strong collection focus. Project results gave crucial support to the case for World Heritage status for Jenolan Caves and the Blue Mountains. Input was provided into cave management and conservation as well as environmental studies in NSW. This project has enhanced the promotion of tourism to Jenolan Caves within Australia and overseas.

All projects have used key Museum research infrastructure, including SEM, optical microscopy, and X-ray diffraction. Results were integrated into public programs, including the Museum's website and *Explore* magazine.

#### Research goal a) Studying animal groups that leave good fossil records to help forecast future change.

A new finding of amber (fossilised tree resin) from the remote northern part of Cape York Peninsula, Queensland, is being investigated jointly by the Australian Museum, University of NSW, Queensland Museum and the original discoverers. This unique material is revealing new information about the origin and development of Australia's environment. It is funded by a 3-year Australian Research Council Discovery Grant.

Amber has been known since ancient times from the Baltic Sea, but also occurs in Lebanon, the Dominican Republic, Burma, and Mexico. Australian amber deposits were previously unknown, until pieces were found washed up on the beaches of the remote Cape York Peninsula. Some scientists were sceptical that this amber was of Australian origin, but thanks to the persistence of its discoverer, subsequent testing revealed its chemical 'signature' to be unique among the world's ambers. This amber is very special because insects and spiders are perfectly preserved within it. The insects are preserved down to the finest hairs in transparent amber, providing a window into the past, a unique view of the most fragile ancient life not found in other types of fossilisation.

Research on amber recently discovered in northern Cape York Peninsula is revealing new information about the origin and development of Australia's environment.



Around 250 specimens of insects and spiders have been found embedded in the amber so far and these are being described and compared to their modern counterparts.

Photo: a parasitic wasp inclusion in a piece of Cape York Peninsula amber, by D Bickel.

Some 250 specimens have been collected so far and these are being described and compared to their modern counterparts. A manuscript describing the

first species from Cape York amber has been submitted. The amber is probably derived from a Kauri genus whose ancient trees still grow in eastern Australian rainforests, but its age and the precise location of the deposits are still unknown, to be clarified by an expedition to find its source. This unique material is revealing new information about the origin and development of Australia's environment.

Other work focused on conodonts, phosphatic, tooth-like microfossils, mouth parts of extinct marine chordates which are important stratigraphic index fossils. This is providing detail for a long-term project to establish the conodont zonal schemes in Australasia, used to reconstruct the palaeogeography, palaeoclimate and ecosystems of the Ordovician world. These studies will fill some of the gaps in Ordovician conodont biostratigraphic successions of eastern Australia, New Zealand, and South China which currently lack adequate precision. This will enable a better understanding of the Ordovician biogeography and biodiversity of the world.

Three important conodont faunas are being documented: Middle Ordovician from Kirkup, Parkes; Middle Ordovician from Thompson Creek, Nelson Province, New Zealand; and early Ordovician, Guizhou, South China. Field work for the Kirkup fauna was completed and the final report published. A small grant from the Linnean Society of New South Wales covered the field work costs. SEM work and taxonomic identifications were carried out on the Chinese and New Zealand specimens.

Research on Ordovician fossil vertebrates of the Amadeus Basin, NT and late Devonian fossil fish faunas of central-west NSW was conducted in collaboration with the Natural History Museum, London. Neogene mega faunas from Wellington Caves were studied, as were Ordovician to Devonian marine invertebrate biota (corals, sponges stromatoporoids, brachiopods etc.) from several sites.

### Research goal c) Sedimentary Mineralogy

The mineralogy and chemistry of cave formations and sediments at Jenolan Caves NSW have been investigated, revealing several previously

unreported mineral species, and radiometric dating of clays from volcanic origins showed the caves are much older than expected, 340 million years in the Carboniferous. Collaboration with CSIRO involved sampling of clays for palaeomagnetic dating. Of particular interest has been recognition of two separate groups of minerals, one resulting from purely non-organic geological processes, and the other from chemical reactions involving leaching of relatively recent organic material such as bat, wallaby and wombat guano. The two mineral-forming processes interacted to give a unique set of cave minerals. The project has used X-ray diffraction, X-ray fluorescence, X-ray spectrometry, sulphur and oxygen stable isotopes, trace element analysis, ultraviolet examination, optical microscopy, SEM, detailed photography and cave surveying. The results have thrown light on the cave-forming processes themselves, as well as timing of the Kanimblan Orogeny in the Carboniferous period. Palaeoclimate inferences can also be drawn, as some calcite oxygen/carbon isotope figures are compatible with cooler temperatures, and some sediments in the Jenolan area could be related to glacial slump deposits. Current work has concentrated on unusual sulphate and sulphate/phosphate cave minerals and data was gathered for work on cave aragonites, dolomites and 'moon milk'.

Research into the minerals of Jenolan Caves has thrown light on cave-forming processes. Of particular interest has been recognition of two separate groups of minerals, one resulting from purely non-organic geological processes, and the other from chemical reactions involving leaching of relatively recent organic material such as bat, wallaby and wombat guano. The two mineral-forming processes interacted to give a unique set of cave minerals. Palaeoclimate inferences can also be drawn, as some calcite oxygen/carbon isotope figures are compatible with cooler temperatures, and some sediments in the Jenolan area could be related to glacial slump deposits.

Photo: Twisted Column, Imperial Cave, by Ross Pogson.



## Other research activities

A wide range of other geological research has been conducted by Senior Fellows and Museum staff in collaboration with Research Associates and outside workers.

A rare form of the lanthanum carbonate mineral lanthanite from New Zealand was characterised, further work was done on a new mineral species from Broken Hill, rules for mineral nomenclature were revised, and X-ray data library files were edited. Zeolite minerals from volcanic rocks in eastern Australia (NSW, Qld, Tas) and New Zealand were studied to characterise their species and chemical variations. Rock types of the Earth's mantle and lower crust under eastern Australia have been studied from samples brought to the surface by volcanic action, to reconstruct the high pressure lithology and past heat flows. The origins of gemstones (sapphire, ruby, diamond) and their internal mineral & fluid inclusions, delivered by volcanic activity in eastern Australia and Pacific margins, have been studied to understand the volcanic sources and gemstone formation.

Eastern Australian volcanic sequences were investigated to understand their genesis and potential future volcanic risks, and radiometric isotope and fission track dating was used to help form a basis for landscape evolution and magma genesis studies for the last 100 million years post eastern Gondwana break-up. Landscape evolution in the Dubbo-Bourke region was examined, revealing older landforms than expected, related to old drainages and volcanic infillings, with implications for discovery of new permanent water sources. Correlations between biozone ages from palynology and radiometric dating of volcanic markers were studied in Tasmania, helping delineate the Tamar drainage system entering Bass Strait. Young volcanic areas in eastern Australia are being studied, to provide exploration targets for geothermal energy using new concepts and drilling techniques. Continuing input into the debate on the Cretaceous-Cenozoic mass extinction event has been provided.

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**Program 1. Addressing knowledge gaps and problems in understanding the biota in Australasian marine environments.**

<b>Key research goals</b>	<b>Researcher to add title of Research Area that addresses goal</b>	<b>Name of Researcher(s)</b>	<b>Major/Minor contribution to goal</b>
a) Understanding Australia's marine biodiversity, emphasising species with key ecological roles and high sensitivity to human impact	Research Area = Taxonomy. Project title = Taxonomy of Australian Cirrolanidae (Crustacea: Isopoda) from Australian Museum collections	S Keable	Minor
	Research Areas = Taxonomy; Biodiversity Assessment; Biogeography; Ecology. Project title = Targeted collecting, checklist and guide to starfish (Echinodermata: Asteroidea) of the Sydney region	S Keable, H Stoddart, R Springthorpe, A Murray, K Attwood	Minor
	Defining evolutionary stability in southeastern Australia: (1) Phylogeographic studies of marine and estuarine mollusca	D Colgan	Major - relevant 5 b) also
	Systematics of Cerapus and related genera (Crustacea: Amphipoda)	J Lowry and P Berents	Minor
	Taxonomy of fish larvae occurring in NSW	A Hay & J Leis	Major
	Larval-fish systematics - Family Lutjanidae	J Leis	Major (also applies to C below)
	Larval-fish and adult systematics - Lobotes, Hapalogenys and Datnioides	J Leis	Major (also applies to C below)
	Arafura Sea Isopoda Asellota (ABRS proposal)	GDF Wilson	Major
	Biodiversity of Algal Substrates	GDF Wilson, AJK Millar (Royal Botanic Gardens Sydney)	Major
	Structure of Deep-sea Invertebrate Assemblages, especially Isopoda	GDF Wilson	Major
	Systematics of Ampharetids	P Hutchings, D Garner	Minor
	Systematics, toxinology, ecology and biogeography of laticaudid sea snakes	H Cogger (SF)	Major
	Reviews of various fish taxa (gobies, clinids)	D Hoese (SF)	Major
	Review of the Acoetidae polychaetes of Australasian region	A Murray & P Hutchings	Minor
	Web-based catalogue of the marine molluscs of NSW	D Beechey (SF)	Major
	Circum-Australian Amphipoda	J Lowry & L Hughes	Major
	Great Barrier Reef Amphipoda	J Lowry	Major
	Systematics and phylogeny of Sabellida	P Hutchings, M Capa	Major
Biology and taxonomy of nudibranchs	W Rudman (SF)	Major	
b) Understanding the connectivity of marine populations.	Defining evolutionary stability in southeastern Australia: (1) Measures of gene flow in marine and estuarine Mollusca, and investigations of shell elemental compositions as an indicator of provenance	D Colgan	Major - relevant to 5 b) also
	Larval-fish ecology - behaviour in relation to dispersal	J Leis	Major
	Larval-fish ecology- biophysical dispersal model for GBR	J Leis	Major

**Program 1. Addressing knowledge gaps and problems in understanding the biota in Australasian marine environments.**

**Cont.**

<i>Key research goals</i>	<i>Researcher to add title of Research Area that addresses goal</i>	<i>Name of Researcher(s)</i>	<i>Major/Minor contribution to goal</i>
	Larval-fish ecology - effects of climate change on Connectivity in coral reef systems	J Leis	Major (also applies to c, below)
	Larval-fish ecology - Connectivity and biodiversity in coral reef systems	J Leis	Major (also applies to c, below)
	Larval-fish ecology - OWNFOR project on larval-fish orientation	J Leis	Major (also applies to c, below)
	Taxonomy, biology and evolution of deep-sea fishes	J Paxton (SF)	Major (also applies to a, above)
c) Understanding the biodiversity of coral reefs.	Larval-fish ecology - effects of climate change on Connectivity in coral reef systems	J Leis	Major (also applies to b, above)
	Larval-fish ecology - Connectivity and biodiversity in coral reef systems	J Leis	Major (also applies to b, above)
	Larval-fish ecology - OWNFOR project on larval-fish orientation	J Leis	Major (also applies to b, above)
	Larval-fish systematics - Family Lutjanidae	J Leis	Major (also applies to a, above)
	Larval-fish and adult systematics - Lobotes, Hapalogenys and Datnioides	J Leis	Major (also applies to a, above)
	Invasive bryozoans	L Christidis	Minor
	Bioerosion of coral substrates	P Hutchings	Minor
Other research on biota in Aust marine environments	Reproductive anatomy of the Isopoda	GDF Wilson	Minor

**Program 2. Addressing knowledge gaps and problems in understanding the biota in Australian terrestrial and freshwater environments.**

<i>Key research goals</i>	<i>Researcher to add title of Research Area that addresses goal</i>	<i>Name of Researcher(s)</i>	<i>Major/ Minor contribution to goal</i>
a) Understanding the species and places of high biodiversity significance in Australia.	Revision of Spilopyrinae (fiery leaf-beetles)	C Reid	Major
	Morphological and Molecular Investigations of the Systematics and Phylogeography of the Speciose Landsnail Genus Gyrocochlea (Mollusca: Charopidae)	D Colgan, J Stanisic, E May	Major
	Evolutionary & conservation genetics of marsupials	M Eldridge	Major
	The systematics of Australian comb-footed spiders in the subfamily Hadrotarsinae (Araneae: Theridiidae)	H Smith	Major
	Investigations of Australian web-building spiders	H Smith, J Gollan	Minor
	Australasian forest spider fauna	H Smith, M Gray	Major
	Systematics of spiders in wet forests of SE Aust.	G Milledge	Minor
	Revision of Australian Lichen Moths (Lepidoptera: Arctiidae, Lithosiinae ).	D Britton	Major
	Revisions of Australian Dolichopodidae -various genera	D Bickel	Major
	Revisions of Australian Empididae - Hilarini- Dance flies	D Bickel	Major
	Dolichopodidae of Trans-Fly/ Cape York	D Bickel	Minor
	Alps to Atherton	D Faith	Major
	conservation planning for key biodiversity places; new global hotspot	D Faith	Major
	insect plant linkages eastern Aus.	D Faith	Major
	GBIF 2010 Campaign	D Faith	Major
	PD phylogenetic diversity analyses, methods	D Faith	Major
	Diversity and conservation of rainforest dependent lizards in eastern Australia	R Sadlier	Major
	Genetic and evolutionary connectivity of Australian ecosystems	L Christidis	Major (also b), below, & 3b, 5b)
	Modelling biodiversity distribution in terrestrial environments for conservation planning	P Flemons, A Ranipeta, M Elliott, M Ashcroft	Major
Morphological and molecular systematics of the funnel-web spiders	M Gray (SF)	Major	
a) Understanding the species and places of high biodiversity significance in Australia. Cont.	Systematics of the Australasian Badumninae	M Gray (SF)	Major
	Ecology and sustainability of estuaries and sandy beaches	A Jones (SF)	Major
	Response of terrestrial invertebrates to riparian habitat rehabilitation in the Hunter Valley	J Gollan	Major
	Distribution patterns of terrestrial arthropods in Pilbara	J Gollan, M Ashcroft	Major
	Deep sea biodiversity ARC Linkage	P Hutchings et al	Major
	Phylogeny and phylogeography of Planorbidae (Pulmonata)	W Ponder (SF)	Major

**Program 2. Addressing knowledge gaps and problems in understanding the biota in Australian terrestrial and freshwater environments. Cont.**

<b>Key research goals</b>	<b>Researcher to add title of Research Area that addresses goal</b>	<b>Name of Researcher(s)</b>	<b>Major/ Minor contribution to goal</b>
a) cont.	Phylogeny and phylogeography of Australian Viviparidae (Caenogastropoda)	W Ponder (SF)	Major
	Arid-zone artesian spring biota - faunal composition, endemism and conservation	W Ponder (SF), E Jefferys, R Fensham	Major
	Australasian freshwater mollusc fauna - composition, distribution, conservation	W Ponder (SF)	Major
	Taxonomy, behaviour and ecology of Diptera	D McAlpine (SF)	Major
	Taxonomy and systematics of cicadas	M Moulds (SF)	Major
	Population biology of endangered frogs	G Pyke (SF)	Major
	Evolutionary genetics and DNA barcoding of Australian termites	N Lo	Major
	Molecular phylogenetics of burrowing cockroaches (Geoscapheinae, Panesthiinae)	N Lo	Major
	Taxonomy and systematics of Psocoptera	C Smithers (SF)	Major
b) Understanding the distribution, interaction and evolution of key species in arid Australia.	Revision of Sagrinae (kangaroo beetles)	C Reid	Major
	Evolutionary & conservation genetics of marsupials	M Eldridge	Minor
	Systematics of Australian mantid fauna	G Milledge	Minor
	Dolichopodidae & Empididae of Great Western Woodlands, WA	D Bickel	Minor
	GBIF 2010 campaign	D Faith	Minor
	Genetic and evolutionary connectivity of Australian ecosystems (ARC Linkage & Environmental Futures Network)	L Christidis	Major (also a), above & 3b,5b)
	Phylogeny and phylogeography of hydrobiids associated with arid-zone artesian springs	W Ponder (SF)	Major
Evolutionary genetics and DNA barcoding of Australian termites	N Lo	Major	
	Molecular phylogenetics of burrowing cockroaches (Geoscapheinae, Panesthiinae)	N Lo	Major
Other projects addressing knowledge gaps in biota in Aust terrestrial and freshwater environments	Effects of day to day temperature fluctuations on pitfall-trapped invertebrates	J Gollan, M Ashcroft	
	Insect damage to fruit of endangered Lillipillies <i>Syngium</i> sp. and an endangered <i>Quassia</i> sp.	D Britton, A Clements	
	Eastern Australian landsnails book	O.Griffiths (RA), M.Shea, J.Stanistic, D.Potter	Major
	Kimberley Islands Landsnails (from 4/08)	F.Koehler, W.Ponder (SF)	Minor

**Program 3. Increasing our understanding of the genetic variation in key taxa (species) of the Australasian and Indo-Pacific biota.**

<b>Key research goals</b>	<b>Researcher to add title of Research Area that addresses goal</b>	<b>Name of Researcher(s)</b>	<b>Major/ Minor contribution to goal</b>
a) DNA Barcoding of taxonomic groups that are of economic, social or environmental concern.	A species flock of <i>Eophreatoicus</i> from Kakadu Nat. Park	GDF Wilson, C Humphrey (ERISS), D Colgan, R Johnson, K Gray	Major
	Forensic DNA-based identification of wildlife	R Johnson, K Gray, R Mason	Major
	A DNA library for the New Caledonian lizard fauna	R Sadlier	Major
	DNA barcoding of Australian fauna	L Christidis, R Johnson, K Gray, R Mason, M McGrouther, D Bickel, G Theischinger	Major
	DNA barcoding of Australian termites	N Lo	Major
b) Genetic approaches to monitoring biodiversity and assisting resource-use planning for biodiversity conservation.	Genetic Criteria for Reserve Selection - publication of the molecular genetic results	D Colgan, D O'Meally	Major
	Evolutionary and conservation genetics of marsupials	M Eldridge	Major
	Characterisation of the marsupial MHC	M Eldridge	Major
	A species flock of <i>Eophreatoicus</i> from Kakadu Nat. Park	GDF Wilson, C Humphrey (ERISS), D Colgan, R Johnson, K Gray	Minor
	Analysis of the population genetic structure of the Bush Stone Curlew ( <i>Burhinus grallarius</i> )	W Boles, R Johnson, R Mason, K Gray, C Price (DECC)	Major
	Phylogenetic analysis of molluscs from the families Viviparidae, Planorbidae, Hydrobiidae	W Ponder (SF), R Mason, K Gray, R Johnson	Minor
	Genetic and evolutionary connectivity of Australian ecosystems (ARC Linkage & Environmental Futures Network)	L Christidis	Major (also 2a, 2b, 5b)
	Morphological and molecular systematics of the funnel-web spiders	M Gray (SF)	Minor



**Program 4. Origin, evolution and biogeography of the biota of the Indo-Pacific and Australasian region.**

<b>Key research goals</b>	<b>Researcher to add title of Research Area that addresses goal</b>	<b>Name of Researcher(s)</b>	<b>Major/ Minor contribution to goal</b>
a) Understanding the origins of the Australian fauna.	Conodont Biostratigraphy and reconstruction of palaeogeography, palaeoclimate and ecosystems in the Ordovician world	Y Y Zhen	Major
	Revision of Spilopyrinae (fiery leaf-beetles)	C Reid	Major
	Revision of Sagraeae (kangaroo beetles)	C Reid	Major
	Understanding gastropod phylogeny, particularly the basal Pulmonate and basal Heterobranchia, that are particularly characteristic of Australian waters	D Colgan, C Lydeard, B Dayrat, W Ponder (SF)	Major - see goal b of this prog and Prog 5, research goals a and c
	Molecular systematics of New Guinean macropods	M Eldridge, C Helgen	Major
	The systematics of Australian comb-footed spiders in the subfamily Hadrotarsinae (Araneae: Theridiidae)	H Smith	Major
	Australasian forest spider fauna	H Smith	Minor
	Systematics of Australian mantid fauna	G Milledge	Minor
	Systematics of spiders in wet forests of SE Aust.	G Milledge	Minor
	Cape York Amber fauna -insect inclusions -origins	D Bickel	Major
	Systematics of Australian Agamid Lizards	R Sadlier	Minor
	Systematics of the Egernia striolata group	R Sadlier	Minor
	Evolutionary genetics and DNA barcoding of Australian termites	N Lo	Major
	Molecular phylogenetics of burrowing cockroaches (Geoscapheinae, Panesthiinae)	N Lo	Major
	Systematics of the Gondwanan group, Phreatoicoidea (Isopoda; freshwater)	GDF Wilson	Major
	b) Understanding the biogeography and evolution of the Indo-Pacific fauna.	Systematics and biogeography of Australo-Pacific avifauna (ABRS)	W Boles, L Christidis
Description and systematics of Australian Tertiary avifauna		W Boles	Major
Revision of Spilopyrinae (fiery leaf-beetles)		C Reid	Minor
Understanding heterobranch (a major gastropod clade) phylogeny, particularly the basal pulmonate and basal Heterobranchia, that are particularly characteristic of Australian waters		D Colgan, C Lydeard, B Dayrat, W Ponder (SF)	Major (also goal 4.a Program 5, goals a and c)
Publication of <i>Emballonura</i> phylogeography (Indo-Pacific Bat genus)		D Colgan, S Soheili	Minor
Molecular systematics of New Guinean macropods		M Eldridge, C Helgen	Major
Systematics and biogeography of Australo-Pacific avifauna (ABRS)		W Boles, L Christidis	Major (also a), above)
Larval-fish ecology - behaviour in relation to dispersal		J Leis	Major
Larval-fish systematics - Family Lutjanidae		J Leis	Major
Larval-fish and adult systematics - Lobotes, Haplogeny and Datnioides		J Leis	Major

**Program 4. Origin, evolution and biogeography of the biota of the Indo-Pacific and Australasian region.**
**Cont.**

<b>Key research goals</b>	<b>Researcher to add title of Research Area that addresses goal</b>	<b>Name of Researcher(s)</b>	<b>Major/ Minor contribution to goal</b>
b. cont	Reviews of various Indo-Pacific fish species	D Hoese (SF)	Minor
	Taxonomic studies of signal flies (New Caledonia, PNG, Australia)	D McAlpine (SF)	Minor
	Fiji Arthropod survey - Co-PI	D Bickel	Major
	Dolichopodidae (Diptera) of Fiji and mid-Pacific	D Bickel	Major
	Dolichopodidae (Diptera) of New Caledonia	D Bickel	Major
	Dolichopodidae of Trans-Fly Cape York region	D Bickel	Minor
	Systematics and biology of New Caledonian Lizards	R Sadlier	Major
	Systematics & phylogeny of sabellida	Pat Hutchings	Major
	Caenogastropod phylogeny	W Ponder (SF), D Colgan, R Golding, E Strong, J Healy	Major
	Phylogeny and phylography of hydrobiid gastropods in the Australasian region	D Colgan, W Ponder (SF), M Haase	Major
	Crustacean phylogeny, relationships within the Arthropoda	GDF Wilson	Minor
	Phylogeny of the Isopoda and the Peracarida	GDF Wilson	Minor
	Molecular phylogenetics of burrowing cockroaches (Geoscapheinae, Panesthiinae)	N Lo	Major
	Comparative morphometrics in three large lizard or lizard-like ecological analogues - NZ tuatara, Australian agamid, Fijian iguanid	H Cogger (SF)	Minor
Other research on origin, evolution and biogeography of the region	Guide to the reptiles and amphibians of the Western Pacific	H Cogger (SF), R Sadlier	Minor
	A Conservation Assessment of the New Caledonian Lizard Fauna. A WEB based assessment of the conservation status of the New Caledonian lizard fauna funded by the territory national government	R Sadlier	

**Program 5. Understanding human impacts on the Australian biota.**

<b>Key research goals</b>	<b>Researcher to add title of Research Area that addresses goal</b>	<b>Name of Researcher(s)</b>	<b>Major/ Minor contribution to goal</b>
a) Assessment of the vulnerability of Australia's freshwater and estuarine ecosystems to human impacts.	Understanding gastropod phylogeny, particularly the basal Pulmonate and basal Heterobranchia, that are particularly characteristic of Australian waters	D Colgan, C Lydeard, B Dayrat, W Ponder (SF)	Minor - Major relevance to program 4.
	A species flock of <i>Eophreatoicus</i> from Kakadu National Park	GDF Wilson, C Humphrey (ERISS)	Major
	Overview of integrative tools and methods in assessing ecological integrity in estuarine and coastal systems worldwide	P Hutchings, A Borja, S Bricker, D Dauer, A Forbes, R Kenchington, J Marques, P Qian	Major
	Reviews of various freshwater fish species	D Hoese (SF)	Minor
b) Investigating the effects of climate change on the Australian fauna.	Defining evolutionary stability in southeastern Australia: (1) Phylogeographic studies of marine and estuarine mollusca	D Colgan	Major - relevant to 1 a) also
	Defining evolutionary stability in southeastern Australia: (1) Measures of gene flow in marine and estuarine Mollusca, and investigations of shell elemental compositions as an indicator of provenance	D Colgan	Major - relevant to 1 b) also
	Australasian forest spider fauna ( <i>Toxopsoides</i> )	H Smith	Minor
	Ecology of Australian White Ibis (also included in [c])	R Major, J Martin, K French	Major
	Larval-fish ecology - effects of climate change on Connectivity in coral reef systems	J Leis	Major
	Genetic and evolutionary connectivity of Australian ecosystems (ARC Linkage & Environmental Futures Network)	L Christidis	Major (also 2a, 2b, 3b)
	Vulnerability of climate on benthic invertebrates of the GBR	P Hutchings, S Ahyong, M Byrne, R Przeslawski, G Wörheide	Major
	Assessing impact of ocean acidification on coral reefs	P Hutchings, S Dove	Major
	Population biology of endangered frogs and use as bio-indicators	G Pyke (SF)	Major
c) Understanding Human Impacts in the Sydney environs.	Bird-habitat relationships in urban areas	R Major, H Parsons, K French	Major
	Ecology of Australian White Ibis (also included in [b])	R Major, H Parsons, K French	Major
	Historical Changes in the Birds of Sydney	R Major, H Parsons	Major
	Assessment of Hill-topping sites for Butterflies in the Hawkesbury-Nepean CMA	D Britton, S Ginn, L Holme	Major
	Human Climate and Fire Nexus in the Sydney Basin	V Attenbrow with S Mooney, UNSW	Major
	Ecology of a recently discovered exotic bee in Australia	J Gollan, M Ashcroft, M Batley	Major
	Forensic DNA-based identification of wildlife	R Johnson, K Gray, R Mason	Minor

## Program 5. Understanding human impacts on the Australian biota.

Cont.

<i>Key research goals</i>	<i>Researcher to add title of Research Area that addresses goal</i>	<i>Name of Researcher(s)</i>	<i>Major/ Minor contribution to goal</i>
Other Human Impacts on Australian Biota	The role of eucalypt plantations in biodiversity conservation.	R Major, T Hsu, K French	Minor
	Invasive Bryozoans	L Christidis	Minor
	Impacts on invertebrates in the Pilbara	J Gollan, M Ashcroft	Minor
	Invasive species analysis of port surveys	P Hutchings & M Bishop	Major

**Program 6. Investigating the history of human cultures and communities in the diverse & changing environments of Aust. & the Pacific region.**

<b>Key research goals</b>	<b>Researcher to add title of Research Area that addresses goal</b>	<b>Name of Researcher(s)</b>	<b>Major/ Minor contribution to goal</b>
a) Understanding the history and diversity of Indigenous material culture	Tracing the diversity of stone tools assemblages in West New Britain, Papua New Guinea	R Torrence, N Kononenko (ANU, PhD student), P Rath (University of Sydney PhD student)	Major
	Indigenous agency and museum collections	R Torrence, A Clarke (Uni of Sydney), J Philp (Uni of Sydney), E Lilje (PhD student, Uni of Sydney)	Major
	Residue analysis of mortars and pestles from Papua New Guinea	R Torrence, H Barton (University of Leicester), P Swadling (ANU)	
	Interpretation and analysis of the Indigenous re-contextualisation of incised wooden weapon designs from far western NSW c1890-1970	L Gibson	Major
	Geographical diversity in the distribution of Holocene Sydney Basin backed artefacts	V Attenbrow, B Asmussen, P Hiscock ANU, M Ashcroft	Major
	Evolution of Technology and Tool Use in 10,000 years of Aboriginal Prehistory	V Attenbrow, P Hiscock (ANU), G Richardson (UQ)	Major
	Cataloguing Roth collection from the Gulf region	K Khan SF)	Major
	History and documentation of the Papunya Permanent Collection	K Khan SF)	Major
	Stone tools and potters of New Britain, PNG	J Specht (SF)	Minor
b) Tracking the history of human interaction with the natural environment incl. effects of urbanisation, industrialisation, tourism, environmental changes & disasters.	Impact of natural disasters on cultural change with special reference to West New Britain, Papua New Guinea	R Torrence, V Neall (Massey Uni), B. Boyd (Southern Cross Uni), C. Lentfer (Uni QLD), C. Petrie (Cambridge Uni), C. McKee (Mineral Resources, PNG)	Major
	Movement, manipulation and management of plant biodiversity east of the Wallace line	R Torrence, T Denham (Monash University)	Major
	Exploring the changing relationship of Barkindji people to the Darling River as expressed through contemporary art making and its content.	L Gibson	Minor
	Port Jackson Tools and Technology - Accessing stone materials	V Attenbrow, T Corkill (MusAssoc)	Middling

	<b>Program 6. Investigating the history of human cultures and communities in the diverse &amp; changing environments of Aust. &amp; the Pacific region.</b>	<b>Name of Researcher(s)</b>	<b>Cont.</b>
	Evolution of Technology and Tool Use in 10,000 years of Aboriginal Prehistory	V Attenbrow, P Hiscock (ANU), Gail Robertson (UQ)	Major
	Human Climate and Fire Nexus in the Sydney Basin	V Attenbrow, S Mooney, UNSW	Major
	Late Holocene mega-tsunamis and the coastal archaeological record of NSW	V Attenbrow, I Hutchinson (S Fraser Uni, Canada)	Major
c) Understanding the origin and functions of social exchange	Prehistoric obsidian exchange in Melanesia	R Torrence, G Summerhayes (UofOtago), P Rath (PhD student, UofSydney)	Major
	Ancient obsidian exchange in Far East Russia	R Torrence, T Doelman (Uni of Sydney), N. Klujev, I. Sleptsov, I. Pantyukhina, V. Popov (Russian Acad of Sci)	Major
	Application of Laser Ramon technique to characterisation of obsidian	R Torrence, E Carter (UofSydney), I Graham (UNSW)	Major
	Stone tools and potters of New Britain, PNG	J Specht (SF)	Minor
	Exchange in the acquisition of human remains from the Torres Strait Islands.	P Gordon, R. Torrence, RVS Wright , F Petchley (Waikato C14 lab), L Matisoo-Smith (UofAuckland)	Major
Other research into human cultures	Ethnography of how work and identity operate in the moral and domestic economy of Aboriginal western NSW from the 1950s until now.	L Gibson	Major
	Marine Carbon Reservoir Variability along the NSW South Coast	V Attenbrow, I Loch, S Ulm (UQld)	Minor

**Program 7. Linking intangible and tangible heritage.**

<b>Key research goals</b>	<b>Researcher to add title of Research Area that addresses goal</b>	<b>Name of Researcher(s)</b>	<b>Major/ Minor contribution to goal</b>
a) Investigating the history of creativity in human cultures and communities in Australia and the Pacific	Indigenous agency and museum collections	R Torrence, A Clarke (Uni of Sydney), J. Philp (Uni of Sydney), E Lilje (PhD student, Uni of Sydney)	Major
	Reconstructing Papuan trading systems	S. Davies, Fleishmann Fellow	Major
b) Understanding the roles of material culture and traditional knowledge in Indigenous cultures.	Ethnography of the role of contemporary art making in the social, cultural and economic spheres of Aboriginal western NSW lifeworlds. This includes the making a short film with Elder Badger Bates. 'One Man his Art and Culture'.	L Gibson	Major
	Yirrkala (Northern Territory) digital exchange project	P Monaghan, P Gordon	Major
	Fiji Tabua Project	P Monaghan, E Waterman	Major
	Solomon Islands Intangible Cultural Heritage Field Kit Project	P Monaghan, E Waterman	Major
	Fiji pottery	M Van Olffen	Major
	NSW Inland River Canoe manufacture of the Murawari	B South	Major
c) Understanding the collecting process.	Indigenous agency and museum collections	R Torrence, A Clarke (Uni of Sydney), J Philp (Uni of Sydney), E Lilje (PhD student, Uni of Sydney)	Major
	Collecting practices of Andrew Goldie and Theodore Bevan	S Davies, Fleishmann Fellow	Major
	Fred McCarthy - the American-Australian Arnhem Land Expedition and NSW archaeological collections	V Attenbrow	Major
d) Engaging with creator communities to better understand the significance of our collections.	Continuing fieldwork with far western NSW Communities and cross fertilisation of ideas on the cultural and social significance of the NSW Material in the ethnographic collections. With Barkindji Elders.	L Gibson	Major
	Yirrkala (Northern Territory) digital exchange project	P Monaghan, P Gordon	Major
	Visiting Cultural Leaders Program	P Monaghan	Major
	Fiji Tabua Project	P Monaghan, E Waterman	Major
	Solomon Islands Intangible Cultural Heritage Field Kit Project	P Monaghan, E Waterman	Major
	Virtual Museum (ARC Linkage - Bali; ARC Linkage - Wollongong)	L Christidis, V Daniel, P Monaghan	Major
	NSW Inland River Canoe manufacture of the Murawari	B South	Major

**Program 8. Investigating extant & extinct faunas and environmental systems in the context of recent geological history to better forecast future changes**

<b>Key research goals</b>	<b>Researcher to add title of Research Area that addresses goal</b>	<b>Name of Researcher(s)</b>	<b>Major/ Minor contribution to goal</b>
a) Studying animal groups that leave good fossil records to help forecast future change	Conodont Biostratigraphy and reconstruction of palaeogeography, palaeoclimate and ecosystems in the Ordovician world	Y Y Zhen, I Percival(Geol. Surv. NSW), J.Pickett (Geol. Surv. NSW), T.Wright (Univ. Wollongong), R.Cooper (Geol. Surv. NZ), J.Liu (Peking Univ.) Y.Zhang (Nanjing), Z.Zhou (Nanjing)	Major
	Cape York Amber fauna - insect inclusions	D Bickel	Major
	Devonian fossil fish	A Ritchie (SF), Z Johanson, Natural History Museum London; R Carr, Ohio USA	Major
b) Analysing dynamics of contemporary and recent reef systems.			
c) Sedimentary Mineralogy	Distribution,origin, and mineralogy of Australian limestone cave formations (speleothems) and sediments in a former continental shelf reef system, featuring Jenolan Caves NSW, with implications for palaeoclimate, cave conservation, environmental management and tourism in a World Heritage area.	R Pogson, D Colchester, A Osborne (USyd), B England	Major
Other Geosciences Research	Triggers for volcanism, Australasia/Antarctica	L Sutherland (SF), R Pogson, I Graham	
	Gemstone origins, Australia/Pacific margins	L Sutherland (SF), G Webb, L Barron, I Graham, K Zaw (U Tas)	
	Post-Gondwana geochronology, eastern Australia	L Sutherland (SF)	
	Landscape evolution, central NSW	L Sutherland (SF), R Pogson, L Barron	
	Bassian- Biogeological connections	L Sutherland (SF)	
	Geothermal prospecting, eastern Australia	L Sutherland (SF)	
	Fossil Birds of Australia	W Boles	
	Cretaceous-Cenozoic mass extinction event	L Sutherland (SF)	
	Eastern Australian zeolites - distribution and origins	R Pogson, L Sutherland, I Graham, D Colchester, B England	
	New Australian mineral species	R Pogson,I Graham, D Colchester	



## Grant funded projects administered by Australian Museum

Principal Investigator(s)	Title of project	Granting body	Amount awarded 07-08	Total value of grant	Years funds	Research Strategy Program
<b>L Christidis, J Norman, W Boles</b>	Systematics, biogeography, genetic differentiation and conservation of the grasswren Amytornis complex (Aves)	Department of the Environment and Water Resources	10,000	30,000	2006-08	2,3
<b>D Colgan, J Stanisic</b>	Morphological and molecular investigations of the systematics and biogeography of the speciose landsnail genus Gyrocochlea	Department of the Environment and Water Resources	33,000	65,000	2006-08	4
<b>P Flemons</b>	Digital Stories for Taxonomic Databases Working Group	Global Biodiversity Information facility	11,000	11,000	2007/08	2
<b>P Flemons</b>	Atlas of Living Australia Tools Review	CSIRO	32,000	32,000	2007/08	2
<b>J Gollan</b>	Bugwise Outreach 07	Coal and Allied Community Trust	43,000	43,000	2007/08	2
<b>D Britton</b>	Hill-Topping Butterflies	Dept of Environment & Climate Change NSW	18,182	18,182	2007/08	5
<b>J Lowry</b>	Australian Benthic Marine Amphipoda	Aust Biological Resources Study	20,000	40,000	2006-2008	1
<b>J Lowry</b>	Circum-Australia Amphipods	Department of the Environment and Water Resources	70,000	250,000	2006-2008	1
<b>J Gollan/ M Ashcroft / M Batley/D Britton</b>	Ecology of a recently discovered exotic bee in Australia	W V Scott Charitable Trust	80,200	80,200	2007/08	2
<b>H Smith</b>	The systematics of Australian comb-footed spiders in the subfamily Hadrotarsinae (Araneae: Theridiidae)	Australian Biological Resources Study	60,000	180,000	2007-2010	2,4
<b>D Beechey (SF)</b>	Web-based catalogue of the marine molluscs of NSW	Department of the Environment and Water Heritage and the Arts	5,000	5,000	2008	1
<b>J Leis/ C Paris</b>	How do baby fish find a home?	Hermon Slade Foundation	23,000	59,000	2007-2010	1, 5
<b>P Monaghan, L Christidis, E Waterman.</b>	Solomon Islands Intangible heritage Field Kit	International Council of Museums (Australian National Committee)	20,562	20,562	2007	7
<b>P Hutchings</b>	Phylogeny of Sabellida 3 postdoctoral Fellowship	Jointly funded ABRS/AM	66,667	150,000	2008-10	1,4,5

Principal Investigator(s)	Title of project	Granting body	Amount awarded 07-08	Total value of grant	Years funds	Research Strategy Program
<b>B South</b>	Inland River Canoe	The Australian Institute of Aboriginal and Torres Strait Islander Studies (IASTIS)	7,140	7,140	2007/08	6,7
<b>M McGrouther (others)</b>	Fish –BOL	Consortium for the Barcode of Life	7,000	7,000	2007-08	1 (other)
<b>M McGrouther</b>	Australian Fishes On-line	Department of the Environment and Water Resources	15000	15000	2007-08	1 (other)
<b>C Reid</b>	Fiery Leaf Beetles, Taxonomy	Department of the Environment and Water Resources (ABRS)	35,000	35,000	2007/08	2,4
<b>R Major</b>	The Australian White Ibis: suburban survivor or climate change refugee.	W V Scott Charitable Trust	78,100	78,100	2007/08	5
<b>N Lo</b>	The evolution of diverse interactions between Wolbachia bacteria and their invertebrate hosts: insights from a novel lineage infecting termites	Australian Research Council (Discovery Grant)	75,587	75,587 (amount transferred to AM)	2007-2008	3,4

#### Grant funded projects administered by another research institution

Principal Investigator(s)	Title of project	Granting body	Amount awarded 07-08	Total value of grant	Years funds	Research Strategy Program
<b>S Ulm, V Attenbrow</b>	Marine carbon reservoir variability along the NSW Coast	Australian Institute of Nuclear Science and Engineering (AINSE)	?	8,950	2007-2008	6
<b>P Hiscock, V Attenbrow</b>	Evolution of technology and tool use in 10,000 years of Aboriginal History	Australian Research Council (Discovery Grant)	45,500	134,000	2006-7 to 2009-10	6
<b>L Christidis, V Daniel, E Waterman.</b>	Search, Navigation and Annotation of Digital Museum Collections Using Concept-Lattices: A Case Study of the Australian Museum's Vanuatu Collections.	University of Wollongong, URC Research Partnership Grant Scheme	12,000	12,000	2007	7
<b>L Christidis; V Daniel; S Valis</b>	Emerging Pacific Cultural Centre: AM Partnership Program	International Council of Museums (ICOM) Australia	12,000	12,000	2007	7
<b>K Belov, M Eldridge, S Beck</b>	Characterisation of the tammar wallaby MHC	Australian Research Council - Discovery	70,000	230,000	2006-2008	3

## APPENDIX 2

Principal Investigator(s)	Title of project	Granting body	Amount awarded 07-08	Total value of grant	Years funds	Research Strategy Program
LA Hughes; AJ Beattie; <b>DP Faith</b> ; RL Kitching	A new phylogenetic framework for estimating local, regional and global biodiversity.	Australian Research Council - Discovery	127,000	254,000	2006-08	2,4,5
SG Dove; WP Leggat; D Yellowlees; JM Lough; <b>PA Hutchings</b> ; KG Caldeira	Assessing the risk of ocean acidification for the Great Barrier Reef	Australian Research Council - Linkage	176,650	476,950	2007-09	1, 5
JN Marshall; SP Collin; RD McCauley; KA Fritsches; NS Hart; BM Degnan; SM Degnan; MD Norman; JN Hooper; <b>PA Hutchings</b> ; et al.	Deep Downunder: designing a deep-sea exploration and discovery capability for Australia	Australian Research Council - Linkage	380,000	1,093,000	2007-09	1
T Dymond, M Edwards, A Freimanis, <b>R Major</b> , K Ravich	Birds as Indicators (program for Schools)	NRAC Forging partnerships.	25,000	25,000	2007-08	2,5
<b>J Leis</b> , L Mason, GP Jones  (Project Leader for Prog 8: T Hughes)	Resilience and connectivity: development of and test of realistic larval-fish dispersal models for the Great Barrier Reef (project within Program 8: Sustainable use and Management of Marine resources of the GBR.	Marine & Tropical Sciences Research Facility, through James Cook University	38,780 (to AM)	155,120	2006-2010	1, 5
I.T. Graham and <b>F.L. Sutherland</b>	PIXE probe analysis of gem corundum suites	Australian Institute of Nuclear Science and Engineering (AINSE)	8,240	8,240	2007	8
AF Clarke, JP Philp, <b>R Torrence</b>	Producers and Collectors: Uncovering the Role of Indigenous agency in the Formation of Museum.	Australian Research Council - Linkage	\$24,650	\$103,950	2006-9	6, 7
<b>R Torrence</b> , N Klujev, T Doelman	Reconstructing Prehistoric Exchange of Volcanic Glasses (U Sydney)	Australian Research Council (Discovery Grant)	49, 367	230,000	2004-7	6
<b>R Torrence</b> , N Klujev,	Pleistocene Origins of Long Distance Obsidian Exchange in Far Eastern Russia	Wenner Gren Foundation for Anthropological Research	?	US\$28,5000	2006-8	6

## APPENDIX 2

Principal Investigator(s)	Title of project	Granting body	Amount awarded 07-08	Total value of grant	Years funds	Research Strategy Program
<b>L Christidis, B Appleton</b>	Phylogeographic relationships within Madagascar <i>Miniopterus</i> bats (with Museum Victoria)	Biodiversity Conservation Madagascar Association.	\$5,000	\$5,000	2008	2 other
S Hand, M Archer, <b>DJ Bickel</b> , ME Dettmann	Precious time-capsule: discovery of fossil-rich amber from Australia. (Uni NSW) also with UQ.	Australian Research Council (Discovery Grant)	80,000	245,000	2008-2010	4,8
S Cameron, T Evans, <b>N Lo</b> , D Yeates	Molecular diagnostics of Australian Termites	CSIRO Entomology Internal Grant	50,000	50,000	2008	2,3,4
G Sword, S Simpson, <b>N Lo</b> , L Kang	Functional genomics of locust migratory behavior	Australian Research Council (Discovery Grant)	203,000	619,000	2008-2010	Other
(Network of 50 individuals) administered by Uni of Adelaide, incl. <b>D Faith</b>	Discovering the past and present to shape the future: networking environmental sciences for understanding and managing Australian biodiversity	Australian Research Council	300,000	900,00	?	2,3,5
<b>D Faith</b> , S Ferrier, C Brown, J Soberon, T Peterson, D Yeates, C Slatyer, J West, V Savolainen	GBIF for 2010	Project lead by UNEP-WCMC to develop proposals for involvement in the GBIF campaign to significantly reduce by 2010 the current rate of biodiversity loss at the global, regional and national level.	50,000	50,000	2007-2010	2,4,5

## Scientific Publications

Details of publications	Prog 1	Prog 2	Prog 3	Prog 4	Prog 5	Prog 6	Prog 7	Prog 8
Ahyong, S.T, J.C.Y. Lai, D. Sharkey, <b>D.J. Colgan</b> , & P.K.L. Ng. 2007. Phylogenetics of the brachyuran crabs (Crustacea: Decapoda): The status of Podotremata based on small subunit nuclear ribosomal RNA. <i>Molecular Phylogenetics and Evolution</i> 45: 576 – 586.				x				
Aktipis, S. H., Giribet, G., Lindberg, D. R. & <b>Ponder. W. F.</b> 2008. Gastropoda: an overview and analysis. In Ponder, W.F. & Lindberg, D.R. (eds) Phylogeny and Evolution of the Mollusca. University of California Press.		x		x				
<b>Attentrow, V.</b> 2007. Emu Tracks, Kangaroo & Echidna, and Two Moths. Further radiocarbon ages for Aboriginal sites in the Upper Mangrove Creek catchment, New South Wales. <i>Australian Archaeology</i> 65:51-54.						x		
Bedford, S., Spriggs, M., Regenvanu, R., <b>Macgregor C.</b> , Kuautonga, T. and Sietz, M. (2007) The excavation, conservation and reconstruction of Lapita burial pots from the Teouma site, Efate, Central Vanuatu, in Oceanic Explorations: Lapita and Western Pacific Settlement, Terra Australis 26, Eds. Bedford S., Sand C. and Connaughton S. P.						x		
<b>Beechey, D.L.</b> and Willan, R.C. 2007. Establishment of the east Asian dove snail <i>Mitrella bicincta</i> (Gould, 1860) (Mollusca: Gastropoda: Columbellidae) in Australia. <i>Molluscan Research</i> 27(2): 51-59.	x							
Bender, D. & <b>L. Romer.</b> 2007. Casuariidae Cassowaries and Emus Pp112-117 in <i>Encyclopedia of Aviculture</i> . Glen Holland and the World's Finest Aviculturists. Hancock House Publishers USA and Canada.		x						
<b>Bickel, D.J.</b> 2007c. <i>Pharcoura</i> (Diptera: Dolichopodidae), a new genus from Chile. <i>Tijdschrift voor Entomologie</i> <b>150</b> : 5-12.								
<b>Bickel, D.J.</b> 2008a. <i>Krakatauia</i> (Diptera: Dolichopodidae) from the southwest Pacific, with a focus on the radiation in Fiji. In: Evenhuis, N.L. and Bickel, D.J. (eds.), Fiji Arthropods X. Bishop Museum Occasional Papers <b>97</b> : 21-64. (Illustration: <i>Krakatauia planticorum</i> )		x						
<b>Boles, W.E.</b> (2007) Family Eupetidae (Jewel-babblers and Allies), pp. 348-373; In del Hoyo, J., Elliot, A. & Christie, D.A. (eds). Handbook of Birds of the World. Vol. 12. Picathartes to Tits and Chickadees. Lynx Edicions, Barcelona.		x						
<b>Boles, W.E.</b> (2007) Family Orthonychidae (Logrunners), pp. 338-347; In del Hoyo, J., Elliot, A. & Christie, D.A. (eds). Handbook of Birds of the World. Vol. 12. Picathartes to Tits and Chickadees. Lynx Edicions, Barcelona.		x						
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Details of publications	Prog 1	Prog 2	Prog 3	Prog 4	Prog 5	Prog 6	Prog 7	Prog 8
Bulazel, K.V., G.C. Ferreri, <b>M.D.B. Eldridge</b> & R.J. O'Neill. 2007. Species-specific shifts in centromere sequence composition are coincident with break point reuse in karyotypically divergent lineages. <i>Genome Biology</i> 8(8): R170. Designated a 'Highly accessed' article by the publisher.		x	x					
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<b>Eldridge, M.D.B.</b> 2008. Authored/coauthored 15 individual rock-wallaby species accounts and the Introduction to the genus <i>Petrogale</i> in <i>The Mammals of Australia, 3<sup>rd</sup> edition</i> . S. Van Dyck and R. Strahan (eds). New Holland, Sydney.		x						
<b>Eldridge, M.D.B. et al.</b> 2008. Rock-wallabies, <i>Petrogale</i> . Pp. 361-394 in <i>The Mammals of Australia, 3<sup>rd</sup> edition</i> . S.M. Van Dyck and R Strahan (eds). New Holland, Sydney.		x						
<b>Eldridge, M.D.B.</b> , 2007. Book Review. <i>Practical Conservation Biology</i> by D. Lindenmayer and M. Burgman. CSIRO Publishing: Melbourne, 2005. <i>Australian Zoologist</i> 34: 108.		x						
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<b>Faith D.P.</b> , S. Ferrier, & K.J. Williams. 2008. Getting biodiversity intactness indices right: ensuring that "biodiversity" reflects "diversity" <i>Global Change Biology</i> 14, 207–217.		x						

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<b>Gollan, J.</b> Evaluating indicators for monitoring riparian rehabilitation success in the Upper Hunter Region of NSW. PhD Thesis, University of New England.		x						
<b>Gollan, J.R., M. Batley &amp; C.A.M. Reid</b> . 2008. The exotic bee <i>Halictus smaragdulus</i> Vachal, 1895 (Hymenoptera: Halictidae) in the Hunter Valley, NSW: A new genus in Australia. <i>Australian Entomologist</i> , 2008, 35: 21-26.		x						
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Details of publications	Prog 1	Prog 2	Prog 3	Prog 4	Prog 5	Prog 6	Prog 7	Prog 8
Graham, I.T., <b>Pogson, R.E.</b> , Colchester, D.M., Hergt, J., Martin, R., Williams, P.A. (2008). Pink Lanthanite-(Nd) from Whitianga Quarry, Coromandel Peninsula, New Zealand. <i>The Canadian Mineralogist</i> <b>45</b> (6):1389-1396.								x
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Grattan, J. & <b>R. Torrence</b> . 2007. Problems of scale: evaluating the effects of volcanic disasters on cultural change in the Willaumez Peninsula, Papua New Guinea. In J. Grattan, J. and R. Torrence (eds), <i>Living under the shadow: The cultural impacts of volcanic eruptions</i> , 1-18. Walnut Creek, California: Left Coast Press.						x		
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<b>Ingleby, S.</b> & G. Gordon (2008). <i>Northern Naitail Wallaby</i> . Pp 359-61 in The Mammals of Australia. Ed. Van Dyck and Strahan.		x						
<b>Jones, A.R.</b> (2007). <i>Homo sapiens</i> : Overabundant and the Ultimate Pest? Pp.233-248 in D. Lunney, P. Eby, P. Hutchings and S. Burgin (eds) Pest or Guest: the zoology of overabundance. Royal Zoological Society of New South Wales, Mosman NSW. ISBN 978 0 9803272 1 2.					x			
<b>Jones, A.R.</b> , W. Gladstone & N.J. Hacking (2007). Australian Sandy-Beach Ecosystems and Climate Change: Ecology and Management. <i>Australian Zoologist</i> 34:190-202.					x			



Details of publications	Prog 1	Prog 2	Prog 3	Prog 4	Prog 5	Prog 6	Prog 7	Prog 8
Jønsson, K.A., M. Irestedt, J. Fuchs, P.G.P. Ericson, L. Christidis, R.C.K. Bowie, J.A. Norman, E. Pasquet & J. Fjeldså. (2008). Explosive avian radiations and multi-directional dispersal across Wallacea: evidence from Campephagidae and other Crown Corvida. <i>Molecular Phylogenetics and Evolution</i> 47: 221-236.				x				
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<b>Leis, J. M., A. C. Hay</b> , M. M. Lockett, J.-P. Chen, & L.-S. Fang, 2007. Ontogeny of swimming speed in larvae of pelagic-spawning, tropical, marine fishes. <i>Marine Ecology Progress Series</i> 349: 257-269.	x							
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<b>Leis, J.M.</b> , M.F. Gomon, & H.K. Larson. 2007. Australian fish taxonomists – an endangered species. <i>Australian Society for Fish Biology Newsletter</i> . 37:8-11.	x						x	
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Lunney, D., Eby, P., <b>Hutchings, P.</b> and Burgin, S. 2007. Pest or Guest: the cultural context of the zoology of overabundance. Pp 258-69 in <i>Pest or Guest: the zoology of overabundance</i> , 2007, edited by D. Lunney, P. Eby, P. Hutchings and S. Burgin. Royal Zoological Society of NSW, Mosman NSW.						x		
Martin, J.M., French, K., and <b>Major, R.E.</b> (2007). The pest status of Australian white ibis ( <i>Threskiornis molucca</i> ) in urban situations and the effectiveness of egg-oil in reproductive control. <i>Wildlife Research</i> 34: 319–324.						x		

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Martin, J.M., <b>Major, R.E.</b> and French, K. 2008. The plight of the white ibis. <i>Wingspan</i> <b>18(1)</b> : 34-38					x			
Metcalfe, C.J., K.V. Bulazel, G.C Ferreri, E. Schroeder-Reiter, G. Wanner, W. Rens, C. Obergfell, <b>M.D.B. Eldridge &amp;</b> R.J. O'Neill, 2007. Genomic instability targets centromeres in interspecific marsupial hybrids. <i>Genetics</i> <b>177</b> : 2507-2517.		x	x					
Murphy, B.F., <b>J.M. Leis</b> and K.D. Kavanagh. 2007. Larval development of the Ambon damselfish ( <i>Pomacentrus amboinensis</i> ) with a summary of pomacentrid development. <i>Journal of Fish Biology</i> <b>71</b> (2): 569-584	x			x				
Neall, V., <b>R. Torrence</b> , T. O'Neill, M. Turner, B. Hayward, W. Boyd 2007 'Reconstructing the impacts of volcanic disasters on Holocene paleoenvironments and human land-use: Willaumez isthmus, New Britain, Papua New Guinea'. <i>Quaternary International</i> <b>167-168</b> : 302-3. Abstract						x		
Norman, J.A., Rheindt, F. E., Rowe, D.L. and <b>Christidis, L.</b> (2007). Speciation dynamics in the Australo-Papuan Meliphaga honeyeaters. <i>Molecular Phylogenetics and Evolution</i> <b>42</b> :80-91.		x	x					
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Percival, I.G., <b>Zhen, Y. Y.</b> , Pogson, D. & Thomas, O., 2008. The Upper Ordovician Kenyu Formation in the Boorowa Region, southeast New South Wales. <i>Proceedings of the Linnean Society of New South Wales</i> <b>129</b> , 197-206.				x				x
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<b>Ponder, W.F.</b> , Parkhaev, P.Yu. and <b>Beechey, D.L.</b> 2007. A remarkable similarity in scaly shell structure in Early Cambrian univalved limpets (Monoplacophora: Maikhanellidae) and a Recent fissurellid limpet (Gastropoda: Vetigastropoda) with a review of Maikhanellidae. <i>Molluscan Research</i> <b>27(3)</b> 129-139	x							
<b>Reid CAM</b> 2008. Book review. Australian ladybirds. Australian ladybird beetles (Coleoptera: Coccinellidae): their biology & classification, Adam Slipinski, ABRS, Canberra. <i>Systematic Entomology</i> <b>33</b> : 211-212.								
<b>Reid, C. A. M.</b> 2007. Book Review. Staines, C. L. 2006. The hispine beetles of America north of Mexico. <i>Coleopterist's Bulletin</i> <b>61</b> : 407-408.								

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<b>Reid, C. A.M.</b> & S. Nally. 2008. Revision of the genus <i>Menippus</i> Clark in Australia (Coleoptera: Chrysomelidae: Galerucinae). <i>Australian Journal of Entomology</i> 47: 87-101.		x		x				
Rheindt, F.E., J.A. Norman & <b>L. Christidis</b> . 2008. Phylogenetic relationships of tyrant-flycatchers (Aves: Tyrannidae), with an emphasis on the elaeiniine assemblage. <i>Molecular Phylogenetics and Evolution</i> , 46, 88-101.		x	x					
<b>Romer, L.</b> 2007. Podargidae Frogmouths Pp 408 – 410 in <i>Encyclopedia of Aviculture</i> . Glen Holland and the World's Finest Aviculturists. Hancock House Publishers USA and Canada.		x						
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Siddle, H.V., A. Kreiss, <b>M.D.B., Eldridge</b> , E. Noonan, C.J. Clarke, S. Pyecroft, G.M. Woods & K. Belov. 2007. Transmission of a fatal clonal tumor by biting occurs due to depleted MHC diversity in a threatened carnivorous marsupial. <i>Proceedings of the National Academy of Sciences, USA</i> . 104: 16221-16226.		x	x					
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<b>Specht, J.</b> 2007. Archaeological Studies of the Middle and Late Holocene, Papua New Guinea. Part III. The Lagenda Lapita site (FCR/FCS), Talasea area, Papua New Guinea. <i>Technical Reports of the Australian Museum</i> 20: 105-129. Published online: <a href="http://www.australianmuseum.net.au/pdf/publications/1475_complete.pdf">www.australianmuseum.net.au/pdf/publications/1475_complete.pdf</a>						x		
<b>Specht, J.</b> 2007. Shaft-hole stone implements of New Britain, Papua New Guinea. In A. Anderson, K. Green and F. Leach (eds), <i>Vastly Ingenious: The archaeology of Pacific material culture in honour of Janet Davidson</i> , pp. 263-274. Dunedin: Otago University Press.						x		
<b>Details of publications</b>	<b>Prog 1</b>	<b>Prog 2</b>	<b>Prog 3</b>	<b>Prog 4</b>	<b>Prog 5</b>	<b>Prog 6</b>	<b>Prog 7</b>	<b>Prog 8</b>

Details of publications	Prog 1	Prog 2	Prog 3	Prog 4	Prog 5	Prog 6	Prog 7	Prog 8
<b>Specht, J.</b> 2007. Small islands in the big picture. In S. Bedford, C. Sand and S. Connaughton (eds), <i>Oceanic Explorations: Lapita and Western Pacific Settlement</i> , pp. 51-70.						X		
<b>Specht, J.</b> and G. Summerhayes 2007. Archaeological Studies of the Middle and Late Holocene, Papua New Guinea. Part II. The Boduna Island (FEA) Lapita site, Papua New Guinea. <i>Technical Reports of the Australian Museum</i> 20: 51-103. Published online: <a href="http://www.australianmuseum.net.au/pdf/publications/1474_complete.pdf">www.australianmuseum.net.au/pdf/publications/1474_complete.pdf</a>						X		
Specht, J. and V. Attenbrow (eds) 2007. <i>Archaeological Studies of the Middle and Late Holocene, Papua New Guinea. Technical Reports of the Australian Museum</i> 20.						X		
Stork, N.E., P.S. Grimbacher, R. Storey, R.G. Oberprieler, <b>C. Reid</b> & S.A. Slipinski. 2008. What determines whether a species of insect is described? Evidence from a study of tropical forest beetles. <i>Insect Biodiversity and Conservation</i> 1(2): 114–119		X						
Strong, E. E., Gargominy, O., <b>Ponder, W. F.</b> , & Bouchet, P. 2008. Global diversity of gastropods (Gastropoda; Mollusca) in freshwater. <i>Hydrobiologia</i> , 595: 149-166.		X						
<b>Strusz, D.L.</b> (Res Assoc), 2007a. Silurian atrypide brachiopods from Yass, New South Wales. <i>Alcheringa</i> 31, 299-337.								X
<b>Strusz, D.L.</b> (Res Assoc), 2007b. Silurian athyridide brachiopods from Yass, New South Wales. <i>Memoir of the Association of Australasian Palaeontologists</i> 34, 87-100.								X
<b>Strusz, D.L.</b> , (Res Assoc)2007c. The Silurian timescale - an Australian perspective. <i>Memoirs of the Association of Australasian Palaeontologists</i> 34, 157-171.								X
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<b>Sutherland, F.L.</b> , Barron, B.J., Colchester, D.M., and A.R. McKinnon (2007). Unusual Baryte-bearing Hybrid Basalt, Bourke-Byrock Area, Northern New South Wales. <i>Journal &amp; Proceedings of the Royal Society of New South Wales</i> , 140, 27-46.								X
<b>Sutherland, F.L.</b> , D. Colchester, A. McKinnon & B.J. Barron, 2007. Baryte-bearing basalt, Burke-Byrock area, NSW. Abstracts, <i>30<sup>th</sup> Mineralogical Societies of Australia Seminar</i> , Waihi Beach, New Zealand, 25-26 October.								X
<b>Sutherland, F.L.</b> , Duroc-Danner, J.-M., Meffre, S. (2007). Age and origin of colombian gem corundums, 30th International Gemmological Conference, Moscow, 15-19 July 2007, Abstracts 113-115.								X

Details of publications	Prog 1	Prog 2	Prog 3	Prog 4	Prog 5	Prog 6	Prog 7	Prog 8
<b>Sutherland, F.L.</b> , Giuliani, A.E. Fallick & <b>G.B. Webb</b> , 2007. Oxygen isotopes in gem corundums, eastern Australia: further clues to their lithologic sources. <i>Abstracts, No. 86, Specialist Group in Geochemistry, Mineralogy and Petrology Second Bi-annual Conference, Dunedin, New Zealand, 87-92. Geological Society of Australia.</i>								X
<b>Sutherland, L.</b> 2007. The Geology of Cataract Gorge, chapter in <i>Health, Wealth and Tribulation: Launceston's Cataract Gorge</i> . Ed P. Richards & M. Johnson, Myola House of Publishing, Tasmania.								X
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Details of publications	Prog 1	Prog 2	Prog 3	Prog 4	Prog 5	Prog 6	Prog 7	Prog 8
<b>Zhen, Y.Y.</b> , 2007: Conodont biostratigraphy of the Honghuayuan Formation (late Early Ordovician) in Guizhou, South China. Proceedings of the Tenth International Symposium on the Ordovician System, The Third International Symposium on the Silurian System and IGCP 503 Annual Meeting, June, 2007, Nanjing. <i>Acta Palaeontologica Sinica</i> <b>46</b> (Suppl.), 537-542.				X				X
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