THE UNIVERSITY OF WESTERN AUSTRALIA

Student Research Projects 2019/2020

School of Biological Sciences

WELCOME

As biologists, we are passionate about how living organisms – plants and animals – live, work, sense the world around them, communicate, reproduce, and can be managed, conserved and restored in threatened environments, as well as how they provide clues to advance medical science and treatment. We are also committed to the communication of science to the public and external stakeholders.

Our researchers tackle grand challenges in the laboratory and at field sites across the globe, studying plants and animals in natural as well as managed environments, including below and on the ground and in the air as well as in fresh and marine waters. We use a wide range of techniques spanning scales from molecular and genetic to individuals as well as to populations and higher order ecosystems.

Ecology & Conservation

We research how animals and plants interact with other species and with their physical environment. This fundamental ecological understanding is required to conserve endangered species and protect their habitats with effective, evidence-based methods. Our research takes us to habitats from suburban backyards to deserts and the depths of the sea.

Evolutionary Biology

Our research explores evolutionary responses to selection at the phenotypic and genomic level, with the broad aim of discovering how organisms adapt to their changing environment. CEB takes a multidisciplinary approach to explore selective processes acting on the morphological and life-history traits of whole organisms and their gametes. We have particular expertise in acoustic signalling, predator-prey interactions, visual ecology, sperm competition, chemical ecology, and the genetic mapping of complex traits.

Science Communication

Science communicators bridge the gap between those researching and working in Science Technology Engineering and Maths (STEM) and the public. Science communicators work with researchers, scientists, technologists, engineers, mathematicians, medical professionals, business and industry, policy-makers and members of the public to engage different communities in discussion about important scientific issues, to enhance understanding and help us all make better decisions about our future priorities

Neuroscience and Neuroecology

Comparative neurobiology and neuroecology aims to decipher how different species perceive and process sensory input from the natural world, under different environmental conditions. Our high quality research attracts the next generation of young scientists interested in animal behaviour, sensory processing and the conservation of biodiversity.

Computational Biology

We address fundamental and applied questions in biology using methods and tools from mathematics, statistics and computer science. Using methods such as computational simulation modelling, bioinformatics and big data algorithms we investigate a range of issues including the evolution of resistance to biocides in weeds, coral and seagrass growth patterns and the maintenance of diversity in ecological communities.

Many projects are available across more than one Honours/Masters Stream/Specialisation. Students are encouraged to contact prospective supervisors directly to discuss the project and find out about additional projects not currently listed in this booklet.

Meet our Teaching and Learning Team

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SUPERVISORS	TOPIC	LEVEL
Prof Jacqui Batley jacqueline.batley@uwa.edu.au	**Evolution of disease resistance genes** Plant disease resistance genes play a critical role in providing resistance against pathogens. The largest families of resistance genes are the nucleotide binding site and leucine rich repeat genes (NBS-LRRs) and receptor like proteins (RLPs). Hundreds of these genes are present within the genome, however the evolutionary history of these genes is not fully understood. Genome wide identification of these genes within and between species allows a study of which genes are core to a species or family and which have variable roles. This project aims to identify all these genes within Brassica species and wild relative species, perform comparative analysis within and between the species and provide an understanding of the evolution of these genes	**Honours** **Masters** **PhD**
Prof Jacqui Batley jacqueline.batley@uwa.edu.au	**Association and localization of NBS-LRR genes with disease resistance QTL** Plant NBS-LRR (Nucleotide Binding Site-Leucine Rich Repeats) genes are important genetic components of the resistance defence mechanisms. The association and co-localization of NBS-LRRs and disease resistance QTL is a common feature of plant genomes. This project will review and assess the correlation between disease resistance QTL intervals and NBS-LRR resistance genes in Brassica napus. QTL intervals for resistance to clubroot, downy mildew and blackleg disease in B. napus will be identified and classified. Results will provide evidence on NBS-LRR distribution and clustering throughout the genome and determine if the clusters tend to be more linked and associated with disease resistance QTL. Further investigation of the similarity/divergence in sequence and gene content of these QTLs will help elucidate their conservation and evolution	**Honours** **Masters** **PhD**
Prof Jacqui Batley jacqueline.batley@uwa.edu.au	**Genomics of Plant pathogen interactions** Research on the interactions between plants and pathogens has become one of the most rapidly moving fields in the plant sciences, findings of which have contributed to the development of new strategies and technologies for crop protection. A good example of plant and pathogen evolution is the gene-for-gene interaction between the fungal pathogen Leptosphaeria maculans, causal agent of Blackleg disease, and Brassica crops (canola, mustard, cabbage, cauliflower, broccoli, Brussels sprouts). The newly available genome sequences for Brassica spp. and L. maculans provide the resources to study the co-evolution of this plant and pathogen. The aim of this project is to use next generation sequencing technologies to characterise the diversity and evolution of these genes in different wild and cultivated Brassica species. This will involve phenotypic analysis of the disease in a variety of cultivars and species and association genetics to link to the phenotype	**Honours** **Masters** **PhD**
Dr Bruno Buzatto, bruno.buzatto@uwa.edu.au **A/Prof Joseph Tomkins** joseph.tomkins@uwa.edu.au	**Male dimorphism and sexual conflict** Male dimorphism usually reflects alternative reproductive tactics among males: the large male morphs typically guard females or reproductive territories and have more elaborate weaponry; the small male morphs sneak copulations and have reduced weaponry. In the bulb mite *Rhizoglyphus echinopus* , fighters have a thick and sharp pair of legs and kill rival males, whereas scramblers search for unguarded females. We have colonies of bulb mites in the lab that have been under artificial selection on the thickness of fighter legs for several generations. The aim of this honours project will be to assess whether selection for thicker legs in fighters generated any response in females. If so, then a sexual conflict should arise and constrain the evolution of sexual dimorphism and male dimorphism, which would be a very significant finding in evolutionary biology. The work will involve manipulating mites under the microscope and measuring their legs with image software.	**Honours**
Dr Bruno Buzatto, bruno.buzatto@uwa.edu.au **A/Prof Joseph Tomkins** joseph.tomkins@uwa.edu.au	**Selection for larger weapons and fight performance** Male dimorphism usually reflects alternative reproductive tactics among males: the large male morphs typically guard females or reproductive territories and have more elaborate weaponry; the small male morphs sneak copulations and have reduced weaponry. In the bulb mite *Rhizoglyphus echinopus* , fighters have a thick and sharp pair of legs and kill rival males, whereas scramblers search for unguarded females. We have colonies of bulb mites in the lab that have been under artificial selection on the thickness of fighter legs for several generations. The aim of this project will be to assess whether selection for thicker legs in fighters generated coevolutionary responses in fighting performance. If so, we will have gathered the first direct evidence for the positive effect of thick legs in winning fights in mites! The work will involve setting up and observing male-male fights bewteen mites under the microscope and measuring their legs with image software.	**Honours** **Masters**

Karen Bell karen.bell@csiro.au karen.bell@uwa.edu.au	**Detecting the floral fingerprint of biocultural dispersal** Ancient anthropogenic influences are often not well considered in studies on biogeography and community ecology, yet ancient dispersal events may well have left a significant and detectable influence on present day community assemblages. This project will examine potential ancient human-mediated species dispersal into and around northern Australia.	**Masters** **PhD**
Karen Bell karen.bell@csiro.au karen.bell@uwa.edu.au	**Tracing the introduction history of invasive plants.** The movement of plant species from one place to another is a significant anthropogenic impact. Following introduction to a new location, plant species can become invasive, threatening the environment, agricultural productivity, and access to Indigenous cultural sites. Understanding the dispersal pathways that have led to the introduction of invasive species can allow for better management, as well as preventing future invasions. This project will use evolutionary genetics and phylogeography to determine geographic origin and introduction pathways for invasive plants in Australia.	**Honours** **Masters** **PhD**
Karen Bell karen.bell@csiro.au karen.bell@uwa.edu.au	**Using DNA metabarcoding to detect plant-pollinator interactions.** Pollination is an essential ecosystem service but can be difficult to directly observe. New methods using DNA metabarcoding may help to determine which plants are being visited by which pollinator. This project will use a combination of traditional field observations, microscopic analysis of pollen, and DNA metabarcoding of pollen, to detect plant-pollinator interactions.	**Honours** **Masters** **PhD**
Dr Cecile Dang cecile.dang@dpird.wa.gov.au **Prof Jacqui Batley** Jacqueline.batley@uwa.edu.au	**Investigation of microorganisms associated with health issues in pearl oysters Pinctada maxima from northern Australia** The pearl oyster industry is one of Australia's most valuable and iconic fisheries, creating significant economic and employment opportunities across Northern Australia. However, as with any major animal production industry, health issues are persistent obstacles inhibiting productivity. Since 2006, the pearl oyster (Pinctada maxima) farming industry in Western Australian has been hampered by health and productivity issues with no identified cause(s). This project aims to characterise active microorganisms (fungus, bacteria, virus) in moribund oysters in order to understand which ones are associated with health issues. Our laboratory has collected unique samples since June 2017 from moribund and healthy adult and spat pearl oysters, which will be used in this study. This molecular work will involve next-generation sequencing (extraction of nucleic acid, library preparation, etc.) and bioinformatics analysis. .	**Honours** **Masters**

Dr Cecile Dang cecile.dang@dpird.wa.gov.au **Prof Jacqui Batley** Jacqueline.batley@uwa.edu.au	**Pathogenicity of Vibrio spp. in pearl oysters Pinctada maxima from northern Australia** The pearl oyster industry is one of Australia's most valuable and iconic fisheries, creating significant economic and employment opportunities across Northern Australia. However, as with any major animal production industry, health issues are persistent obstacles inhibiting productivity. Since 2006, the pearl oyster (Pinctada maxima) farming industry in Western Australian has been hampered by health and productivity issues with no identified cause(s). Bacteria belonging to Vibrio alginolyticus clade have been associated with moribund oysters and can harbour plasmids, which contain virulence genes and may be responsible for the pathogenicity of the bacteria. This project proposes to characterise the virulence factors of Vibrio alginolyticus and assess which environmental factors enhance the pathogenicity. This work will involve bacteriology (culture techniques), molecular biology (qPCR and next-generation sequencing), and microscopy techniques. .	**Honours** **Masters**
Raphael Didham raphael.didham@csiro.au, raphael.didham@uwa.edu.au	**How do plant-insect interactions differ between native and introduced ranges?** When plant species are introduced to new environments, this disrupts its ecological interactions. Projects are available examining the insect communities associated with threatening weeds in Australia, both in their native and introduced range, including fieldwork across WA.	**Masters** **PhD**
Prof Michael Douglas michael.douglas@uwa.edu.au **Dr Leah Beesley** leah.beesley@uwa.edu.au **Prof Matt Hipsey** matt.hipsey@uwa.edu.au	**Do thermal associations drive the spatial aggregation of fish in dry season pools of the Fitzroy River?** Dry season waterholes in intermittent rivers are important refuges for biota, including fish. These waterholes are typically supported through the dry season by the influx of cool groundwater. Water resource development that lowers the water table and reduces the depth of refuge pools may impact the suitability of these habitats for fish. This study will map the depth and temperature of a number of pools using GPS data-logger technology. Sonar will also be used to map the location of fish during different times of the day (dawn, midday, dusk, night). Temperature-related changes in fish habitat use will be assessed by examining the extent to which fish spatial positioning is linked with temperature. This project will contribute the determining the environmental flow requirements of the Fitzroy River, and is part of National Environmental Sciences Program.	**Honours** **Masters**
A/Prof Jon Evans, jonathan.evans@uwa.edu.au	**Uncovering trade-offs between pre- and postcopulatory sexual selection** Males are expected to balance their investment into gaining matings (pre-copulatory sexual selection) and fertilisations (post-copulatory sexual selection) according to the resources available for investment into reproduction. However, trade-offs may only be apparent when resources limit a male's ability to invest maximally into these successive episodes of sexual selection. But where are the tipping points that determine whether such resource allocation trade-offs occur? Research opportunities at either PhD or Honours level are available to address this question, using experimental and quantitative genetic approaches in the guppy Poecilia reticulata.	**Honours** **Masters** **PhD**
A/Prof Jon Evans, jonathan.evans@uwa.edu.au **Dr Rowan Lymbery** rowan.lymbery@uwa.edu.au	**Can environmental effects on sperm distort patterns of genetic variation in offspring fitness?** Over the last decade or so we have come to realise that sperm can be highly sensitive to environmental variables, and that these effects can have profound influences on offspring fitness. In this project, you will have the opportunity of designing an experiment that explores these effects in the mussel M. galloprovincialis. By incorporating an experimental approach (where sperm are exposed to different environmental treatments) within a quantitative genetic breeding design (North Carolina II), you will determine how much variance in offspring fitness can be attributable to environmental effects (i.e. due to changes in the sperm environment prior to fertilization) and additive genetic effects (i.e. due to the sire's intrinsic genetic 'quality'). The results from this project could have profound implications for studies that use quantitative genetic approaches to estimate genetic variation in offspring traits without considering the possible role of sperm-moderated paternal effects.	**Honours**

A/Prof Jon Evans, jonathan.evans@uwa.edu.au **Dr Rowan Lymbery** rowan.lymbery@uwa.edu.au	**Can ocean pH influence gamete signalling mechanism in broadcast spawning marine invertebrates?** Mussels have proved to be superb models for understanding the role that egg chemoattractants (chemical cues realised by eggs to attract sperm) play in moderating gamete interactions. Evidence from our lab has shown that in M. galloprovincialis egg chemoattractants selectively attract sperm from genetically compatible males, a process we term 'differential sperm chemotaxis'. However, the efficacy of egg chemoattractants to effectively exert this form of 'gamete choice' may depend on the chemical environment in which sperm chemotaxis occurs. In this project, you will determine whether seawater pH (acidity) influences gamete signalling processes in mussels, and thus evaluate the extent to which predicted changes in ocean chemistry may disrupt critical processes that moderate reproduction in marine invertebrates.	**Honours**
Assoc/Prof Patrick Finnegan patrick.finnegan@uwa.edu.au **E/Prof Hans Lambers** hans.lambers@uwa.edu.au **Dr Kosala Ranathunge** kosala.ranathunge@uwa.edu.au	**Nutrient acquisition in Hakea prostrata (Proteaceae)** The Proteaceae (banksia, grevillea, etc.) are incredibly well adapted to the nutrient poor soils of Western Australia. Our model plant is Hakea prostrata (Proteaceae), a plant that grows on some of the poorest soils in the world. We are identifying the genes that control the novel up-take and transport of the essential nutrients phosphate and nitrate around Hakea prostrata and are involved in the profound nutrient use efficiency of this plant. You will conduct plant physiological experiments and make use of our in-house Hakea prostrata genome sequence and RNAseq data, which you will supplement with your own quantitative PCR results.	**Honours** **Masters**
Assoc/Prof Patrick Finnegan patrick.finnegan@uwa.edu.au **E/Prof Hans Lambers** hans.lambers@uwa.edu.au **Dr Kosala Ranathunge** kosala.ranathunge@uwa.edu.au	**Leaf nutrient use efficiency – Delayed leaf greening in Proteaceae** The trait of delayed leaf greening displayed by many iconic Proteaceae (banksia, grevillea, etc.) is an adaptation to maximise leaf number for plants growing on some of the most nutrient-poor soils on earth. We are identifying the genes involved in delayed greening in Hakea prostrata so that we can investigate thier usefulness in creating more fertiliser-efficient crop plants. You will investigate important physiological traits that define delayed greening by conducting plant physiological experiments in Hakea prostrata and making use of our in-house Hakea prostrata genome sequence and RNAseq data, which you will supplement with your own quantitative PCR results.	**Honours** **Masters**
Assoc/Prof Patrick Finnegan patrick.finnegan@uwa.edu.au **E/Prof Hans Lambers** hans.lambers@uwa.edu.au **Dr Kosala Ranathunge** kosala.ranathunge@uwa.edu.au	**Computational bioinformatics – Understanding traits in the extremophile plant Hakea prostrata (Proteaceae)** We have a large amount of genomic DNA and RNA sequencing data from Hakea prostrata, a plant that is very well adapted to the harsh, extremely nutrient poor soils of southwestern Australia. This project involves mining our datasets to improve our understanding of the genetic modules that allow this plant to prosper under these extreme conditions. We are particularly interested in nutrient acquisition and metabolism, especially of phosphorus and nitrogen, because this plant has a unique way of interacting with these nutrients that differs from all other plants studied in any detail.	**Honours** **Masters**
A/Professor Lindy Fitzgerald lindy.fitzgerald@curtin.edu.au	**Limiting damage following neurotrauma** Traumatic injury to the central nervous system has serious and long-term functional consequences. We have demonstrated that oxidative stress in the cells that make the myelin required for efficient functioning of the nervous system is associated with disruptions to myelin structure and chronic functional loss. Here we will use in vivo models of neurotrauma and assess the mechanisms of damage to myelin and the contribution of inflammatory cells both at the site of injury and remotely. We will use inhibitors that will help us determine which of the changes lead to loss of function, and these may serve as therapeutic strategies.	**Honours** **PhD**

Dr Jan Hemmi jan.hemmi@uwa.edu.au	**Heart rate monitoring of aquatic invertebrates** Heart rate is well known as an indicator of physiological 'state', activity and stress in animals such as mammals, including humans. Heart rate varies similarly in invertebrates such as crabs and molluscs, providing a method to monitor the animals to determine their state of physiological stress (e.g. in response to pollutants), to optimise husbandry for welfare reasons, or to maximise growth rates in aquaculture. We have constructed a small electronic package comprising an infrared (IR) light emitting diode (LED) and IR detector that can be mounted on the shell of a mollusc or carapace of a crab and used to monitor heart rate with minimal impact on the animal. We will use this to measure the affect of physico-chemical environmental conditions such as dissolved oxygen tension, temperature, and pH on aquatic invertebrates including farmed animals such as abalone and marron. We will also investigate heart rate in the context of marine invertebrates with complex behavioural repertoires and/or that live in environmentally highly varying conditions (e.g. fiddler crabs).	**Honours** **Masters** **PhD**
Dr. Jan Hemmi jan.hemmi@uwa.edu.au	**Comparative colour vision and spatial vision in ants** Ants have some of the smallest brains in the animal kingdom, yet they show a wide range of interesting behaviours, many of them visually driven. Their small size and limited head and eye space has forced them to optimise their visual system in very distinct ways. We have recently shown that one of the Australian bull ants, a species exclusively active in the dark of the night, has trichromatic colour vision like humans. As this is the first ant that has been shown to have more than two spectral photoreceptor types, this project will compare ants from different phylogenetic branches in order to understand the evolution of colour vision and spatial vision in ants in general. This project runs in collaboration with researchers from Macquarie University and will use a range of complementary techniques (physiology, behaviour and possibly molecular biology).	**Honours** **Masters** **PhD**
Dr. Jan Hemmi jan.hemmi@uwa.edu.au	**How fiddler crabs see the world** This project aims to understand how animals, in particular fiddler crabs, see their world. Using a mix of behavioural, physiological and anatomical experiments, we seek to understand how these animals see colours, patterns and polarisation, and how these visual capabilities influence how these crabs interact with their environment, their predators and conspecifics. Experiments will be conducted using our resident UWA fiddler crab colony, housed in a 4 m^2 fully-functional artificial mudflat. You will discover how sensory information underpins animal behaviour, learn how to probe the visual capabilities of animals and, depending on your interests and abilities, learn different combinations of behavioural and physiological and possibly genetic techniques.	**Honours** **Masters** **PhD**
Dr. Jan Hemmi jan.hemmi@uwa.edu.au	**Escape responses in fiddler crabs** How do animals decide when to escape from an approaching predator? We are trying to understand the sensory information animals underlying this decision. The results will tell us how animals measure risk and how they manage to avoid being eaten while still being able to feed and find mates. Fiddler crabs are highly visual animals that live under constant threat of predation from birds. Field experiments have shown that the crabs are not able to measure a predator's distance or their direction of movement – a problem they share with many other small animals. You will bring fiddler crabs into the laboratory and their escape decisions will be tested in our artificial mudflat (at UWA) and/or on a custom made treadmill controlled conditions. Depending on your interests, you can use a combination of behavioural and physiological measurements to understand the mechanisms underlying the crab's escape behaviour.	**Honours** **Masters** **PhD**
Dr. Jan Hemmi jan.hemmi@uwa.edu.au	**Eye movements for high resolution in fiddler crabs** The compound eyes of arthropods such insects and crustaceans are well known for their low spatial resolution. By our visual standards, almost all these animals seem to have a hopelessly blurry view of the world. This low spatial resolution is due to the optical design of their eyes: in particular the relatively broad angular sensitivity of the ommatidia – the individual photoreceptor elements of the eye – and the interommatidial angle – the way in which each ommatidia's line of sight differs from that of its neighbour. If each ommatidium looks in a very different direction, it is inevitable that the whole eye's view will lack spatial detail. Unless, that is, arthropods have evolved a way to overcome this problem. In machine vision, a technique of subpixel interpolation is used to increase the resolution of an imaging system or camera. This is done by taking several images of a scene but shifting the image sensor slightly for each image. You will use macro high speed video to investigate whether fiddler crabs move their eyes in a way that would enable them to employ such sub-ommatidial interpolation.	**Honours** **Masters** **PhD**

Dr. Jan Hemmi jan.hemmi@uwa.edu.au	**Comparative eye anatomy** We have recently developed an exciting new tool to measure the visual field of animals with compound eyes, such as ants and bees. MicroCT is a technique that uses x-rays to image eyes on a very fine spatial scale. We have now developed unique new software to analyse these 3D images and reconstruct how the eyes sample the world. This has never been done before. The output will be a much improved understanding of how animals see their world and much detail they can see. The speed and accuracy of this technique will allow you to compare numerous eyes and can form the basesused for a comparative study of fiddler crab eyes, or to compare the eyes of a range of other animals groups such as ants. For a PhD project, this could involve developing a new staining technique to investigate neural connections in the intact eye, to see how neurons are	**Honours** **Masters** **PhD**
Dr Jan Hemmi jan.hemmi@uwa.edu.au **Prof Shaun Collin** shaun.collin@uwa.edu.au	**Reaction of marine invertebrates to sound** Sound travels well underwater and underwater sounds is increasingly recognised as a form of pollution that has impacts on a wide range of animals. Little is known, however, about the affect of sound on marine and estuarine invertebrates. This project will investigate the reaction of marine invertebrates such as crustaceans and aquatic insect larvae to sound. Experiments will include analyses of in situ natural sound recorded with hydrophones in the Swan River, observations of invertebrate behaviours in reaction to these sounds, and sound play-back experiments.	**Honours** **Masters** **PhD**
Dr. Jan Hemmi jan.hemmi@uwa.edu.au **Dr Zahra Bagheri** zahra.bagheri@uwa.edu.au **Callum Donohue** callum.donohue@uwa.edu.au	**Risk assessment and decision making in fiddler crabs** Risk assessment and decision-making is an essential process for animal survival. In natural environments, animals are constantly exposed to several threating stimuli at any one time. It is not clear how animals make escape decisions in these situations. Do animals identify the most dangerous threat and organize their escape accordingly? Or do they try to escape from all threatening stimuli at the same time? To answer these questions, this project aims to study fiddler crabs escape response to multiple simultaneous threats. The study will test the effect of different stimulus characteristics such as visibility and speed on the crabs' risk assessment and decision-making process. The results will not only improve our understanding of how animals escape predators, but may also contribute to technologies such as robotic rescue.	**Honours** **Masters**
Dr. Jan Hemmi jan.hemmi@uwa.edu.au **Dr Zahra Bagheri** zahra.bagheri@uwa.edu.au **Anna-Lee Jessop** anna-lee.jessop@uwa.edu.au	**Diurnal modulation of colour vision in fiddler crabs** Unlike in humans, the colour vision of fiddler crabs has been shown to involve a shift in spectral sensitivity towards longer wavelengths over the course of each day, making them more sensitive to 'red' light in the late afternoon. At night their eyes reset to have more shortwave 'blue' sensitivity once again. We assume that coloured 'screening' pigments that move within the eye are responsible for this shift, but this has never been shown. This project will use Electron Microscopy to examine the position of these screening pigments within the crabs' eyes at different times of the day and will correlate their position with physiological measurements of the crabs' spectral sensitivities. The results will show how these animals adjust their perception of colour and light sensitivity throughout each day.	**Honours** **Masters**
Dr. Jan Hemmi jan.hemmi@uwa.edu.au **Dr Huon Clark** huon.clark@uwa.edu.au	**The importance of fiddler crab burrows** Fiddler crabs have intricate mating behaviours designed to lure potential partners to mate. Some species mate in the male burrow, while others employ a tactic known as surface mating, whereby the female returns to her own burrow. In some species the males search for a partner, in others, the females do. Different species have different burrow structures and there are differences between male and female burrows in at least some species. Are burrow structures linked to mating tactics? How do mixed species populations partition the mudflat into territories and what impact does this have on sediment structure and population dynamics? By taking burrow casts of multiple species we can answer some or all of these questions.	**Honours** **Masters**

Dr. Jan Hemmi jan.hemmi@uwa.edu.au **Dr Tim Langlois** tim.langlois@uwa.edu.au **Dr Huon Clark** huon.clark@uwa.edu.au **Callum Donohue** callum.donohue@uwa.edu.au	**Taking the pulse of crustaceans – monitoring heart rate in response to environmental changes** Non-invasive measurements of physiological parameters can provide important insights into how short or long-term environmental changes impact on the health of species, populations, or individuals. The focus of this project is to test whether it is possible to use a small-scale optical heart rate monitor to understand (1) the impact of changes in environmental conditions such as temperature, water salinity and PH, or (2) stress - brought about by handling, transportation or exposure to dummy predators on the heart rate of either fiddler crabs or western rock lobsters. The outcomes of the study will help improve animal husbandry and transportation (rock lobster) or aid our understanding of how species respond behaviourally and physiologically to environmental stressors (fiddler crabs).	**Honours** **Masters**
Dr. Jan Hemmi jan.hemmi@uwa.edu.au **Anna-Lee Jessop** anna-lee.jessop@uwa.edu.au	**The function of the lobula plate in crustaceans** The lobula plate is an optic neuropil (part of the brain) found in many species of arthropods. It has been extensively studied in dipterous insects such as blowflies, where its role is to process large-field motion information used for controlling gaze (optomotor responses). Blowflies use this information to stabilize themselves when moving, especially in flight. However, the functional significance of the lobula plate in crustaceans remains unknown. This study will aim to further understand the relationship between the lobula plate and the optomotor behaviour in crustaceans, by comparing behavioural measurements of eye stabilisation and Micro-CT (x-ray) measurements of the lobula plate structure in a range of crustacean species.	**Honours** **Masters**
Prof Hans Lambers hans.lambers@uwa.edu.au **Asst/Prof Matthias Leopold** matthias.leopold@uwa.edu.au **Dr Kosala Ranathunge** kosala.ranathunge@uwa.edu.au	**Phytogeography of Declared Rare Flora species at Great Brixton Street Wetland or Alison Baird Reserve?** The Great Brixton Street Wetland, located in the Perth metropolitan, however harbors an extraordinary high biodiversity within the Swan Coastal Plain. The long-term interactions between alluvial/colluvial inputs from Darling Range on the east and coast sand dune development from the west have given this seasonal wetland area a unique combination of geography and hydrology. These significantly contribute to the existence of such biodiversity, and provide a fortunate ecological niche for many rare flora species. Some species only restricted to certain areas, but why? The potential Honours or Masters project are aimed to answer this. Field and glasshouse experiments will be conducted to investigate the distribution of selected rare flora species in relation to soil and water resources.	**Honours** **Masters**
Prof Jessica Meeuwig jessica.meeuwig@uwa.edu.au	**Changes in scale of coral bleaching in the British Indian Ocean Territory.** The 2016 El Nino swept the world's oceans causing unprecedented rates of coral bleaching globally. Reports in October 2016 suggest that 80% of corals in the northern Great Barrier Reef are dead as a result of this warming event. Some evidence suggests that corals recover from bleaching faster when in fully protected marine protected areas (MPA). As part of a fish survey using baited remote underwater video systems (BRUVS) we have habitat data from the British Indian Ocean Territory MPA pre and post the 2016 bleaching event. This project would examine (1) whether BRUVS be used to detect bleaching and (2) the chance in incidence rate of bleaching pre event and at two points post bleaching.	**Honours**
Professor Jessica Meeuwig jessica.meeuwig@uwa.edu.au	**Detecting coral bleaching from baited remote underwater visual imagery** Assessment of coral bleaching largely relies on either aerial surveys of *in situ* underwater visual census. Our large data set of baited remote underwater video systems (BRUVS) provides an opportunity to score the scale of bleaching globally and also through time at key locations. This project involves developing a new technique for quantifying bleaching based on BRUVS and analysing spatial and temporal patterns.	**Masters**
Professor Jessica Meeuwig jessica.meeuwig@uwa.edu.au	**Environmental DNA in pelagic environments** This project would develop a protocol for obtaining eDNA samples in Western Australiafor pelagic species, that would include contributing to a global library of bar codes for pelagic species.	**Masters** **PhD**

Prof Jessica Meeuwig jessica.meeuwig@uwa.edu.au **Prof Christine Erbe** (Curtin)	**Cross-shelf patterns in fish biodiversity at Bremer Basin.** The Bremer Basin has been identified as a "hotspot" of diversity, supporting an iconic aggregation of orcas. The degree to which this area also is a hotspot for area is a fish hotspot is however unknown. Towed video imagery has been collected at numerous locations in the area and this project will focus on (1) assessing the information generated by towed video an d (2) interpreting this in terms of regional diversity.	**Honours**
Dr Jane Prince jane.prince@uwa.edu.au	**Karajarri Inter-Tidal Reef Project** A unique opportunity to engage with the indigenous custodians of the shore between Roebuck Bay and 80 mile beach. This project is not the typical honours project, incorporating aspects of citizen science and science communication. Its main objectives are: 1. Initiate activities to gain baseline biodiversity data on karajarri sea country – initially intertidal reefs (but also interested in mangroves, seagrass and intertidal creek systems). Current focus is sustainable harvest of trumpet shells. 2. Build capacity of rangers and community members to undertake these activities 3. Establish an ongoing monitoring program that can detect changes due to natural and anthropogenic events. 4. Compare biodiversity as well as management practices at other locations in the West Kimberley	**Masters** **Honours**
Dr Jane Prince jane.prince@uwa.edu.au	**Cygnet Bay** 1. Survival of oyster spat following settlement This project aims to understand the survival of oyster spat in the weeks following settlement and how this is influenced by the surrounding conditions, including the presence of its own and other species. 2. Structure of the biofouling community on pearl oyster panels The objective of this project is to understand the nature of the biofouling assemblage to investigate if there is any possible use for this by-product of the industry. Both projects will require a long stay at the Cygnet Bay Research station, interactions with traditional owners and volunteer interns.	**Honours** **Masters**
Dr Kosala Ranathunge kosala.ranathunge@uwa.edu.au **E/Prof Hans Lambers** hans.lambers@uwa.edu.au **Assoc/Prof Patrick Finnegan** patrick.finnegan@uwa.edu.au	**Understanding the traits of cluster- and non-cluster-roots in Proteaceae plants** The ancient, highly-weathered and severely nutrient-impoverished landscapes of south-western Australia are home to an enormous diversity of vascular plants, and one of the world's hotspots for diversity of the Proteaceae family. The extremely low concentration of P in these soils is often unavailable to plant roots. Almost all Proteaceae are non-mycorrhizal. Instead, they develop 'cluster' roots that exude carboxylates, a remarkable morphological and physiological adaptation that chemically extracts P from P-impoverished soil. However, roots of plants usually undergo intense sealing, depositing suberin and lignin. These barriers protect roots against pathogens and they also have antifungal properties. However, successful carboxylate exudation by cluster-roots of Proteaceae would require a lack of perfect sealing. Absence of perfect barriers would be risky for the plant, due to an increased exposure and vulnerability to pathogens. Do Proteaceae roots have other mechanisms to fight against pathogens? Why don't they have mycorrhizal colonisation? We will explore, how these roots maximise P acquisition and stress tolerance at anatomical, physiological, biochemical and genomic levels.	**Honours** **Masters** **PhD**
Dr Cristina E Ramalho cristina.ramalho@uwa.edu.au	**Biodiversity and human-nature connection considerations in urban forest management** Urban forests are vital for climate change adaptation and mitigation, human wellbeing, and biodiversity conservation in cities. Although socio-ecological values are normally identified as primary drivers of urban forest management, they are often not properly, if at all, taken into account in the actual decision-making process for tree species selection. This socio-ecological study aims to provide insight and guidance on how to better cater for biodiversity and human-nature connection values in urban forest management. A first component of this project will analyse how biodiversity and human-Nature connection values are considered in other cities located in global biodiversity hotspots. A second component of the project, will survey actors in urban forest management in the Perth Area to understand among others: 1) the biodiversity and social-ecological aspects that they perceive as relevant in urban forest management, 2) the challenges and dilemmas they face when trying to address those aspects in decision making, 3) how those aspects influence practical decision-making on the ground, and 4) the knowledge gaps perceived. Project of the Clean Air and Urban Landscapes hub.	**Honours** **Masters** **PhD**

Dr Cristina E Ramalho cristina.ramalho@uwa.edu.au	**Ecological benefits and functional gaps in native plant palettes commonly used in urban greening** Urban greening often relies on a limited pallet of native and non-native plants that are 'proven performers' and have a range of traits that makes them suitable for urban green spaces. While biodiversity conservation is normally presented as a key reason for the use of native plants, often little thought is put into what ecological functions may be provided by and which native fauna may benefit from a particular plant pallet. Urban plantings have the potential to provide several ecological functions to a variety of native bird, reptile, and arthropod functional guilds. However, the limited range of native plants likely means that their potential for biodiversity conservation is not fully realized. This study aims to understand the biodiversity conservation value of native plant pallets used in urban greening in the Perth Metropolitan Area, and how these pallets could be improved so to cater for a wider range of biodiversity values. The study examines 1) the native fauna functional guilds that are known to or that could use the urban environment (with focus on species with positive or neutral interactions with people); 2) the range of native plants commonly used in urban plantings and that are available in commercial nurseries, the ecological services they provide and the taxa and functions they support; 3) which functional groups are not supported by those plant pallets; 4) candidate species to fill the identified gaps, based on the analysis of local remnant plants, and plant lists provided by specialized native nurseries and volunteering groups (WA Wildflower Society and Friends of Kings Park). Project in collaboration between the Clean Air and Urban Landscapes hub and Kings Park Science	**Honours** **Masters** **PhD**
Dr Kosala Ranathunge kosala.ranathunge@uwa.edu.au **E/Prof Hans Lambers** hans.lambers@uwa.edu.au	**Grevillea thelemanniana: what determines its very narrow distribution and why is it so rare?** Grevillea thelemanniana (Proteaceae) is a Declared Rare Flora species with a very narrow distribution. It is easy to grow in a garden, yet can be found in only very few natural habitats. Alison Baird Reserve is one of very few locations where this species occurs naturally, on swampy sites, alongside with two other Proteaceae, Banksia telmatiaea, swamp fox banksia. However, we cannot explain the distribution of G. thelemanniana simply by its water relations, because the two co-occurring Proteaceae (Banksia telmatiaea and Hakea sulcata) have much wider distributions, albeit restricted to wet habitats. Other soil factors are likely responsible for the narrow distribution of G. thelemanniana. The aim of the project is to discover what soil and plant traits determine the extreme rarity of Grevillea thelemanniana. The main outcome of the project will be a thorough understanding of the specific requirements of a rare species which has important implications for the management of species associated with Muchea limestone.	**Honours** **Masters** **PhD**
Professor Leigh Simmons leigh.simmons@uwa.edu.au	**Sexual selection and sperm competition** Research opportunities are available to explore the role of pre-copulatory and post-copulatory sexual selection in the evolution of male and female reproductive behaviour and morphology. We seek to understand how life-history trade-offs affect male allocation of resources to the weapons and ornaments of mating competition and sperm production for competitive fertilization success. These questions can be addressed in a variety of taxa from insects to humans, and using a variety of approaches, from comparative morphology to genetics.	**Honours** **Masters** **PhD**
Professor Leigh Simmons leigh.simmons@uwa.edu.au **Dr Nikolai Tatarnic** nikolai.Tatarnic@museum.wa.gov.au	**Traumatic insemination in plant bugs** In traumatic insemination (TI), males use hypodermic genitalia to inject sperm into the female through the side of her abdomen, bypassing her genitalia. This project will use plant bugs in the genus Coridromius to examine sexual conflict arising from TI. Experiments might include but are not limited to: determining the costs of TI to females; measuring the immune response of females to TI; studies of mating behaviour/mate choice; identifying the sperm pathway through the female bloodstream. The project will involve collaboration with researchers at the WA Museum.	**Honours** **Masters** **PhD**
Professor Leigh Simmons leigh.simmons@uwa.edu.au **Dr. Jan Hemmi** jan.hemmi@uwa.edu.au	**The costs of male weaponry: are males with enlarged weapons visually impaired** Male dung beetles invest in horns which are used in battles over access to tunnels and the females breeding within. However, some males do not develop horns or fight for access to females, but rather sneak copulations guarded by horned males. Males that develop horns compromise the development of their eyes. This project will compare the visual capabilities of minor and major males using a combination of anatomical, physiological and behavioural methods. You will learn how to make electroretinogram measurements to assess the beetles' visual acuity and light sensitivity and correlate these findings with anatomical predictions based on 3D microCT measurements of the beetles' eyes.	**Honours**

Dr Miriam Sullivan miriam.sullivan@uwa.edu.au	**How private is the public domain?** Most universities consider that all posts made to public online discussion boards are in the public domain. Therefore, people's posts on the internet are able to be used as research data without needing specific consent from the poster.While researchers are sensitive to the potential ethical issues involved and have suggested guidelines for use of public posts, we do not know if people understand the implications of posting in the public domain or if they would consent to their data being used if they did know. In this project, you will explore people attitudes and emotional responses to the use of their social media posts for research purposes.	**Masters** **Honours**
Dr Miriam Sullivan miriam.sullivan@uwa.edu.au	**Employment outcomes for science communication students** Employers specifically look for good communication skills when hiring science students. However, we don't know specifically which communication skills or theoretical knowledge is important for employers who are specifically looking to hire science communication specialists. In this project, you will explore what science communication employers (eg. museums, science centres, zoos, government, etc) view as desirable graduate outcomes for potential employees.	**Masters** **Honours**
Dr Greg Skrzypek grzegorz.skrzypek@uwa.edu.au **Dr Mat Vanderklif** mat.vanderklift@csiro.au	**Ecology of feral predators at Ningaloo:** Feral cats and foxes are a threat to fauna along the Northwest Cape, including to hatchling turtles. This project will work with DBCA (Department of Biodiversity, Conservation and Attractions Western Australia) to understand what these predators eat, and will use the stable nitrogen and carbon isotopes and stomach content. This is a collaborative project with CSIRO.	**Masters**
A/Prof Erik Veneklaas erik.veneklaas@uwa.edu.au **Dr Paul Drake** paul.drake@uwa.edu.au	**Water and CO2 transport in relation to stomatal distribution** Why do fast-growing crops and drought-tolerant trees, very different plant types, have pores on both sides of their leaves, when the vast majority of plants don't? This project aims to assess the (dis)advantages of having stomata (leaf pores bound by guard cells) on both leaf sides (amphistomaty), rather than on one side (hypostomaty), and determine how these traits relate to the leaf's specific micro-climate. This knowledge will provide novel insights into the functional diversity of plants, direct plant breeding targets and contribute to the fundamental understanding of plant transpiration and photosynthesis, two processes that regulate the global exchange of water, CO2 and energy.	**Honours** **Masters** **PhD**
Bruce Webber bruce.webber@csiro.au, bruce.webber@uwa.edu.au	**Identifying vulnerabilities to improve the management of threatening weeds.** Improvements in weed management can be achieved through a greater understanding of plant ecophysiology and plant-ecosystem interactions. Projects are available, depending on the interests of the applicant, including fieldwork across WA, interstate and overseas	**Masters** **PhD**
Professor Philip Withers philip.withers@uwa.edu.au **Dr. Christine Cooper** c.cooper@curtin.edu.au	**What controls insensible evaporative water of mammals and birds?** The insensible evaporative water loss (non-thermoregulatory evaporative water loss, EWL) has traditionally been considered to be a passive biophysical process, not under physiological control, but we have recently shown that it is regulated by mammals (dasyurid marsupials) and birds (parrots). This project will measure the effect of ambient relative humidity on the insensible EWL of a mammal or bird, and investigate the biological control of its regulation, either water conservation at low humidities or facilitation of thermoregulation at high humidities.	**Honours** **Masters**
Professor Philip Withers philip.withers@uwa.edu.au **Dr. Christine Cooper** c.cooper@curtin.edu.au	**Comparison of thermal imaging and spot-lighting as tools for nocturnal mammal surveys** Environmental researchers have typically used spotlights or head torches as the primary technique for non-invasive fauna observations and surveys of nocturnal fauna. In recent years, thermal technology has advanced and there are now commercially available high quality thermal scopes. But, are they as good as a spotlight or a head torch in determining abundance, based on distance sampling (now widely used to determine relative abundance based on transect searches). Distance sampling techniques will be used to test the comparative efficacy of these relatively new thermal imagery devices compared with traditional spotlighting in relatively open areas (e.g. pastures) and in open Banksia and eucalypt woodlands, which are both typically found on the Swan Coastal Plain. The project will involve collaboration with a local environmental consulting company.	**Honours** **Masters**

Professor Dirk Zeller dirk.zeller@uwa.edu.au	**Fisheries in Indian Ocean Rim countries** Science and policy on Indian Ocean fisheries are heavily skewed towards industrial tuna fisheries, yet most Indian Ocean Rim countries gain domestic food security, livelihoods and economic benefits from domestic non-tuna fisheries within their Exclusive Economic Zone waters. These coastal fisheries, however, are often heavily under-valued and under-represented in fisheries science at the national and regional level, as they are often dominated by marginalized small-scale fisheries with substantial data gaps. As part of the international Sea Around Us - Indian Ocean research initiative (www.seaaroundus-io.org), students will engage in country-level or ocean-basin scale aspects of fisheries science using big-data approaches. These types of projects could be especially interesting for students that have links to specific countries in the Indian Ocean basin, or are excited by data mining and historical ecology, or wish to be challenged by big-data approaches in an interdisciplinary setting. The Sea Around Us – Indian Ocean collaborates closely with the global Sea Around Us initiative (www.seaaroundus.org) and the interdisciplinary Global Fisheries Cluster (http://global-fc.oceans.ubc.ca/) at the University of British Columbia in Vancouver, Canada, and with FishBase (www.fishbase.org) and SeaLifeBase (www.sealifebase.org) hosted in the Philippines. Most Sea Around Us research does not involve field-based data collection, as we emphasize the utility of pre-existing secondary data and databases for enhancement through data harmonization, data gap assessments and large-scale data approaches. An open and keen mind, critical thinking skills, team work abilities and a curiosity about fisheries data science is all that is required, but if you also have programming skills (e.g., R) or even advanced computing skills for big-data approaches …. all the better.	**Masters** **PhD**
Dr Abbie Rogers, Dr Belinda Cannell, Prof Michael Burton belinda.cannell@uwa.edu.au	**How big is the value of a little penguin?** Little penguins are the smallest penguin species. Their largest breeding colony in Western Australia is just off the shore of Rockingham, in the Perth metropolitan region. They face many threats given their co-location with a major human population base, including marine and coastal developments, predation, watercraft strikes, and pressures from eco-tourism. To balance the benefits and costs of coastal activities with the benefits and costs of conserving little penguins, decision makers need to identify what the value of the penguin colony is. This project will involve developing a non-market valuation survey to estimate how much people are willing to pay to protect little penguins through improved management outcomes. Applicants will need to have a background in economics (e.g. units in microeconomic theory, environmental and resource economics) or strong skills in statistical analyses.	**Honours** **Masters**
Dr Craig Lawrence craig.lawrence@dpird.wa.gov.au **Dr Justin Blythe** justin.blhythe@watercorporation.com.au **Assoc Prof Julian Partridge** julian.partridge@uwa.edu.au **Prof Phil Vercoe** philip.vercoe@uwa.edu.au	**Using fish as biosentinels to protect our drinking water supply** This is a collaborative project between UWA, DPIRD and Water Corporation to trial a biological-based early warning monitoring system which uses fish as bioindicators of water quality. The system employs video surveillance together with data analyses to monitor changes in fish behaviour in response to varying water quality conditions. In this project anaesthesia will be used to mimic changes in fish behaviour due to either accidental (i.e. chemical spill) or intentional (i.e. terrorism) contamination (UWA AEC approval has already been obtained for this project). This project will result in an early warning system to protect Perth's drinking water supplies.	**Honours**

Dr Michael Renton michael.renton@uwa.edu.au **Dr Francois Teste** francois.teste@uwa.edu.au	**Evolution and ecology of plant-fungal interactions during invasion** Most invasive trees depend closely on mycorrhizal symbionts to provide required resources, and thus their invasive success depends on the dispersal of these symbionts as well as their own dispersal. Invasive trees may also be negatively impacted by pathogenic fungi in their natural range, and thus benefit from 'enemy release' if they spread into new areas faster than these pathogenic fungi. Previous empirical and theoretical work has shown that the dispersal characteristics of organisms can undergo selection pressure and evolution during the course of an invasion or colonization of new areas, but the evolutionary dynamics of dispersal during co-invasion has not been considered. This project will use spatially-explicit eco-evolutionary simulation modelling to investigate how the dispersal characteristics of trees and their mycorrhizal symbionts and pathogens evolve over the course of a tree invasion, and how managment that accounts for both evolution and ecology can help slow tree invasions and protect natural environments. Applicants do not need prior modelling experience, but should be passionate about ecology and evolution.	**Honours** **Masters**
Dr Michael Renton michael.renton@uwa.edu.au **Dr Pieter Poot** pieter.poot@uwa.edu.au	**Evolution of rooting strategies** Plants use their roots to forage for the water and nutrients they need to survive and reproduce. Different rooting strategies evolve in different conditions, to enable plants to find these resources as efficiently as possible. This project will use eco-evolutionary models that simulate populations and communities of plants with detailed three-dimensional root structures evolving over time. This modelling can address big questions such as the costs and benefits of phenotypic plasticity, the uniqueness or repeatability of evolution, the drivers of diversity in plant communities, and the processes that lead to the creation of new species. Applicants do not need prior modelling experience, but should be passionate about ecology and evolution.	**Honours** **Masters**
Prof Dave Edwards Dave.Edwards@uwa.edu.au	**Applied bioinformatics** Data is increasingly abundant in biology, and being able to analyse data is fundamental to asking biological questions. The applied bioinformatics group at UWA is a dedicated computational group asking biological questions using big data and high performance computing. Projects range from genome and pangenome assembly and annotation, population analysis, trait association, evolutionary studies and crop improvement, predominantly using wild plant and crop species, though also venturing into animal and even human genomics. Candidates are expected to have a good understanding of biology and use of Linux and will recieve in training in the use of high performance computing in biology. Please contact Dave Edwards to discuss specific opportunities.	**Honours** **Masters** **PhD**
A/Prof Jon Evans, jonathan.evans@uwa.edu.au	**Ejaculate-mediated paternal effects as sources of non-genetic inheritance in guppies** This project aims to unravel the evolutionary importance of ejaculate-mediated paternal effects, through which paternal lifestyle factors and experiences influence offspring growth and health independently of genes. This project will focus on predation risk experienced by adult males, as simulated by a 'robo-fish' predator model. By identifying non-genetic sources of inheritance the project expects to generate new knowledge that will be relevant across the biological, medical and agricultural sectors.	**Honours**
Dr Giovanni Polverino giovanni.polverino@uwa.edu.au **A/Prof Jon Evans** jonathan.evans@uwa.edu.au	**Fitness consequences of personality in guppies and mosquitofish** Boldness, aggressiveness, and exploration are three behavioural traits often considered in studies on animal personality. Despite the increasing interest in studying animal personality in the last few decades, we still know little about how variation in these traits is maintained within populations, and, in particular, the reproductive outcome of individuals differing in those traits. This project will test whether fish that invest more in dominance behaviours and searching for mates have a higher fitness return than others when living in social groups. We expect bolder/dominant males producing more offspring and females producing clutches more genetically diverse (multiple paternity).	**Honours**

Dr Giovanni Polverino giovanni.polverino@uwa.edu.au **A/Prof Jon Evans** jonathan.evans@uwa.edu.au	**Links between plasticity traits in guppies and mosquitofish** Understanding causes and consequences of behavioural plasticity is a major focus in animal behaviour studies for its importance to any population's ability to persist under changing environments. However, behavioural plasticity in traits linked to reproduction has received surprisingly limited attention. This project will test whether male individuals maintained in isolation increase their investment in sperm traits and behaviour after exposure to adult females. We expect that exposure to females will result in higher sperm production, boldness, and aggressiveness towards rivals.	**Honours**
Dr Belinda Cannell belinda.cannell@uwa.edu.au **Dr Harriet Paterson** harriet.paterson@uwa.edu.au	**Eavesdropping on the lives of shearwaters** The objective of this study is to investigate the vocalizations of Flesh-footed Shearwaters on Muttonbird Island (Albany) while they occupy their burrows during their breeding season. This will increase our understanding of their behaviour during breeding. This project uses a novel sound recording device operated by a Raspberry Pi Computer, a credit-card-sized computer that can be used, amongst other things, for electronic projects. It is equipped with microphones and an infrared camera to observe birds arriving and leaving the burrow. Data have already been collected from the 2017/18 and 2018/19 seasons and we expect to collect more in 2019/20. The data will be interrogated as a desk top study, but the student will be expected to visit the site when the equipment is deployed or retrieved. The candidate will identify and describe vocalisations encountered and assign likely functions to them. The range of vocalisations encountered are likely to include those related to reforming pair bonds, mating, contact calls and sounds related to hatching of chicks, chicks begging and being fed .The candidate may be based at either the Crawley or Albany campus, but must be enrolled through CENRM at the Albany campus. The preferred start date is Semester 2 2019. A top up of $500 will be offered to cover costs of the project.	**Honours (must be enrolled through CENRM at Albany campus)**
Professor Leigh Simmons leigh.simmons@uwa.edu.au	**The evolution of mating spurs in trapdoor spiders** Many male trapdoor spiders use their front legs to move females into a suitable position during mating, by locking highly specialised mating spurs located on their anterior legs under the female's fangs during copulation. Using landmark geometric analyses, the project will quantify and map shape variation onto a pre-existing molecular phylogeny of the spiders, and test evolutionary hypotheses for the divergence of these male mating structures. The project will involve collaboration with the WA Museum.	**Honours** **Masters**
Dr Jane Prince jane.prince@uwa.edu.au	**Rottnest Island** Rottnest IslandThe Rottnest Island Authority has several projects they would like students to work on. Marine projects include: distribution of invasive species around Rottnest, population numbers of NZ fur seal, and relationship of intertidal and shallow subtidal invertebrate species. Please contact Jane Prince for exact details.	**Honours** **Masters**
Thomas Wernberg thomas.wernberg@uwa.edu.au, wernberglab.org	**Developing a novel restoration tool for threatened kelp forests** Human-driven impacts on our oceans are intensifying and there is urgent need for novel solutions to combat habitat loss and promote resilience in marine ecosystems. In warmer margins of their range kelp forests are being replaced by algal turfs. This project will develop and test a novel restoration tool 'green gravel' and evaluate its ability to restore kelp forests in Australia. Green gravel involves seeding kelp spores onto pebbles, where they grow into small sporophytes that can be scattered across an impacted area. This tool could be effective at overcoming reinforcing feedbacks (propagule and recruitment limitation) that prevent recovery of kelp forests after shifts to turf. This is a collaborative project between UWA and the NSW Department of Primary Industries.	**Hons/Masters**
Thomas Wernberg thomas.wernberg@uwa.edu.au, wernberglab.org	**Thresholds for kelp forest loss and turf expansion.** Pervasive habitat deterioration and destruction presents one of the biggest threats to species and global ecological function. There has been an accelerating loss kelp forests globally, and an associated rise and persistence of degraded seascapes of sediment-laden algal 'turfs'. This project will conduct field experiments on kelp and turf reefs across different environments to identify thresholds for collapse and mechanisms for recovery. Advances here will improve how we understand the stability of these marine habitats, and the reversibility of sudden changes in the context of ongoing climate change. This is a collaborative project between UWA and the NSW Department of Primary Industries.	**Hons/Masters**

Thomas Wernberg thomas.wernberg@uwa.edu.au, wernberglab.org	**Novel intervention-based solutions using strong genotypes to boost resistance or restore threatened kelp forests** Research on marine habitat loss has mainly focused on negative impacts and declining performance of foundation species, and the effectiveness of passive strategies for recovery (e.g. marine reserves). Instead, an innovative approach targets individuals and areas that perform well under stress ('bright spots') to discover mechanisms, traits and active interventions that promote persistence. This project will use cutting edge genetic analyses to identify strong genotypes in natural 'bright spots' where surviving kelps have resisted or adapted to degraded conditions. This will provide a foundation to develop innovative proactive restoration and conservation solutions to breed resistance or promote recovery of degraded systems. This is a collaborative project between UWA and the NSW Department of Primary Industries.	**Hons/Masters**
Dr Jane Prince jane.prince@uwa.edu.au **Dr Tim Langlois,** tim.langlois@uwa.edu.au **Dr Simon de Lestang** **s**imon.deLestang@fish.wa.gov.au **Dr Jason How** jason.how@fish.wa.gov.au	**Inferring environmental change through cross shore and long-shore abundance distribution pattern in macroinvertebrate assemblages associated with western rock lobster puerulus collectors.** The western rock lobster fishery is the highest value single species fishery in Australia, worth over $500 Million per annum. An important metric used by fisheries scientists to monitor the health of this resource is the abundance of post-larvae (puerulus) that recruit each year to artificial collectors located along the coast of WA. In 2008 the historic settlement pattern of puerulus changed, with settlement occurring at lower numbers, further north, and in later months each settlement season. In addition to puerulus, the collectors also collect samples of a wide range of macroinvertebrate species. We have a project to evaluate patterns in the abundance distribution of the macroinvertebrates, investigate how these patterns may relate to puerulus counts and develop additional indicators based on species of macroinvertebrates that typically occur simultaneous to western rock lobster puerulus.	**Honours** **Masters**
Dr Tim Langlois, tim.langlois@uwa.edu.au **Shaun Wilson** shaun.wilson@dbca.wa.gov.au **Thomas Holmes** thomas.holmes@dbca.wa.gov.au	**What drives change in size spectra of fish assemblages?** The structure of fish assemblages is influenced by both fishing pressure and habitat. Increased fishing typically removes large predatory species and allows proliferation of smaller bodied fish, whilst changes in structural complexity alter availability of refuge space for different sized fish. Consequently, the size distribution of fish assemblages can be linked to changes in both fishing pressure and habitat. On coral reefs habitat structure and complexity is often governed by the size and composition of the coral colonies which is also indicative of reef status with respect to disturbance history. This project will use information from stereo video to assess how the size distribution of fish and coral assemblages relate to each other. Using surveys from fished and unfished reefs and across reefs with different coral communities, the project will also explore the relative importance of fishing and habitat on the size distribution of fish.	**Honours** **Masters** **PhD**
Prof Leigh Simmons leigh.simmons@uwa.edu.au **Dr Tim Langlois,** tim.langlois@uwa.edu.au **Dr Simon de Lestang** **s**imon.deLestang@fish.wa.gov.au **Dr Jason How** jason.how@fish.wa.gov.au	**Fertilization ecology and implications of sperm limitation in the western rock lobster** The western rock lobster fishery is the highest value single species fishery in Australia, worth over $400 Million per annum. Very little is known about the occurrence of sperm limitation for the fertilization ecology of western rock lobster, however it is assumed that the selective removal of larger males from the fishery could result in the occurrence of sperm limitation.This study will involve conducting mating trials to establish the mechanics of fertilization within western rock lobster. In addition, both laboratory and field investigations will be used to investigate the relationship between sperm abundance and spermatophore size, using methods to count sperm isolated from spermatophores and relate this data to field surveys of spermatophore size across areas of the fishery with contrasting adult body-size distribution.	**Honours** **Masters**

Dr Tim Langlois, tim.langlois@uwa.edu.au **Dr. Matt Navarro** matthew.navarro@uwa.edu.au **Dr. Jacquomo Monk** jacquomo.monk@utas.edu.au	**Monitoring highly targeted mesophotic fish populations: optimising stereo-video monitoring of large offshore no-take marine reserves** Large offshore no-take marine reserves have recently been created around Australia and New Zealand. This project will involve field work to collect baited remote stereo-video samples within no-take areas within the Ningaloo and South-west Capes region. Existing data sets will be provided from New Zealand. This project will use novel methods of power analysis to design optimal future monitoring plans to detect differences in highly targeted mesophotic grouper populations (e.g. hāpuku *Polyprion oxygeneios*) that may occur after the cessation of fishing. The student will develop skills in field work and novel statistical analyses applicable to marine park monitoring design.	**Honours** **Masters** **PhD**
Dr Matt Navarro, matthew.navarro@uwa.edu.au **Dr Tim Langlois** tim.langlois@uwa.edu.au **Dr Dave Fairclough** David.Fairclough@fish.wa.gov.au	**Designing recreaitonal fishing policies using representative fisher preferences** Whilst recreational fishing policies are designed to meet biological based management objectives, fishers preferences are also incorporated into these decisions. At present there is a lack of transparency about how these preferences are measured and accounted for. This study will test the use of an economic technique known as choice experiments to measure fishers' preferences for suites of management interventions including bag limits, seasonal closures and size limits and attempt to combine these preferences with biological based management strategy evaluations to generate recommendations for policy interventions.	**Honours** **Masters**
Dr Matt Navarro, matthew.navarro@uwa.edu.au **Dr Tim Langlois** tim.langlois@uwa.edu.au **Dr. Jacquomo Monk** jacquomo.monk@utas.edu.au	**Spatial usage of the Australian Marine Parks network** In 2019 44 new marine parks were implemented in offshore commonwealth waters around Australia as part of the Australian Marine Parks network. At present little is known about how boat based fishers and non-fishing recreators are using these areas. This project will analyse existing data and collect new data on spatial usage patterns at boat ramps adjacent to 13 of these new marine parks. These usage patterns will form baselines in Parks Australia's social and economic monitoring program and inform the planned 10 year review of the marine parks zoning.	**Honours** **Masters**
Harriet Davies harriet.davies@uwa.edu.au **Dr** **Tim Langlois** tim.langlois@uwa.edu.au	**Developing Sea Country management protocols through combining traditional ecological knowledge of Indigenous Australians and Western Science.** Indigenous Australians have a profound connection to nature and a cultural obligation to take care of Country. As a result, Indigenous people have been sustainably managing their marine estates for millennia. There is an increasing interest in documenting and embedding traditional knowledge into marine management and monitoring yet little work has been done in developing methods and protocols to achieve these goals. This project will build upon participatory mapping methods to document knowledge of senior knowledge holders to help inform marine park and fisheries management in Western Australia.	**Honours** **Masters** **PhD**
Dr Ana M M Sequeira (UWA) ana.sequeira@uwa.edu.au **Dr Matthew Fraser (UWA)** matthew.fraser@uwa.edu.au **Prof Gary Kendrick (UWA)** gary.kendrick@uwa.edu.au	**Ecological links between coastal habitats and marine megafauna conservation** The 2011 Western Australian marine heatwave associated with global climate change has strongly affected the Shark Bay World Heritage Area, known for its extensive seagrass meadows and unique marine megafauna. The aftermath of this heat wave highlighted that strong links exist between the habitat-forming dominant temperate seagrass, Amphibolis antarctica, in Shark Bay and the health and abundance of marine megafauna, such as green turtles and dugongs. Understanding these ecological links is crucial to predicting the effects of predicted seagrass loss in Shark Bay on the populations of marine megafauna species that contribute to its World Heritage status. This project will be a collaboration between UWA and DBCA and will be most suitable for a student passionate about remote iconic areas in the Western Australia coastline and with strong interest in investigating behaviour and movement of marine megafauna in relation to coastal habitats.	**PhD** **Honours** **Masters**

Dr Ana M M Sequeira (UWA) ana.sequeira@uwa.edu.au **Dr Matthew Fraser (UWA)** matthew.fraser@uwa.edu.au **Dr Hector Lozano-Montes (CSIRO)** hector.lozano-montes@csiro.au **Dr Ben Radford (AIMS)** B.Radford@aims.gov.au **Prof Gary Kendrick (UWA)** gary.kendrick@uwa.edu.au	**Understanding the iconic World Heritage Shark Bay using an ecosystem modelling framework** Regional warming and extreme events such as the 2011 Western Australian marine heatwave associated with global climate change has promoted large ecosystem shifts to the marine ecosystem in the Shark Bay World Heritage Area including extensive loss of seagrasses, starvation in turtles and major effects on invertebrate fisheries and fish communities. Understanding how to predict and manage the impacts of climate change on marine ecosystems is a key emerging issue and it is imperative that we are prepared to effectively manage ecosystem scale shifts in Shark Bay to safeguard its World Heritage status. Extreme climatic events are predicted to increase in frequency, intensity and duration. Therefore, understanding the ecosystem impacts of water temperature changes and climate-related seagrass loss is particularly pertinent in ecosystems where foundation seagrasses grow near the edge of their biogeographical range, such as in Shark Bay. This project will pull together physical, habitat, and animal community data into an ecosystem modelling framework to examine physical and biological interactions in Shark Bay, and help predict the trajectory of this World Heritage Site under future climate scenarios. This project will be a collaboration between UWA, AIMS and CSIRO and will be most suitable for a student with strong interest in understanding ecological links within ecosystems and with interest to develop quantitative skills.	**PhD** **Honours** **Masters**
Pauline Grierson Pauline.Grierson@uwa.edu.au, **Svenja Tulipani (DWER)** **Greg Skrzypek** Grzegorz.Skrzypek@uwa.edu.au **Brad Degens (DWER)**	**Managing excess nutrients in aquatic ecosystems - understanding interactions between dissolved organic matter and phosphorus-binding clays.** This research project will compare DOM adsorption by Phoslock® and HT-clay and investigate how this varies across a range of environmental conditions (e.g. salinity and P concentrations). The project will include a range of lab experiments to elucidate if particular types of DOM are preferentially retained by the clays. Outcomes from the project will help optimise both the efficacy of clay applications and also inform understanding of any potential environmental impacts of clay treatment on waterways. The project is supported by DWER will also offer the opportunity to experience fieldwork for the collection of water samples in the Mandurah region.	**Honours** **Masters**
Prof Gary Kendrick gary.kendrick@uwa.edu.au **Dr Elizabeth Sinclair** elizabeth.sinclair@uwa.edu.au **Dr Matthew Fraser** matthew.fraser@uwa.edu.au	**Seagrass adaptation and acclimation responses to extreme climatic events** Extreme climatic events are predicted to become more frequent and severe, causing rapid ecosystem change. These extreme events can act as strong and acute agents of selection, generating widespread mortality and collapse of ecosystem services. Understanding how ecosystem engineers, such as seagrasses, respond to change will be a critical component of their management in the future. Shark Bay is a World Heritage Area with some of the largest seagrass meadows in the world. These meadows have high ecological, economic, and social values, supporting abundant and diverse animal communities. However, the large meadows formed by temperate seagrass species are directly threatened by climate change, underlined by large-scale dieback following a marine heatwave event in 2011. This project will focus on plant growth and physiological responses to environmental stressors associated with extreme events under predicted climate change scenarios. Experiments will be conducted in growth tanks with sampling to quantify physiological and genomic stress responses.	**Honours** **Masters** **PhD**
Prof Dave Edwards dave.edwards@uwa.edu.au **Dr Elizabeth Sinclair** elizabeth.sinclair@uwa.edu.au **Dr Philipp Bayer** philipp.bayer@uwa.edu.au	**Comparative Genomics of Seagrass** Comparative genomics provide a powerful tool to study evolution. Marine plants, the seagrasses, are an extremely old polyphyletic group representing multiple 'return to sea' events. These independent events resulted in habitat-driven solutions to adaptation to a marine environment. A recent genome comparison among two seagrass species provided strong evidence for convergent evolution. This project will compare multiple seagrass genomes to further explore their evolution and to identify genes associated with stress responses and extreme climate events. Candidates are expected to have an understanding of Linux.	**Honours** **Masters** **PhD**

Jason Kennington jason.kennington@uwa.edu.au **Joseph Tomkins** joseph.tomkins@uwa.edu.au	**The genetics and genomics of sexual selection** We have a number of project ideas relating to the evolutionary genetics of sexual selection. Primarily we are interested in separating the effects of different bouts of sexual selection and identifying their effects on fitness and the genome. The questions are directly relevant to Evolutionary genetics, sexual selection but also conservation and the management of species in captivity. These projects could use a number of different techniques including genomic analyses, artificial selection for 'studs' and 'duds' and quantitative and population genetics (e.g. Dugand et al 2018,2019). These projects are largely focussed on but not limited to Drosophila melanogaster. Topics 1) Genomic sequence divergence in pre-existing evolved lines. 2) Genomic profiles of 'stud' and 'dud' males across environments/species. 3) Evolvability following selection for studs and duds. 4) Separating male competition and female choice. 5) Separating the effects of per and postcopulatory sexual selection. 6) Testing the resurgence of Lamarck's hypothesis for the inheritance of environmentally induced variation. 7) Manipulating the costs of male display. 8) Selection on polyandry.	**Honours**
Giovanni Polverino giovanni.polverino@uwa.edu.au **Joseph Tomkins** joseph.tomkins@uwa.edu.au	**Bullying and its lifelong consequences on the development of personality** The Rottnest Island brine shrimp Artemia parthenogenetica, is, as its name suggests, parthenogenetic. How cool is that! Instantly available genetic lineages for studying reaction norms, plasticity and responses to the environment! We have established a laboratory culture of numerous lines of these brine shrimps and are looking for a student to start assaying lifetime variation in their response to environmental cues such as fear.	**Honours**
Joseph Tomkins joseph.tomkins@uwa.edu.au **Wladimir Fae** wladimir.faeneto@research.uwa.edu.au	**Experimental evolution and algal production** We have a number of experimental evolution lines of the single celled alga Chlamydomonas reinhardtii that have diverged in size and in their growth conditions. These evolved lines are of interest to us from an evolutionary perspective and also from the perspective of applying them to questions of algal production (e.g. biomass, pigments and lipids) in the lab and 'field' conditions.	**Honours**
A/Prof Erik Veneklaas erik.veneklaas@uwa.edu.au **Dr Paul Drake** paul.drake@uwa.edu.au	**How does vegetation affect the water balance on mine waste rock dumps?** Vegetation on mine waste rock dumps is not only a legal requirement but also provides "ecosystem services". On waste dumps where net percolation is undesirable because of toxic material, plant transpiration helps create a favourable "store-and- release" function. This line of research aims at determining the ideal mix of water use behaviours and drought tolerance levels in plant species, as dependent on substrate properties and climate. Projects may have an emphasis on transpiration, root water uptake, hydraulics, etc.	**Honours** **Masters** **PhD**
A/Prof Erik Veneklaas erik.veneklaas@uwa.edu.au **Dr Justin Valliere** justin.valliere@uwa.edu.au	**Ecophysiological research to support mine-site restoration** Restoring a diverse plant community on post-mining sites in WA is challenging our understanding of what substrate and climatic conditions plants need and tolerate. Ecophysiology can help to identify the drivers of species success in plant establishment, growth and survival. Ongoing research addresses issues of plant nutrition, plant water relations, heat tolerance etc. in relation to soils, climate, seed provenance, management and other relevant factors. Our projects use traditional and novel technology in plant physiology to measure plant traits and plant condition. This includes gas exchange, hydraulics, spectral and thermal sensing and several other field and lab methods. Projects on plant-plant, plant-microbe and plant-pathogen interactions are also possible.	**Honours** **Masters**

A/Prof Erik Veneklaas erik.veneklaas@uwa.edu.au **Dr Greg Skrzypek** grzegorz.skrzypek@uwa.edu.au **Dr Gavan McGrath** gavan.mcgrath@dbca.wa.gov.au	**Water sourcing of plants in a Swan River saltmarsh** Ashfield Flats is a threatened temperate coastal saltmarsh in the Perth Metropolitan Area. Changes are expected in the local hydrology of the site, due to likely modifications to urban drainage and due to climate change. Improved knowledge of the water dynamics at the site and the use of different water sources (depth, salinity etc.) by vegetation is needed. This project, supported by DBCA, involves experimental research in a controlled environment to test methodology for field studies. The project has elements of plant physiology, soil science, and isotope biogeochemistry, and will include measurements as well as some modelling.	**Honours** **Masters**
A/Prof Erik Veneklaas erik.veneklaas@uwa.edu.au **Dr Carolyn Harding** carolyn.harding@dbca.wa.gov.au	**Salinity and drought tolerance of samphires in a Swan River saltmarsh** Ashfield Flats is a threatened temperate coastal saltmarsh in the Perth Metropolitan Area. Changes are expected in the local hydrology of the site, due to likely modifications to urban drainage and due to climate change. Samphires are a characteristic element of salt marshes. Contrasting spatial distributions of the five species occurring at Ashfield Flats suggest that there is niche differentiation related to salinity and inundation regimes. This project, supported by DBCA, involves experimental research in a controlled environment to assess tolerance to salinity and inundation, which will assist with conservation efforts.	**Honours** **Masters**
A/Prof Erik Veneklaas erik.veneklaas@uwa.edu.au	**Plant water relations** Water is an essential but scarce resource for almost all plants in WA. We do fundamental and applied research to understand how plants maximise water uptake, minimise water loss, and optimise water use efficiency. The projects can be field or lab-based, and may focus on roots, stems, leaves or whole plants. Techniques include hydraulics, gas exchange (photosynthesis/transpiration), micrometeorology, microscopy, stable isotopes and others.	**Honours** **Masters** **PhD**