Masters of Research

Annual M2 Introductory Seminars

Monday 14th March, 2016

Biology Tea Room E8A 280

Sylvia Earle – regarded as the world's first female oceanographer, Sylvia Earle is a marine biologist, explorer, author and lecturer. She was the first female chief scientist of the US National Oceanic and Atmospheric Administration, was named Time Magazine's first Hero for the Planet in 1998, and is an inspiring woman of science. She is wonderful!

SCHEDULE

Time	Student	Supervisor
9:15	Samuel O'Neill	Jane Williamson & Culum Brown
9:30	Julianna Kadar	Culum Brown
9:45	Ciaran Mathewson	Glenn Brock
10:00	Liana Wait	Michelle Power
10:15	Timothy Maher	Ian Wright
10:30 10:45	Morning Tea (10:30 – 11:00)	
11:00	Sally Dupont	Rob Harcourt
11:15	Anthony Corrigan	David Nipperess
11:30	Kelly-Anne Lynch	Grant Hose
11:45	Mareshell Wauchope	Linda Beaumont
12:00	Michelle Demers	Brian Atwell
12:15	Nicholas Powell	Michael Gillings
12:30 12:45 13:00 13:15	Lunch (12:30 – 1:30)	
13:30	Samantha Lynch	Nathan Hart
13:45	Nicole O'Donnell	Mariella Herberstein
14:00	Grant Webster	Martin Whiting

*Talks are 15 minutes each (12 min and 3 min for questions

ABSTRACTS

CORRIGAN, Anthony (Tony)

Fauna community responses to pyrodiversity in montane forest systems in the northern Australian Alps.

Supervisors: David Nipperess; Julian, Seddon

The impact of fire on fauna species in ecological communities has been the subject of a large body of work recent decades. The integration of this knowledge into land management planning processes has been advocated by a number of authors, yet the conservation needs of native fauna are not explicitly considered in fire management planning in some jurisdictions.

Data describing the fire responses of individual species is now widely available, however little research has focussed on the impact of fire on the ecological integrity of fauna assemblages. Faunal assemblage metrics such as phylogenetic diversity can provide information for analysis of the relative resilience of such communities to further disturbance.

The subjects of this study, Namadgi National Park (NNP) and Tidbinbilla Nature Reserve (TNR) in the ACT are the northernmost national parks of the Australian Alps National Parks system. In 2003, wildfire impacted both these parks significantly, burning approximately 90% of the area of NNP and TNR entirely.

Using a space-for-time approach, this study intends to examine the current state of wet forest communities in NNP and TNR with reference to two fire variables, 2003 fire severity and fire frequency over the past 100 years. Faunal habitat data including vegetation structure will be collected from 30 plots stratified by landscape and vegetation community. Arrays of both active and passive camera traps will be placed at each plot to survey mammal species, while bird species data will be collected using standard observational techniques. These data will then be used to develop models examining the relationships between fire variables and metrics describing phylogenetic diversity, functional redundancy and ecosystem function amongst the target faunal assemblages.

DEMERS, Michelle

A reverse genetics approach to low oxygen tolerance in Arabidopsis

Supervisors: Brian, Atwell: Wright, Ian

Flooding is a major abiotic stress for crops worldwide as it creates an anoxic environment; by restricting the access of plants to oxygen and thus the synthesis of ATP by oxidative phosphorylation, normal cell growth and function is restricted. Eventually the vacuolar membrane will depolarize, causing ionic imbalance in the cytoplasm, potassium loss and cell death. A gene in rice encoding for a vacuolar H+ pyrophosphatase (V-PPiase) proton pump has been found to confer dramatically improved tolerance for anoxia because it uses an alternative energy source (PPi) to keep the vacuolar membrane polarized even when ATP-driven pumps have failed. This is because PPi remains available when ATP supplies are critically low. A V-PPiase ortholog has been found in *Arabidopsis*, a model plant which is naturally intolerant to anoxia. The aim is to determine whether *Arabidopsis* plants overexpressing this gene have an altered phenotype in anoxia compared with wild-type plants. This will be determined by placing three-week old vegetative plants in various hypoxic and anoxic treatments over different time courses to determine phenotype (e.g. survival, growth and solute leakage). Western blots and qPCR will be used to analyze protein presence and transcription levels, respectively. Understanding this gene and its effect on related energy pathways using *Arabidopsis* is critical to the understanding of anoxia stress tolerance in all plants.

Keywords: (note: provide up to 5 key words or phrases)

DUPONT, Sally

Aerial Surveys: the effect of aircraft speed and environmental drivers on abundance counts of marine wildlife.

Supervisors: Rob Harcourt, Lisa-Marie Harrison, Vic Peddemores

Aerial surveys are a common tool used to monitor animal population and behaviour in both terrestrial and marine settings. By using aircrafts (mostly light planes or helicopters) instead of other platforms, this method has the advantage of being faster, able to access remote locations and cover a wide area. However, marine aerial surveys face two major problems. Firstly, the animals of interest spend the majority of their time below the surface where they cannot be seen by observers. Secondly, observers can sometimes miss animals that are visible. A possible solution to both these problems is to reduce the speed of the aircraft. This would potentially increase the likelihood of an animal being seen by giving the observer more time to sight the animal. It would also give animals more time to surface. As such, in this study we aim to investigate whether observers are able to sight a greater number of marine animals travelling at 80 knots compared to the speed of 100 knots currently used in most aerial surveys. The results will be vital in determining whether speed or observer training and experience has the biggest impact on both the number and type of animals seen. Secondly, marine animals are known to congregate in certain coastal areas, with their abundance fluctuating both seasonally and annually. What is the relationship between abundance counts and environmental factors? We also aim to explore any potential correlation with environmental drivers such as sea surface temperature and chlorophyll A using data collected from IMOS.

Keywords: aerial survey, speed, marine wildlife abundance, environmental drivers

KADAR, Julianna Piroska

Discovering behaviours in captive Port Jackson sharks using accelerometers

Supervisors: Culum Brown, Monique Ladds

Uncovering how animals utilise their time in the wild is vital to understanding their ecology. Continuous tracking and observation in a marine environment is not feasible, but telemetry devices provide an opportunity for fine scale analysis of movement and behaviour. We used accelerometers to investigate activity patterns and behaviours of the Port Jackson shark (*Heterodontus portusjacksoni*) with the aim of building a model from captive sharks that can be applied to wild populations. We established a novel, non-invasive attachment method to provide maximum accelerometer stability on the dorsal fin of the shark and minimum irritation to the dorsal area. We developed techniques to identify behaviours from two types of accelerometers, one of high and one of low resolution. To validate the accelerometer data, we identified shark behaviours from multi-angle, high definition video (GoPro Hero4) that was time matched to both types of accelerometer data. The lower resolution type of accelerometer (Vemco V13AP) was used to identify bouts of resting and activity. The high-resolution accelerometer (Cefas G6a+) data was used to train a machine learning algorithm to recognise six behaviours: resting, resting in a group of conspecifics, transitioning from resting to swimming, swimming, and foraging. We used frequency counts and odds ratios to evaluate the ability of the low-resolution accelerometer to predict the two behavioural states. Through evaluating the ability of two types of accelerometers to identify captive shark behaviour, we are validating methods for long-term (low res - looking for trends) and short-term (high res - detailed behaviours) monitoring of wild shark populations.

LYNCH, Kelly-Anne

Responses of periphyton to current velocities in the Nepean River, NSW

Supervisors: Grant Hose; Helen Keenan (DPI Water); Simon Mitrovic (DPI Water)

Warragamba Dam regulates and reduces natural flow in the Hawkesbury-Nepean River. River regulation impacts water quality, bethic algal assemlages and macrophyte growth. The benefits of variable environmental flow from Warragamba Dam are being investigated by the NSW Government and it is theorised that flows may scour periphyton, reduce filamentous algae and stimulate algal succession, thus improving macroinvertebrate diversity. This study will assist water managers to understand the flow required to reduce nuisance filamentous algal growths and stimulate the succession of algae more palatable to macroinvertebrate grazers. In turn, this will benefit riverine ecology more holistically and improve river condition for human uses. A preliminary study of two cobble-dominated riffle sites in the Nepean River has shown similarities in the two sites in community structure in comparison to a riffle in the unregulated Grose River. Algal community structure in the Nepean River at Penrith was dominated by cyanobacteria (*Leptolyngbya* and *Heteroleibleinia*) and diatom (*Navicula* and *Cyclotella*) genera. The downstream site at Yarramundi with higher nutrient levels, had a greater overall abundance of periphyton with higher proportions of filamentous green algae (*Stigeoclonium*) and charophyte (*Coleochaete*). The cobble dominated riffle in the Nepean River at Penrith was selected for further study as it is representative of many sites in the Nepean River and has multiple velocity zones within the riffle. Analysis indicates periphyton communities are velocity-dependent and distinct zones have been identified. Low velocities are higher in abundance with green algae. Increasing velocity reduces overall abundance, and cyanobacteria and diatoms become increasingly dominant.

Keywords: periphyton, diatoms, cyanobacteria, Nepean River, velocity

LYNCH, Samantha

Predictive models for shark attacks in Australian waters based on environmental factors.

Supervisors: Nathan Hart, Robert Harcourt, Vic Peddemors (NSW DPI), David Slip
   (Taronga Zoo /Australian Shark Attack File)

Shark attacks, although infrequent, have increased over the last twenty years, relative to the long-term average, both internationally and within Australia. The reason(s) for this increase are unknown and, therefore, highlight the need for further research into the biological and ecological factors that influence shark movements and behaviours. In this study, we will: 1) review the patterns of shark attacks in Australia; 2) look to identify correlations between environmental variables (e.g. sea surface temperature, water-depth, chlorophyll-a levels, currents, etc.) and the incidence of shark attacks, with a particular focus on climatic anomalies, that have explain shark attack 'clusters'; and 3) build a predictive model based on any identified environmental-factors that can be used to forecast shark movements and assess the relative risk of shark attacks. This is the first large-scale correlative study of its kind to be undertaken and, therefore, is an important and necessary step in understanding interactions between sharks and humans. Shark attack data will be sourced from Taronga Zoo's, Australian-Shark-Attack-File, and the environmental data sourced from the Integrated Marine Observing System. The collated shark attack and environmental data will be analysed statistically, with the use of multiple ordination and mixed models, through the statistical software program R(R-studio). Potential outcomes of this study include: the provision of new insight into large-scale environmental-factors influencing shark movement patterns, and the ability to predict the likelihood of shark attacks, based on current and/or future environmental conditions, thus aiding in reducing the risk of shark attacks on humans in Australian waters.

Keywords: (Shark attacks, clusters, correlating environmental-factors, shark and human interactions, ASAF)

MAHER, Tim

Comparison of heat-shock proteins in seedlings from different natural populations of E. grandis in response to heatwave conditions

Supervisors: Ian Wright

Heatwaves are a common summertime phenomenon in Australia and the frequency and severity of such events is expected to increase under climate change. Extreme heatwaves can adversely affect how organisms function, especially plants which are unable to relocate and do not possess efficient cooling mechanisms. Seedlings are most vulnerable and such events may wipe out whole seedling cohorts, thereby affecting future population demographics. Most at risk are slow maturing trees like Eucalypts that have a long generation turnover (up to 30 years) meaning their seedlings may become increasingly poorly adapted to new heat conditions under climate change. Because of this, the expression of molecules such as heat shock proteins (hsps) which help maintain normal cell functioning under such extreme conditions are vital ecological traits in these species. A major unknown is how hsps are expressed in response to different heat intensities to confer heat resistance in Eucalypts. Furthermore, how much variation exists in hsp molecules and their amounts in response to heatwaves between Eucalypt populations? My project will address each of these outstanding questions through heat manipulation experiments on *Eucalyptus grandis* and using a proteomics approach.

Keywords:

MATHEWSON, Ciaran

Biostratigraphy and Chemostratigraphy of the Lower Normanville Group, South Australia

Supervisors: Brock, Glenn

The Cambrian period contains the most important surge of biological diversification throughout history, the Cambrian radiation. Although a biostratigraphic scheme of Cambrian time is developing on a global scale, there are still gaps on a regional (basinal) scale. There are four subdivisions of the early Cambrian, although a regional classification in Australia is essentially a blank canvas as very little biostratigraphic work has been conducted. Recently, Betts et al. (in review; in prep) introduced a new multi-proxy chronostratigraphic scheme for the Arrowie Basin (Flinders Ranges) in South Australia. This approach utilised both bio- and chemostratigraphic data, providing independent techniques to refine the Cambrian timescale. The studies further discovered that new shelly fossil biozones were closely aligned with a significant **negative** δ^{13}C (carbon-13 isotope) excursion identified as the "SHICE" negative. The authors predicted that an older succession of rocks in the neighbouring Stansbury Basin should align with a significant **positive** excursion known as the "ZHUCE" positive.

This project will utilise a similar multi-proxy approach on the Stansbury Basin succession, measuring a 500 m stratigraphic section through the Wangkonda Formation and overlying Sellick Hill Formation. The resulting samples will be processed for biostratigraphic shelly fossil range data, and isotope data in the form of a synchronous chronostratigraphic curve. The project aims to test the prediction of the ZHUCE positive shift within the Stansbury Basin, to then answer whether the global Cambrian chemostratigraphic curve is valid for the region. It will provide further data to refine the lower Cambrian subdivisions in South Australia.

Keywords: Cambrian, chronostratigraphy, biostratigraphy, chemostratigraphy, δ^{13}C

O'DONNELL, Nicole

What is relationship between diet, ageing and longevity: a case study using the orb-web spider Argiope keyserlingi

Supervisor: HERBERSTEIN, Mariella

The macronutrient composition of diets can vary in nature and affect the ageing and longevity of animals. This relationship is most prominent in model species, such as zebra fish, rats, mice, fruit flies *(Drosophila melanogaster)* and the nematode worm (*C. elegans*). This pattern suggests that the observed relationship between diet, ageing and longevity may be a product of laboratory cultures, where populations are raised for generations, free from diseases, predators and parasites. Wild populations of animals, on the other hand, are less likely to show relationship between diet, ageing and longevity. Here, I aim to determine whether the macronutrient content affects the ageing and longevity of a wild population of spiders: the web building spider, *Argiope keyserlingi.* Adult female spiders will be maintained on a diet (*Drosophila melanogaster*) containing differing amounts of protein, (low protein 0.56% or high protein 2.67%). Based on previous studies, I predict that spiders on a low protein treatment will increase their longevity, but decrease their rate of ageing compared to spiders on the high protein treatment. On a weekly basis, I will measure spider performance, as a proxy for aging, such as running speed, spider weight and web size. Spider longevity will be recorded as to the number of days they were alive as adults. The experiment will demonstrate if there is a relationship between diet, ageing and longevity in a wild population.

O'Neill, Samuel

Testing the link between personality traits and cognitive styles in fish

Supervisors:　　　Williamson, Jane; Brown, Culum

Although research into animal personality has implications for theoretical and practical science, as well as conservation and management, research has only begun to boom in popularity over the last few decades. There are many areas of personality research where we lack a clear understanding and, lately, research has shifted to focus onto the relationships between personality, behaviour, and other phenotypic traits. It has been theorised that there might be an interaction between personality, cognitive/coping styles and learning. It has been hypothesised that bold/exploratory fish engage with learning tasks faster and will therefore complete learning tasks quickly, but that shy fish may pay more attention and therefore learn quickly once they are engaged, and be far more likely to learn changes in environment. We aim to explore the relationship between personality traits and performance across different learning tasks. Using behavioural tests, we will place individual fish along bold-shy, exploration, sociability and activity personality axes. We will then test fish across four simple learning tasks. First, a stimulus will be associated with feeding in a specific corner of the tank. Second, the feeding location will be moved. Third, the stimulus will be unpaired from any reward. Fourth, we performed a social learning task. In these tests we will record the number of trials taken and the total time taken to sufficiently learn, relearn, or unlearn the task. These test will allow us to investigate 1) personality traits, 2) the relationship between personality traits (syndromes) and 3) relationships between personality traits/syndromes and performance across different types of learning tasks.

Keywords:　　Behaviour, syndromes, cognitive styles, personality, learning

POWELL, Nicholas

Induction of the SOS response by sub-inhibitory concentrations of silver nanoparticles.

Supervisor: Michael Gillings

Our ability to control bacterial infections is being jeopardised by the onset of the "post-antibiotic era". There is a pressing need to develop new antimicrobial agents to replace older antibiotics. Of recently developed antimicrobials, silver nanoparticles may be the most promising for infection control. Silver nanoparticles are being used in hospitals to keep equipment and wounds sterile. They are also being used in a number of consumer products, such as tooth brushes and counter tops, which have no need to be "germ-free". This misuse of silver nanoparticles will inevitably lead to pollution, releasing nanoparticles into the environment. Such pollution may facilitate the generation and spread of resistance. Where the environment contains sub-inhibitory concentrations of silver nanoparticles, bacteria may trigger the SOS response. The SOS response induces error-prone DNA replication, thus increasing the numbers of mutations, some of which may confer resistance. In this project, I will expose three bacterial species to low concentrations of silver nanoparticles in an experimental evolution trial. Two strains of each species will be tested; a near-wild-type strain, and a RecA mutant strain that cannot mount the SOS response. All six strains will be grown for 25 generations on agar plates containing sub-inhibitory concentrations of silver nanoparticles. Genetic and phenotypic changes will then be analysed, and compared between strains, and with control lines. This research will examine the potential for three species of medical importance to generate resistance to silver, will determine the role that the SOS response might have, and with downstream genome sequencing, will identify the modes and targets of mutational change.

WAIT, Liana

Parasite diversity in the Tasmanian devil in the context of a conservation management program

Supervisors: Michelle, Power

Conservation management may impact host-parasite interactions and increase disease risk for the host. The Tasmanian devil is an endangered carnivorous marsupial that is currently subject to conservation management due to a lethal transmissible tumour – devil facial tumour disease (DFTD). This study aimed to investigate the impact of conservation management on parasite ecology in the Tasmanian devil by comparing the prevalence and diversity of gastrointestinal parasites in different populations of devils. A total of 191 faecal samples were collected opportunistically from 167 devils in four different population types: intensively managed captive populations, free-range captive populations, and wild populations, and fourth population consisting of captive devils that were vaccinated against DFTD and released into the wild. Samples were screened using zinc sulphate faecal flotation and microscopy for helminth eggs, protozoal cysts and oocysts to estimate the overall diversity of parasites in each sample. Samples were further screened using molecular methods to look specifically at the diversity of *Cryptosporidium*, a protozoan parasite. Overall, 17.4% of devils were positive for *Cryptosporidium*, and preliminary sequence analysis indicates that the devils are harbouring a novel and probably host-specific genotype of *Cryptosporidium*. The overarching question investigated by this study was: Are different species of parasite found at different densities in captive-bred populations of devils compared with free-range and wild populations? The results provide baseline data on parasite ecology in the Tasmanian devil and are the starting point for a risk analysis of devil conservation management in terms of changing host-parasite relationships and the potential for emergent disease.

Keywords: Tasmanian devil, conservation management, parasite diversity, Cryptosporidium

Describing the species within the Australian frog Pseudophryne bibroni.

Supervisors: Martin Whiting

Compared to other vertebrate groups the taxonomy of Australian frogs is relatively poorly understood. Several new species have been discovered in the past decade and many other species have recently been identified using genetic techniques. The Myobatrachid genus *Pseudophryne* occurs across southern Australia and comprises a number of similar species and species complexes. Frogs of this genus are conservative in their morphology, advertisement call and breeding habits making reliable identification difficult. The species *Pseudophryne bibroni* has long been a source of confusion for herpetologists and it is recognised to be a complex of undescribed frog species across New South Wales, Victoria and South Australia. In New South Wales, *P. bibroni* is found along the coast and ranges with a disjunct population in the south-west. Previous research has identified four distinct taxonomic groups under the name of *P. bibroni* in New South Wales, which can be readily distinguished by appearance and habitat. The aim of this project is to compare and describe the four *P. bibroni* groups in New South Wales as distinct species. This will be done by investigating differences in morphology, habitat, call and breeding habits between the groups. *P. bibroni* is also recognised to have declined over much of its range and a conservation assessment of the groups will also form part of the study.

Keywords: (note: provide up to 5 key words or phrases)