University Grants 2012

The Wildlife Preservation Society of Australia University Research Grants are scholarships offered to honours or postgraduate students at Australian universities.

Each year, ten grants of $1,000 are awarded. The following articles are contributed by the 2012 winners.

Decision-making for conserving Australia's freshwater biodiversity under climate change and land-use change

Chrystal Mantyka-Pringle,
ARC Centre of Excellence for Environmental Decisions & Centre for Spatial Environmental Research,
The University of Queensland,School of Geography, Planning and Environmental Management

Australia is highly vulnerable to the effects of climate change. Average surface temperatures have increased 0.9°C since 1950 and significant changes in rainfall patterns have also occurred; increasing over the north-west, and declining in the south-west and along the eastern coast. Based on the Fourth Assessment Report published by the Intergovernmental Panel on Climate Change (IPCC) in 2007, temperatures are predicted to exceed another 1°C by 2030 and annual rainfall is predicted to decrease by 2-5 percent, not including the far northern tropics. Much of Australia's natural environment is climate-sensitive and at risk of a potential decline in biodiversity due to climate change impacts such as increasing temperatures, more severe droughts, riverine flooding, storm tides and sea-level rise. When combined with other threats such as land clearing, urbanisation and changes in hydrology, there is growing evidence to suggest that climate change will negatively interact with other stressors and synergistically contribute to the degradation of biological diversity at the species, genetic and habitat level. It is therefore one of Australia's primary challenges to identify strategies for mitigation and adaptation to climate change to maintain essential ecosystem services, heritage values, aesthetic values, recreational and educational values, national identity, and tourism in a changing climate.

Bower bird, Queensland

In my PhD I will develop a framework and recommendations for making robust decisions to conserve biodiversity in terrestrial and freshwater systems in the face of both climate and land-use change. Climate and land-use change are both key threatening processes for biodiversity, but when they occur together their effects are likely to be much more devastating. Despite this, almost nothing is known about what decisions need to be made to mitigate the combined effects of land use and climate change to conserve biodiversity. This research will combine decision analysis with quantitative ecological models to identify priority actions to conserve biodiversity threatened by climate and land-use change in Queensland and worldwide.

Crimson spotted rainbow fish (*Melanotaenia duboulayi*), Queensland

Chrystal documenting the quality of riparian vegetation for river health

Wallaby stranded during the Brisbane floods

This will address critical questions arising in the development of policy for climate change adaptation, especially in respect to maintaining environmental values and ecosystem function.

I was the first to find that current climate and climate change are both important factors determining the negative effects of habitat loss on species density and/or diversity. Habitat loss and fragmentation effects were greatest in areas with high maximum temperatures and lowest in areas where average rainfall has increased over time. This baseline study was then used to inform a predictive model to calculate the probability of a negative habitat loss effect on species richness, of mammals and birds across the world caused by future climate and land-use change.

I built a Bayesian belief network model as a decision support tool for southeast Queensland (SEQ), Australia, to analyse how climate interacts with land use on water quality and predict how macro-invertebrate and native freshwater fish species will respond to future changes. I predicted important impacts from both land use and climate change and highlighted the importance of understanding how climate change and land-use change interact at multiple spatial scales. I also demonstrated the key role riparian vegetation restoration can play as an adaptation tool to mitigate the negative effects of climate change and land-use change impacts on freshwater ecosystems.

I will evaluate which management actions are the most cost-effective for conserving and maximising freshwater biodiversity within SEQ in the face of climate and land-use change. I will now combine expert knowledge with empirical data and rank management actions according to decisions that will most likely lead to desired outcomes. These results will aid in decision-making for the conservation of freshwater biodiversity because existing management strategies in SEQ may no longer be appropriate under changed climatic conditions and future development.

I would like to thank the Wildlife Preservation Society of Australia for providing me with this grant money, which will contribute towards attending the 2012 Ecological Society of America Conference in Portland, Oregon, where I will accept an Applied Ecology Student Award.

Reptile responses to variable fire regimes in southeast Queensland

Diana Virkki,
Griffith School of Environment,
Griffith University

Fire plays an important ecological role in ecosystems globally. However, natural fire regimes have been anthropogenically altered in many landscapes and are likely causing negative impacts on native biodiversity. There is a need for a more integrated understanding of the mechanisms driving the responses of species to fire management practices, particularly in response to the timing and scale of fires within the landscape. Determining the effects of fire on reptiles is particularly important due to their general ground-dwelling habits, and reliance on specific microhabitat structures such as leaf litter, fallen dead wood and shrub cover. Understanding faunal responses to variable fire regimes that inform the application of mosaic (patchy) burning strategies is therefore vital for maintaining faunal biodiversity. Research investigating faunal responses to fire is particularly lacking in southeast Queensland and is therefore an important focal region for this study.

Thanks to the funding awarded by the Wildlife Preservation Society of Australia, I will be able to enhance my PhD research through the inclusion of a rapid assessment survey of reptile responses to fire at a landscape scale. This specific component aims to increase our understanding of reptile responses to spatio-temporally variable fire events in order to determine whether faunal biodiversity is maintained through the application of these fire regimes. An underlying objective driving this research is to empower ecologists and forest managers to develop burning regimes that will conserve and enhance wildlife within the landscape. The focus of this component of my project will answer the following research questions:

1. How does variable fire history affect habitat heterogeneity, and how does this influence the reptile assemblages within these habitats at the landscape scale?
2. Does the spatio-temporal variability in fire management practices increase reptile biodiversity, and are such biodiversity patterns nested at a landscape scale?

Eastern stone gecko - *Diplodactylus vittatus*

In this study, three forests will be utilised, including a long-term fire experiment site and two forests that represent a mosaic of differing fire regimes and sites have been identified as unique fire history units based on total number of fires, mean fire interval and time since the last fire. The first round of reptile surveys were undertaken between February and April 2012 at each of the 74 survey plots that were representative of the fire mosaic chronosequence. I am also undertaking vegetation/habitat surveys and am in the process of undertaking a spatio-temporal analysis of landscape fire heterogeneity which will aim to quantify the heterogeneity of fire patterns across the landscape. Initial results reveal a number of correlations between reptiles and fire variables. The best models that describe both reptile abundance and richness in fire mosaic units include: total number of fires; fire interval; and the total number of fires + fire interval. Relationships between reptiles and fire parameters across mosaic units did not hold at the experimental site, where very frequent and infrequent fire had little influence on reptile abundance and richness. This potentially contradicts the Intermediate Disturbance Hypothesis but requires further data to assess patterns in reptile community structure and other environmental parameters that may also be driving reptile responses. The initial results also appear confounded by the timing of surveys that were staggered over time in response to extreme rainfall events and difficulties with site access during wet periods. Consequently, repeat reptile surveys will be undertaken in September 2012 when completing remaining vegetation surveys.

Understanding the role of fire in managing brush-tailed mulgara (*Dasycercus blythi*) populations in central Australia

Jenny Molyneux

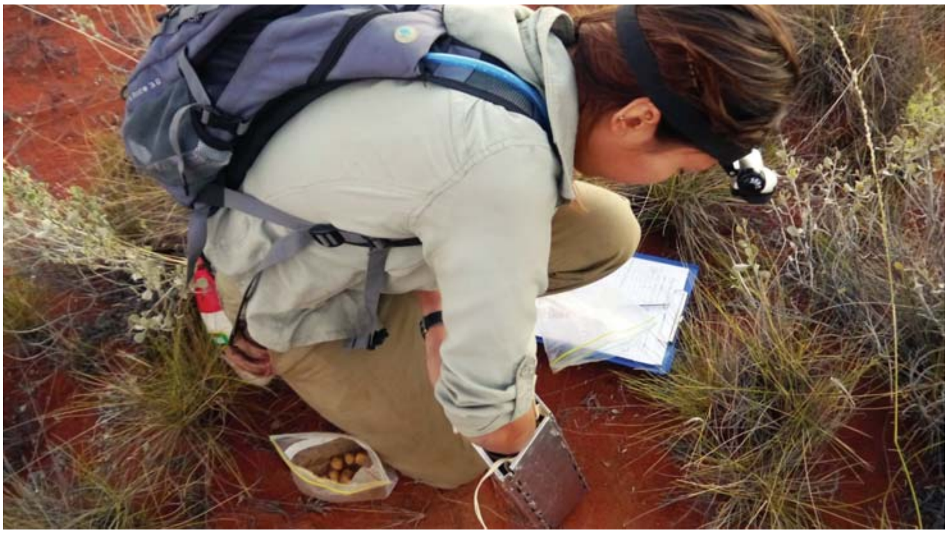
Arid Australia has experienced some of the most globally significant extinctions and declines in small to medium-sized mammals within the last century. The main causes of species decline is thought to include the predation by introduced predators, degradation of habitat from introduced herbivores and changes in landscape-scale fire regimes.

Since European settlement, introduced predators have dominated the arid zone landscape resulting in the decline of many native species, particularly large predators such as the western quoll. With complete removal of feral predators unlikely in the near future, the importance of conserving and promoting growth in surviving native predator populations becomes increasingly essential. Furthermore, with climate change predicted to further increase fire regularity and intensity of fires in many areas, threats to vulnerable and endangered native species are likely to escalate. The brush-tailed mulgara (*Dasycercus blythi*) is one of the largest arid zone native predators still surviving in central Australia, however its distribution has decreased dramatically in recent years with populations becoming isolated in areas of scattered suitable habitat. A greater understanding of the effect of changes now occurring in the landscape is urgently needed to halt the decline of this and other vulnerable species. This project will increase this understanding by assessing the effect of current fire management techniques on the spatial ecology of mulgara within Newhaven Sanctuary, Northern Territory.

Several previous studies have shown that a reduction of vegetation cover caused by large-scale wildfires reduces habitat suitability and increases predation pressure on mulgara. Moreover, while there is some evidence indicating mulgaras avoid recently burnt areas, other studies have found individuals continued to utilise burnt patches directly after fire, even though suitable unburnt habitat was available nearby. These discrepancies in the literature invoke questions to whether the proximity of unburnt patches increases the ability of mulgara to survive in areas even after fire. With increasing numbers of land managers utilising small mosaic patch burning to manage areas inhabited by mulgara, it is becoming increasingly essential to determine how these new fire regimes affect mulgara populations and alter their ability to persist in the landscape.

This study will utilise new GPS technology to determine mulgara habitat use at a finer scale than previously found with VHF transmitters. Knowledge of fine-scale habitat use in areas of different fire history will enable us to understand the relationship between fire type, fire frequency and habitat suitability for mulgaras. This will allow land managers to implement better fire management strategies aimed at maximising suitable habitat for the species.

This project will increase our understanding of the ecology of brush-tailed mulgara and help to inform land managers on the effect of active fire management on population success. It will further aid in developing more sustainable land management techniques for the benefit of mulgara populations and aid in the conservation of populations across the arid zone. In addition, this project will also help to refine and improve monitoring techniques utilised in the management and research of other cryptic species. With many species within the arid zone considered difficult to monitor, this information will have potential benefits to a broader spectrum of species facing similar decline within the region.



Volunteers checking Elliot traps. Photo: P Moore

Above: Jenny and her first mulgara caught for the year. Photo: P Moore

University Grants 2012

The Wildlife Preservation Society of Australia University Research Grants are scholarships offered to honours or postgraduate students at Australian universities.

Each year, ten grants of $1,000 are awarded. The following articles are contributed by the 2012 winners.

The presence of the amphibian chytrid fungus (*Batrachochytrium dendrobatidis* (*Bd*)) in frog populations of the Adelaide bioregion of South Australia

Jerome Kalvas,
Murdoch University

Chytrid fungus, *Batrachochytrium dendrobatidis (Bd),* is the most significant harmful organism affecting amphibian populations, and is already responsible for numerous amphibian population extinctions and declines globally. The pathogen's widespread global host range, in over 400 amphibian species on five continents, gives unfortunate candidacy for it being the most destructive infectious disease ever known. Chytrid fungus invades the thickened skin layers around the mouth, feet and abdomen of amphibians causing damage to the keratin layer. It is not known exactly how this can kill the frogs, however it is thought that the fungus may release toxins that are absorbed through the skin, or it may directly affect the amphibian's water uptake and respiration given frogs can drink and breathe through their skin. Surviving individuals are thought to be carriers and once in the environment there is no means of eliminating it. Because some frog species are highly susceptible and some appear less susceptible, chytridiomycosis can have variable mortality effect on frog populations. Amphibian population declines due to chytridiomycosis can occur rapidly with a real risk of extinction for rare, specialised or endemic species. Within Australia, *Bd* is considered the primary cause of extinction in at least four amphibian species (*L. nannotis, L. rheocola, T. acutirostris, N. dayi*) and has been detected in an additional 14 threatened species and 33 non-threatened species. Given the severity of this disease risk, the federal Department of Environment and Heritage (now referred to as the Australian Government Department of Sustainability, Environment, Water, Population and Communities) has listed *Bd* as a Key Threatening Process and prepared a Threat Abatement Plan which states that surveillance for chytridiomycosis is essential to manage this threat to native amphibians.

Fletcheri swab

The distribution of chytrid fungus throughout Australia, while not completely known, appears to include four zones; an east coast zone (Cooktown to Melbourne); a south-west zone (Perth through southwest Western Australia); Tasmania, where infections were first identified in 2004; and a zone

Ewingi swab

around Adelaide first identified in 1995. Concerningly, climatic and geographic modeling have identified the Adelaide bioregion as a high-risk area for *Bd*, yet reliable data on the presence of *Bd* in South Australian amphibians remain sparse.

The main aim of this project is to conduct a broad disease survey into the presence of the disease chytridiomycosis in frog and tadpole populations in the Adelaide bioregion, and thereby allow further investigations as to whether *Bd* is involved in any declines in abundance and/or range of native frog species in this region. Of the 11 frog species found in the greater Adelaide bioregion, the growling grass frog, *Litoria raniformis*, is listed nationally as vulnerable and Bibron's toadlet, *Pseudophryne bibronii*, is listed as rare in South Australia and threatened within the Adelaide and Mount Lofty Hills regions. Three of the 11 species (*L. ewingi, L. dumerili* and *L. tasmaniensis)* have been found to be infected with *Bd* in the Adelaide zone (Speare, 2005); and unpublished data indicates the potential presence of *Bd* in *C. signifera* and *G. laevis* around Adelaide as well. The secondary objective is to apply the first national non-invasive chytridiomycosis mapping protocol, recently developed by Skerratt *et al.* (2008), and assess its usefulness as a national and global standardised protocol that may enable comparison among amphibian populations world wide. The study's third objective is to provide new data to improve the accuracy of the national model of *Bd*'s biogeographic requirements within Australia. This will help identify which naïve populations would be at greatest risk if *Bd* was introduced and contribute to the conservation of South Australia's native amphibians and South Australia's and Australia's wildlife biodiversity.

This study will use a simple and standardised survey protocol, involving non-invasive sampling of frog populations to detect the presence and distribution of chytrid fungus at 12 different sites within the Adelaide bioregion, more if funding allows. This will make an important and urgent contribution to South Australia's ability to manage the risks associated with *Bd*, and safeguard South Australia's native frogs from this serious disease. Once conservation managers have information about chytrid distribution in the region, they will be able to make more informed decisions about quarantine, testing, treatment and movement of amphibians. This will help prevent *Bd* transmission from areas with chytridiomycosis to areas that are chytrid-free, and will help to direct conservation actions towards populations that are most likely to be affected by the disease.

I would like to thank the Wildlife Preservation Society of Australia for contributing towards the diagnostic costs of this surveillance project to thus enable me to complete my Masters degree in Veterinary Conservation Medicine.

Monarto Restoration Plan Newsletter 2012

Hi, my name is Dr Jerome Kalvas and I am working as a Veterinarian for ZoosSA based at Monarto Zoological Park. It is a real privilege working at such a site that has bountiful wildlife and exciting to see the restoration of the degraded habitats. I am currently studying a Masters Degree in Veterinary Conservation Medicine and am undertaking a survey of the presence of the amphibian chytrid fungus *Batrachochytrium dendrobatidis* (*Bd*) in frog populations of the Adelaide bioregion of South Australia. Monarto Zoo is one of the sites which I will be using within the study region and to date I have collected and sampled good numbers of three frog species, the Eastern Banjo frog, the spotted grass frog and the common froglet. Chytrid fungus is the most harmful organism affecting amphibian populations globally. Chytrid fungus and the associated disease chytridiomycosis are causing many amphibian extinctions and declines worldwide, including in Australia, where the disease is listed as a Key Threatening Process.

Although chytrid occurs throughout Australia, its distribution in South Australia is poorly known. This study will use a simple and standardised survey protocol, involving non-invasive sampling of frog populations to detect chytrid fungus presence. By determining presence and distribution of chytrid in areas with sparse data currently available including the Adelaide bioregion, this study will allow the disease threat to be better managed; informing decisions on movements of frogs, quarantine, testing and treatment; and helping to safeguard Australia's native amphibians.

Understanding the interactions between wallabies and roads in an expanding urban context

Amy Bond

Roads are a significant part of urbanised landscapes and, while they are vital for the development and connection of cities and towns, they often cut through and further fragment remnant habitat patches. This breaking up of wildlife habitats can have a variety of significant impacts on the wildlife populations living within these areas and the daily movements and behaviour of the individuals within these populations. The most obvious of these impacts is mortality from wildlife–vehicle collisions, but this is just one aspect of interactions between roads and wildlife. The impact of roads and traffic on the daily behaviour of wildlife has been greatly understudied, but is a crucial part to understanding the full suite of impacts from roads on wildlife.

Red-necked wallabies living in urban areas can have very regular contact with road environments as they move between remnant habitat patches, and in some places forage along the roadsides. Due to this relatively regular and sometimes extended contact with roads, the behaviour of wallabies while they are close to roads may be greatly influenced by the presence of the road. Wallabies often forage in the grassy verges of some roads, but this may come at the expense of being in a high disturbance environment. By investigating and comparing rates of foraging, maintenance activities and vigilance between wallabies near roads and away from roads, changes in the regular activities of wallabies caused by roads of varying disturbance levels will be able to be revealed.

Other behavioural aspects have also been investigated, exploring how differences in the behaviour of wallabies while crossing roads and in response to vehicles may be influencing their risk of road mortality. Preliminary results suggest that wallabies may behave differently at different roads, perhaps depending on the traffic volume of the road. Wallabies at the road with the highest traffic volume and speeds tended to display slightly more risky behaviours when crossing the road than wallabies at lower traffic volume and speed roads. Wallabies at this road were slightly less likely to be present within the road verge before crossing, and so may be less aware of the current traffic condition on the road before crossing. Wallabies were also much more likely to pause in the middle of the road and have higher pausing frequencies when crossing this road compared to the lower volume roads. Additionally, wallabies at this road were more likely to pause if a vehicle approached them during the road crossing. This pausing behaviour greatly lengthened the time that the wallaby took to cross the road and was therefore at risk of a collision with a vehicle. It is hoped that further investigation of these behaviours and wallaby responses to approaching vehicles will help inform drivers of appropriate actions when faced with wallabies on or beside roads, so as to help avoid collisions.

Other aspects of this project include characterising wallaby roadkill hotspots and investigating best approaches of avoiding wildlife–vehicle collisions from the drivers' perspective. From this project I aim to be able to inform road agencies, councils and drivers of areas where and when collisions with wallabies are more likely and the best possible ways to reduce and avoid such collisions. Additionally, through revealing physical features of roads that may contribute to collisions with wallabies, recommendations may be able to be made on design features to avoid around new and upgraded roads.

Wallabies on road

Sourcing to the sink or sinking to the source: how do fragmentation barriers influence dispersal of rainforest mammals?

Katrien Geurts, PhD,
James Cook University,
Cairns

In the Wet Tropics bioregion of north Queensland, rainforest restricted species are threatened by habitat fragmentation and further degradation by climate change. Suitable habitat will contract when temperatures increase. For endemic upland species dispersal to highland refuges will be imperative for their continued existence. We investigated the influence of patch size, vegetation structure, isolation distance and surrounding landscape matrix on population dynamics, movements and genetic variation. Non-flying mammals were surveyed by spotlighting, mark-recapture and DNA sampling in continuous rainforest, remnants close to continuous forest and fragmented patches.

First results show that for some animals size doesn't seem to matter. Beforehand it was conceived that bigger was better: better habitat quality, more resources and more refuge from predators. Trapping and spotlighting surveys that were conducted for a year in rainforest patches of different size and with a different degree of isolation show that abundance, sex ratio and body condition of mammals in small patches are just as high as in large patches. This demonstrated that small patches have an important habitat value and was exemplified by a Lumholtz's tree-kangaroo female that was found raising a juvenile joey and a pouch young in a fragment as small as three hectares.

However, for dispersal movements through fragmented landscape interspaced with hostile pasture land, a certain level of connectivity is needed. It is possible that animals seem to be doing well, but will be suffering from inbreeding effects in the long term. Species composition, for example, across the sites appeared more variable, which may indicate that some species are more sensitive to fragmentation effects. Therefore, trapping surveys are still continued to build on existing data and DNA samples are currently under analysis.

Small pockets of rainforest have a great possibility to play an important role in the landscape for mammals of the region. As most of these patches are on private land, it will be beneficial to create greater community and landholder involvement by making it interesting for them to conserve these small rainforest remnants, for example by carbon trading or tax rebates. It is also possible to strike conservation agreements on these properties so that habitat can be preserved for the future. One of the landowners, after being informed about these results, was convinced of the value of his land and has pledged it for revegetation.

Research is still continuing and, if future results show less gene flow between patches than between continuous rainforest sites, then this would provide an incentive for building corridors and revegetating small patches to maintain them as stepping stones and habitat in the landscape. If varying distances between populations show different degrees of isolation, this would assist in estimating an optimal corridor length. Overall the information from this PhD should contribute to design the landscape for higher connectivity, which will accommodate successful dispersal of some iconic species, such as Lumholtz's tree-kangaroo, to climate change refugia.

A large amount of gratitude is owed to the land-owners for letting me access their properties and to the volunteers who provided me with vital assistance during field work. I also thank my supervisors for their guidance and support. This project has received James Cook University ethics approval (A1569) and a scientific purposes permit from Queensland Parks and Wildlife Service (WISP08662211/ATH11/006). This PhD project would not be possible without the funding support of James Cook University, Skyrail Rainforest Foundation, Australian Geograpic Society, Norman Wettenhall Fund, Wet Tropics Management Authority and the Wildlife Preservation Society of Australia.

Fawn-footed melomys in a climbing palm. Photographer: Michelle Venter

Above: Giant white-tailed rat in a straight jacket. Photographer: Matt Moss

Cape York rat in the bag. Photographer: Sophie Hince

Fragmented landscape of the Atherton Tablelands Photographer: Katrien Geurts

Katrien Geurts with the catch of the day, a brushtail possum. Photographer: Shelby Southworth

Katrien Geurts weighing up the evidence. Photographer: Alberto Rico

Lumholtz's tree-kangaroo joey watching us set traps. Photographer: Debbie Vanvaerenbergh

Bats, birds, insects and floods: understanding ecosystem processes to better conserve our river red gums

Rachel Blakey
Australian Wetlands,
Rivers and Landscapes Centre,
University of New South Wales

Introduction

River red gums (*Eucalyptus camaldulensis*) are among the most widespread eucalypts in Australia. Their ability to withstand both drought and flood allows them to dominate the riparian zones and wetlands of the Murray–Darling basin. These trees form the basis of a range of plant communities, and support a great diversity of flora and fauna, including many threatened species. Despite their importance, river red gum communities are under threat from clearing, grazing and altered hydrological regimes. Large areas of trees are in a state of dieback and the Murray–Darling basin has been declared one of the top ten threatened river systems worldwide.

In response to these problems, successful campaigning by WPSA and other environmental groups has seen over 200,000 hectares of remnant river red gum forests along the Murray River declared national parks in 2010. This leaves conservation managers with the significant challenge of protecting and restoring these remnant forests in light of uncertain future climate conditions. While conservation strategies in the past have focussed on preserving species, populations and communities, there is increasing consensus that in order to conserve these assets effectively, we need to shift our emphasis to understanding the ecosystem processes which maintain them.

Rachel setting up bat recording equipment in the Barmah–Millewa forest. Photo credit: Emma Pont

Important ecosystem processes which drive river red gum persistence include: flooding, drying and defoliation from herbivorous (leaf-chewing, mining, galling or sap-sucking) insects. These processes may interact. For example, overall impact of herbivorous insects on leaf loss increases when trees are in drought. This reduction in leaf area affects trees' ability to photosynthesise and ultimately their health. For saplings, which have young, highly palatable nitrogen-rich leaves, these pressures can be even more acute. Globally, herbivorous insect populations are predominantly regulated by insectivorous birds and bats in terrestrial systems. When influences of these two predators have been examined separately, bats have far outstripped birds in their ability to control insect populations and limit leaf loss. However, these interactions have never been examined in Australian systems. Given the widespread water stress, high rates of insect herbivory and abundance of insectivorous bats within river red gum communities, it follows that bats may provide a significant ecosystem service to trees suffering the dual impacts of water stress and leaf loss.

This is where my project comes in. I want to unravel the relationships between river red gum saplings, herbivorous insects and their predators within a floodplain context. To do this, I will set up an experiment where I use removable nets to exclude predators from trees in the largest remaining stand of river red gums,

Above: Rachel with one of the suspects for insect regulation: a lesser long-eared bat

Barmah–Millewa Forest. I will be measuring insect abundance and leaf loss in trees where birds and bats have been excluded and comparing them to control trees. This will allow me to determine whether birds or bats (or both) are playing a role in regulating leaf-chewing insect communities, and thus maintaining tree health. The study will be replicated in both dry and wet sites, to find out the effect of flooding on these interactions.

As similar studies have never been conducted in Australia, it will be interesting to see whether bats will be discovered to play a role in maintaining ecosystem health, as observed overseas. This could have flow-on effects for how we approach forest management, potentially leading to integrated management of bat habitat within areas prone to dieback.

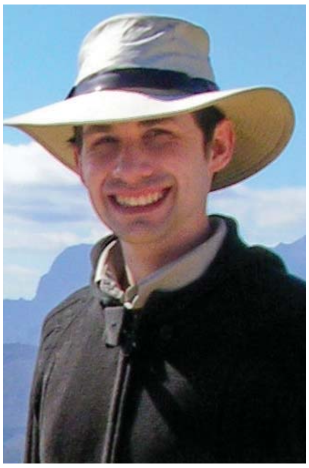
This project wouldn't be possible without the generous assistance of the Wildlife Preservation Society of Australia and the Australasian Bat Society. I look forward to reporting back my project outcomes in *Australian Wildlife* in 2013!

Volunteer Emma Pont, trying to keep her feet dry in the wetland

To many Australians, river red gums are a symbol of the resilience of the Murray–Darling Basin. Photo credit: Celine Steinfeld, UNSW

This long-eared bat has the ability to glean insects from leaves, so it may play a role in regulating insect populations on trees

Improving the conservation of the Great Barrier Reef through better prediction of coral bleaching



Robert Mason,
University of Queensland

Coral bleaching is a phenomenon that risks the health and ecology of the world's coral reefs. Coral reefs are built on a symbiotic relationship between single-celled algae and corals, which the algae live within. The energy that the algae provide to the coral from photosynthesis is the main energy source of corals, and allows them to create calcium carbonate skeletons that are the basis of all tropical coral reefs today. When the temperature of seawater or the level of sunlight become too high, the algae begin to produce compounds that are toxic to the coral, and the algae are expelled by the coral tissues. Without their main source of energy, corals and all creatures that depend on them decline in health and face increased mortality.

The research aquaria at Heron Island Research Station, January 2012. Photo credit: R Mason

Climate change is causing a general increase in sea temperature, and may cause changes in the levels of cloud cover, affecting light levels received by corals. These effects are leading to increased occurrence and severity of extreme temperature events that can cause coral bleaching.

A better understanding of coral bleaching is required to help us protect areas such as the Great Barrier Reef. Coral bleaching is a physiological process, and can be investigated using well known methods developed for physiological research. An understanding of the physiology behind coral bleaching can help us to predict when, where and why coral bleaching will occur. Through physiological research, my PhD project aims to increase our understanding of, and our ability to predict, coral bleaching.

Heron Island, in the southern Great Barrier Reef, is the location of a field station run by the University of Queensland, where I am conducting this PhD study. The research station contains aquarium tanks that are supplied by seawater taken from the surrounding reef. Using large water conditioners, the water temperature can be changed to any desired water temperature for experimental studies, and large indoor lights replicate sunlight for photosynthesis. Using this facility, corals can be exposed to the extreme temperatures (29-33°C or more) and light levels that they experience during episodes of coral bleaching. Precise measurements can be taken in time series, and coral samples snap frozen at any point, enabling the physiological state of the coral to be preserved and investigated.

During my first experiment (conducted in January last year), I recreated in these aquarium facilities the different rates of sea temperature increase that occur in nature prior to a coral bleaching event. Using small live coral samples collected from the surrounding reef, I found that, no matter what the rate of heating, coral bleaching always occurs at the same temperature (32°C). This information will be used to help develop a method of predicting coral bleaching using satellite–detected sea temperatures and light levels (much like the weather is predicted by the Bureau of Meteorology).

Reef. Photo: M. Mello Athayde

In August last year, I performed another field trip to Heron Island Research Station to collect coral samples for an experiment that I ran over October and November. Following collection by hand, the small coral samples (four centimetres or less) were attached to frames and set out on the reef to grow and recover before being brought into the research aquarium for the experimental treatment in October. This experiment examined the influence of high versus low light levels on coral bleaching.

I would like to thank the Wildlife Preservation Society of Australia for their invaluable support of my project, along with the Heron Island Research Station and my supervisors Associate Professor Sophie Dove, Dr William Skirving, Professor Ove Hoegh-Guldberg and Dr Bronte Tilbrook.

Conducting research on SCUBA at Heron Island Reef. Photo credit: M Mello Athayde.

Mortality and behaviour of juvenile northern quolls during dispersal

Teigan Cremona,
PhD Candidate,
University of Technology Sydney

Northern quolls were once abundant in Kakadu but have been declining for the past 10 years. The invasion of the cane toads in 2003 was the final nail in the coffin and caused quolls in the East Alligator Region to become all but locally extinct. Researchers from the University of Technology Sydney and the University of Sydney have collaborated with the Territory Wildlife Park to reintroduce captive-bred 'toad-smart' quolls to East Alligator. These quolls were conditioned to avoid eating cane toads, and as a result have higher survival than toad-naïve quolls. 'Toad-smart' quolls have survived and reproduced in Kakadu for three years and we are now seeing the second-generation reach sexual maturity. I have been radio-tracking young quolls as they become independent from their mothers. I have found that juvenile quolls spend significant amounts of time foraging and denning with their mothers even after they become independent. This suggests that young quolls may learn to avoid toads via social learning. Potentially, young quolls may learn to avoid eating toads by watching their mothers sniff and reject toads.

While the results of the toad training are promising, the quoll population is still declining at East Alligator. Hence, we need to investigate the other factors affecting quoll survival including predation by dingoes and feral cats and the effects of changed fire regimes. Unfortunately, wild dogs and dingoes are abundant on the study site, and forage atop some of the highest rocky outcrops. Dog numbers may be elevated via roadkill and campground rubbish in the dry season, and during the wet season when food is scarce, predation by dogs may be preventing the recovery of this quoll population.

We would like to acknowledge the Wildlife Preservation Society's support of this project, making access to volunteers possible.

Above: Teigan and a toad-trained quoll at the Territory Wildlife Park. © Teigan Cremona

Teigan radio-tracking a juvenile quoll in Kakadu National Park. © Jonathan Webb

A toad-trained northern quoll. © Jonathan Webb

A juvenile quoll after being microchipped and collared. © Teigan Cremona