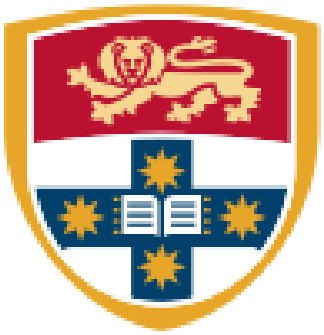

THE UNIVERSITY OF SYDNEY

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Book of Abstracts

Contents

Dr Maurizio Rossetto & Dr Peter Weston – Sydney Royal Botanic Gardens

Delving beneath the surface: habitat selection and thermal ecology of a fossorial lizard

DE-ANNE ATTARD *Supervisors:* Professor M Thompson & A/Professor D Hochuli
School of Biological Sciences, University of Sydney, NSW 2006

Understanding of thermoregulation in squamates is based primarily on studies of diurnal heliothermic species and tropical nocturnal species. These groups exploit aspects of the thermal environment using behavioural and physiological mechanisms to optimize performance. Unlike most heliothermic species of skinks, *Saiphos equalis* is a nocturnal fossorial skink and has a limited capacity to use behaviour to thermoregulate, remaining beneath the ground during the day and foraging at night, in a cool temperate environment. I identified habitat and retreat sites used by *S. equalis* and determined the thermal properties of key habitat components within these environments. Lizards selected retreats that were characteristically different from those available and using discriminant functions analysis I described a composite set of habitat variables which explain these associations. In laboratory experiments, individuals selected retreat sites that were fragmented and had a preference for substrates that were moist and composed primarily of leaf litter as opposed to dry and friable soils. When offered the option of heated retreats (28ºC), individuals selected cooler retreats (17ºC) 95% of the time regardless of the time of day. Thus, physical characteristics of retreat site selection may offset potential thermoregulatory deficits associated with a fossorial and nocturnal lifestyle. I also determined individuals from northern-viviparous (12.4 ± 0.50 ºC) and southern-oviparous (19.0 ± 0.5 ºC) populations have significantly different mean selected temperatures (MST). This corresponds with an altitudinal temperature difference between populations. My findings show (1) that habitat use and retreat site selection convey thermoregulatory benefits for *S. equalis* and (2) that lower mean selected body temperatures within individuals from northern populations likely correspond with physiological processes (such as reproductive mode) and thermoregulatory advantages in a colder climate.

A fish for every season: the capacity of the eastern mosquito fish (*Gambusia holbrooki*) to adjust to seasonal temperatures is dependent on the developmental environment

JULIAN BEAMAN *Supervisor:* A/Professor F Seebacher
School of Biological Science, University of Sydney, NSW 2006.

The metabolic capacity of ectotherms is affected by fluctuations in environmental temperature. In response to longer-term (seasonal) temperature changes, many aquatic ectotherms adjust their physiology to compensate for the potentially negative effect of changing temperatures (thermal acclimation). These changes may occur during development, when they are often irreversible, or reversibly during adulthood. The aim of the project was to investigate whether the environment experienced during development influences the ability of the eastern mosquito fish (*Gambusia holbrooki*) to acclimate to different seasonal temperatures later in life. Here, I show that *G. holbrooki* respond differently to changes in temperature depending on the time of year when they are born. Individuals born in early spring had significantly greater capacity to acclimate, and endurance swimming performance and aerobic capacity were similar at their respective acclimation temperatures (15˚C and 25˚C). In contrast, individuals born in summer did not acclimate, and endurance swimming performance and aerobic capacity were always maximized at the warmer temperature (25˚C). At Manly Dam, where *G. holbrooki* were collected, mean daily temperature increased from 15˚C in early spring to 25˚C throughout summer. In *G. holbooki*, phenotypic changes during development match the performance of individuals to the temperatures they will experience in their life-time. The interaction between developmental plasticity and acclimation of individuals is likely to buffer populations from environmental temperature variation.

Quantifying Biodiversity Value: Is Vegetation Enough?

JAYNE HANFORD *Supervisors:* A/Professor D Hochuli & Dr M Crowther
School of Biological Sciences, University of Sydney, NSW 2006

Biodiversity offset schemes have grown in presence and popularity worldwide in the last decade due to the need to conserve biodiversity in the face of increasing development pressures. By 'offsetting' the impacts of development through conservation actions elsewhere, offset schemes aim to achieve 'no net loss' of biodiversity. However, methods for quantifying biodiversity value are often based on untested assumptions, primarily that vegetation structure is an adequate surrogate for overall biodiversity value. Therefore, site value scores calculated by offset schemes may be unrepresentative of the actual biodiversity value. To test assumptions of vegetation structure surrogacy, I surveyed 14 sites of varying quality in western Sydney, using the NSW Biobanking Scheme as a model biodiversity offset scheme. At each site, I measured ten vegetation structural attributes. I also measured seed removal using seed depots containing 50 native Australian seeds, and richness and abundance of ant morphospecies and functional groups using pitfall traps. I hypothesised that if vegetation structural attributes were an adequate surrogate for biodiversity values, there would be relationships between site value scores and rates of seed removal, and between site value scores and ant community composition. My results showed significant positive relationships between the vegetation attribute 'native plant species richness' and both functional group richness and morphospecies richness, although these were not correlated with any other vegetation attributes. However, there were no significant relationships between site value scores and rates of seed removal, or between site value scores and ant community composition. Also, most vegetation structural attributes were not adequate predictors of site value score. It appears that site value scores have little predictive power for seed removal rates or ant community composition, and therefore cannot be considered adequate measures for these components of biodiversity value. Furthermore, the lack of correlations between vegetation structural attributes and site value scores, seed removal rates or ant community composition suggests that, in this case, vegetation structure is not an adequate surrogate for biodiversity value.

Insects eating eucalypts: a highly volatile situation?

PETAH LOW *Supervisors:* A/Professor D Hochuli & A/Professor C McArthur
School of Biological Sciences, University of Sydney, NSW 2006

Host plant quality can directly affect insect herbivore fitness, but can also have an indirect effect on herbivores by influencing rates of predation or parasitism. In eucalypts, nutrient enrichment has been shown to enhance leaf chemical quality (higher nitrogen, lower phenolics). However, concomitant increases in volatile terpene concentration may increase herbivore susceptibility to attack, since the release of these volatiles while feeding could provide natural enemies with stronger host/prey location cues. To test this, I manipulated the quality of *Eucalyptus tereticornis* seedlings to create 'low nutrient' and 'high nutrient' plants. I then quantified a number of key foliar properties and, using the caterpillar *Uraba lugens* (the gumleaf skeletoniser) as a model herbivore, assessed in a five-day feeding trial the direct effects on herbivore performance. The foliage of high nutrient seedlings, as predicted, contained greater concentrations of nitrogen and 1,8-cineole (the major terpene in most *Eucalyptus* species) and tended to have lower levels of total phenolics. Herbivores on high nutrient seedlings consumed on average 65 % more than those on low nutrient seedlings. This did not translate into significant differences in the other performance measures, possibly because the trial was too short. To investigate whether high nutrient plants could provide natural enemies with stronger cues, I used solid-phase microextraction to monitor the emission of cineole from low and high nutrient plants in response to: (1) no damage, (2) a single incident of artificial damage and (3) more sustained feeding damage by *U. lugens* larvae. The emission of cineole increased significantly following damage (artificial or herbivore), but continued only in the herbivore treatments where damage was sustained. There was also weak evidence of high nutrient seedlings emitting greater amounts of cineole. I also investigated rates of predation on cineole-baited and unbaited model caterpillars in the field and found that rates of predation were significantly greater on model caterpillars that were baited with cineole. My study suggests that eucalypt-feeding insects may be most at risk while feeding and that although insects may eat more on high quality foliage, possibly enhancing performance, this may indirectly increase the risk of predation or parasitism.

Promiscuous Proteaceae: Hybridization between native Australian *Lomatia* species

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Natural hybridization events are important phenomena in the evolution of plant lineages yet many questions remain. This study explores the value of a multidimensional approach in understanding natural hybridization between closely related species, using the Australian native shrub species *Lomatia myricoides* (Gaertner f.) Domin and *L. silaifolia* (Smith) R.Br. (Proteaceae) as a model system.

Lomatia individuals have been found which exhibit a range of morphological traits intermediate between those of the tall, linear leaved *Lomatia myricoides,* and the low shrub, *L. silaifolia* with its highly divided leaves. These putative *L. myricoides* x *silaifolia* hybrids occur in Eastern Australia within the zone of overlap between the two species' distributional ranges.

In this study, three populations containing both *L. silaifolia* and *L. myricoides* and their putative hybrids were analysed in order to characterise the diversity present at these sites. A combination of genetic (nuclear microsatellites), morphometric and ecological approaches were adopted to uncover the structure of hybrid populations, and to understand the mechanisms which led to hybrid formation.

We hypothesised that the three populations differed in structure, hybrid composition and patterns of diversity, and subsequently proved this to be true. Combining the genetic, morphometric and ecological datasets revealed that one population consisted of pure individuals only, another contained distinct pure individuals and a small number of first generation hybrid individuals (F1s), while the third was a hybrid swarm, displaying extensive introgression and admixture of genotypes. Interestingly, hybrids were fertile, as flowering produced seeds, with comparable germination rates to parental species.

These findings have demonstrated the importance of combining ecological and genetic approaches in order to best appreciate complex patterns of hybridization and the underlying evolutionary processes in operation.

Top predator: dingo or fox? – must be raven mad

JAMES REES *Supervisors:* Dr M Letnic & Dr J Webb
School of Biological Sciences, University of Sydney, NSW, 2006

Nest predation is the primary cause of breeding failure in most birds, with effects at the population level and for community organisation. Shorebird populations throughout Australia are in decline and nest predation has been identified as a contributing factor. It is therefore of great interest that nest predators be identified and factors affecting predation rates be better understood.

I conducted an artificial nest experiment across 6 study sites on a 140 kilometre stretch of the NSW Lower North Coast to (i) identify the main predators of shorebird nests and their relative importance, (ii) determine nest survival relative to predator activity, and (iii) investigate the effects of proximity to urban and agricultural edges, campsites and garbage tips on predator abundance and nest survival.

Australian ravens (*Corvus coronoides*) and forest ravens (*Corvus tasmanicus*) were the main predators, responsible for 75% of predated nests, followed by the red fox with 15%. There was a significant effect of raven activity on nest survival. The best models for explaining nest predation rates involved combinations of the variables, in order of relative importance: raven activity, distance from urban development and distance from campsites. There was a significant negative correlation between dingo and raven activity.

I conducted further investigation to determine the importance of dingo activity and anthropogenic food subsidies on the level of nest predation by ravens. There was no effect of dingo activity, simulated with a domestic dog, but a substantial effect of food subsidies near the nest. This supports the conclusion that anthropogenic food subsidies available in proximity to urban areas contribute to elevated levels of nest predation. I also demonstrate interspecific competition for food between foxes and ravens, indicating the possibility of a similar interaction between dingoes and ravens.

It's getting hot in here: thermoregulation and nectar-processing in Australian stingless bees

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The current and potential threats to honeybee populations have forced us to consider alternative pollinators. *Tetragonula carbonaria*, *T. hockingsi* and *A. australis* are three native stingless bee species which are potential alternative pollinators in Australia. I investigated two behaviours important to the suitability of these species for crop pollination.

Firstly, effective nest thermoregulation in the European honeybee has allowed it to be exploited as a crop pollinator outside of its natural distribution and in glasshouses. I investigated if *T. carbonaria* and *T. hockingsi* are able to maintain a stable brood temperature at different ambient temperatures. I placed data loggers within different areas of the nest in 3 colonies of each species over a period of three weeks. I found that brood comb temperatures in both species were stable independent of ambient temperature. I also found a significant difference in brood comb temperatures within the same species among colonies. My results show that *T. carbonaria* colonies are better able to maintain the temperature of the brood (28 to 30°C) than *T. hockingsi*. I further exposed a colony of *T. hockingsi* to a range of temperatures (10 to 40°C) to investigate worker behaviour at high and low temperatures. My results suggest that brood temperature is actively regulated by workers clustering on brood cells when the temperature is low, and vacating the brood area when the temperature is high.

Secondly, the transfer of nectar by returning honeybee foragers to receiver bees is thought to regulate the number of workers that forage at the colony level. Hence, nectar transfer is a favourable pollinator trait. Thus I investigated if nectar transfer occurs in *T. carbonaria*, *T. hockingsi* and *A. australis* by observing interactions between returning foragers and hive bees. My results show that in all three species returning foragers transfer nectar to hive bees.