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Book of Abstracts

Contents

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Reproduction, evolution and serotiny in an invasive species. Is reproduction in *Pinus radiata* wildlings better suited to environmental conditions?

James Bevan. *Supervisors:* Drs G Wardle & C Warren
School of Biological Sciences, University of Sydney, NSW 2006

Delayed seed release is a reproductive characteristic known as serotiny that has evolved in many plants growing in fire-prone habitats. These plants retain seeds in the canopy for long periods, then release them following fire when conditions are favourable to seedling establishment. The serotinous *Pinus radiata* has invaded from commercial plantations into adjacent native bushland. If wildlings have developed reproductive traits which are selectively better suited to respond to environmental conditions than plantation trees, the rate of invasion may increase. The spatial variation in the length of time seeds are retained in the canopy (level of serotiny) and the temperatures required to stimulate seed release (degree of serotiny) is poorly understood. Morphological variations in cone traits affect the temperature and time required to open cones and release seed. Cones insulate seeds thereby enhancing seed viability. I have investigated variation in the level of serotiny in *P. radiata* between plantations and wildling trees and the role of various aspects of cone morphology on the degree of serotiny and seed viability. Preliminary results indicate that there is both a higher proportion and a greater number of open cones in wildling trees compared to the plantation. Data on the role of cone morphology on seed viability have thus far been inconclusive. Further work investigating the insulating effects of serotinous cones is currently being conducted.

Is the arid zone skink, *Ctenotus pantherinus*, nocturnal?

Christopher Gordon. *Supervisors:* Professors C Dickman & M Thompson
School of Biological Sciences, University of Sydney, NSW 2006

I instigate hypotheses regarding night-time activity in the arid zone skink *Ctenotus pantherinus*, an odd species as it is active during day and night time period. I tested four specific hypotheses in order to understand mechanisms facilitating such night time activity:

1) Night time metabolic rate will be equal to, or greater than day time metabolic rate
2) When in a thermal gradient, *C. pantherinus* will select colder temperatures during night periods opposed to day periods, as night foraging occurs in a colder environment than day foraging
3) *C. pantherinus* will prefer to eat termites, a dependable nocturnal food source, over other prey types in cafeteria trials
4) *C. pantherinus* will be ale to detect prey using only auditory and olfactory senses, as the efficiency of vision reduced at night.

Our results suggest that *Ctenotus pantherinus* shows many features of a diurnal life history, with metabolic rate being 32 % lower at night than during the day, and mean selected temperature not differing between night and day periods, averaging at 36 °C. As *C. pantherinus* had a 66 % preference for termite prey in cafeteria trials, and was shown to detect prey using only auditory and olfactory sensors, we conclude that termites are important in facilitating night-time activity in *C. pantherinus*.

The effects of plant toxins and predation risk on the foraging behaviour of *Trichosurus vulpecula* (the common brushtail possum).

Sahar Kirmani. *Supervisors:* Drs C McArthur & P Banks*
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Optimal foraging theory predicts that a balance is required between obtaining high quality food whilst staying safe (avoiding predation). For the common brushtail possum, this means avoiding or regulating the intake of plant toxins found in *Eucalyptus spp*., which forms part of their diet; and responding to the risk of potential predators (red foxes, powerful owls etc) in their environment. I aimed to determine the effects of a plant toxin (cineole) and predation risk (using cover and predator cues) on the foraging behaviour of brushtail possums. I used a series of giving-up density (GUD) experiments, which combined the two factors of toxin and predation risk, and measured food intake of sultanas by brushtail possums across treatments. In initial experiments, toxin reduced sultana intake but cover did not. In later experiments, there was a significant interaction between toxin and predator cues (owl pellets) on intake. As predicted, intake was greatest when there was no toxin and no risk of predation at a food patch, and lowest when both toxin and predation risk was the highest. Thus it appears that foraging decisions by possums represent a trade-off between intake of toxins in their food and safety. These findings demonstrate the importance of combining plant-animal interactions and predator-prey interactions to gain greater insight into the constraints acting on foraging animals.

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Bufo for breakfast; how cane toads affect native predators and their prey.

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The ongoing spread of the cane toad (*Bufo marinus*) through tropical Australia is commonly thought to spell disaster for native predators. However, if a predator can survive an encounter with a toad, it may learn to avoid them thereafter. Understanding this possibility is important in determining cane toad impacts on predators and, indirectly, other components of the ecosystem.

I investigated the capacity for two native predators to learn to avoid cane toad tadpoles – a fish (the northern trout gudgeon, *Mogurnda mogurnda*) and a frog (Dahl's Aquatic Frog, *Litoria dahlii*). After an initial experience, both predators showed a decreased tendency to attack toad tadpoles compared with a naïve control group. This experience had no effect on rates of predation upon an alternate prey type (crickets). This aversion to toad tadpoles after an initial encounter lasted at least seven days in gudgeons though did not persist as long in frogs.

In a separate experiment, gudgeons given toad experience exhibited a strong aversion to normally palatable native tadpoles. If gudgeons were given the option of alternate food, the aversion to native tadpoles was prolonged. Native tadpoles therefore may benefit from 'incidental mimicry', that is, happening to look like the unpalatable cane toad.

I also mimicked the complexity of natural conditions to examine the interplay between native tadpoles and toad tadpoles. Fish that experienced a mixture of (unpalatable) toad and (palatable) native tadpoles showed less aversion to tadpoles as prey. Finally, given long-term exposure, both fish and frogs are able to learn to tell the difference between the two types of tadpole and thus the benefit to the native 'mimic' decreases.

Plant-animal pollination interaction networks in arid sand dune habitat.

Tony Popic. *Supervisors:* Drs G Wardle & Y Davila
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There is a recent increase in emphasis in the need to understand the role of positive and indirect interactions in structuring ecological communities. Recent studies have shown that pollination is a predominantly generalised interaction, and so interacting species exist within a network. My main aim was to understand the interaction network of plants and their visitors in arid sand-dune habitat. The flowering phenology and floral rewards were investigated to determine influences on structuring the network. Pollen movement by bees was investigated to determine which bees are possible pollinators within the visitor network. The visitation of flowers by small mammals was also investigated.

A total of 1273 plant-visitor interactions, of which 464 were unique, where observed between 159 insect and 61 plant species. This included 47 native bee species. The resulting network displayed small-world properties including high nestedness (specialists interact only with proper subsets of those species interacting with the more generalists), small path length and power-law degree distribution. Of the 47 bee species visiting 51 plant species, 20 were moving 34 pollen species. The resulting network was less nested than the plant-bee visitor network. The flowering phenology was characterised by a 'boom-bust' cycle, with times of mass co-flowering dictated by rain events. The nectar quality (volume and % brix) of *Crotolaria cunninghamia* was found to be variable within plant inflorescences, ranging from 0-104ul and 0-51.6 % brix, and also not influenced by the time of day nor temperature. Experiments showed that small mammals do not retain pollen grains in enough numbers to determine whether they do or do not visit flowers.

The network of plants and their visitors in arid sand-dune habitat is characterised by cohesive, nested, complex networks, and the predominance of generalisation.

Faith in fate: The impacts of disturbance on ant-seed dispersal and plant recruitment in open woodlands.

James Schlunke. *Supervisor:* Dr D Hochuli
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Seed dispersal by ants (myrmecochory) is particularly important in areas of nutrient-poor soil in Australia. Disturbance may cause shifts in abundances of key seed-dispersing ant species, disrupting the seed dispersal mutualism. Ants exhibit considerable inter-specific variation in seed dispersal behaviour, impacting on seed fitness. Previous studies of disturbance on myrmecochory have focussed only on initial seed removal, rather than seed fate.

My aim was to determine the effect of disturbance, in this case clearing of land for agriculture, on the ant-seed dispersal mutualism in an open woodland community in Southern NSW. I followed the process of myrmecochory from initial seed removal, through seed predation levels and seed burial depth to germination and emergence.

Pitfall trapping surveys of ant assemblages revealed that pre-regenerative pasture vegetation differed significantly from undisturbed remnant vegetation, with regenerating areas as an intermediary between the two. The abundances of three key seed dispersers were higher in disturbed areas. Species richness in regenerating areas was comparable to remnant areas, but higher than in pasture.

Seed removal rates were contrasted between vegetation types, for two ant-dispersed *Acacia* species common in the area. Removal of the larger seeded species was negatively affected by disturbance, with little impact on the smaller species. Observations of seed removals identified three key dispersing species. Removal of the larger seeded species was restricted to larger ants, which carried seeds further. Smaller seeds were more likely to be removed by *Pheidole* species, known to be 'poor quality' dispersers. The relative proportions of seed removing ants were not significantly different between vegetation types.

Excavation of nests revealed that the smaller seeds were more likely to be eaten or buried at a depth unsuitable for emergence. A field germination experiment and seed heating trials showed that most seeds recovered from within ant nests were buried at depths suitable for germination and emergence.

My results indicate that some aspects of the ant-seed dispersal mutualism are altered as a result of disturbance. Vegetative recovery from disturbance appears to alleviate these changes. Significant variation exists between plant species in ultimate seed fate within this habitat.

Density-dependent aposematism in a stick insect?

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When defended prey species use warning signals (commonly conspicuous colours) to advertise their unprofitability to potential predators, it is referred to as aposematic. The advantages of aposematism as an anti predator strategy are becoming clear, however, the evolution of aposematism from a cryptic population is still puzzling. This is because novel aposematic individuals suffer a greater risk of predation and are too rare to facilitate predator aversion learning. Aposematism may have evolved via density-dependent plasticity in prey colour phenotypes, whereby insects are cryptic at low population densities and aposematic at high population densities. In this case a conspicuously coloured prey would neither stand out to predators or be too rare to facilitate predator learning, thus reducing the pressures under which aposematism could evolve. I aimed to discover whether the outbreaking species of stick insect, *Podacanthus wilkinsoni*, displays density-dependent aposematism.

I first aimed to quantify their density-dependent colour phenotypes. The stick insects were reared at isolated and crowded population densities to induce colour phase change. Crowded individuals developed black melanised patterns and a yellow background resulting in conspicuousness. Isolated individuals were a uniform green colour that was rather cryptic in appearance. I then aimed to quantify behavioural differences between the different rearing densities. Crowd-reared insects had greater mobility and motility and were attracted towards conspecifics more than isolated individuals. This behavioural phase change indicates the importance of higher activity levels and attraction to conspecifics in insects that reach high population densities and display conspicuous colouration.

Unpalatability in other density-dependent aposematic insects is a result of toxic host plant use. Noisy miner birds (*Manorina melanocephala*) did not develop taste or learned aversions towards conspicuous coloured prey fed eucalyptus, but showed an existing bias towards attacking cryptic over conspicuously coloured prey. Lizards (*Ctenotus pantherinus*) accepted all mealworms coated in *P. wilkinsoni* regurgitate. The results indicate that *P. wilkinsoni* are palatable to these predators and that these insects may not be aposematic at high population densities. Given these results, I compared total phenolic levels in eucalypt host plants between a cryptic coloured low population density and a conspicuously coloured high population density. The results show greater levels of phenolic at the site with crowded conspicuous individuals. This indicates a potential for conspicuously coloured stick insects to be more unpalatable due to host plant use. However, further investigation into *P. wilkinsoni* unpalatability is required.