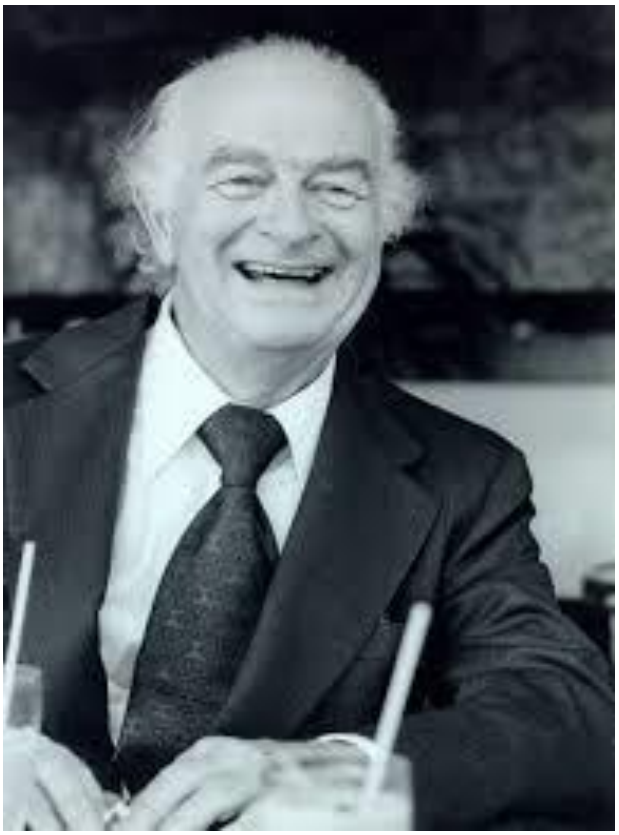
Masters of Research

Student Seminars

Monday March 16th, 2015



Linus Pauling – ***"The way to get a good idea is to get lots of ideas and throw the bad ones away."***

- Talks are 12 mins + 3 mins for questions (15 mins total)
- Talks should be pre-loaded on computers to save time during presentations
- Presenters to ready themselves and their talk on the display during the previous question time

Schedule of Presenters

Time	Presenter	Title
Session 1		
9:00	Samiya Tabissam	Competitive interactions between invasive and native species from a low nutrient environment
9:15	Katherine Berthon	Invertebrate diversity on green roofs in Sydney, Australia
9:30	Michelle Vecsei	Investigating song learning in juvenile regent honeyeaters at Taronga Zoo
9:45	Tahereh Moadeli	Environmentally benign methods for control of tephritid fruit flies (Q-Fly): improved larval diets for Sterile Insect Technique
10:00	Saleh Mohammad Adnan	Methoprene and dietary yeast as pre-release supplements promoting sexual maturation of Queensland fruit fly
10:15	Truszewski Elayna	Intraspecific divergence, hybridization and assortative mating in the Amazonian frog, *Allobates femoralis*
Morning tea (10:30-11:00am)		
Session 2		
11:00	Richard O'Brien	Discovering New Variants of an Abiotic Stress Tolerance Gene, RUBISCO activase (RCA), in Species of Nicotiana and Gossypium from the Australian Savannah
11:15	Belinda Fabian	Functional biology of extrafloral nectaries of Australian native wild cottons (Gossypium spp.) from the arid zone
11:30	Victoria Bywater	Behavioural Ecology of the Chirruping Wedgebill (*Psophodes cristatus*)
11:45	John Little	An inter-catchment assessment of groundwater ecosystems under irrigated agriculture and pasture (in rural New South Wales and Queensland)
12:00	Rachel Self	Developing *Botrytis cinerea* as a potent non-GM enzyme producer for the removal of haze-forming proteins under normal winemaking conditions
12:15	Louise Tosetto	Microplastics in the marine environment: Understanding impacts on marine biota and potential for trophic transfer

Time	Presenter	Title
Lunch (12:30-1:30pm)		
Session 3		
13:30	Evan Byrnes	Individual Boldness Influences Spatial Navigation Style in Port Jackson sharks (*Heterodontus portusjacksoni*)
13:45	Shanta Nair	Epigenetic Regulation of Immune Defenses and Starvation Response in the Mealworm Beetle, *Tenebrio molitor*
14:00	Sabine Schiller	Are captive grey-headed flying foxes (*Pteropus poliocephalus*) at greater risk of infection with human-borne pathogens?
14:15	Laura Fernandez	Ecological impacts of the invasive fungus *Puccinia psidii* (Myrtle Rust) on three Australian Myrtaceae species of coastal swamp woodland
14:30	Michelle Jerry	Energetic costs of sexual coercion—the price of persuasion
14:45	Fonti Kar	Predictors of social dominance and the effects of social dominance on social learning in Eastern Water Skinks (*Eulamprus quoyii*)
Afternoon tea (3:00-3:30pm)		
Session 4		
15:30	Gareth Johnston	
15:45	Jennalee Clark	Innate chemosensory recognition of predators in Port Jackson shark embryos
16:00	David Connolly	The effect of climate change on the temporary gel-adhesion of the sea urchin, *Holopneustes purpurascens* to its host algae
16:15	Jessica Thompson	Gene flow between farmed and wild populations of Sydney rock oysters

Abstracts

ADNAN, Saleh Mohammad

Project stage: commencing

Methoprene and dietary yeast as pre-release supplements promoting sexual maturation of Queensland fruit fly

Supervisor: Phil Taylor

Queensland fruit fly (Bactrocera tryoni Froggatt, or 'Q-fly') is one of Australia's most devastating insect pests, infesting a wide range of commercial and back-yard fruit crops. In some regions Q-fly is managed using the sterile insect technique (SIT) in which sterile flies are reared and released in very large numbers to disrupt reproduction of wild populations. Pre-release supplements that accelerate sexual maturity, enhance mating competitiveness or increase longevity of released sterile males can increase efficacy of SIT. In Q-fly, the addition of yeast hydrolysate (YH) to sucrose in the pre-release diet has been associated with increased mating propensity, enhanced remating inhibition and increased longevity. The application of the juvenile hormone analogue methoprene dissolved in acetone to pupae or adults has been reported to further promote sexual maturation and mating performance in many tephritid flies, including Q-fly, but this means of application is not practical in operational settings and also has toxic side effects for the flies. I will investigate whether the positive effects of methoprene are maintained when this hormonal supplement is incorporated into the pre-release diet rather than applied in acetone. It is important to note that current SIT programs release both sexes and so the impact of released males can be greatly diluted by the presence of sexually receptive sterile females. Accordingly, the effects of methoprene supplements on reproductive development, mating propensity and longevity, will be investigated in both males and females.

Keywords: q-fly, methoprene,yeast, sexual, maturation

BERTHON, Katherine

Project stage: commencing

Invertebrate diversity on green roofs in Sydney, Australia

Supervisors: David Nipperess; Matthew Bulbert; Peter Davies

Increasing urban densities in Sydney and regional centres have reduced the capacity of urban/suburban landscapes to support biodiversity through connectivity of green space. Green roofs provide unique opportunities for habitat creation in urban environments, and enhancing connectivity of remaining green space. Although green roofs are often cited as providing wildlife habitat, there is little evidence to support this claim. There is a particular paucity of knowledge on green roofs in Australia. The effectiveness of green roofs as habitat is limited by the inherent constraints of green roof design. This is particularly the case for invertebrates which respond to microhabitat changes and are dispersal limited. Several design factors have been found to be important in influencing invertebrate diversity on green roofs, though the processes underlying the influence of these factors is poorly understood. A major limitation of previous studies has been the absence of a bare roof control. Bare roofs provide a baseline for roof invertebrate diversity in urban areas. Comparison to this baseline enables deeper investigation into the mechanisms driving invertebrate colonisation as well as the added habitat value of green roofs. This project will investigate green and bare roofs as habitat for invertebrates within the context of highly urbanised inner Sydney. By drawing from the ecological frameworks of island biogeography and altitudinal gradients, I aim to provide the first Australian insight into the principles which influence invertebrate diversity on green roofs.

Keywords: invertebrate diversity, green roofs, habitat islands

BYRNES, Evan

Project stage: commencing

Individual Boldness Influences Spatial Navigation Style in Port Jackson sharks (Heterodontus portusjacksoni)

Supervisors: Culum Brown

In the 1920's Ivan Pavlov introduced the idea of individual personality in animals, and since then personality differences have been identified in over 100 species of non-human animals. Boldness, or the propensity to take risks is the most extensively studied personality trait, and has been shown to effect many aspects of an animals' daily life. One such aspect is cognition.

Research on animal personality and cognition demonstrates that boldness positively correlates with cognitive abilities in animals; such that bolder individuals complete cognitive tasks with higher speed and accuracy. However, recent research indicates that the relationship between personality and cognition is more complex than a simple correlation. Research suggests that personality influences cognitive style, or how an animal thinks, independent of their cognitive ability. Cognitive style and how it is influenced by personality differences has not been examined in animals; thus this study aims to better understand this interplay between personality and cognitive style in animals, using Port Jackson sharks as a model species. Understanding how personality effects cognitive style in predatory animals, such as sharks, is important for understanding food web interactions that are key to ecosystem health. Additionally, exploring personality and cognition in Heterodontus sharks provides a unique opportunity to investigate one of the most ancient origins of personality and cognition in vertebrates.

Keywords: personality, boldness, elasmobranch, spatial navigation, cognitive style

BYWATER, Victoria

Project stage: completing

Behavioural Ecology of the Chirruping Wedgebill (Psophodes cristatus)

Supervisors: Simon Griffith; Andy Russell

Approximately 90% of the Australian continent is classified as arid zone. However to date, the majority of species in this area have not been formally studied. The Chirruping Wedgebill, *Psophodes cristatus* is one such species. Locally endemic, this small passerine is highly conspicuous with males singing loudly throughout most parts of the year. Females of this species also sing and males and females can be heard forming duets, a temporally precise form of joint song. My research has focused on the context and function of solo song and duets in the Chirruping Wedgebill. While many studies have examined song function across breeding seasons, much of this research has been conducted in the Northern Hemisphere where breeding seasons are predictable. Furthermore, few studies consider the function of female song. Using behavioural observations and playback experiments I examined song rates and duet function of male and female Chirruping Wedgebills across the breeding season. Results show that song output is affected by stage of the breeding cycle and that both sexes will vary their song rate during this cycle. As well as this, duet function has been shown to be context dependent and may be used in territorial defence and mate guarding. This study provides the first research on behavioural ecology of the chirruping wedgebill and contributes to our understanding of song function in Australia passerines.

Keywords: song, duets, arid species, passerines

CLARK, Jennalee

Project stage: commencing

Innate chemosensory recognition of predators in Port Jackson shark embryos

Supervisors: Jane Williamson; Culum Brown

Innate behaviours are responses to specific stimuli due to the activation of developmentally encoded neural pathways. In marine environments, fishes exhibit innate predator recognition via detecting and interpreting chemical cues. Innate predator recognition is critical for optimal predator avoidance during early life history stages, when organisms are particularly vulnerable. Additionally, an ability to rapidly differentiate between non-predatory and predatory animals is crucial because it avoids wasting energy and time on futile anti-predator behaviours.

Although studies have investigated innate responses of larval fish to predators, no studies have examined innate predator recognition in egg-laying elasmobranchs (sharks, skates and rays). As a result, it is unknown how encountering and interpreting chemical cues, produced by predators, will impact the embryonic development of elasmobranchs. The purpose of this study is to determine if Port Jackson sharks (*Heterodontus portusjacksoni*) exhibit innate predator recognition during embryonic development and how this may impact their development.

Viable Port Jackson shark eggs will be collected from Jervis Bay, NSW and used for laboratory-based chemosensory experiments. These involve introducing predator and herbivorous fish odours to embryos and observing responses. Heart rate and cortisol will be measured before and after the introduction of chemical cues. Additionally, development stages and hatch time will be monitored to determine if predatory cues impact development and growth. The results of this study will assist marine authorities in the management of *H. portusjacksoni.* An understanding of how predation pressure impacts embryonic development in egg-laying elasmobranchs may help to design conservation strategies that better protect *H. portusjacksoni*, and other species during early life history stages.

Keywords: Port Jackson, shark, predator, innate behaviour, chemosensory

CONNOLLY, David

Project stage: commencing

The effect of climate change on the temporary gel-adhesion of the sea urchin, Holopneustes purpurascens to its host algae

Supervisors: Jane Williamson

Anthropogenic climate is arguably one of the greatest threats to marine biodiversity in the 21st century. The biological effects of ocean acidification and increased sea surface temperatures have been well documented in echinoderms thus far, but few studies have acknowledged the threat of climate change to behaviour. Echinoderms, such as sea urchins play an important ecological role as 'ecosystem engineers' by regulating algal biomass through herbivory. The Australian sea urchin *Holopneustes purpurascens* is one such engineer, living and grazing amongst the fronds of its host algae, *Ecklonia radiata.* The adhesion of *H. purpurascens* to its host algae is not only vital to the survival of *H. purpurascens* but also to the control of *E. radiata's biomass.*

Temporary gel-adhesion works via the use of a dual gland excretion system, whereby one secretion initialises adhesion and the other de-adhesion. Any loss or hindrance of this temporary gel-adhesion to its host algae has the potential for significant mortality of *H. purpurascens* and host algal proliferation. It is our aim to test whether increased levels of ocean acidification and/or sea surface temperatures will impact or reduce tenacity of *H. purpurascens* adhesion to *E. radiata.* We hypothesis that under increased ocean acidification and ocean temperature that *H. purpurascens* adhesive tenacity to *E. radiata* will decline. The greater environmental stress (acidification and temperature) the greater the loss of adhesive tenacity.

TRUSZEWSKI, Elayna

Project stage: commencing

Intraspecific divergence, hybridization and assortative mating in the Amazonian frog, Allobates femoralis

Supervisor: Adam Stow

The origins of diversity within the Amazon basin have been widely debated, with a number of vicariant barriers proposed to have caused intraspecific divergence and speciation within this region. Large rivers, in particular, are considered to be effective barriers to gene flow for many vertebrate species, and their role in facilitating intraspecific divergence has been well supported. As anuran amphibians are generally philopatric and have low vagility, barriers to gene flow should promote diversification between populations and result in strongly structured phylogeographic patterns. These characteristics make anurans an excellent model system to investigate the origins of intraspecific divergence.

The pan-Amazonian frog, *Allobates femoralis*, has been used to investigate the evolutionary aspects of intraspecific diversification. This species is characterised by strong genetic structuring between populations, with phenotypic traits, such as call repertoire and colouration, varying among lineages. I will use molecular techniques to investigate (1) whether hybridisation occurs between lineages of *A. femoralis*, (2) whether assortative mating occurs with respect to their genetic lineage, and (3) to test the riverine barrier hypothesis as a mechanism for diversification in this species. Results will contribute towards an understanding of the complex history of evolution within the Amazon basin, help resolve taxonomic uncertainties, and identify significant units for conservation.

Keywords: intraspecific divergence, hybridisation, assortative mating, riverine barrier hypothesis, refugial hypothesis

FABIAN, Belinda

Project stage: commencing

Functional biology of extrafloral nectaries of Australian native wild cottons (Gossypium spp.) from the arid zone

Supervisors: Brian Atwell; Lesley Hughes

Extrafloral nectar (produced outside flowers) is the foundation of many ant-plant interactions worldwide. Producing extrafloral nectar is a significant cost for plants in terms of metabolic resources and energy, but this cost can be traded off against the benefit of ant mutualists providing protection from herbivores. Even though these ant-plant interactions are important in many ecosystems, the mechanism by which extrafloral nectar is produced and nectar composition are not well characterised. Another unknown is the way in which nectar production and/or composition may change in the future, in response to rising levels of atmospheric carbon dioxide. Increased CO_2 is known to affect other aspects of plant growth and composition, and any changes in extrafloral nectar might have significant flow-on impacts within ecosystems.

This project firstly investigates the functional biology, including the nectary structure and nectar composition, of extrafloral nectaries in native cotton species (*Gossypium* spp.), found in Australia's arid zone. Extrafloral nectaries in arid region plants are poorly studied compared with plants from temperate and tropical regions. The impact of increased CO_2 on nectar production and composition will then be tested, representing the first investigation of elevated CO_2 impacts on any extrafloral nectar system.

Keywords: arid zone, carbon dioxide, extrafloral nectary, nectar composition, structure

FERNANDEZ, Laura

Project stage: completing

Ecological impacts of the invasive fungus Puccinia psidii (Myrtle Rust) on three Australian Myrtaceae species of coastal swamp woodland

Supervisors: Michelle Leishman; Angus Carnegie

Exotic fungal pathogens can substantially affect individuals and populations of susceptible plant species, potentially resulting in changes in community structure and composition. *Puccinia psidii* (Myrtle Rust) is a pathogenic fungus native to Central and South America that affects species in the family Myrtaceae. Myrtle Rust mostly attacks young growing tissues such as apical meristems, flower buds and fruits, resulting in reduced plant growth and reproduction. The pathogen was introduced accidentally to Australia and was first detected in the Central Coast region of NSW in April 2010. It has spread rapidly and is now found along the east coast of New South Wales, Queensland and Victoria and very recently was reported in Tasmania.

Ecological impacts have been poorly studied in the native range of Myrtle Rust and even less for Australian native communities. A wide range of Australia Myrtaceous species have been reported as susceptible to Myrtle Rust and preliminary studies have found significant impacts of the pathogen on individual species in some plant communities, including coastal swamp woodland of northern NSW. Two experiments were conducted to assess Myrtle Rust impacts in three co-occurring species of coastal swamp woodland that are known to be susceptible: *Melaleuca quinquenervia*, *Leptospermum laevigatum* and *Baeckea linifolia*. *M. quinquenervia* is dominant in coastal swamp communities and is highly susceptible to Myrtle Rust attack, thus changes in community structure are likely in Myrtle Rust-infected coastal swamp communities.

The first experiment was designed to test individual-level impacts of the pathogen. Sixty seedlings of each species were grown in individual pots, spread equally across 4 glasshouses. Individuals in two of the glasshouses were left as control and individuals in the other two glasshouses were inoculated with fungus spores (treatment) after 3 months growth to test for individual species impacts. The second experiment was designed to test community-level responses to Myrtle Rust infection. The three species were grown in a mixture of five seedlings of each species in seedling trays, simulating regeneration from the seed bank after fire. Twenty replicates of each species mixture were grown, spread equally across four glasshouses. In two of the glasshouses the seedling mixtures were left as controls while in the other two the seedling mixtures were inoculated with spores of Myrtle Rust after 3 months growth. Plants were inspected every 2-3 days for evidence of Myrtle Rust infection level (size and number of sori) and to assess survival and growth (seedling height, number of leaves). This study is critical for increasing knowledge on the ecological impacts of Myrtle Rust which is essential for conservation and management of native and threatened Australian plant communities.

Keywords: *Puccinia psidii*, Myrtle rust, invasive pathogen, exotic fungus, Myrtaceae

JERRY, Michelle

Project stage: commencing

Energetic costs of sexual coercion—the price of persuasion

Supervisor: Culum Brown

Females of certain fish species are subjected to unwanted mating advances, and such advances can have costs to both male and female individuals. The presence of harassment has welfare implications. The costs of harassment to female (especially poeciliids) have been widely explored in the literature; however, few studies have directly measured the direct fitness costs associated with harassment. Moreover, the focus of sexual harassment has most often focused on costs to females, with little attention to the male costs of constantly chasing and displaying to females. My project aims to quantify the costs of harassment in both males and females by observing responses and long-term effects of unsolicited mating attempts in a controlled setting. We will measure fitness directly by recording growth (in small individuals) and reproductive output (in large individuals).

Sexually mature males and gravid females will be used for the study. Fish will be subjected to various treatments: control (equal numbers of males and females), males only and females only. The effects of male coercion on males and females will be assessed by measuring time spent foraging, changes in body mass/size and brood size in females. Conventional wisdom would lead us to hypothesise that when males and females are housed together, the costs of harassment will be higher when compared to single sex groups. However, it may be the case that growth and reproduction are maximised in natural, mixed sex shoals.

Keywords: sexual harassment; guppies; energetic costs; poeciliids; fitness costs

KAR, Fonti

Project stage: commencing

Predictors of social dominance and the effects of social dominance on social learning in Eastern Water Skinks (Eulamprus quoyii)

Supervisors: Martin Whiting; Daniel Noble

The relative dominance status between male reptiles is often determined through contest competition (physical combat). Most research focuses on the morphological traits that may predict contest outcome, such as body size and colour signals. However, increasingly more attention is paid to whole-organism performance (e.g. bite force, sprint speed, running endurance) because performance may be a more suitable measure of fighting ability and a more direct target of selection than morphology. Furthermore, there is currently very little work done the cognitive consequences of being dominant or subordinate. The Eastern Water Skink (*Eulamprus quoyii*) is an excellent system to examine whole-organism performance in the context of male contests and the effects of dominance status on social learning. Males are territorial and show greater performance capacities than females, suggesting that performance may be favoured in contest competition. Additionally, previous research shows that *E. quoyii* are capable of age-dependent social learning. My thesis research will examine two questions, 1) does maximal performance capacities (e.g. bite force, sprint speed, running endurance) predict the probability of winning a contest in male *E. quoyii*? And 2) how does the relative dominance status between two males influence the rate of social learning in *E. quoyii*? To the best of our knowledge, this study will be the first to examine multiple performance measures in the context of contest competition and the effects of relative dominance status on social learning in a lizard. It is important to understand the determinants of contest outcome, in order to make sense of how sexual selection is operating in *E. quoyii*. Moreover, the effects of social factors such as dominance status may have implications on social information transmission in a population due to individual differences in cognitive abilities.

Keywords: lizard, dominance status, contest, performance, social learning

LITTLE, John

Project stage: commencing

An inter-catchment assessment of groundwater ecosystems under irrigated agriculture and pasture (in rural New South Wales and Queensland)

Supervisors: Grant Hose; Kathryn Korbel

Biological communities in groundwater consist of two groups of organisms: the stygofauna, and microorganisms. Stygofauna are obligate groundwater invertebrates, completing their entire lifecycles in subsurface aquatic environments. Alluvial aquifers underlie many river systems and drainage basins in eastern Australia. The supply of organic material, nutrients, and dissolved oxygen to alluvial groundwater ecosystems is dependent on the downward percolation of water through the soil, or the mixing of surface and groundwater flows. The ecology and functional roles of stygofauna are not fully understood. Few studies have been able to identify clear relationships between patterns of stygofauna distribution and variation in water chemistry, which is perhaps because species have narrow distributions, and are biologically adapted to local physiochemical conditions. Groundwater microorganisms are collectively responsible for carbon and element cycling. Aquatic microbial communities are characterised by few abundant and many relatively rare species. Next generation DNA sequencing approaches recover a greater amount of taxonomic information than preceding microbial community profiling methods. The focus this project is an investigation of how biological communities vary in groundwater under irrigated agriculture and relatively undisturbed pasture. The aim is to identify links between stygofaunal and microbial diversity, land-use, and associated environmental correlates in groundwater. Stygofaunal communities will be assessed through comparison of diversity indices. Microbial diversity will be assessed through high-throughput DNA sequencing (HTS) and genetic analysis. Given the power of HTS to recover both abundant and rare subcommunities, large variation in species composition between land-use categories is not expected; however, given potential differences in the carbon and nutrient status of groundwater under pasture versus irrigation, differences in species' relative abundance are anticipated.

MOADELI, Tahereh

Project stage: commencing

Environmentally benign methods for control of tephritid fruit flies (Q-Fly): improved larval diets for Sterile Insect Technique

Supervisors: Phil Taylor; Ian Jamie

Bacterocera tryoni (Diptera: Tephritidae), the Queensland fruit fly or 'Q-fly', is Australia's most economically damaging insect pest of fruit crops. Q-fly is highly polyphagous, attacking more than 150 different fruiting plants, including major commercial crops such as citrus, apples, grapes, cherries and stonefruit. A proposed new program involves greatly increased use of the sterile insect technique (SIT), a chemical-free method for control of Q-fly. In SIT millions of flies are reared, sterilized and then released in the field to mate with wild flies, which leads to sterility in mates. As a consequence, pest population levels are reduced in the next generation. Successful implementation of SIT requires a cost-effective mass-rearing method and production of high-quality flies. Research into larval diets for Q-fly is very limited, and current diets are either overly expensive or insufficiently productive. New larval diets are urgently needed. I will develop new larval diets, especially liquid diets. Compared with solid diets, liquid diets can increase efficiency and cost-effectiveness of mass rearing, decreasing labour costs, space and the need to store diet ingredients. Key quality parameters of flies, including parental egg hatch, larval duration, pupal weight, pupal yield, pupal recovery, sex ratio, adult emergence, egg production and egging latency will be evaluated and compared for a variety of liquid diets, which will be compared with the best available solid diets. Analysis of changes in nutrient state of the larval medium will provide insights to the rate that each diet component is depleted, thereby guiding changes in diet composition.

Keywords: Queensland fruit fly, *Bacterocera tryoni*, , larval diet, sterile insect technique (SIT)

NAIR, Shanta

Project stage: commencing

Epigenetic Regulation of Immune Defenses and Starvation Response in the Mealworm Beetle, Tenebrio molitor

Supervisors: Sham Nair; David Raftos

Previous research has measured immune responses in the mealworm beetle *T. molitor* to starvation, which would create a crisis for resource allocation. Phenoloxidase activity (an innate defence mechanism) showed down-regulation in response to a bacterial challenge following varying durations of starvation (Siva-Jothy & Thompson, 2002). Many insect species display plasticity in their immune responses as a result of previous exposure to a particular pathogen (Sadd et al., 2005; Laughton & Siva-Jothy, 2010). This immune priming has long been considered a result of epigenetic changes to immune response genes, such as methylation (Jones, 2012). This puts studies of epigenetic change in insects at the forefront of research into the newly emerging field of ecological immunity, as it suggests methylation as a mechanism by which such changes can occur (Martin et al., 2011). This study will measure changes in phenoloxidase activity and gene methylation signatures in *T. molitor* following a period of starvation and immune challenge. I propose that methylation signatures in previously starved *T. molitor* individuals will be associated with observed down-regulation of immune response, following resource allocation away from immunity. This will illuminate epigenetic regulation as a mechanism by which transgenerational immune priming occurs in insects, and will further illuminate our understanding of epigenetic regulatory mechanisms with respect to immunoregulatory genomic regions.

O'BRIEN, Richard

Project stage: commencing

Discovering New Variants of an Abiotic Stress Tolerance Gene, RUBISCO activase (RCA), in Species of Nicotiana and Gossypium from the Australian Savannah

Supervisors: Brian Atwell; Andrew Scafaro

Increasing yields for modern agricultural species will require the introgression of genes from wild relatives to accommodate the food demands of growing human populations. Furthermore, the capacity of crop species to tolerate drying climates (i.e. drought and heat) will become increasingly important as climate change tightens its grip. When wild relatives of modern crop species are selected from extreme climatic biomes, they are often a rich source of abiotic stress tolerance genes, including those encoding proteins tolerant to heat. Specifically, this project exploits the observation that wild relatives of rice (*Oryza* sp.) from arid Central Australia have alleles that confer heat tolerance in photosynthetic biochemistry. The aim of this project is to expand this investigation to other Australian desert genera, namely various dicotyledonous species of tobacco and cotton (genus *Nicotiana* and *Gossypium* respectively). The critical gene conferring heat tolerance is Rubisco activase (RCA), a core gene for regeneration of Rubsico during photosynthesis. The analysis of these homologues, with any species-specific variations in sequence, could identify RCA–Rubisco interactions that are more effective as temperatures rise above 32°C. Through RCA sequencing and analysis, gas exchange measurements and specifically, A-C_i curves to assess rubisco efficiency, we hope to identify either new variants of the RCA gene or co-evolution of this gene is wild relatives of rice, tobacco and cotton.

ROY, Anindita

Project stage: commencing

Implications of Sea Level Rise on Critical Migratory Shorebird Habitat in Jervis Bay, NSW.

Supervisors: Linda Beaumont; Ian Goodwin

As a result of climate change sea level is rising (SLR), altering coastal habitats. Globally, a number of coastal regions have been classified as Important Bird Areas (IBA) as they contain favourable environments for feeding, breeding, nesting or stopover sites, supporting a rich diversity of migratory shorebirds and waders. These regions are vulnerable to SLR, and there is already evidence that SLR-driven losses or changes to coastal habitats have impacted avian abundance and distribution. Within Australia, 314 IBAs have been declared, one of which is located at Jervis Bay, NSW. This area contains saltmarshes, mangroves and fringe forests that support a variety of resident and migratory birds. Previous studies of the Jervis Bay coastal area have revealed that over the last five decades climate and human impacts have resulted in habitat changes. Continuation of this process due to climate change or SLR may lead to declines in migratory shorebirds in the future. Using advanced simulations of SLR across the Jervis Bay area and GIS modelling tools this study will assess a) potential habitat changes (loss or gain) under different SLR scenarios and b) the implications of these changes for migratory shorebirds and waders.

Keywords: sea level rise, Jervis Bay, IBA, Shorebirds, GIS modelling tools

SCHILLER, Sabine Eva

Project stage: commencing

Are captive grey-headed flying foxes (Pteropus poliocephalus) at greater risk of infection with human-borne pathogens?

Supervisors: Michelle Power

Habitat loss has resulted in increasing numbers of endangered grey-headed flying fox populations seeking shelter in highly populated urban centres. Ecological changes are known to drive altered host-parasite interactions and may consequently result in the emergence of infectious diseases. Flying foxes in particular are known vectors for a wide variety of zoonotic pathogens and increased contact rates with humans might therefore increase the potential for spillover events. The process of reverse zooanthroponosis, whereby human-borne pathogens spillover into wildlife populations has not been investigated in bats and we therefore aim to identify the potential presence of human-borne parasites in wild and captive *Pteropus poliocephalus* populations.

The protozoan parasites *Cryptosporidium* and *Giardia* spp. are capable of infecting humans and a wide variety of animals and are therefore of clinical importance. These parasites are primarily transmitted via contaminated water and through the faecal-oral route, resulting in enteric illness. We hypothesise that captive populations of grey-headed flying foxes are at increased risk of infection with human species of *Cryptosporidium* and *Giardia* spp. as a result of lowered immune function, handling and close contact with humans, when compared to wild populations. We aim to screen faecal samples from captive and wild grey-headed flying fox populations, in order to investigate the prevalence and origin of *Cryptosporidium* and *Giardia* spp. within these populations. Molecular techniques will be employed to identify *Cryptosporidium* and *Giardia* species and strains, allowing for identification of potential transmission sources, including those of human origin.

Keywords: reverse zooanthroponosis, Grey-headed flying foxes, *Cryptosporidium*, *Giardia*, spillover

SELF, Rachel

Project stage: commencing

Developing Botrytis cinerea as a potent non-GM enzyme producer for the removal of haze-forming proteins under normal winemaking conditions

Supervisors: Michael Gillings; Steven Van Sluyter; Junior Te'o

Improvement in winemaking processes has long been a focus of research efforts to increase the efficiency and economy of the industry. Key processes include alternative methods of fining and heat stabilizing the wine. Wine haze is caused by the aggregation of grape proteins following heating, usually during transport and storage, making the wine unappealing to consumers. Fining with bentonite clay has long been the most common method of heat stabilizing wine. However, this process is less than ideal as bentonite fining can remove desirable compounds from wine and also creates environmental waste. Additionally, 3 to 10% of the total wine volume is sequestered in the bentonite lees, requiring rotary drum filtration to remove residual wine which will be of greatly reduced quality and value.

Microbial enzymes have been the recent focus of advancement in this area, with many showing promise as a feasible alternative to bentonite. Unfortunately these enzymes generally require heat treatment to activate the enzyme and denature the haze-forming proteins, a process which is thought to damage the wine sensory properties. Recently, proteases from the fungus *Botrytis cinerea* have been studied for their effect on wine haze-forming proteins, namely chitinases and thaumatin-like proteins (TLPs) under normal winemaking conditions. The most abundantly secreted protease from *B. cinerea* was characterized and expressed by inserting the desired gene into *Pichia pastoris*. Removal of chitinases, the most common cause of wine-haze, was observed as well as a reduction in TLPs. In order to utilise this method for commercial winemaking, this project will focus on screening a number of wild-type strains of *B. cinerea* that have the greatest natural secretion of desired enzymes.

Keywords: *Botrytis cinerea*, winemaking, enzymes, heat stabilisation, wine haze

TABASSUM, Samiya

Project stage: completing

Competitive interactions between invasive and native species from a low nutrient environment

Supervisors: Michelle Leishman

Invasive species constitute a major threat to biodiversity globally and in Australia. Numerous studies have found a link between successful invasion and high resource availability. Invasiveness has often been attributed to traits, such as high photosynthetic rate and low tissue construction costs, that allow plants to exploit additional resources. However, little is known about how nutrient availability affects competitive interactions between invasive and native species. Hawkesbury Sandstone vegetation of the Sydney region provides an excellent opportunity to study the effect of nutrient availability on competitive interactions between native and invasive species due to the low nutrient content, particularly phosphorus, of Hawkesbury Sandstone-derived soils. We investigated the effect of nutrient addition on competitive interactions between functionally similar native and invasive species from Hawkesbury Sandstone-derived soil by growing them in the glasshouse, using a standard competition design. The general questions addressed were: (1) Does nutrient availability mediate competitive interactions between invasive and native species from low nutrient Hawkesbury Sandstone-derived soil? (2) Which plant functional traits are driving these changes in competitive ability? We predicted that under low nutrient conditions native species would be competitively superior due to their resource conservation traits while under high nutrient conditions invasive species would be competitively superior due to their resource exploitative traits. Understanding mechanisms of invasive species success under varying environmental conditions is essential to improve management and improve biodiversity outcomes.

Keywords: plant invasion, competition, nutrients, functional traits

THOMPSON, Jessica

Project stage: commencing

Gene flow between farmed and wild populations of Sydney rock oysters

Supervisors: David Raftos; Adam Stow

Oysters are globally important organisms that are keystone species in their coastal ecosystems. However since the expansion of human activity, over 85% of natural oyster reefs have been lost worldwide. This deterioration is due to the selective harvesting of large individuals and degradation of water quality. As a result, many remnant wild oyster populations have reduced growth rates, decreased resilience to environmental stress and are more susceptible to disease. The New South Wales oyster industry has successfully overcome this issue through managed aquaculture of Sydney rock oysters (*Saccostrea glomerata*). This aquaculture industry now relies on a selective breeding program which has mass selected oysters for faster growth rates, disease resistance and tolerance to environmental stress.

These selectively-bred oysters are currently farmed throughout New South Wales and Queensland, where they often co-exist with wild *S. glomerata* populations. As this species reproduces using the non-selective strategy of broadcast spawning, this coexistence provides the opportunity for interbreeding between wild and farmed populations. Although there is the potential to improve the genetic variability of wild *S. glomerata* populations through the transfer of desirable genes from selectively bred individuals into the wild population, the existence or extent of any gene flow is presently unknown. In the current study, we will determine whether any gene flow is occurring between farmed and wild *S. glomerata* populations using genetic markers that are commonly found in selectively-bred individuals. Markers will be identified using a next generation sequencing approach. If beneficial gene flow does exist between populations, it could be managed in order to future-proof wild *S. glomerata* populations and the ecosystems they support.

Keywords: S*accostrea glomerata;* aquaculture; selective breeding; gene flow

TOSETTO, Louise

Project stage: commencing

Microplastics in the marine environment: Understanding impacts on marine biota and potential for trophic transfer

Supervisors: Jane Williamson; Culum Brown

Microplastics have gained attention in recent times due to their dispersal across marine and coastal environments worldwide. Such widespread distribution exposes a broad range of organisms across the food chain, and presents a complex risk to individuals, populations and communities. Despite an increasing body of research into microplastics in the marine environment, our understanding of plastic pollution at the population and community scale is still limited. Very few studies have explored impacts on survival, growth and behaviour of organisms that ingest microplastics. Furthermore, our understanding surrounding the trophic transfer of associated microplastic contaminants and the resultant effects on the food web remain largely unknown.

My research assesses the impacts of microplastics on the ecology of marine biota and the potential for trophic transfer using sandy coastal ecosystems as a model system. I am examining the impacts of microplastics on survival and key behaviours of beachhoppers, primary consumers that live in and around sediment. Moreover, I am evaluating the impact of trophic transfer of microplastics by feeding contaminated beachhoppers to sand gobies, ray finned fish that are natural predators. I will then assess any effects of microplastics on goby behaviour, specifically examining changes in the shyness-boldness continuum and spatial learning. Understanding biological effects and the potential for microplastic pollutants to transfer through the food web has implications not only for the marine ecosystem, but also for human health and wellbeing.

Keywords: microplastic, pollutants, marine, behaviour, trophic transfer

VECSEI, Michelle

Project stage: commencing

Investigating song learning in juvenile regent honeyeaters at Taronga Zoo

Supervisors: K-Lynn Smith

The majority of oscine passerines, or 'songbirds', develop their songs through learned processes. Generally, there are three forms of song learning: 1. Imitation; where a bird attempts to copy a model, 2. Innovation; where a bird copies a model but adds unique elements, and 3. Improvisation; where an entirely new song is produced based on multiple models. Models were traditionally believed to include mainly parents, however evidence suggests songbirds may also learn from a variety of conspecifics including siblings and neighbouring adults. While most of the research in vocal learning has focused on North American and European species, Australian songbirds generally have not been well studied. For many of these Australian species much is unknown regarding song learning, including which population members are chosen as song learning models. The current study will explore song learning in a captive population of juvenile regent honeyeaters, *Anthochaera phrygia*, at Taronga Zoo. Specifically we will compare the similarity of juvenile songs to the songs of other population members to discover which models they may copy and which learning strategy they use. Additionally, we will investigate whether juvenile regent honeyeaters can learn from a broadcasted live tutor compared to direct interaction with other birds. This work will not only be the first to investigate vocal learning in regent honeyeaters, it will be the first to explore this topic involving any honeyeater (meliphagidae) as this group has been neglected in song learning research. Furthermore, this work will add to the limited behavioural knowledge of regent honeyeaters, assisting in the conservation of this critically endangered species.

Keywords: song learning, regent honeyeater, vocal