The effect of fauna underpasses on the ecology and movement patterns of western grey kangaroos (*Macropus fuliginosus*) in a landscape fragmented by anthropomorphic development

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The construction of roads drastically alters the landscape and can present a significant barrier to the physical movement of animals. Such a barrier may restrict the ability of animals to find suitable habitat for foraging and can result in direct mortality through vehicles colliding with an animal. By far the most visible species of wildlife killed on roads in Australia are large macropods such as kangaroos. Every year countless numbers of kangaroos are injured and killed by vehicles. Such collisions are a common occurrence in many parts of Australia, especially on the outskirts of cities such as Perth, where rapid development and the construction of roads has resulted in a substantial loss of habitat for native fauna. Also, as more people move into those areas, the number of roads and cars travelling on the roads has, and continues to, increase at a dramatic rate. Vehicles colliding with kangaroos present a serious problem, not only from a conservation and animal welfare perspective, but also in terms of cost to humans as such collisions are responsible for significant property damage, injury and human mortality.

One solution to reduce the incidence of vehicles colliding with kangaroos would be to install wildlife fencing along major roads to prevent kangaroos and other animals accessing those roads. This solution, although effective at reducing vehicles colliding with kangaroos, would have a negative impact on sensitive areas such as nature reserves, as it would severely restrict the ability of kangaroos and other native animals to move between habitats, migrate in response to seasonal variations in climate or availability of food, or disperse away from maternal ranges. Animals would therefore be effectively locked up in nature reserves, and this could lead to overpopulation, overgrazing, ecosystem damage, loss of biodiversity and potentially the extinction of some plant and animal species.

A photograph taken by a motion sensitive camera of a kangaroo using an underpass beneath the Kwinana Freeway

In North America and Europe, fauna underpasses in combination with wildlife fencing have been demonstrated to be effective at reducing the incidence of animal-vehicle collisions involving animals such as large ungulates and carnivores, while allowing animals to maintain their usual daily and seasonal movements. Although a number of fauna underpasses have been constructed in Australia, no previous study has ever investigated the effectiveness of fauna underpasses in relation to large macropods. Also no previous study worldwide has ever examined the use of underpasses by large mammals at the level of individuals rather than species.

Several fauna underpasses have been installed under the newly constructed Perth to Bunbury Highway. This highway runs through a portion of the Rockingham Lakes Regional Park, which incorporates Marlee Reserve and Paganoni Swamp Nature Reserve, which has been identified as being of regional and international importance.

The main aim of this project is to determine the extent to which a large macropod species utilises wildlife underpasses to move between habitat in an environment fragmented by major roads and other human development. Within that aim I will be investigating:

- The home-range requirements as well as the daily and seasonal movements of a population of peri-urban western grey kangaroos (*Macropus fuliginosus*).
- The extent to which kangaroos use fauna underpasses at an individual

Above: Paul Chachelle working in the field

'Max' wearing his identification collar and ear tag

level, rather than species level, by incorporating novel technologies such as identification collars fitted to kangaroos and infrared cameras installed in the underpasses.

- The potential of fauna underpasses to reduce intra-specific competition and grazing pressure on reserves by allowing animals to move between habitat and access their traditional feeding areas.
- Whether there is any sex bias in underpass use and if so, what impact that has on the ability of males with an aversion to underpasses to pass on their genes (ie their fitness).
- Which aspects of underpass design and environmental factors influence underpass use.

Currently I have 47 kangaroos collared and ear-tagged, 17 of which (11 females and 6 males) are fitted with VHF radio collars, while the other animals have been fitted with white collars which have a unique three to four letter name printed in large black letters. These collars will allow me to recognise kangaroos using infrared cameras installed within the underpasses. A community participation campaign will encourage local residents to report sightings of collared animals, including the name of the kangaroo, the location, date and time of the sighting on a specially constructed website.

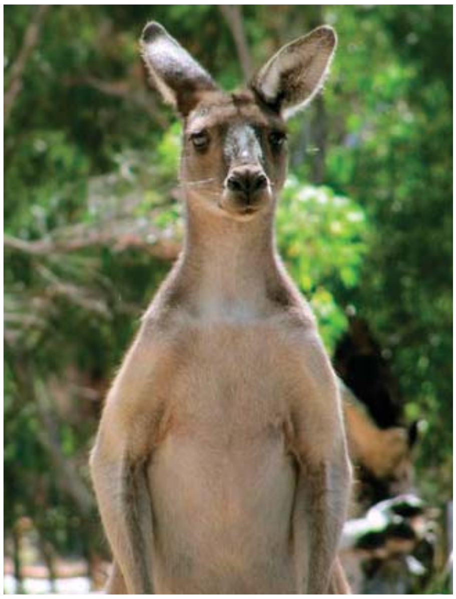
Although my project is still in its early phases, from data collected so far from both radio tracking and infrared cameras, I estimate that 60-65% of individuals from within the population are currently using the underpasses on a nightly basis, to move from the reserve to the grasslands in the evening to feed, and returning to the reserve early in the morning. From the data so far it appears that the radio-collared females exhibit very strong site fidelity. as those individuals which I have recorded using the underpasses do so every night. Interestingly, I have not recorded movement of an adult male through an underpass. As female western grey kangaroos experience a synchronised breeding season, some males may start using the underpasses to follow females during the October – January mating season.

DNA analysis will allow me to determine whether males which use the underpasses sire significantly more offspring to those females which use the underpass than those males which have an aversion to underpasses. I will also be able to compare the paternity of the offspring of females which do not use the underpass to those which do. I will compare the DNA of individual females with a high overlap in home-range to determine if those individuals are related. If two individuals which have a home-range overlap of 90-100% are found to be related, this would suggest that feeding and resting sites are maternally inherited and thus underpass use would also be behaviour which was learned from an individual's mother.

In the latter period of my PhD I will be investigating the aspects of underpass design and environmental factors which may encourage or discourage underpass use by western grey kangaroos.

The results of my study will make a significant contribution to the relatively new but rapidly expanding sub-discipline of road ecology. This will be one of the few studies which has ever attempted to study the landscape ecology of western grey kangaroos, and the first to ever study the landscape movements of a population of western grey kangaroos in an area experiencing rapid development due to the construction of roads and housing developments. It will be the first study to investigate how aspects such as population dynamics and intra-specific interactions may be influenced by the use of fauna underpasses. It is expected the findings of this study will also be applicable to other large macropod species and will contribute to a national database on the effectiveness on fauna underpasses. If underpasses are demonstrated to be effective and become more widely adopted by road authorities, this will not only benefit large macropods such as kangaroos and wallabies, but it will also have a flow-on effect as other native species may utilise those underpasses.

The aspect of my research I love the most is that I am gaining an intimate understanding of one of our most iconic Australian native animals. The more I learn I realise the amount of misinformation that is out there in regards to kangaroos. I also feel privileged that I am able to contribute to the knowledge regarding the use of underpasses by Australian fauna and that this knowledge will hopefully lead to the construction of fauna underpasses in Australia becoming more widespread. I am also very grateful to the Wildlife Preservation Society of Australia for supporting my research.



A young male from my study population

The conservation of arid zone ecosystems in Australia:

From genes to climate science

Paul Duckett,
Conservation Genetics Lab,
Biological Sciences,
Macquarie University

A small arboreal gecko (*Gehyra variegata*) (tree dtella),

Covering more than 70 percent of continental Australia, the arid zone represents the country's largest biome and houses an exceptionally diverse and largely endemic lizard fauna. Partly associated with the difficulties of working in such a harsh and large environment, the dispersal characteristics of many species in the arid zone are unknown, yet gaining knowledge of dispersal is vital if we are to manage and help mitigate the negative impacts of climate change.

It is commonly accepted that global climates have controlled the natural distribution of biodiversity. Evidence from both contemporary observations and the fossil record exemplify the influence a changing climate exerts on the distribution of species. However, the world's climate is now changing at an unprecedented rate and a large number of species are expected to face extinction. To survive, species may adapt to climate change, yet this seems unlikely as the rate of change is predicted to exceed the rate of adaption. The alternative is to relocate, but only mobile species with sufficiently high dispersal ability can be expected to keep pace with the shifts in their environmental suitability.

Predicting the areas which species will either expand or contract into is relevant to understand future population structure and help mitigate any deleterious genetic consequences. Using ecological niche modelling (ENM) to predict species distributions under various climate scenarios has become a central research technique. However, this approach lacks a quantitative process to evaluate if species are capable of relocating to their new predicted range. Coupling

ENM with genetic measurements of dispersal has potential to achieve this objective.

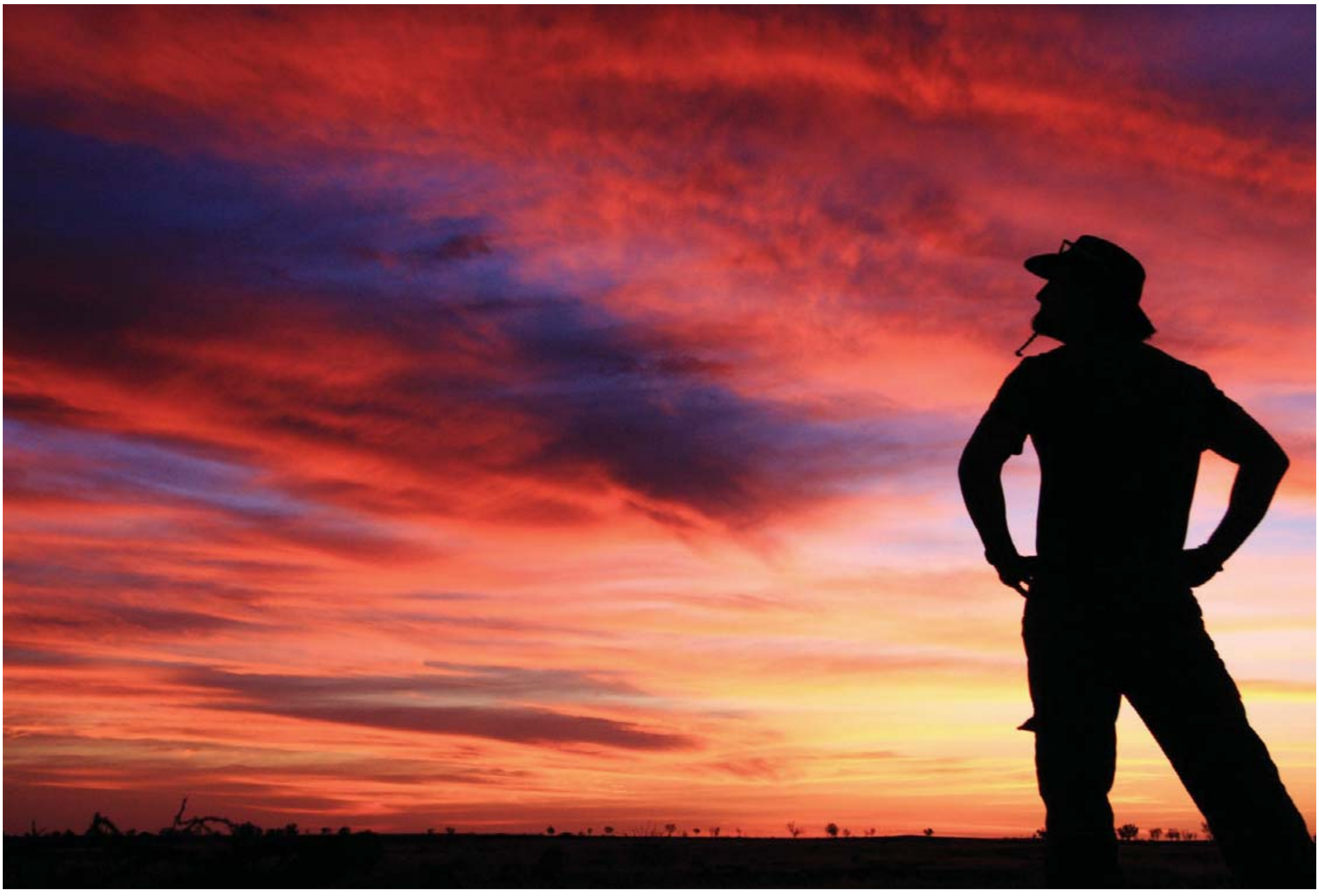
For part of my PhD thesis, I use standard genetic techniques to measure the average annual distance a small arboreal gecko (*Gehyra variegata*) (tree dtella), disperses across the various arid zone landscapes which represent the entire distribution for this species. I will then couple the genetic findings with ecological niche models to develop a new quantitative assessment method, which analyses the connectivity between the species present and predicted future distribution. Finally, I will measure the loss of genetic diversity the predicted range shift will cause, and the evolutionary consequences for this gecko species.

Fieldwork throughout the arid zones of New South Wales, Queensland, South Australia, and the Northern Territory was completed successfully during 2009 and 2010, where 874 individual tissue samples were biopsied from geckos across approximately 1 million km^2. After the successful development of microsatellite markers required for the genetic component of this study, genotyping of all samples was successfully completed in 2010.

Preliminary analysis indicates that climate change will cause dramatic distributional shifts in the location of favourable environmental conditions for this gecko species. With consideration for the dispersal characteristics of *G . variegata* I show that up to 41 percent of the species' current distribution may fail to reach areas of favourable climate in the near future. We can therefore expect substantial reductions in the population of this species and losses to genetic diversity. This new approach takes advantage of molecular and occurrence record datasets allowing critical assessments of how rapid climate change will impact the world's biodiversity.


Simpson Desert

The core of this project is funded by Macquarie University, and the financial support from the WPSA which has contributed to the genetic analysis in this study is greatly appreciated – thank you.


Sunset over the Simpson Desert

Drought, disease or destiny?

Identifying the cause of decline of the eastern quoll

Bronwyn Fancourt,
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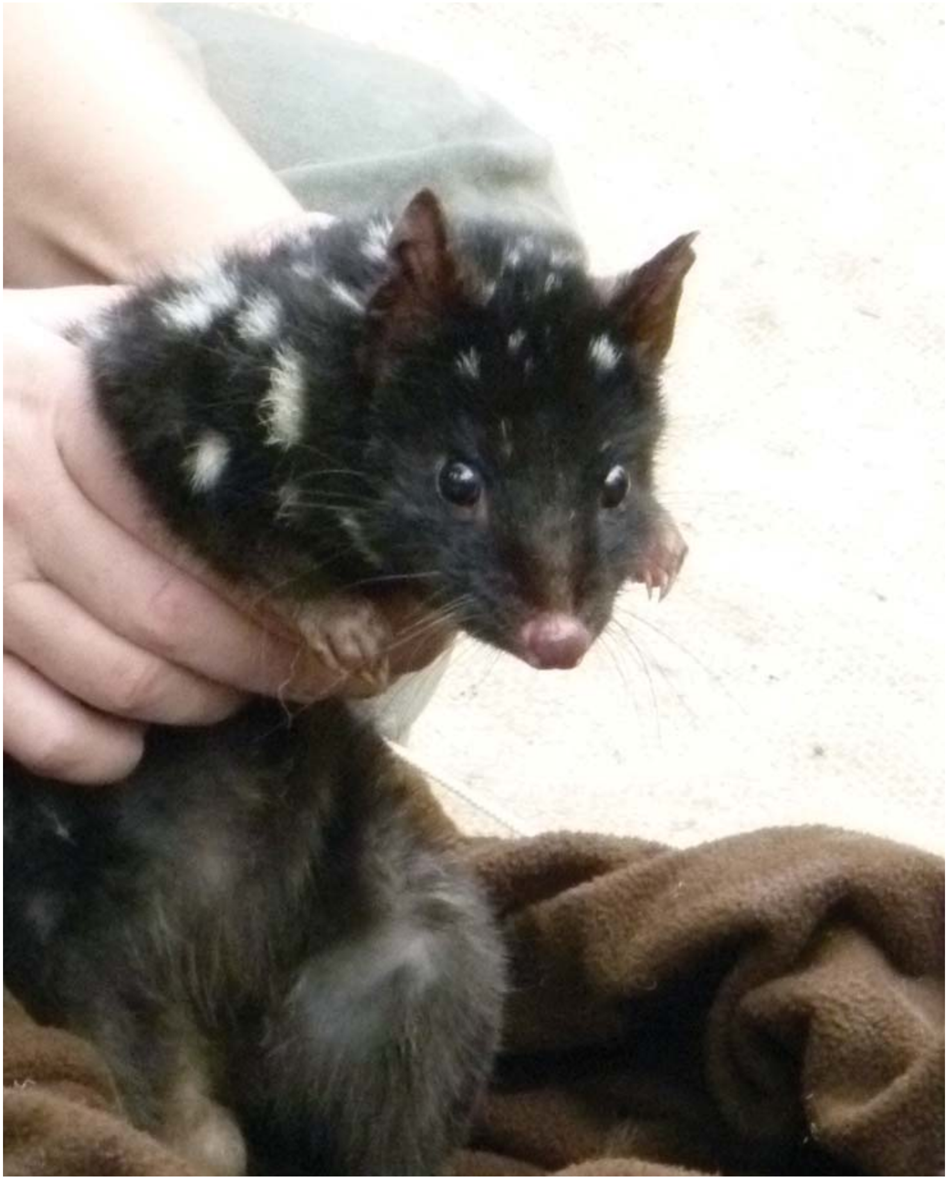
University of Tasmania

The eastern quoll (*Dasyurus viverrinus*) was once an integral part of faunal communities throughout south-eastern Australia. Their numbers dwindled rapidly in the early 1900s, and they are now considered extinct on the mainland. While the species has persisted in Tasmania, their numbers are declining rapidly, with statewide spotlighting surveys recording declines of more than 50% over the past ten years. Live trapping at a number of sites in 2010 supported this finding, indicating local declines of 60-100% over the past 20-30 years. The cause of this recent decline is not known.



Black eastern quolls are historically less common than the tan morph, however declining populations are showing a reversal of colour ratios in favour of the black quolls

While Australian fauna has endured numerous extinctions and declines in recent history, Tasmania remains a stronghold for marsupial diversity. The eastern quoll is one of five species that were once widespread on the mainland that now survive only in Tasmania. However, marsupial dynamics in Tasmania are changing rapidly and new threats are emerging. The Tasmanian devil is in steep decline due to the spread of the fatal devil facial tumour disease, and the red fox was recently introduced to the state. Devil declines may be allowing increases in feral cat abundance, which could threaten quolls and other species. Given this background of instability, it is imperative that we identify the cause of the eastern quoll's decline, and understand how it relates to factors involved in changes to other species.

Diagnosing the cause of a threatened species' decline is an essential first step in management for recovery. But diagnosis can be very difficult when several different factors act together. Furthermore, many species that are now endangered and in need of recovery declined to their present state of rarity many years ago, so that it is no longer possible to directly study the factors that were responsible for decline and measure their impacts on populations.

My PhD research aims to understand eastern quoll demography, population viability and ecological sensitivity in the current environment of rapidly changing predator dynamics (with declining devils and introduction of a novel predator, the red fox), anthropogenic disturbance (habitat modification and fox baiting

Above: Bronwyn Fancourt with an eastern quoll programs) and changing climate (recent drought and long-term climate change). Eastern quoll populations will be regularly monitored at four sites (two with declining populations, two with relatively stable populations) over the next 2½ years. The comparison of a range of demographic, health and environmental variables in declining populations with stable populations as a reference will enable identification of specific factors associated with the decline. Field work commenced in May and will continue every second month in the pursuit of critical leads and much needed data to help answer these questions.

The Wildlife Preservation Society of Australia generously contributed to my honours research in 2010 which provided strong supporting evidence that eastern quolls are indeed in marked decline. This research has formed the basis of a nomination for listing the species as endangered under the Tasmanian *Threatened Species Protection Act 1995*, and has provided me with a solid foundation to continue this research to the next crucial step of identifying the cause of the decline of the eastern quoll. I am extremely grateful to the Wildlife Preservation Society of Australia for continuing their support of this research into 2011.

Eastern quolls can be found in a range of habitats including sub-alpine areas

Volunteer Halley Durrant checks a trap in the snow

The evolutionary ecology of an endangered alpine lizard threatened by climate change

Maggie Haines,
University of Melbourne

Alpine bioregions are among the most threatened by climate change worldwide and comprise only 0.15 percent of the Australian landscape. Australia's alpine ecosystems are particularly susceptible to both direct and indirect effects of climate change because they comprise small and highly fragmented populations, many of which are at serious risk of local population extinction. Alpine-restricted species are often physiologically adapted to cold climates and they may not be able to adapt fast enough to keep up with the current rate of climate change. Since they already inhabit the highest elevations, they cannot expand their range upwards to escape shrinking habitats and higher temperatures.

Adult male Pseudemoia cryodroma (alpine bog skink) taken in the field at Mt Buller

Victoria's alpine communities contain several of Australia's most threatened habitats and animal species. These include four alpine-restricted reptiles listed as endangered or critically endangered at the state level, two of which are also listed as federally endangered. The greatest obstacle to conservation of alpine reptiles is lack of essential information for effective management and federal protection. I will help to redress this via a detailed study of an endangered alpine lizard, the alpine bog skink (*Pseudemoia cryodroma*). The alpine bog skink is a small (approximately 55mm body length), live-bearing lizard found only in Victoria at elevations above 1,200m. As part of my PhD, I am investigating key habitat requirements, genetic diversity, genetic distinctiveness, and temperature tolerances of the alpine bog skink as well as its common, widespread sister species the southern grass skink (*P. entrecasteauxii*).

Thus far, I have collected 106 samples from sites in the Victorian Alps, which include popular ski resorts such as Mt Baw Baw, Mt Buller and Mt Hotham. I also used available samples from the Australian Museum, Museum Victoria, and South Australian Museum. These species have variable colour patterns and it can be difficult to distinguish them. An important outcome of this project will be to provide tools such as effective field identification resources that will contribute to long-term survey and monitoring for the alpine bog skink.

Preliminary genetic analysis suggests possible hybridisation between the alpine bog skink and the southern grass skink. Interestingly, the data indicates that the alpine bog skink is actually more closely related to another species within its genus. I will examine more samples and analyse additional genetic markers to fully understand the genetic relationships and distinctiveness of the alpine bog skink.

The Wildlife Preservation Society of Australia grant will contribute to the cost of fieldwork. My goals for this field season are to complete habitat surveys, collect samples from potential hybrid zones and bring animals back to the laboratory to study their thermal physiology. In addition to the Wildlife Preservation Society, I would also like to thank the Arthur Rylah Institute, Department of Sustainability and Environment; Holsworth Wildlife Research Foundation; and Museum Victoria 1854 Student Scholarship for financial and in-kind support.

Mt Loch is one of my field sites

Alpine bog skink (*Pseudemoia cryodroma*) taken at Lake Mountain

Community structure, altitudinal gradients and climatic responses of microbats in the wet tropics

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Centre for Tropical Biodiversity and Climate Change,
School of Marine and Tropical Biology,
James Cook University

The rainforests of the Wet Tropics World Heritage Area are globally recognised for their high level of biodiversity and their unique biota. Over 200 different species inhabit the 9,000 square kilometre area, with over 90 of these species being regionally endemic. Microbats contribute significantly to this diversity with over 30 species (60 percent of all mammals) inhabiting the area. The biogeographic history of this unique region means many species found in the Wet Tropics have adapted to a cool, wet and relatively stable environment. This makes the fauna of the area particularly vulnerable to emerging threats such as global climate change.

In order to mitigate potential biodiversity loss in the Wet Tropics World Heritage Area we must first gather baseline data on different taxa. The high species variation found in microbats makes them an ideal study taxon for investigating how species distributions and community assemblages may be affected by different climate change scenarios. This study will examine microbat ecology in the Wet Tropics through a thorough investigation into regional and altitudinal species distributions, species activity patterns, and community structures, and make predictions about how these species may respond to climate change.

In order to achieve this, species distributions and activity are being monitored at six independent altitudinal gradients throughout the Wet Tropics, incorporating 25 individual sites spanning elevations of 100m to 1,600m. Data is being collected through a combination of acoustic monitoring (recording of species specific echolocation calls) and capture of animals. Collected acoustic data will provide information on species presence, abundance, and activity, while capture data will provide information on morphometric attributes of animals (sex, size, reproductive condition).

The northern long-eared bat (*Nyctophilus bifax*). Photo: Arnaud Gourret

In addition to species data, environmental data, including daily and annual temperature, humidity, and rainfall measurements, is also being collected. This data, collected from long term monitoring stations set up by the Centre for Tropical Biodiversity and Climate Change, will be analysed in combination with species data. Relationships between species ecology and current and predicted environmental trends will be investigated using predictive modelling. The models will be used to explore how species may react under various predicted climate warming scenarios. Understanding how species may respond to such changes will allow us to make informed decisions regarding the conservation of this diverse group, as well as the mitigation of overall biodiversity loss in the Wet Tropics and other tropical ecosystems.

A large proportion of my candidature has been spent in the rainforests of North Queensland, collecting necessary data. The funding I have received from the Wildlife Preservation Society of Australia, along with support from the Skyrail Rainforest Foundation, and the Centre for Tropical Biodiversity and Climate Change, James Cook University has helped cover the cost of my field work. This support is greatly appreciated.

Above: Tamara Inkster with the eastern tube-nosed bat (*Nyctimene robinsoni*)

Wildlife responses to black rat control in Sydney Harbour National Park

Helen Smith,
University of Sydney

Invasion of non-native species into foreign ecosystems is one of the biggest challenges for conservation and restoration biologists. In particular, fragmented ecosystems with vacant niches are highly susceptible to invasion by alien species. The black rat (*Rattus rattus*) is a major threat to biodiversity, and has caused significant declines in fauna and flora through competition, predation and disease. Despite this, black rat impacts have not been quantified in Australia. My research will quantify the ecological impacts of black rats in the Sydney Harbour National Park, specifically to inform management authorities of the ecological consequences of alien invasion.

Progress so far

I began my PhD in March 2011. During this time I have:

- Selected 16 suitable sites in the Sydney Harbour National Park and determined initial black rat densities using live trapping, chew cards and camera traps
- Successfully run two trials at Taronga Zoo (see results below)
- Completed a tree climbing course to install bat boxes safely
- Purchased all required bat boxes (using a combination of funding from the WPSA and other sources) and have begun installing boxes into the sites.

In this report I will outline how I spent my WPSA award, and report on the preliminary results from two trials. I will also outline the significance of my work and the next stage for my research.

Helen Smith installing a bat box

Budget

The WPSA grant of $1,000 was put towards purchasing bat boxes. Artificial bat boxes are essential to ensure microbat residency on each site (hollows are hard to find, and difficult to monitor non-invasively). A total of 80 boxes are required for replication and to maximise the chance of occupancy over the course of my PhD. This grant covered an eighth of the total number of boxes required for my project, and I have already begun installation of these boxes. The grant was also used to cover travel costs, mainly petrol, as the study areas are well spaced (to ensure independence) and transport is essential to move gear around (ladder, boxes, etc).

Preliminary Results

Trial 1: Bat box entrance

Aim: to design an appropriate modification of my bat boxes to ensure that black rats can enter, which will allow me to record microbat predation events by black rats.

Bat boxes were modified with four designs to allow black rats to enter: three designs had slit entrances made with rubber of 0.8mm, 1.6mm, 3.0mm thickness and one box had a PVC pipe elbow entrance. Boxes were trialled at Taronga Zoo and installed with peanut butter bait to encourage visitors.

Black rats were able to enter the PVC elbow, whereas the rubber entrance was difficult to push through, and was damaged by the rats chewing at it.

Trial 2: Possum guard exclusion

Aim: to design a simple way of excluding black rats from climbing so that I can record differences in reptile predation events on trees with/without black rats.

For the reptile predation section of my project, I ran a two-week trial at Taronga Zoo to establish if I could use metal sheets to exclude black rats from climbing up trees. I need to make sure that the foils exclude rats, but allow possums to pass. This trial fits into the reptile impact section, where the foils can be used as a way to exclude rats from trees, and the number of reptiles on rat proof and non-rat proof trees can give a measure of rat predation. I used peanut butter bait to encourage visitation. I selected trees with isolated branches so that rats could not climb another tree and reach the bait from above.

Results: Brushtail possums were easily able to straddle the foil, and were not hindered by the presence of the foil. Ringtail possums found it more difficult to climb the foil, but were still able to get over the foil. No black rats were observed climbing or jumping over the foil, provided there were no side branches which the rat could grip onto.

Future Directions

My research explores the concept of replacement, and more specifically, the ecological impacts of replacing a native species with an alien one. In my case, I focus on the replacement of native bush rats (*Rattus fuscipes*) with feral black rats (*Rattus rattus*). In July, I began the black rat removal treatments, and in August, I helped release 100 native bush rats into four one hectare sites in the Sydney Harbour National Park. Using the apparatus bought with WPSA money, and trialled earlier this year, I will now be able to compare predation rates of black rats on microbats, small birds, reptiles, seedlings and invertebrates in the upcoming breeding season. My long-term goal is to compare the impacts of native and non-native rats in bushland areas of Sydney.

One of the bat box designs with PVC pipe. All boxes are installed at minimum height of 4m

Helen Smith Rat trapping

Significance

My research is the first experimental study to determine the ecological implications of alien black rats on native Australian wildlife. My research will explore the ecological factors that shift when a resident rodent is displaced, and the knock-on effects that influence overall ecosystem health. This will fill a major knowledge gap about the current and future potential threat of the black rat to Australian natives. It also explores the responses of wildlife to the reintroduction of a rodent that was once abundant in Sydney. The reintroduction program will provide enormous conservation benefits to natives by blocking reinvasion processes. The findings from my project will inform management authorities of the direct impacts of the black rat, and the wildlife responses to the reintroduction of the bush rat. This will help authorities to effectively use management techniques and financial resources that promote ecologically sustainable bushland reserves.

Acknowledgements

This project could not happen without the financial support of the WPSA. It is an honour to receive a 2011 University Grant Award, and the $1,000 has made this work possible. I look forward to being involved with the Wildlife Preservation Society for the duration of my PhD award.

Evaluating the effectiveness of road mitigation measures for wildlife: how much monitoring is enough?

Kylie Soanes,
Australian Research Centre for Urban Ecology,
Royal Botanic Gardens/University of Melbourne

A large amount of time, effort and funds are spent in an attempt to mitigate the impacts of disturbance on wildlife. As such, rigorous evaluation of the effectiveness of wildlife mitigation and restoration programs is critical to ensure successful strategies are widely adopted, and unsuccessful ones are not repeated. However, when survey efforts are reduced to save costs the ability of monitoring programs to detect an effect is limited.

For example, millions of dollars are spent worldwide on crossing structures in an attempt to reduce the impacts of roads on wildlife. These structures aim to increase population viability by reducing habitat fragmentation and roadkill. While studies monitoring the use of structures by wildlife are common, quantitative evaluation of their effectiveness at improving population viability is typically lacking. A comprehensive evaluation of crossing structures should address several key questions, including: a) Are the structures used by wildlife?; b) Do populations become more connected?; and c) Does population viability increase?

Possums and gliders are particularly susceptible to increased mortality rates (ie roadkill) and habitat fragmentation caused by large gaps in canopy cover at roads. Mitigation measures include gliding poles (for gliding species only), canopy bridges, and the retention of tall trees in the centre median (referred to as 'natural canopy connectivity').

A female common ringtail possum with her two back-young photographed using the canopy bridge to cross the highway

In 2005 research was undertaken to investigate the impact of the Hume Highway on arboreal mammal populations in Victoria. These studies found that the highway reduced survival rates for the squirrel glider (*Petaurus norfolcensis*) (McCall et al. 2010), and created a barrier to movement for squirrel gliders (van der Ree et al. 2010) and common brushtail possums (*Trichosurus vulpecula*), (Gulle, unpub. data) where natural canopy connectivity was not present. Glider poles and canopy bridges were installed at these sites in 2007. Post-mitigation research is now required to evaluate the effectiveness of these structures.

This project aims to evaluate the effectiveness of each mitigation measure for squirrel gliders and common brushtail possums. Once the full monitoring program is completed, I'd like to explore the influence of reduced sampling effort on the outcome to identify an optimum level of effort.

Are the structures being used?

Two canopy bridges and four gliding poles were fitted with remotely triggered infrared cameras. These cameras have detected frequent use by several species including squirrel gliders and common brushtail possums.

Do populations become more connected?

Post-mitigation radio tracking surveys were recently completed and preliminary results indicate that canopy bridges, glider poles and natural canopy connectivity enable squirrel gliders to cross the highway, whereas unmitigated sites remain a barrier to movement. Analysis of geneflow will also be completed using genetic samples collected during mark-recapture surveys.

One of two 70m long canopy bridges which are used by arboreal animals to cross the dual-carriage Hume Highway in north-east Victoria

Does population viability increase?

Mark-recapture surveys are conducted annually at mitigated, unmitigated and control sites. These surveys will be used to determine if survival rates, population density and reproductive output change as a result of mitigation. Surveys have been ongoing since 2008, and preliminary analysis will begin late 2011.

How much monitoring is really enough?

Study design, duration and sampling methods are often reduced to save cost, which can severely limit the ability of monitoring to detect an effect of mitigation. It is therefore important to identify monitoring methods that provide high quality information cost-effectively. Upon completion this project will compare the information costs of using more limited study designs in an attempt to identify an optimal monitoring effort.

Common brushtail possum

Squirrel glider

Ecology and management of flying foxes in urbanised south-east Queensland

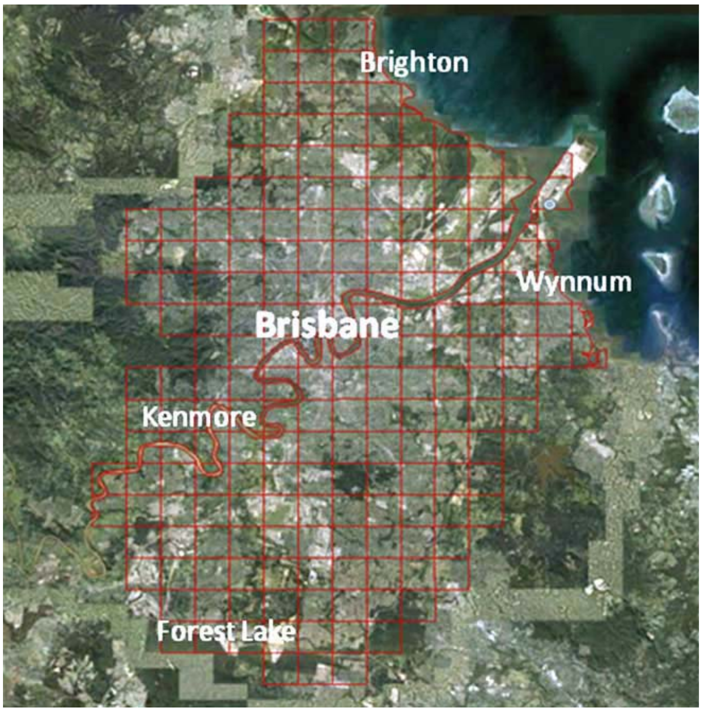
Joanne Towsey,
School of Biological Sciences,
University of Queensland

Flying foxes are large bats that roost communally in camps during the day then spread out at night to forage in vegetation in surrounding areas. While foraging they play an essential role ecologically by dispersing and pollinating forest trees. Despite their ecological significance, populations of some Australian flying foxes are declining as a result of factors such as habitat loss, persecution by humans and poor management. Continuing declines in flying fox numbers will likely have significant ramifications for many of Australia's native forest ecosystems.

In recent years, flying foxes have been coming into increasingly closer contact with people due to existing daytime camps becoming enveloped by urban sprawl, and as a result of flying foxes shifting into urban areas possibly in order to access more reliable food sources. Our towns and cities can support large numbers of these animals, and this close proximity to people can lead to human-wildlife conflict situations. This conflict puts managers of flying foxes in a difficult position; they need to conserve populations of flying foxes, but also need to manage the negative consequences. This presents a really interesting challenge for conservation, and my PhD is focused around (i) understanding how and why the animals are distributed across urban environments in the way that they are, and (ii) how we can manage Australia's urban flying fox populations to make sure we conserve them, but also minimise the human-wildlife conflict.

My research is being conducted in south-east Queensland, a region where many flying fox camps have split up or changed location over the past few years. I want to find out why these changes are occurring and whether they are temporary or permanent. To answer these questions I am currently measuring the amount of foraging resources available for flying foxes in Brisbane, and working out how the bats are spreading out across the urban environment when they leave their camps in the evenings. My ultimate goal is to find out how we can manage urban vegetation into the future in order to ensure both adequate supply for the maintenance of urban flying fox populations and thus their ecosystem services, such as pollination and seed dispersal, and to help ameliorate human-flying fox conflicts.

I would like to thank the Wildlife Preservation Society of Australia for providing me with this grant money which will contribute greatly towards the field work component of my research.



Google map of my study area in Brisbane, Queensland.

Joanne with flying fox

Modelling fauna populations within a production landscape

Maggie Triska,
Ecosystem Restoration and Intervention Ecology (ERIE) Research Group,
The University of Western Australia

Habitat loss directly linked to human consumption demands (ie, land use) is growing worldwide. Therefore, integrating land use with maintaining biodiversity is an increasing challenge that may be partially addressed in production landscapes through restoration efforts. However, restoration may take decades to reach completion, thus monitoring (through field work and modelling) can be used as predictive measures of success prior to restoration completion based on restoration trajectories and species habitat requirements.

Tracking tunnel mounted on a marri (*Corymbia calophylla*) used to survey for brush-tailed phascogales within the jarrah forest

My research occurs in a production landscape in the jarrah (*Eucalyptus marginata*) forest in southwestern Australia. Within this region, Alcoa World Alumina Australia mines and restores approximately 550 hectares annually creating a mosaic of seral and mature forest. Many native fauna species have been documented in restored forest, but their continued use of restored areas ultimately depends on their habitat requirements. To assess species' current and potential distributions I analyzed habitat associations of reptiles and small mammals, from data already collected, and the presence of brush-tailed phascogale (*Phascogale tapoatafa*), for which minimal data (observations and potential sign) were available for the region.

Reptile and small mammal presence-absence data was analysed in the program Presence (MacKenzie et al. 2002) to determine occupancy and detection probabilities. Detection probabilities often varied by month or year and occupancy by habitat variables (vegetation cover, time since fire, log density, etc). GIS techniques were then applied to display habitat associations and predicted occupancy of detected species. Additional reptile and small mammal trapping will commence this spring to validate the completed models and supplement species for which few detections occurred.

Brush-tailed phascogale presence was assessed using tracking tunnels, which were placed in the field from April to August 2011. However, these resulted in only one phascogale detection, which further suggests their rarity in the region. The lack of detections restricted additional analysis and, without further research, only provides speculations as to the cause (historic or current disturbances and land use, predation) of the low density and what restoration techniques will promote their return.

Overall, in order to maintain biodiversity in a changing landscape we need to understand how species utilise unmined regions and extrapolate that to restoration as it ages. Modelling techniques provide an outlet to predict species occupancy based on various scenarios and encourage new management procedures (such as nest boxes, log piles, or corridors) for successful species return.

Example of a trapping grid, in unmined forest, used for surveying reptiles and small mammals

Acritoscincus trilineatum, one of the species for which occupancy maps and models were created from presence-absence data

Discovering and protecting Australia's hidden biodiversity

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Imagine that some people had twice as much DNA as others. Imagine that they looked the same as everyone else but were unable to have children with 'normal' people. This may sound fanciful (because it doesn't happen in humans), but this is exactly the situation in many plant species around the world.

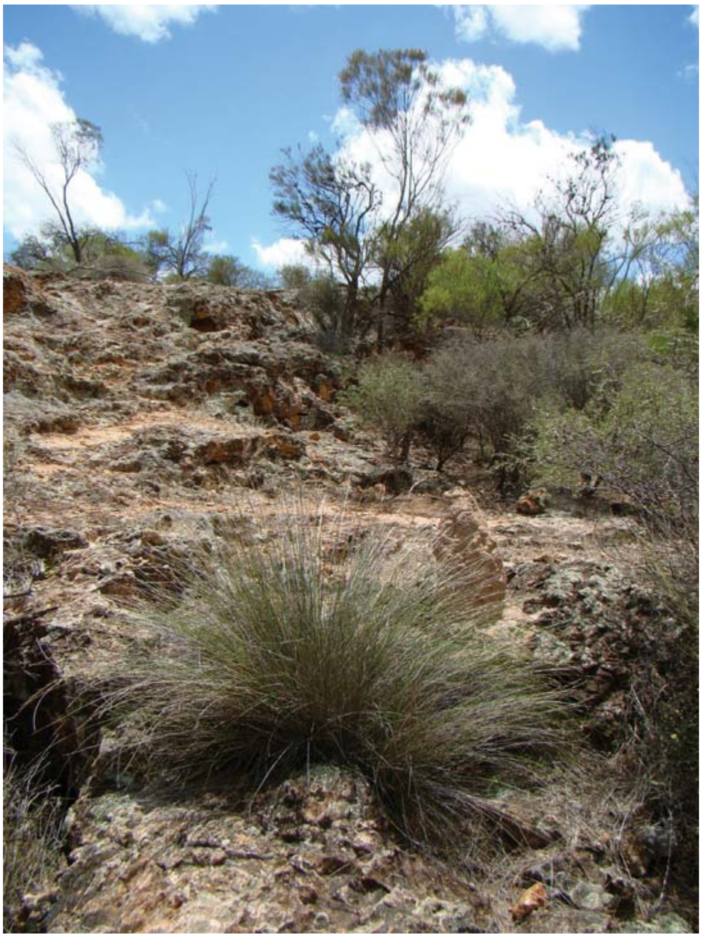
Plants that have twice as much DNA as others are known as polyploids. Polyploids are very common in the plant kingdom, particularly in crop species such as wheat, and weed species such as lantana. In natural systems polyploids help generate and maintain biodiversity; however, relatively little attention has been given to their conservation. Their conservation has been overlooked because we are often unaware of their existence because they appear to be the same as 'normal' plants. New technology, however, has made identifying polyploids much faster, simpler, and cheaper. For the first time, polyploids can now be properly considered in conservation planning in Australia.

Ribbed sword sedges often grow on banded ironstone

Identification of polyploids is important when assessing the conservation status of a species. Conservation assessments usually hinge on the total number of remaining individuals and the ability of these populations to survive and reproduce into the future. Some people, particularly in Europe and North America, argue that polyploids and 'normal' plants should be considered separately when planning conservation and restoration. This is primarily because these plants cannot interbreed, but also because they often possess different ecological traits. To be considered separately, however, they first need to be identified and my project will explore new means of identifying polyploid plants.

During efforts to restore a threatened species, particularly when returning a species to a habitat, it is important to identify polyploids because, generally, they do not grow in the same area as 'normal' plants. If, through restoration, polyploids and 'normal' plants are unintentionally mixed in a single population there can be dire consequences because if they breed they will produce sterile offspring thereby threatening the viability of the population. Sterile offspring are produced in the same way that a horse and a donkey (which have different amounts of DNA) produce sterile

Westernmost population of ribbed sword sedges. Plants can be seen in foreground of photo



Ribbed sword sedge (foreground) growing in cracks on a granite rock

mules if they breed. This is obviously something that is vital to avoid when planning conservation and restoration of a species if it is to survive in the long term.

My project focuses on the conservation of a group of rare plants endemic to Western Australia's biodiversity hotspot. These plants, the ribbed sword sedges, are particularly important because they are threatened by the expansion of iron ore mining in the region. To ensure that polyploids are properly considered when planning conservation of this group, I will use WPSA funds to conduct fieldwork to determine how many polyploid plants exist and where they occur. This information will help inform environmental impact assessments and can be used by mining companies (eg Gindalbie Metals who provide core funding for this research) to plan their restoration so that polyploids and 'normal' plants are not unintentionally mixed. By doing this I can hopefully contribute to better conservation of these rare plants and pave the way for a greater consideration of this type of hidden biodiversity in Australia.

Sampling plants from the edge of a granite outcrop near Paynes Find