School of Agriculture and Environment

# Honours and Masters Research:

Potential projects and supervisors

2021

Agricultural Science
Biotechnology
Environmental Science

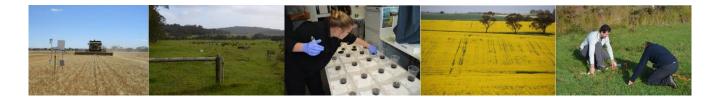




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# **Agricultural Science**



The table below shows which supervisors have projects listed under each of the seven 'Specialisations' that are offered within the Master of Agricultural Science. All projects are suitable for Honours.

POTENTIAL   POTE		Agribusiness		Agricultural	Crop and	Genetics	Integrated	Soil
Nutrition			Economics	Technology				
SUPERVISOR         V         V           Michael Ashworth         V         V           Martin Barbetti         V         V           Louise Barton         V         V           Umprinique Blache         V         V           Michael Burton         V         V           Roberto Busi         V         V         V           Nik Callow         V         V         V           Wallace Considine         V         V         V           Wallace Cowling         V         V         V           Jamine Croser         V         V         V           Ken Flower         V         V         V           Jamine Fogarty         V         V         V           Kankelty Hailu         V         V         V           Sasha Jenkins         V         V         V           Parwinder Kaur         V         V         V           Ross Kingwell         V         V         V         V           Marit Kragt         V         V         V         V         V           Judith Lichtenzveig         V         V         V         V         V	DOTENTIAL					Breeding	Management	
Michael Ashworth         V         V           Martin Barbetti         V         V           Louise Barton         V         V           Hugh Beckie         V         V           Dominique Blache         V         V           Michael Burton         V         V           Roberto Busi         V         V         V           Nik Callow         V         V         V           Michael Considine         V         V         V           Wallace Cowling         V         V         V           Janine Croser         V         V         V           Ken Flower         V         V         V           James Fogarty         V         V         V           James Fogarty         V         V         V           Sasha Jenkins         V         V         V           Parwinder Kaur         V         V         V           Ross Kingwell         V         V         V         V           Marit Kragt         V         V         V         V           Amin Mugera         V         V         V         V           Phillip Nichols         V					Systems			Nutrition
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Louise Barton					V	-1	V	
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Roberto Busi					√			
Nik Callow			√					
Michael Considine								
Wallace Cowling         V           Janine Croser         V           Ken Flower         V           James Fogarty         V           Atakelty Hailu         V           Sasha Jenkins         V           Parwinder Kaur         V           Ross Kingwell         V         V           Marit Kragt         V         V           Judith Lichtenzveig         V         V           Amin Mugera         V         V           Phillip Nichols         V         V           David Pannell         V         V           Andrew Rate         V         V           Zed Rengel         V         V           Megan Ryan         V         V           Kadambot Siddique         V         V           Erik Veneklaas         V         V           Phill Vercoe         V         V					٧		√	
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Phil Vercoe         V         V           Ben White         V         V						√		
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- Studies that can be taken using a 'desktop' approach, and thus not requiring field or laboratory work. These studies can be undertaken remotely.

TBC = To be confirmed.

# **Agribusiness**

Specialisation coordinator: Dr Amin Mugera (Amin.mugera@uwa.edu.au)

#### Prof. Ross Kingwell (Ross.kingwell@uwa.edu.au)

# Impact of Covid-19 on demand for Australian agricultural commodities



The global impact of COVID has affected consumer behaviour in many ways. How has the demand for Australian agricultural commodities been affected, and why? Which types of commodities have been least affected, or most affected? What have been the COVID-related industry and government responses in Australia and in other competing agricultural countries? Co-supervised by TBC.

#### Diversification of farm businesses in Australia



One of the farm business defences towards market, price and production risk is enterprise diversification. How diversified are farm businesses in Australia. Has their degree of diversification changed over time? Are there notable regional differences in farm diversification? The student can draw on ABARES AgSurf data to help answer these questions. Co-supervised by TBC.

#### Dr Marit Kragt (Marit.kragt@uwa.edu.au)

#### Crowdfunding as an alternative source of finance for agricultural enterprises



Crowdfunding has taken the world by storm. It offers a means to fund agricultural innovation or sustainable practices by connecting entrepreneurs to a multitude of supporters who provide some of the required project funding. What would the opportunities for this be in Australia? In this project, you will do a comparative analysis of successful crowdfunding campaigns, complete an experiment for sustainable agriculture practices, and draw lessons for Australian farmers. Co-supervised by Fiona Dempster.

#### Behavioural barriers to innovation adoption



Many new technologies and practices are developed that could improve the sustainability or profitability of farming systems. Despite their obvious advantages, adoption of innovations is lagging. In this research, you will conduct an in-depth systematic review of studies on farmers' adoption of innovations and the barriers/challenges they face. This study will focus specifically on the use of behavioural science to consider adoption processes. Co-supervised by Fay Rola-Rubzen and Ben White.

#### A/Prof. Fay Rola-Rubzen (Fay.rola-rubzen@uwa.edu.au)

Constraints facing smallholder farmers in participating in agribusiness value chains (Developing countries)

Market access is important for farmers in developing countries for them to fully benefit from agricultural development. However, smallholder farmers often find it difficult to access high value markets. This study will examine the production and marketing constraints that prevent smallholders from accessing high value markets. The study will involve interviewing farmers and selected key high value supply chain participants (e.g., supermarkets, restaurants, hotels). The findings will provide important information required for an enabling environment for farmers to be able to participate in high value agribusiness markets. Co-supervised by TBC.

#### Mapping the supply chain for conservation agriculture-based sustainable intensification technologies (Developing countries)

One of the bottlenecks faced by farmers in developing countries in the adoption and scaling of conservation agriculture-based sustainable intensification technologies (e.g., zero till (ZT) machines, seeders/ seeding machines) is the lack of available technologies in rural areas. In this study, you will map the supply chain for CASI technologies and determine the barriers faced by various actors in the supply chain. Co-supervised by TBC.

# **Agricultural Economics**

Specialisation coordinator: Dr Amin Mugera (Amin.mugera@uwa.edu.au)

#### Prof. Michael Burton (Michael.burton@uwa.edu.au)

#### Are drinkers confused about what they drink?



This project will analyse data on consumer choices between wine, beer, and spirits products that have different attribute combinations and test whether consumer choices are consistent with the prediction implicit in standard models of consumer choice. Co-supervised by James Fogarty.

#### A new form of food label



There is a plethora of labels that give consumers information about the unobservable environmental impacts of the goods they consume, in an effort to influence behaviour. This study will evaluate a new, simple, theoretically correct method of conveying this information, and its impact on consumers. Co-supervised by TBC.

#### Prof. James Fogarty (James.fogarty@uwa.edu.au)

## Trade policy, the tyranny of distance, and Trump



Australian agricultural producers are global leader in terms of production efficiency, and Australia has been a strong advocate of multilateral trade agreements to reduce tariff barriers. The focus of recent trade policy has seen a shift away from multilateral trade agreements towards bilateral trade agreements. This research project will: (i) review trade policy theory; (ii) document tariff changes implemented under multilateral trade agreements and the impact of these changes on the agriculture sector; (iii) provide a critical evaluation of the benefits of Australia's bi-lateral trade agreements for the agricultural sector, and assess the potential benefits of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership. Potential co-supervisor: Ross Kingwell.

#### Distance education for improved productivity in the agriculture sector



In the past decade there have been substantive changes in the way higher education is delivered, and these changes provide opportunities to provide education services to Agricultural Science and Agribusiness students in new ways. This research project will (i) review the education literature to identify best practice approaches for on-line education, (ii) survey institutions delivering Agricultural Science and Agribusiness education via online platforms and understand the business model of these institutions and (iii) develop a financial model that can identify the breakeven point for operating an online Agricultural Sciences and Agribusiness education program. Potential co-supervisors: Amin Mugera, Dominique Blache.

#### Industry levies for agricultural production



In Australia, compulsory levies are charged to growers to fund biosecurity, generic marketing functions, and industry research and development. This research project will (i) review the different funding arrangements implemented across agricultural industries in Australia to fund these functions, (ii) evaluate different models of service delivery, using criteria such as efficiency and equity and (iii) make recommendations for best practice industry levy schemes. Potential co-supervisor: Ben White.

## Wine quality and price: a quantitative survey of the literature



Studies have investigated the price-quality trade-off in the wine market. This project involves (i) discussing the existing literature and (ii) undertaking a quantitative analysis of the existing literature using a meta-analysis approach. The main data source for this research will be existing published studies. Potential co-supervisor: Chunbo Ma.

# Weather and Fine Wine: Cabernet Sauvignon for the Yarra Valley and Margaret River



This project will use a regression model to explain observed wine quality through analysis of weather variables during the grape growing season. The project involves the creation of a database of fine wine sale price data collected from an auction house. The final sale price of the wines will then be regressed on weather data collected from the Bureau of Meteorology to determine the role of weather variables in determining wine quality. Separate models will be estimated for the Yarra Valley and Margaret River. Potential co-supervisor: Chunbo Ma.

## Regulation and deregulation in Australian Agriculture



The case for deregulation of agricultural markets has been argued successfully by agricultural economists over an extended period. This project will provide a historical review of the role of Agricultural economics in shaping the national process of industry deregulation, and will involve setting out the theoretical model that supports deregulation and reviewing the performance of each industry sector post deregulation. Potential co-supervisor: Ross Kingwell.

#### Potato market deregulation and the spud shed



To ensure supply and mitigate against price fluctuations the Western Australian ware potato market was regulated during the Second World War, and production regulations remained in place until 2016. This research project will: (i) provide a historical review of potato market regulation; (ii) estimate the consumer welfare loss due to market regulation; and (iii) describe the change in the industry structure post deregulation. Potential cosupervisor: Ben White.

# The Demand for Meat: a meta-analysis approach



The consumer response to price changes in the market for meat has been studied extensively. This project involves: (i) discussing the existing published literature on the price elasticity and income elasticity for meat as a whole, and specific meat products; and (ii) undertaking a quantitative analysis of the existing literature, starting with Australia. You will collect information from existing studies and undertake a systematic review of the published information using a meta-analysis method. Depending on the size of the literature identified it may be possible to extend the analysis to other countries. Potential co-supervisor: Michael Burton.

# Counting calories: A meta-analysis of posting calorie content information



Requiring fast-food chain restaurants to post information on the energy content of the food they serve is an increasingly common requirement. A number of studies have investigated the effect of calorie posting. This project involves: (i) reviewing the issue of obesity and the relationship to fast food consumption; and (ii) conducting a structured review and meta-analysis of the existing literature on the effect of calorie posting. A major part of the project will be to collate and review the existing literature. Potential co-supervisor: Michael Burton.

#### A/Prof. Atakelty Hailu (Atakelty.hailu@uwa.edu.au)

#### Profitability and productivity analysis

Did you ever wonder why some firms or farms do better than others? Why they have lower prices, lower costs or better revenues? Or why some tend to improve their performance faster than others? Well, you might be able to generate good answers to the questions using productivity and efficiency analysis. The focus industry could be mining, agriculture, manufacturing, utilities or other service industries. The analysis could be at a local or aggregate level (State or National). Methods that are relevant include data envelopment analysis (DEA) and econometric methods such as stochastic frontier analysis (SFA). Co-supervised by Amin Mugera, Michael Burton.

# Bio-economic modelling of optimal farm management practices



What do farms consider when they make decisions about what to grow and how? How do they modify their activities to take advantage of changes in market prices or environmental policies? Would farms alter their behaviour to take advantage of initiatives that pay for greenhouse gas emission reduction? How do predictions from models compare with actual farm management decisions? This project is suitable for a student who is keen to survey farmers to investigate the degree to which farm management practices are rational and conform to assumptions made in economic modelling. You will use an existing whole-farm economic model and interview farmers to test critically and improve the assumptions and data underpinning the economic model. Cosupervised by Ross Kingwell.

#### Developing quality indicators for soil, land, parks, and all that

Developing indicators or quality measures to compare apple and orange type problems is fun. Soil scientists have wanted to summarise diverse soil quality variables into summary measures. The problem applies to many other cases, e.g. comparing park quality, cities, countries, etc. The focus depends on the interest of the student. Economic models can be used to provide sound basis for quality indicator construction. This project is relevant to researchers in agriculture, environmental science or development economics. For example, in development economics, the researcher might be interested in comparing different countries (e.g. in a single continent or more broadly). A researcher interested in conservation might want to focus on developing quality indicators for natural habitats. Co-supervised by Michael Burton, Chunbo Ma, Steven Schilizzi.

#### Prof. Ross Kingwell (Ross.kingwell@aegic.org.au)

#### The impact of climate variability on farm productivity gain

Does climate variability reduce a farm's ability to attain high rates of productivity improvement? What might be the implications of climate change on broadacre farm productivity growth in Western Australia? Using simulation models of representative farms, this project will examine how climate variability affects farm profit and the ability of different farms to invest in productivity-improving innovation. Co-supervised by TBC.

#### Principle-agent theory to improve sheep management

A problem in modern large-scale farming is that some crop-dominant farm owners/managers neither have the time nor interest in ensuring sheep management is well-integrated into their farm business practices. Can principal-agent theory provide any guidance to improving sheep management on broadacre farms? This study will involve interacting with farmers and their advisers in order to build, apply and refine a principal-agent model to capture key viewpoints and determine economic solutions that improve sheep management. Co-supervised by TBC.

#### Adoption of GM canola in WA

Why is adoption of GM canola in WA so different to what has occurred in many other countries or regions? The ADOPT model will be applied to GM and non-GM canola in WA to see what factors most likely may have influenced farmers' adoption decisions regarding canola and GM canola in particular. Co-supervised by TBC.

#### Dr Marit Kragt (Marit.kragt@uwa.edu.au)

## Crowdfunding as an alternative source of finance for agricultural enterprises



Crowdfunding has taken the world by storm. It offers a means to fund agricultural innovation or sustainable practices by connecting entrepreneurs to a multitude of supporters who provide some of the required project funding. What would the opportunities be for this in Australia? In this project, you will do a comparative analysis of successful crowdfunding campaigns, complete an experiment for sustainable agriculture practices, and draw lessons for Australian farmers. Co-supervised by Fiona Dempster.

#### Behavioural barriers to innovation adoption



Many new technologies and practices are developed that could improve the sustainability or profitability of farming systems. Despite their obvious advantages, adoption of innovations is lagging. In this research, you will conduct an in-depth systematic review of studies on farmers' adoption of innovations and the barriers/challenges they face. This study will focus specifically on the use of behavioural science to consider adoption processes. Co-supervisors: Fay Rola-Rubzen and Ben White.

# Socio-economic costs of agricultural waste management



This project is part of a large interdisciplinary and industry-funded project that is developing novel ways to process livestock waste using Black Soldier Flies (BSF). The student will evaluate the non-marketed costs of current livestock waste management strategies. You will conduct a meta-analysis of the literature to quantify the costs of current waste treatment strategies, including direct financial costs, environmental costs, and impacts on human and animal health. Co-supervised by Fiona Dempster.

#### Black Soldier Fly meal and oil as a high quality animal feed product

This project is part of a large interdisciplinary and industry-funded project that is developing novel ways to process livestock waste using Black Soldier Flies (BSF). The student will evaluate whether BSF products from approved waste materials could be used as animal feed. Based on desktop research, data from the BSF project, and industry consultation, you will write a research report that describes how well BSF meal and oil could meet the feed specifications, diet formulations and other requirements for monogastrics. Co-supervised by Sasha Jenkins.

#### Dr Amin Mugera (Amin.mugera@uwa.edu.au)

# Research in international development



Research projects in development economics field emphasize the economics of agricultural growth and development with a focus on the analysis of food and nutrition security, poverty and vulnerability to poverty, farm household efficiency and productivity, marketing policy, and performance of food systems in developing countries. Given the geographical diversity of students in our course, those research projects are tailored to the specific research interest of the student subject to availability of data and financial resources where necessary. Often, the projects involve analysis of large survey dataset available in the public domain - such as the World Bank Living Standard Survey - using econometric techniques to address specific issues in international development. Co-supervised by TBC.

#### A/Prof. Fay Rola-Rubzen (fay.rola-rubzen@uwa.edu.au)

# The economics of early seeding in the Eastern Gangetic Plains



Farmers in the Indo-Gangetic Plains of South Asia are faced with many challenges, some exacerbated by climate change. An intervention to improve farmers' resilience is early seeding which is seen to have several advantages such as better opportunity for pest, disease and weed control, and early harvesting which could open up opportunities for a third crop. However there are also risks and economic considerations involved. This project will look at the economics of early seeding using field-level data of farmers in the Eastern Gangetic Plains South Asia. Co-supervised by TBC.

#### Are CASI farmers more technically efficient than non-CASI farmers?



Using scarce resource efficiently is critical in achieving food security. This is especially important in South Asia, home to one of the largest concentration of poor people in the world. The type of farming systems and technologies adopted also have a bearing on the efficiency of farmers. This study will examine the technical efficiency of farmers using Conservation Agriculture-based Sustainable intensification (CASI) technologies compared to those using conventional tillage (CT) using stochastic production frontier analysis. The findings will provide important policy recommendations on sustainable production in the region. Co-supervised by TBC.

## Sources of technical (in)efficiency of vegetable farmers in Mindanao



Farmers are constantly striving to improve their productivity and profitability. In Mindanao, Philippines, vegetable farmers have adopted various farming practices geared towards improving productivity. However many farmers are still producing below the optimal level. In this study, you will use existing survey data to analyse farmers' technical efficiency and identify sources of technical inefficiency using stochastic frontier production analysis (SFA) or data envelop analysis (DEA). Co-supervised by TBC.

#### Constraints facing smallholder farmers in participating in agribusiness value chains (Developing countries)

Market access is important for farmers in developing countries to fully benefit from agricultural development. However, smallholder farmers often find it difficult to access high value markets. This study will examine the production and marketing constraints that prevent smallholders from accessing high value markets. The study will involve interviewing farmers and selected key high value supply chain participants (e.g., supermarkets, restaurants, hotels). The findings will provide important information required for an enabling environment for farmers to be able to participate in high value agribusiness markets. Co-supervised by TBC.

#### **Improving Service Provision for CASI Technologies (Developing countries)**

One of the bottlenecks faced by farmers in developing countries in the adoption of innovative technologies is the lack of availability of these technologies (e.g., zero till (ZT) machines, seeders/ seeding machines) in their area. Despite the increasing interest of farmers in ZT machines, service providers do not seem interested in providing this machinery. In this study, you will analyse the reasons for the lacklustre response of service providers in supplying ZT machines. You will also examine their willingness to supply ZT machines. Co-supervised by TBC.

#### Analysis of preferences for conservation agriculture incentives among smallholder farmers in South Asia

In this study, you will apply framed choice experiments to examine the relative preferences of smallholder farmers in either India, Bangladesh, or Nepal, in regards to three policy-based incentives to adopt conservation agriculture-based sustainable intensification practices. The policy incentives include: an index-based crop insurance contract, micro-incentive payments, and fertilizer subsidies. Co-supervised by TBC.

## Do farmers perception of climate change risk influence adoption of Conservation agriculture-based sustainable technologies?

This study will examine whether farmers' perception of climate change risks influences their adoption behaviour towards the use of conservation agriculture-based sustainable intensification (CASI) using survey data collected from a random sample of farmers in the Indo-Gangetic Plains in South Asia. There will be an opportunity to develop an adoption-decision making framework and analyse the data using logit models. Co-supervised by TBC.

## Behavioural factors influencing adoption of conservation agriculture-based sustainable intensification technologies in South Asia

Decisions to adopt new technology is influenced by economic and non-economic factors such social, cultural, psychological and other behavioural factors. In this study, you will examine the role of behavioural factors in technology adoption. Co-supervised by TBC.

#### Climate change coping strategies of men and women in South Asia

One of the largest remaining pockets of poverty around the world is in South Asia. To compound the issue, the region is faced by climate-related challenges. Climate change does not affect women and men in the same way because of their different roles at the household, the farm and the community. Hence their coping mechanisms also differ. In this project, you will examine the differential strategies used by men and women farmers to cope with climate change using mixed methods (quantitative and qualitative analysis). The analysis will provide important insights in regards to policy instruments that can support men and women farmers become more resilient to climate change. Co-supervised by TBC.

#### Willingness to pay for ICT-based agricultural extension among farmers in the EGP

The lack of agricultural extension workers and wide coverage per extension worker mean that many farmers in the Eastern Gangetic Plains (EGP) do not receive important agricultural information. With the advent of big data and increased affordability of mobile phones, ICT-based agricultural extension may provide some solution to this problem. This study will focus on examining farmers' acceptability and willingness to pay for mobile phone based agricultural extension in the Eastern Gangetic Plains using non-market valuation. Co-supervised by TBC.

#### Prof. David Pannell (David.pannell@uwa.edu.au)

#### Prioritising agricultural research projects



There are many more potential agricultural research projects than there is funding for, so it is important to do a good job of prioritising which projects receive funding. This project focuses on the maths and the economics of that prioritisation. Using data from real research projects, and working in collaboration with US-based researchers, we will investigate the performance of difference mathematical systems for prioritising projects. Co-supervised by Prof. Phil Pardey (University of Minnesota).

#### Prof. Steven Schilizzi (Steven.schilizzi@uwa.edu.au)

#### Food safety in Vietnam or other developing country

A large ACIAR research project had been designed before Covid19 for looking at vegetable growers, pig slaughterhouses and consumer attitudes towards food safety in Vietnam. Different aspects have been studied and corresponding datasets being collected by one of our (Vietnamese) PhD students. This provides ample material for an Honours or Masters project to work on, by analysing some of the data from a particular angle, or using them as a starting point for a comparison with another country. Co-supervised by Michael Burton, Amin Mugera.

#### A/Prof. Ben White (Benedict.white@uwa.edu.au)

# Where there is no muck there is money: value of dung beetles in farming systems



Introduced dung beetles do a dirty job in that they bury livestock manure, but they are highly valued in terms of increasing soil fertility and suppressing blow flies. This Masters or Honours project will estimate the value of dung beetles in farming systems in the Northern Wheatbelt. Funding to support the project will be available through a Meat and Livestock Australia project. Co-supervised by Fiona Dempster.

#### The economics of beneficial insects for pollination



This study will explore the value of honey bees to a number of pollinator dependent industries possibly avocados. Managed honey bees are good pollinators, but so are feral honey bees and some native insects. This Masters or Honours project will be linked to the Honey Bee products Cooperative Research Centre. Co-supervised by Liz Barbour.

#### How do farmers select cereal varieties? What determines the rate of adoption and dis-adoption of cereal varieties?

This project would involve developing a questionnaire to assess how farmers select "portfolios" of varieties to plant on their farms based on variety attributes that include yield, grain quality, disease resistance and frost tolerance. The project would focus on how farmers trade-off risk and return in making variety selections. Cosupervised by Fiona Dempster

#### The Aliens are coming! How should Western Australia prepare?



The Russian wheat aphid is a potentially devastating cereal pest of wheat and barley in Australia. It established in South Australia in 2016 and this was the first incursion into Australia. This project will involve an economic analysis of how the WA cereal industry should respond in terms of resistant varieties and pesticides. Cosupervised by Fiona Dempster.

#### How do poor households reduce exposure to risk



This study will use panel data from Vietnam (possibly another country if data is available) to test hypotheses about the strategies households use to avoid exposure to weather and natural disaster risk. For instance do they reallocate labour out of agriculture into other employment or businesses? Co-supervised by Amin Mugera.

# Agricultural Technology

Specialisation coordinator: Prof. Megan Ryan (Megan.ryan@uwa.edu.au)

#### A/Prof. Nik Callow (Nik.callow@uwa.edu.au)

# Scouting for pests using smartphone applications and drone-based crop assessment of plant stress



Scouting grain crops for pests and diseases is time consuming and often inaccurate. Random sampling hopes to find pest hotspots in parts of paddocks, but often miss them. This means growers are either losing money on unnecessary pesticide application or yield loss in parts of crops which are missed. Spatial data such as remote sensing using near infrared and infrared spectra have been shown to be able to detect and map regions of crop which are experiencing biotic or abiotic stress. Our prior research has shown the potential for using NDVI nod other indices to identify stressed areas of canola crops impacted by biotic (e.g. aphid) and abiotic (e.g. potassium deficiency) processes. Pests can cause a crop stress response and the student will work with industry to use new remote sensing technologies to live-stream remote sensing indices like Normalised Difference Vegetation Index (NDVI) video from a drone, to inform where to sample for agricultural pests and evaluate the use of this new, cutting-edge approach. Jointly supervised with Ken Flower and Dr Dustin Severtson (DPIRD).

#### Dr Ken Flower (Ken.flower@uwa.edu.au)

#### Weed detection in crops for site specific management

Weeds have major impacts on crops and they are currently managed by treating whole paddocks uniformly. This project will investigate different ways to detect and map weeds in crops using remote sensing. This would help farmers locate weed patches in the field and evaluate the success of previous weed management strategies, as well as assist with planning future herbicide applications and cultural control measures. Co-supervised by Mike Ashworth and Hugh Beckie (Australian Herbicide Resistance Initiative AHRI).

#### A/Prof. Fay Rola-Rubzen (Fay.rola-rubzen@uwa.edu.au)

# Are CASI farmers more technically efficient than non-CASI farmers?



Using scarce resource efficiently is critical in achieving food security. This is especially important in South Asia, home to one of the largest concentration of poor people in the world. The type of farming systems and technologies adopted also have a bearing on technical efficiency of farmers. This study will examine the technical efficiency of farmers using Conservation Agriculture-based Sustainable intensification (CASI) technologies compared to those using conventional tillage (CT) using stochastic production frontier analysis. The findings will provide important policy recommendations on sustainable production in the region. Co-supervised by TBC.

## Sources of technical (in)efficiency of vegetable farmers



Farmers are constantly striving to improve their productivity and profitability. In Mindanao, Philippines, vegetable farmers have adopted various farming practices geared towards improving productivity. However many farmers are still producing below the optimal level. In this study, you will use existing survey data to analyse farmers' technical efficiency and identify sources of technical inefficiency using stochastic frontier production analysis (SFA) or data envelop analysis (DEA). Co-supervised by TBC.

#### **Improving Service Provision for CASI Technologies (Developing countries)**

One of the bottlenecks faced by farmers in developing countries in the adoption of innovative technologies is the lack of availability of these technologies (e.g., zero till (ZT) machines, seeders/ seeding machines) in their area. Despite the increasing interest of farmers in ZT machines, service providers do not seem interested in providing this machinery. In this study, you will analyse the reasons for the lacklustre response of service providers in supplying ZT machines. You will also examine their willingness to supply ZT machines. Co-supervised by TBC.

# Behavioural factors influencing adoption of conservation agriculture-based sustainable intensification technologies in South Asia

Decisions to adopt new technology is influenced by economic and non-economic factors such social, cultural, psychological and other behavioural factors. In this study, you will examine the role of behavioural factors in technology adoption. Co-supervised by TBC.

#### Prof. Phil Vercoe (Philip.vercoe@uwa.edu.au)

#### Reducing methane emission from sheep and cattle

Mitigating methane emissions from sheep and cattle through manipulating the feed base, exploring the antimethanogenic properties of plant secondary compounds in Australian native plants, and genetic selection. This work includes plants, feed additives and grazing management practices that are relevant to the northern WA beef industry (northern and southern rangelands, fodder from pivot irrigation) as well as southern sheep and beef systems and is part of the approach to addressing the goal of the red meat industry to be carbon neutral by 2050. Potential co-supervisors: Zoey Durmic, Peter Hutton, Dean Revell.

# **Crop and Livestock Farming Systems**

Specialisation coordinator: Prof. Megan Ryan (Megan.ryan@uwa.edu.au)

#### Dr Mike Ashworth (Mike.ashworth@uwa.edu.au)

#### Remote sensing crops for weed competitiveness

The normalized difference vegetation index (NDVI) is widely used in agriculture and environmental research and the industry as a measure of plant health. It utilizes the reflectance from a leaf's surface of near infra-red and red light waves of sunlight to estimate an index. Canopeo is a mobile app that helps to estimate green canopy cover, it's potential use for environmental and agricultural use as a surrogate for NDVI is huge but it has not been widely studied. The agronomy team at the Australian Herbicide Resistance Initiative has been collecting field data over two years where a significant correlation was found (R²=0.77). The prospective student will carry out laboratory experiments to determine whether it is possible to create a regression model which allows to predict NDVI from Canopeo measurements. Co-supervised by TBC.

#### Effectiveness of the time of the spray topping/crop topping and alternatives to glyphosate/paraquat

Spray-topping of annual weed species during the reproductive growth stages is commonly done to prevent the formation of viable seeds. This late-stage intervention weed management approach is used to stop the target weeds from setting seed without negatively impacting the ability of the crop or the pasture species to produce seed. Spray topping/crop topping is widely used in Australian cropping systems in canola and pasture, however weeds are adapting their reproductive timing to evade spraytopping applications. This project will investigate whether we can effectively spray-top early flowering time brome grass populations without compromising crop and pasture grain and seed production? Co-supervised by TBC.

#### A/Prof. Louise Barton (Louise.barton@uwa.edu.au)

Quantifying the relative efficiency of nitrogen fertilizer uptake from surface and subsoils by agricultural crops Staple food crops are needed to maintain food security over the next two decades, with some suggesting this will be best achieved via intensification of production inputs such as N fertilizer. This will require losses of reactive forms of N from the soil to the environment, such as ammonia (NH₃), nitrous oxide (N₂O) and nitrate (NO<sub>3</sub>-), to be minimised if N fertilizer use is to be sustainable. Minimising N leaching is particularly problematic as our region's coarse textured sandy soils are particularly prone to N leaching. Any N that moves below the surface soil horizons needs to be utilised by roots in the subsoil if N leaching to ground and surface waters is to be prevented. The aim of this glasshouse study is to investigate the extent to which annual crops can utilise nitrogen stored in the subsoil. Co-supervisor: Dr Craig Scanlan (DPIRD).

#### Dr Dominique Blache (Dominique.blache@uwa.edu.au)

#### Investigating phytoestrogens as potential endocrine disruptors in the ram

Despite the persistence of oestrogenic pasture species in Australian production systems, the role of phytoestrogens as endocrine disrupting agents is poorly defined in livestock species, especially in males. This project aims to identify changes in ram sperm production, function and fertility following phytoestrogen exposure throughout the spermatogenetic cycle. Co-supervised by Kelsey Pool and Dr Peter Mark.

#### Pathways to infertility: mechanisms of action of phytoestrogens

Trifolium subterraneum clover has historically been used as a pasture throughout Western Australian sheep farms, but reproductive anomalies in flocks grazing this clover were linked to the presence of phytoestrogens. This project aims to investigate these pathways using artificial rumen model to study the changes in microbial population and production and activity of enzymes involved the metabolism of plant phytoestrogens in tissues such as fat and liver. Co-supervised by Phil Vercoe, Kelsey Pool and Caitlin Wyrwoll.

#### Is there a clock in the sheep stomach? Or chronobiology and rumen function

Circadian rhythms refer to endogenous biological processes that fluctuate over a 24-hour period. The microbial population present in the rumen is naturally exposed to circadian rhythms of temperature. Amazingly, so far all in-vitro study of rumen physiology have been done at constant temperature. You will explore the role of circadian rhythms of temperature in the rumen on the activity and survival of the microbial population. Cosupervised by Phil Vercoe and Shane Maloney.

#### Early life stress and subsequent stress resilience and emotionality in pigs

There is a substantial body of evidence in laboratory species, particularly non-human primates and rodents, that stress affects adult vulnerability to stressors. This project investigates how stress resilience acquired in early life will be mediated by long term changes in the activity of the pig's brain serotonergic and noradrenergic systems and stress axis. Co-supervised by Alan Tilbrook (Uni of Queensland).

#### Debugging few old wives tales about polled cattle



The adoption of genetically hornless cattle has been slow possibly because of a number of "old wives tales" about pollness including lower reproductive performance, lower resilience to harsh environments and poorer growth performance than horned cattle. The project consists of an in-depth analysis of a large database of growth and reproductive performance of polled and horned beef cattle obtained from cattle stations and slaughterhouses over several years. Co-supervised by David Walker and Alan Tilbrook (Uni of Queensland).

#### Dr Roberto Busi (Roberto.busi@uwa.edu.au)

#### Levels of resistance to the new herbicide bixlozone before it is commercialized in Australia

This project aims to reveal the level of herbicide resistance in annual ryegrass samples collected from across Australia submitted to UWA in 2020 for comprehensive herbicide tests in 2021. Project starts in March 2021. The work can presented at regional and national conference and published in a peer-reviewed journal. This would best position a candidate student with an interest in pursuing an academic career towards PhD. Work done entirely at UWA campus. Co-supervised by Hugh Beckie, Dr Danica Goggin (AHRI).

# Levels of herbicide resistance across different weeds: annual ryegrass, wild radish, brome, barley grass and

This project aims to reveal the level of herbicide resistance in weed samples (100+) collected from across Western Australia submitted to UWA for comprehensive herbicide tests in 2021. Project starts in early to mid-2021. The work will be suitable for presentation at regional and national conferences and publication in a peerreviewed journal. The project is within a greater GRDC-funded project with great opportunities of participating to extension workshops (June 2021) in regional WA and interact directly with WA growers and advisers. This would best position a candidate student with an interest in pursuing an academic career towards PhD. Work done entirely at UWA campus. Co-supervised by Hugh Beckie, Dr Danica Goggin (AHRI).

#### A/Prof. Nik Callow (Nik.callow@uwa.edu.au)

# Scouting for pests using smartphone applications and drone-based crop assessment of plant stress



Scouting grain crops for pests and diseases is time consuming and often inaccurate. Random sampling hopes to find pest hotspots in parts of paddocks, but often miss them. This means growers are either losing money on unnecessary pesticide application or yield loss in parts of crops which are missed. Spatial data such as remote sensing using near infrared and infrared spectra have been shown to be able to detect and map regions of crop which are experiencing biotic or abiotic stress. Our prior research has shown the potential for using NDVI nod other indices to identify stressed areas of canola crops impacted by biotic (e.g. aphid) and abiotic (e.g. potassium deficiency) processes. Pests can cause a crop stress response and the student will work with industry to use new remote sensing technologies to live-stream remote sensing indices like Normalised Difference Vegetation Index (NDVI) video from a drone, to inform where to sample for agricultural pests and evaluate the use of this new, cutting-edge approach. Jointly supervised with Ken Flower and Dr Dustin Severtson (DPIRD).

#### A/Prof. Michael Considine (Michael.considine@uwa.edu.au)

#### Which climate cues regulate dormancy and viability in grapevine?

Grapevine is highly climate sensitive. In temperate regions it displays a deciduous habit, whereas in subtropical and tropical climates it tends towards evergreen. Managing production however relies on orderly and predictable growth. There are enormous opportunities to expand production in northern regions and to contribute to adaptation under climate change in existing production areas. Suitable research projects: (i) Dynamics of bud dormancy in key varieties and climate regions of Western Australia; (ii) Epigenetic regulation of dormancy, and (iii) Dynamics of the photoperiod regulon of CO/FT during dormancy. Co-supervised by Joanne Wisdom; John Considine.

#### Climate effects on fruit quality in citrus

Sadly blemishes cause serious food wastage. In citrus, albedo, the white pith under the orange epidermis can die, causing spotting and blemishes (albedo breakdown). It is considered a response to climate stress – waterdeficit or thermal stress. The extent of the problem is regional: Moora and Harvey based orchards tend to suffer while those in West Gingin do not. Available projects include: (i) Effect of meso- and micro-climate on albedo breakdown; (ii) Determination of particular nutritional factors associated with albedo breakdown, and (iii) Spatial location of the disorder occur within tree with respect to solar and wind exposure. Co-supervised by Joanne Wisdom; John Considine.

#### Reserves as signals in perennial plant phenology and development

Perennial plants are distinguished by the presence of tissues and organs that serve as reserve pools of carbon and nitrogen and usually by episodic annual growth cycles. One or two vegetative cycles in temperature trees and shrubs but as many as four in subtropical and tropical trees and shrubs. This project seeks develop analytical tools to dissect the partitioning of metabolisable carbon through the annual cycle(s) of growth and to follow the path of their flow – symplast/apoplast. We seek then to apply that to explore their role in periodicity –stasis – acclimatisation – growth and of biomass partitioning: reproductive organs to vegetative organs. Co-supervised by Joanne Wisdom; Prof. John Considine.

#### Dr Ken Flower (Ken.flower@uwa.edu.au)

#### Weed detection in crops for site specific management

Weeds have major impacts on crops and they are currently managed by treating whole paddocks uniformly. This project will investigate different ways to detect and map weeds in crops using remote sensing. This would help farmers locate weed patches in the field and evaluate the success of previous weed management strategies, as well as assist with planning future herbicide applications and cultural control measures. Co-supervised by Mike Ashworth and Hugh Beckie (Australian Herbicide Resistance Initiative AHRI).

#### Dr James Fogarty (James.fogarty@uwa.edu.au)

# The Demand for Meat: a meta-analysis approach



The consumer response to price changes in the market for meat has been studied extensively. This project involves: (i) discussing the existing published literature on the price elasticity and income elasticity for meat as a whole, and specific meat products; and (ii) undertaking a quantitative analysis of the existing literature, starting with Australia. You will collect information from existing studies and undertake a systematic review of the published information using a meta-analysis method. Depending on the size of the literature identified it may be possible to extend the analysis to other countries. Potential co-supervisor: Michael Burton.

#### Prof. Ross Kingwell (Ross.kingwell@aegic.org.au)

#### The impact of climate variability on farm productivity gain

Does climate variability reduce a farm's ability to attain high rates of productivity improvement? What might be the implications of climate change on broadacre farm productivity growth in Western Australia? Using simulation models of representative farms examine how climate variability affects farm profit and the ability of different farms to invest in productivity-improving innovation. Co-supervised by TBC.

#### Principle-agent theory to improve sheep management

A problem in modern large scale farming is that some cropdominant farm owners/managers neither have the time nor interest in ensuring sheep management is well-integrated into their farm business practices. Can principal-agent theory provide any guidance to improving sheep management on broadacre farms? This study will involve interacting with farmers and their advisers in order to build, apply and refine a principal-agent model to capture key viewpoints and determine economic solutions that improve sheep management. Co-supervised by TBC.

#### Adoption of GM canola in WA

Why is adoption of GM canola in WA so different to what has occurred in many other countries or regions? The ADOPT model will be applied to GM and non-GM canola in WA to see what factors most likely may have influenced farmers' adoption decisions regarding canola and GM canola in particular. Co-supervised by TBC.

#### Dr Marit Kragt (Marit.kragt@uwa.edu.au)

#### Black Soldier Fly meal and oil as a high quality animal feed product

This project is part of a large interdisciplinary and industry-funded project that is developing novel ways to process livestock waste using Black Soldier Flies (BSF). The student will evaluate whether BSF products from approved waste materials could be used as animal feed. Based on desktop research, data from the BSF project, and industry consultation, you will write a research report that describes how well BSF meal and oil could meet the feed specifications, diet formulations and other requirements for monogastrics. Co-supervised by Sasha Jenkins.

#### Dr Judith Lichtenzveig (Judith.Lichtenzveig@uwa.edu.au)

#### Plant response to deep sowing in chickpea and lentil (multiple projects available)

Are you looking forward to getting your boots dirty while applying modern scientific concepts and techniques? Dr Rich's trials have uncovered promising aspects of deep sowing of profitable pulses of immediate impact to agricultural practices in the medium to low rainfall region of the Central and Eastern Wheat belt of WA. You are welcome to join us and choose your project's focus: root physiology, plant-water/nutrient interactions, and genetics underlying the response to deep sowing. Co-supervised by Dr Sarah Rich (CSIRO, Farming Systems).

#### Prof. Zed Rengel (Zed.rengel@uwa.edu.au)

#### Effects of glyphosate drifts on non-resistant canola and wheat crops

Glyphosate-resistant canola is grown in proximity of non-resistant crops. Given that glyphosate is now applied in-crop to resistant varieties, there is potential of drift to nonresistant varieties. Work in 2015 showed that such drift (2-3% of the weed-kill rate) can damage root and shoot growth and micronutrient uptake of non-resistant canola and wheat varieties. This work can be extended by testing the alleviating effects of micronutrient sprays before glyphosate drift occurring. Co-supervised by TBC.

#### Plant physiology of nutrient uptake and transport (multiple projects)

Multiple projects on offer including (i)Transport pathways of root- and leaf-supplied micronutrients into developing cereal or legume grains; (ii) Fertilizer placement and nutrient uptake by various crops; (iii) Modelling 3D root growth nutrient uptake and determining optimal fertilization; (iv) P nutrition and root exudation by various crops and genotypes and (v) Characterise N-use efficiency of selected wheat and barley genotypes, specifically looking at potential mechanisms underlying differential efficiency (eg. root growth, stem carbohydrates, N remobilisation from leaves into developing grain, etc). Co-supervised by TBC.

#### **Effectiveness of various elemental S fertilizers**

CSBP would support the project financially, and their staff would be involved in supervision. Many soils in WA are testing low in sulphur (S). Canola has particularly high S requirement. One to two soils will be used in testing various sources and rates of S fertilisers. Co-supervised by TBC.

#### Biology and chemistry of rhizosphere

Projects on offer include (i) Role of root exudates in acquisition of micronutrients and phosphorus and (ii) Isolating bacteria and fungi capable of increasing availability of phosphorus in the rhizosphere. Co-supervised by TBC.

#### Effectiveness of liquid and granular Zn fertilizers

CSBP would support the project financially, and their staff would be involved in supervision. A large proportion of crop samples in WA tests are low in Zn. Around 1/3 of the human population in the world is deficient in Zn, resulting in various disorders and in critical cases even death. Biofortification of crops via Zn fertilisation is an effective way to increase Zn intake in the human diet. Co-supervised by TBC.

#### Exploring the effects of a carbon supply on performance of feremycorrhizal symbiosis in wheat (Triticum aestivum)

Feremycorrhiza (FM) is a beneficial plant-fungus symbiosis. Due to lack of root colonisation in the FM symbiosis, host plants presumably feed the fungus by exuding sugars or other organic compounds into the rhizosphere (main fungal habitat). This project will (i) characterise the effects of different carbon sources (including glucose and sucrose) on growth of wheat inoculated with the FM fungus, and (ii) determine whether soil sugar application influences the P nutritional benefits provided by the FM fungus via monitoring P nutrition of plants, soil pH, and carboxylates exudation. Co-supervised by Khalil Kariman.

#### Exploring the role of native leaf fungal endophytes on heat stress tolerance in wheat (Triticum aestivum)

Endophytes are microbial endosymbionts that colonise different plant organs without causing any visible symptoms. Endophyte-plant associations are driven by environmental constraints e.g. hot climates would potentially favour the evolution/selection of plants adapted to forming connections with beneficial endophytes. This research project will (i) isolate fungal endophytes from leaves of several Australian native plants growing in high temperature environments and (ii) determine the effects of foliar application of fungal endophytes or their exudates on heat tolerance of wheat grown in a glasshouse. Co-supervised by Khalil Kariman.

Characterising the functional mechanisms of sand-binding roots in the Australian native plant Lyginia imberbis Sand-binding roots (SBR) are found in certain plant species including the Australian native plant Lyginia imberbis (Restionaceae). Improved plant nutrition and drought tolerance have been proposed as some of the potential benefits provided by SBR. This project will (i) explore the potential nutritional function of SBR in L. imberbis seedlings growing under nutrient deficiency/sufficiency conditions; via monitoring their morphology, amount of sand bound to roots (as a mineral nutrient source), and carboxylate exudations, and (ii) determine whether soil microbes are involved in SBR formation. Co-supervised by Khalil Kariman.

#### A/Prof. Fay Rola-Rubzen (fay.rola-rubzen@uwa.edu.au)

## The economics of early seeding in the Eastern Gangetic Plains



Farmers in the Indo-Gangetic Plains of South Asia are faced with many challenges, some exacerbated by climate change. An intervention to improve farmers' resilience is early seeding which is seen to have several advantages such as better opportunity for pest, disease and weed control, and early harvesting which could open up opportunities for a third crop. However there are also risks and economic considerations involved. This project will look at the economics of early seeding using field-level data of farmers in the Eastern Gangetic Plains South Asia. Co-supervised by TBC.

# Are CASI farmers more technically efficient than non-CASI farmers?



Using scarce resource efficiently is critical in achieving food security. This is especially important in South Asia, home to one of the largest concentration of poor people in the world. The type of farming systems and technologies adopted also have a bearing on technical efficiency of farmers. This study will examine the technical efficiency of farmers using Conservation Agriculture-based Sustainable intensification (CASI) technologies compared to those using conventional tillage (CT) using stochastic production frontier analysis. The findings will provide important policy recommendations on sustainable production in the region. . Co-supervised by TBC.

## Sources of technical (in)efficiency of vegetable farmers



Farmers are constantly striving to improve their productivity and profitability. In Mindanao, Philippines, vegetable farmers have adopted various farming practices geared towards improving productivity. However many farmers are still producing below the optimal level. In this study, you will use existing survey data to analyse farmers' technical efficiency and identify sources of technical inefficiency using stochastic frontier production analysis (SFA) or data envelop analysis (DEA). . Co-supervised by TBC.

#### Prof. Megan Ryan (megan.ryan@uwa.edu.au)

#### Climate friendly annual pastures

Can nutrient inputs and root exudates of annual pasture legumes be manipulated to together enhance microbial transformation of carbon inputs into soil organic matter in pasture systems and thereby aid these systems to become carbon neutral? This project will be undertaken with an industry partner, PGW Seeds, through the ALBA Joint Venture. Co-supervisors: John Kirkegaard (CSIRO), Phil Nichols, Jiayin Pang, Daniel Kidd.

#### **Understanding oestrogenic subclover pastures**

Old cultivars of subterranean clover high in phytoestrogens are prevalent in pastures across southern Australia and causing reproductive loss in ewes. In this project you will investigate how environmental factors impact the concentration of oestrogens in pastures. Your results will impact how breeders assess lines for oestrogenicity. Co-supervisor: Kevin Foster.

#### Prof. Kadambot Siddique (Kadambot.siddique@uwa.edu.au)

#### The effect of terminal drought on chickpea reproduction and grain yield

Chickpea is the second most important grain legume globally, and is the largest pulse crop in Australia. Water shortage during the reproductive phase ('terminal drought') is one of the major abiotic stresses limiting chickpea production and causes up to 50% yield losses. Our previous glasshouse study found that the failure for chickpea pod/seed set is associated with the increased level of abscisic acid and/or the reduction of photosynthesis and assimilate supply to the seeds under terminal drought. The project will investigate the role of sucrose on pod/seed set at both early and later stages of seed development, and associated enzymes and hormones related to sucrose processing in chickpea, through exogenous sucrose application. Co-supervised by Jiayin Pang.

#### How do root architecture traits improve resource-use efficiency and adaptation to edaphic stress?

Recently we have characterised root architecture trait variabilities in legume (e.g. narrow-leaf lupin, chickpea and soybean) and cereal crops (e.g. wheat, barley, maize) using a novel semi-hydroponic system. The root system is the main organ for water and nutrient uptake from the soil and thus determines plant growth and productivity. Food crops are facing a number of edaphic/environmental stresses in Australia and around the world, such as low soil water availability, low soil fertility (particularly P and N), salinity and compaction. Genotypic variation in response to stress exists in many crop species. The proposed project/s will evaluate how differences in root system architecture respond differently to edaphic stresses for enhanced adaptations.

Multiple projects are available to tesr crop species (narrow-leaf lupin, chickpea, soybean, wheat, barley and castor bean) and different stresses (drought, low P/N, salinity, acidity and soil compaction ). Co-supervised by Yinglong Chen.

#### Prof. Erik Veneklaas (Erik.veneklaas@uwa.edu.au)

#### Water and CO<sub>2</sub> transport in relation to stomatal distribution

Most plant species have stomata on the lower side of the leaf only. In crop species there is a large variation in stomatal distribution: one side only (hypostomaty), or equally distributed on both sides (amphistomaty). This project will assess the (dis)advantages of having stomata on both leaf sides, rather than on one side, 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 determine crop yield and wateruse efficiency. Co-supervised by TBC.

#### Plant water relations in challenging climates and soils

The Western Australian climates and soils present many challenges to a favourable plant water status, and plant growth is often limited by water availability. Understanding the concept of water availability requires insights into soil properties (hydraulics, texture, gravel/rocks, salinity, hardpans etc.) root architecture (depth, branching, root diameters, hydraulics etc.), biomass partitioning, shoot hydraulics, leaf area, stomatal control etc. We are interested in root-soil, leaf atmosphere and overall plant hydraulic research to increase our insight into drought tolerance and water limitation of growth. Projects may vary in focus, e.g. phenotyping a range of genotypes for several traits; detailed analysis of root distribution and water uptake pathways in different soils; the effect of rock/gravel on plant-soil water relations, etc. Co-supervised by TBC.

#### Salinity and flooding tolerance of samphires

Samphires are stem-succulent halophytes, i.e. plants that live in saline environments. Western Australia has many species in this group, some of which are edible. The species vary in distribution, presumably due to ecological gradients of salinity, inundation regimes and water availability. This project, supported by DBCA, involves experimental research in a controlled environment to assess tolerance to salinity and inundation in a selected group of samphire species. Co-supervised by TBC.

#### Prof. Phil Vercoe (Phil.vercoe@uwa.edu.au)

#### Genetic resistance of sheep to gastro-intestinal worms - reducing our reliance on drugs

In ruminant livestock, gastro-intestinal worms (helminths) reduce productivity, and can cause diarrhoea (or 'scouring'). In Merino sheep, this leads to faecal contamination around the anus (or 'breech') that attracts blowflies, leading to flystrike. Globally, worms are becoming resistant to anthelminthic drugs. Breeding wormresistant sheep is very effective, but a significant proportion of the worm-resistant sheep scour. We need to identify the components of the immune system that are affected by worm infection and by genetic selection for worm resistance so we can simultaneously select for resistance to both worms and diarrhoea. Co-supervised by Graeme Martin.

#### A/Prof. Ben White (Benedict.white@uwa.edu.au)

Where there is no muck there is money: value of dung beetles in farming systems



Introduced dung beetles do a dirty job in that they bury livestock manure, but they are highly valued in terms of increasing soil fertility and suppressing blow flies. This Masters or Honours project will estimate the value of dung beetles in farming systems in the Northern Wheatbelt. Funding to support the project will be available through a Meat and Livestock Australia project. Co-supervised by Fiona Dempster.

# The economics of beneficial insects for pollination



This study will explore the value of honey bees to a number of pollinator dependent industries possibly avocados. Managed honey bees are good pollinators, but so are feral honey bees and some native insects. This Masters or Honours project will be linked to the Honey Bee products Cooperative Research Centre. Co-supervised by Liz Barbour.

#### How do farmers select cereal varieties? What determines the rate of adoption and dis-adoption of cereal varieties?

This project would involve developing a questionnaire to assess how farmers select "portfolios" of varieties to plant on their farms based on variety attributes that include yield, grain quality, disease resistance and frost tolerance. The project would focus on how farmers trade-off risk and return in making variety selections. Cosupervised by Fiona Dempster.

#### The Aliens are coming! How should Western Australia prepare?

The Russian wheat aphid is a potentially devastating cereal pest of wheat and barley in Australia. It established in South Australia in 2016 and this was the first incursion into Australia. This project will involve an economic analysis of how the WA cereal industry should respond in terms of resistant varieties and pesticides. Cosupervised by Fiona Dempster.

# **Genetics and Breeding**

Specialisation coordinator: Prof. Megan Ryan (Megan.ryan@uwa.edu.au)

#### Prof. Martin Barbetti (Martin.barbetti@uwa.edu.au) (MB)

#### Identifying and understanding novel host resistances in Brassica crops (e.g., canola, mustard) or in forage legumes e.g. subterranean clover, annual medic)

The Plant Pathology group at UWA currently is a world leading group in terms of diseases of oilseed Brassica crops, and has strong international linkages to leading research programs on Brassicas both nationally and internationally (India, China, France, the United Kingdom and Poland). We have developed a diverse and extensive Brassica germplasm collection that can be exploited for many new host resistances to major diseases and our research includes studies to understand the operational mechanism of different and novel host resistances. Co-supervised by Ming Pei You.

#### Identifying and understanding novel host resistances in forage legumes (e.g., clovers, medics, lucerne)

The Plant Pathology group at UWA currently is a world leading group in terms of diseases of forage legumes, including both those which have been (e.g. subterranean clover, annual medic) or are being developed (many new annual and perennial species). We have strong international linkages to leading research programs on forage legumes both nationally (State Departments of Agriculture and private consultants across WA, Victoria, NSW, SA) and internationally (France, China, Italy). We have a diverse and extensive subterranean clover germplasm collection that can be exploited for many new host resistances to major diseases and our research includes studies to understand the operational mechanism of different and novel host resistances. Cosupervised by Ming Pei You.

#### A/Prof. Michael Considine (Michael.considine@uwa.edu.au)

#### Which climate cues regulate dormancy and viability in grapevine?

Grapevine is highly climate sensitive. In temperate regions it displays a deciduous habit, whereas in subtropical and tropical climates it tends towards evergreen. Managing production however relies on orderly and predictable growth. There are enormous opportunities to expand production in northern regions and to contribute to adaptation under climate change in existing production areas. Suitable research projects: (i) Dynamics of bud dormancy in key varieties and climate regions of Western Australia; (ii) Epigenetic regulation of dormancy, and (iii) Dynamics of the photoperiod regulon of CO/FT during dormancy. Co-supervised by Joanne Wisdom; John Considine.

#### Climate effects on fruit quality in citrus

Sadly blemishes cause serious food wastage. In citrus, albedo, the white pith under the orange epidermis can die, causing spotting and blemishes (albedo breakdown). It is considered a response to climate stress – water-deficit or thermal stress. The extent of the problem is regional: Moora and Harvey based orchards tend to suffer while those in West Gingin do not. Available projects include: (i) Effect of meso- and micro-climate on albedo breakdown; (ii) Determination of particular nutritional factors associated with albedo breakdown, and (iii) Spatial location of the disorder occur within tree with respect to solar and wind exposure. Co-supervised by Joanne Wisdom; John Considine.

#### Reserves as signals in perennial plant phenology and development

Perennial plants are distinguished by the presence of tissues and organs that serve as reserve pools of carbon and nitrogen and usually by episodic annual growth cycles. One or two vegetative cycles in temperature trees and shrubs but as many as four in subtropical and tropical trees and shrubs. This project seeks develop analytical tools to dissect the partitioning of metabolisable carbon through the annual cycle(s) of growth and to follow the path of their flow – symplast/apoplast. We seek then to apply that to explore their role in periodicity –stasis – acclimatisation – growth and of biomass partitioning: reproductive organs to vegetative organs. Co-supervised by Joanne Wisdom; John Considine.

#### Prof. Wallace Cowling (Wallace.cowling@uwa.edu.au)

#### Plant breeding – speeding up and gearing up for the future

Our group works on accelerating plant breeding to meet future global food demands while adapting crops to changing climates. We seek to improve crop yield, disease resistance, heat and drought tolerance, and adaptation. We do this in a holistic way taking into account all the traits that future crops will need. We work with a wide range of experts inside and outside of UWA to achieve these goals.

#### Projects co-supervised by Dr Li Li and Emer Prof Brian Kinghorn, University of New England:

- Accelerating crop breeding for future food production based on pedigree and genomic selection and optimised mating designs
- Breeding with genetic diversity in elite crop breeding programs
- The genetic basis of heterosis (hybrid vigour)

#### Projects co-supervised by Dr Sheng Chen, UWA Institute of Agriculture:

- Improving heat and drought stress tolerance in Brassica crops
- Understanding the physiological, genetic and molecular mechanism of abiotic stress tolerance
- Molecular genetics of hexaploid Brassica

#### Projects co-supervised by Prof Guijun Yan, UWA School of Agriculture and Environment:

• Improving heat stress tolerance in wheat

#### Projects co-supervised by Adj Assoc Prof Matthew Nelson and Dr Jens Berger, CSIRO:

- Harnessing genetic diversity in wild Brassica species for canola improvement. This project will involve a combination of desk-based (identifying the most promising wild relatives for canola improvement), field work (evaluating wild relatives) and glasshouse work (crossing canola with its wild relatives).
- Discovering new flowering time genes in crops
- Identifying domestication genes in narrow-leafed lupin (Lupinus angustifolius)

#### Projects co-supervised by Prof Jacqueline Batley, UWA School of Biological Sciences:

• Understanding the molecular basis of disease resistance and susceptibility

#### Projects co-supervised by Prof Martin Barbetti, UWA School of Agriculture and Environment:

• Resistance to Sclerotinia stem rot in canola

#### Dr Janine Croser (Janine.croser@uwa.edu.au)

# Size matters: plant miniaturisation with anti-gibberellins to facilitate high throughput systems under controlled conditions

Plant miniaturization is required for efficient resource use under controlled environment conditions. Antigibberellin-treated plants can flower and set seed at a much-reduced height, enabling growth in multi-tier units. This project will determine the exact concentration and timing of application of the antigibberellin across a range of crop species. Co-supervised by Maria Pazos-Navarro and Richard Bennett.

#### From the glass to the pot: precious seed germination in faba bean leads to faster breeding

Precious seed germination leads to faster generation turnover. This project will determine a protocol for robust in vitro germination for faba bean. This will involve learning sterile tissue culture protocols, microscopy and embryology. Co-supervised by Maria Pazos-Navarro.

#### Numbers matter: how cell division and seed size are affected by growing conditions

Growth of plants under intensive controlled environment conditions alters the hormone content within the developing seed, compressing embryo maturity. Changes in the hormones are likely to affect the kinetics of cell division and seed filling. This project will determine the effect of plant growing temperature and photoperiod on cell division and DNA content during early stages of pea seed development and how this might be translated to changes in seed size and germination ability. Involves learning flow cytology and biochemical measurements, as well as general sterile laboratory skills. Co-supervised by Maria Pazos-Navarro.

#### Quality matters: how storage protein profiles of developing seeds are affected by growing conditions

Access to high quality and affordable plant-based protein is a key requirement to feed a burgeoning population. Exposure to intensive plant growth conditions alters the hormone content within the developing seed. The hormone profile in turn affects the kinetics of cell division and seed filling. The increased DNA synthesis results in the accumulation of storage proteins. This project will study how controlled environment growing conditions alter the storage protein profiles of developing seeds, and ultimately seed quality. Co-supervised by Maria Pazos-Navarro.

#### A/Prof. Parwinder Kaur (Parwinder.kaur@uwa.edu.au)

#### **Gene editing for climate smart crops**

The United Nations continues to raise the alarm on climate change. The UN's International Panel on Climate Change released their latest report, this time focusing on agriculture's impact on the environment and the need to make the most use out of our current farmlands to prevent further damage. Today, around 75 percent of the earth's usable land is dedicated to feeding the world's population. And as the population increases to be 9.7 billion in 2050, the strain on farmland will intensify. However, ag biotech innovations like gene editing hold

tremendous promise to slow the expansion of farmland by enabling farms to grow more food on less land—and with less resources. Multiple projects are available across legume and cereal crops for traits like improving yield potential, biofortification, root hair architecture manipulations for better nutrient acquisition etc. Please contact for further details and choosing a specific topic of interest. Co-supervised by TBC.

#### Dr Judith Lichtenzveig (Judith.Lichtenzveig@uwa.edu.au)

#### **Chickpea domestication and evolution**

Crop domestication and evolution is a fascinating story interlocking plants, country and humans. Your project can take one of multiple directions in investigating the crop's evolution and its impact on current cropping practices (e.g. seed dormancy, pod shattering). For this purpose, you will have access to (i) a recent collection of wild Cicer specimens, evolutionary snapshots of ancestral relatives of chickpea, (ii) inter-specific offspring populations and high-density genetic maps, (iii) large DNA sequence databases for chickpea and other Cicer in the public domain, and (iv) the infrastructure to conduct common garden experiments. Co-supervisors: Janine Croser and Maria Pazos Navarro.

#### **Gene flow between Cicer species**

Chickpea and a close wild relative species, Cicer echinospermum, vary in their genome structure. However, the extent of such variation is unknown. Genome structure variation is a major impediment to gene flow and a leading drive to speciation in both animals and plants. In addition to being of interest to fundamental evolution studies, gene flow is of importance in conservation of plant diversity in a changing climate. This project includes aspects of cytogenetics, linkage mapping, and genomics; it is also conducive to the generation and analysis of new DNA sequencing data. Co-supervisors: Janine Croser and Maria Pazos Navarro.

#### Genomics of pulse crops' reproductive phenology

Today a large amount of genomic data is available to the public; the challenge is producing relevant syntheses. In this project, you will take a candidate gene approach to evaluate gene diversity within and between cultivated and wild legume species. The choice of which genes to target is yours and will follow a thorough literature review. We are particularly interested in reproductive phenology of legumes. A pre-requisite to undertaking this project is participation at a bioinformatics course (e.g. SCIE4002\_SEM-2). Co-supervisor: TBC and Dr Maria Pazos Navarro.

#### Quantitative genetics of chickpea's reproductive phenology

Despite the large box of molecular tools (including whole-genome sequences) available to legume crops, linking genotypes to phenotypes remains a challenge. We are adopting high-throughput phenotyping techniques to bridge the genotype-phenotype gap to improve chickpea. Your project will include running common garden experiments under control conditions and/or in the field, using genome-wide genetic markers, producing high-density genetic linkage maps and quantitative trait loci (QTLs) analyses. This project will facilitate developing proficiency in R (programming language). Co-supervisors: Janine Croser and Maria Pazos Navarro.

#### A/Prof. Phillip Nichols (Phillip.nichols@uwa.edu.au)

#### Diversity within purple clovers collected from the Mediterranean region

Purple clover (*Trifolium purpureum*) is a highly vigorous, deep-rooted annual forage legume, native to the Mediterranean basin. To date, little genetic improvement has been conducted on the species and there appear to be significant opportunities to develop more productive and better adapted cultivars. A range of purple clover germplasm has been collected from the Mediterranean region and this project will involve examining important traits to determine their potential as new cultivars. This work will be conducted at the Shenton Park Field Station,

as part of an ongoing pasture legume breeding and selection program. Particular traits of interest include biomass in winter and spring, flowering time, hardseededness and threshability of seeds, but other traits could also be examined. Variety differences can also be related to characteristics of their sites of collection. Cosupervised by William Erskine, Megan Ryan.

#### Diversity within ssp. brachycalycinum subterranean clovers collected from the Mediterranean region

Subterranean clover (*Trifolium subterraneum*) is the most important annual pasture legume in southern Australia and a large collection of wild populations from its native habitat in the Mediterranean region has been assembled. It consists of three subspecies, *subterraneum*, *yanninicum* and *brachycalycinum*. To date, little genetic improvement has been conducted on ssp. *brachycalycinum* and there appear to be significant opportunities to develop more productive and better-adapted cultivars. This project will involve examining important traits among wild populations to determine their potential as parents for crossing. Particular traits of interest include biomass in winter and spring, flowering time, seed yield and hardseededness, but other traits could also be examined. Variety differences can also be related to characteristics of their sites of collection. This work will be conducted at the Shenton Park Field Station, as part of an ongoing pasture legume breeding and selection program. Co-supervised by William Erskine, Megan Ryan.

#### Population improvement of Persian and arrowleaf clovers

Persian clover (*Trifolium resupinatum* var. *majus*) and arrowleaf clover (*T. vesiculsoum*) are highly vigorous, upright out-crossing fodder species. A breeding program on both species has been conducting recurrent selection for seedling vigour, high biomass in winter and spring and late flowering. This project will examine the genetic gains following two generations of recurrent selection in either one or both species, in comparison with the original parents and other cultivars. This work will be conducted at the Shenton Park Field Station, as part of an ongoing pasture legume breeding and selection program. Co-supervised by William Erskine.

#### Identifying traits in subterranean clover for easier seed harvesting

A key feature for the success of subterranean clover as a pasture plant is its ability to bury its seed-bearing burrs. However, this trait is a major disadvantage for commercial seed production. Current seed harvesting methods involve cultivating dry soil in summer to loosen up the burrs, which are then removed from the soil by specially designed vacuum harvesters. However, this process is very slow and energy inefficient, resulting in relatively high seed prices, and also causes significant soil erosion. The pasture seed industry is currently investigating more efficient and sustainable seed harvesting systems. This project will examine diversity for plant traits associated with seed burial and harvestability among the commercially available cultivars to identify plant and seed traits that are easier to harvest. This work will be conducted at the Shenton Park Field Station, as part of an ongoing subterranean clover breeding and selection program. Co-supervised by William Erskine, Kevin Foster.

#### Prof. Megan Ryan (Megan.ryan@uwa.edu.au)

#### Mycorrhizal fungi - can non-mycorrhizal crops be bred to be mycorrhizal?

Brassicas are generally non-mycorrhizal which means that several major crops (e.g. canola, mustard) present a break for mycorrhizal fungi in cropping systems. In this project you will confirm previous findings of a group of native brassicas being highly colonised and investigate the role of root exudates and the genetic basis of this interesting finding. Co-supervisors: Jacqui Batley (SBS), John Kirkegaard (CSIRO).

#### Prof. Guijun Yan (Guijun.yan@uwa.edu.au)

#### Genetic dissection of agronomically important traits and pre-breeding of wheat

The sustainable production of wheat, the the most important crop in Australian agriculture, faces many challenges. We are interested in genetically dissecting some agronomically important traits such as heat, drought, herbicide and pre-harvest sprouting tolerances to develop molecular markers for marker assisted wheat breeding and to identify associated genes for understanding the genetic control of those traits. This research involves germplasm screening to identify extremes, and crossing of these to develop recombinant inbreeding lines and near isogenic lines using our newly developed fast generation cycling system which can advance eight generations of wheat per year. We conduct quantitative trait locus mapping to identify major genes and molecular markers. The group also use deep sequencing, microarray genotyping, genome wide association studies, RNA sequencing and fine mapping in their research. Co-supervised by Helen Liu and Kadambot Siddique.

#### Prof. Erik Veneklaas (Erik.veneklaas@uwa.edu.au)

#### Water and CO2 transport in relation to stomatal distribution

Most plant species have stomata on the lower side of the leaf only. In crop species there is a large variation in stomatal distribution: one side only (hypostomaty), or equally distributed on both sides (amphistomaty). This project aims to assess the (dis)advantages of having stomata on both leaf sides, rather than on one side, 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 determine crop yield and water-use efficiency. Co-supervised by TBC.

# **Integrated Pest Management**

Specialisation coordinator: Prof. Megan Ryan (Megan.ryan@uwa.edu.au)

#### Dr Mike Ashworth (Mike.ashworth@uwa.edu.au)

#### Evaluate the effectiveness of weed management options in reducing weed seed banks in serradella

The positive impacts of pasture have been evident for decades, but over the last 25 years pasture and livestock have not been economically attractive to many farmers and advisers. There are many instances where pastures are used in cropping dominated systems, that weed control is reported as poor and pastures are actually regarded as the 'weak' point, increasing weed seed banks in the rotation. The resurgence in the value of livestock and wool requires a renaissance in pastures and their role in cropping-dominated farming systems. French serradella (*Ornithopus sativus* Brot.) is one of the new annual pasture legume species which have been released for Australian agriculture. There is little information about weed management in this species, particularly when aiming to maximize pasture productivity and if the weeds are herbicide resistant. This project will focus on two main issues: (1) evaluate the effectiveness of weed management options in reducing weed seed banks in serradella; (2) evaluate pasture productivity, weed control and its impact on weed seed and serradella seed viability, including changes in the soil weed seed bank. In order to address these issues, two trials will be conducted at UWA-glasshouses, including a trial of single tactical treatments and a trial of the effectiveness of spray top timing. Co-supervised by Yaseen Khalil.

#### Effectiveness of the time of the spray topping/crop topping and alternatives to glyphosate/paraquat

Spray-topping of annual weed species during the reproductive growth stages is commonly done to prevent the formation of viable seeds. This late-stage intervention weed management approach is used to stop the target

weeds from setting seed without negatively impacting the ability of the crop or the pasture species to produce seed. Spray topping/crop topping is widely used in Australian cropping systems in canola and pasture, however weeds are adapting their reproductive timing to evade spraytopping applications. This project will investigate whether we can effectively spray-top early flowering time brome grass populations without compromising crop and pasture grain and seed production? Co-supervised by TBC.

#### Prof. Hugh Beckie (Hugh.beckie@uwa.edu.au)

#### Impact of frequency of soil renovation on herbicide-resistant weed seed bank dynamics

This project will determine the impact of frequency of soil renovation (profile inversion by mouldboard plough) on herbicide-resistant weed seed bank dynamics. Deep burial of herbicide- resistant weed seeds by mouldboard plough is a strategy to 're-set' the herbicide resistance clock. Weed emergence the season following deep burial is reduced, but how does that affect the frequency of herbicide resistance in the population? Project starts in early to mid 2021, and involves testing weed populations of various species in the glasshouse, using existing seeds obtained from field renovation sites, for resistance to key herbicides. The work can be presented at regional workshops or conferences and published in a scientific journal. Work will be done entirely at UWA campus. Co-supervised by Mike Ashworth (AHRI).

#### Dr Roberto Busi (Roberto.busi@uwa.edu.au)

#### Levels of resistance to the new herbicide bixlozone before it is commercialized in Australia

This project aims to reveal the level of herbicide resistance in annual ryegrass samples collected from across Australia submitted to UWA in 2020 for comprehensive herbicide tests in 2021. Project starts in March 2021. The work can presented at regional and national conference and published in a peer-reviewed journal. This would best position a candidate student with an interest in pursuing an academic career towards PhD. Work done entirely at UWA campus. Co-supervised by Hugh Beckie, Dr Danica Goggin (AHRI).

#### Levels of herbicide resistance across different weeds: annual ryegrass, wild radish, brome, barley grass and capeweed

This project aims to reveal the level of herbicide resistance in weed samples (100+) collected from across Western Australia submitted to UWA for comprehensive herbicide tests in 2021. Project starts in early to mid-2021. The work will be suitable for presentation at regional and national conferences and publication in a peerreviewed journal. The project is within a greater GRDC-funded project with great opportunities of participating to extension workshops (June 2021) in regional WA and interact directly with WA growers and advisers. This would best position a candidate student with an interest in pursuing an academic career towards PhD. Work done entirely at UWA campus. Co-supervised by Hugh Beckie, Dr Danica Goggin (AHRI).

#### A/Prof. Nik Callow (Nik.callow@uwa.edu.au)

# Scouting for pests using smartphone applications and drone-based crop assessment of plant stress



Scouting grain crops for pests and diseases is time consuming and often inaccurate. Random sampling hopes to find pest hotspots in parts of paddocks, but often miss them. This means growers are either losing money on unnecessary pesticide application or yield loss in parts of crops which are missed. Spatial data such as remote sensing using near infrared and infrared spectra have been shown to be able to detect and map regions of crop which are experiencing biotic or abiotic stress. Our prior research has shown the potential for using NDVI nod other indices to identify stressed areas of canola crops impacted by biotic (e.g. aphid) and abiotic (e.g. potassium deficiency) processes. Pests can cause a crop stress response and the student will work with industry to use new

remote sensing technologies to live-stream remote sensing indices like Normalised Difference Vegetation Index (NDVI) video from a drone, to inform where to sample for agricultural pests and evaluate the use of this new, cutting-edge approach. Jointly supervised with Ken Flower and Dr Dustin Severtson (DPIRD).

#### Dr Judith Lichtenzveig (Judith.Lichtenzveig@uwa.edu.au)

#### Genomics of pea response to necrotrophic pathogens

Ascochyta blight of field pea is caused by at least four Didymellaceae species, *Didymella pinodes*, *D. pinodella*, *Ascochyta pisi* and *Phoma koolunga*. Genome sequences are available for field pea and the causal agents of ascochyta blight. Your project will undertake transcriptomics analysis of plant-pathogen interactions to discover key networks in plant resistance and fungal pathogenicity. A pre-requisite to undertaking this project is participation at a bioinformatics course (e.g. SCIE4002\_SEM-2). Co-supervisor: TBC.

#### Phylogenomics of the Didymellaceae

Speciation of plant-pathogenic fungi is fundamentally and economically important yet the process remains poorly understood. This project aims to identify genomic signatures of selection underlying speciation and host specialisation in an important fungal family of plant pathogens, the Didymellaceae. This project is an opportunity for you to sequence and analyse the most important Didymellaceae species compromising your country's key crop. A pre-requisite to undertaking this project is participation at a bioinformatics course (e.g. SCIE4002\_SEM-2). Co-supervisor: TBC.

#### Legume response to symbionts and pathogens under shade

In this project, shade is defined by the red to far-red ratio in light spectra to isolate it from other associated factors such as temperature and humidity. Plant response to shade involve a phyto-hormonal environment with molecular shared by the plant response to disease. To dissect genetic factors affecting these responses and their interaction you will conduct experiments under control conditions in a given legume-microbe symbiotic/pathogenic interaction. Co-supervisor: Janine Croser.

## Soil Science and Plant Nutrition

Specialisation coordinator: Prof. Megan Ryan (Megan.ryan@uwa.edu.au)

#### A/Prof. Louise Barton (Louise.barton@uwa.edu.au)

# Examining the suitability of critical cation exchange capacities for predicting risk of NH<sub>3</sub> volatilisation losses from limed soils

Volatilization is the loss of surface-applied fertilizer N to the atmosphere as ammonia gas (NH<sub>3</sub>). Emitted NH<sub>3</sub> represents a loss of N fertilizer and can impact on air and water quality, as well as ecosystem biodiversity. In south-western Australia, there has been a tendency for growers to simultaneously lime and apply N fertilizer so as to reduce operating costs. Anecdotal evidence suggests this has resulted in decreased N use efficiency, presumably due to loss of N fertiliser via NH<sub>3</sub> volatilisation. This laboratory-based project will examine the potential for NH<sub>3</sub> volatilisation to occur under varying liming rates and from soils that range in cation exchange capacity (CEC). Co-supervised by Dan Murphy.

#### Revisiting drying techniques for assessing soil water repellence in soils

Soil water repellency (SWR) is widespread globally and is expected to increase with climate change. Soil water repellency inhibits soil water infiltration, which can have a negative impact on plant production, and also promotes soil water erosion. Soil preparation is critical for accurate assessment of SWR. A recent study

recommended vacuum drying-water repellent sandy soil under anoxic conditions at 20 °C and 1.3 kPa prior to measuring soil water repellence, however it is unclear if this is suitable for other soil textures. The aim of this project would be to assess the effect of soil drying temperature and vacuum drying on soil water repellence for a range of soil textures. Co-supervisor: Dan Murphy.

Quantifying the relative efficiency of nitrogen fertilizer uptake from surface and subsoils by agricultural crops Staple food crops are needed to maintain food security over the next two decades, with some suggesting this will be best achieved via intensification of production inputs such as N fertilizer. This will require losses of reactive forms of N from the soil to the environment, such as ammonia ( $NH_3$ ), nitrous oxide ( $N_2O$ ) and nitrate ( $NO_3$ -), to be minimised if N fertilizer use is to be sustainable. Minimising N leaching is particularly problematic as our region's coarse textured sandy soils are particularly prone to N leaching. Any N that moves below the surface soil horizons needs to be utilised by roots in the subsoil if N leaching to ground and surface waters is to be prevented. The aim of this glasshouse study is to investigate the extent to which annual crops can utilise nitrogen stored in the subsoil. Co-supervisor: Dr Craig Scanlan (DPIRD).

#### A/Prof. Atakelty Hailu (Atakelty.hailu@uwa.edu.au)

#### Developing quality indicators for soil, land, parks, and all that

Developing indicators or quality measures to compare apple and orange type problems is fun. Soil scientists have wanted to summarise diverse soil quality variables into summary measures. The problem applies to many other cases, e.g. comparing park quality, cities, countries, etc. The focus depends on the interest of the student. Economic models can be used to provide sound basis for quality indicator construction. This project is relevant to researchers in agriculture, environmental science or development economics. For example, in development economics, the researcher might be interested in comparing different countries (e.g. in a single continent or more broadly). A researcher interested in conservation might want to focus on developing quality indicators for natural habitats. Co-supervised by Michael Burton, Chunbo Ma, Steven Schilizzi.

#### Dr Sasha Jenkins (Sasha.jenkins@uwa.edu.au)

#### Black Soldier Fly castings as a high quality fertiliser product

This project is part of a larger, interdisciplinary and industry funded project that is developing novel ways to process agricultural waste using Black Soldier Fly (BSF) larvae. The BSF larvae convert waste into high quality fertiliser (casting residues or frass) and/or protein for animal feed (larvae). Adoption of BSF technology and its products has potential to increase productivity and profitability on farms by reducing input costs and generating alternative revenue streams. However, the BSF fertiliser products cannot be used as a fertiliser in Australia until the environmental, agronomic and economic value of this product is fully evaluated. As part of the project, you will conduct a glasshouse pot trial study to determine whether BSF larvae castings could be used as fertilisers. You will measure crop nutrition, growth and yield responses to BSF larvae residues and frass applied to soil as a fertiliser. Co-supervised by Megan Ryan, Kadambot Siddique.

# Quantifying the leaching potential of applying Black Soldier Fly castings residue (a novel fertiliser product) to soils

This project is part of a larger, interdisciplinary and industry funded project that is developing novel ways to process agricultural waste using Black Soldier Fly (BSF) larvae. The BSF larvae convert waste into high quality fertiliser (casting residues or frass) and/or protein for animal feed (larvae). Adoption of BSF technology and its products has potential to increase productivity and profitability on farms by reducing input costs and generating alternative revenue streams. However, the BSF fertiliser products have a high ammonium content which could result in nitrogen (N) loss following its application to land via leaching. As part of the project, you will conduct a

glasshouse pot trial study to determine the leaching potential of BSF larvae castings when it is applied to a soil as a fertiliser. You will measure leaching behaviour of N and other nutrient (elements/heavy metals) as well as crop nutrition, growth and yield responses to BSF larvae residues and frass applied to soil as a fertiliser. Cosupervised by Megan Ryan, Talitha Santini.

#### How do we measure soil quality?

Soil microorganisms play a central role in maintaining soil health and quality through their activities that include recycling nutrients, nitrogen fixation, disease suppression, pollutant mitigation, improved soil structure and degradation of organic matter. Thus, they determine the form and availability of nutrients that are essential for plant growth and subsequently impact on grain productivity. To continue to improve the sustainability, quality and productivity of agricultural grains, producers need monitoring tools that directly measure soil biology enabling them to adopt the best management practices to enhance crop performance. Consequently, there is a pressing need to identify a set of biological indicators that can be used to assess the quality of Australian soils; this project will develop these bio-indicators. Co-supervised by TBC.

#### Dr Andrew Rate (Andrew.rate@uwa.edu.au)

#### Robust, absolute measurement of nutrient additions and depletions at the UWA Future Farm

The concept of a "phosphorus bank" is often used in the context of fertilised agricultural soils; other biologically essential elements are also likely to accumulate in these soils. Conversely, subsoils may become depleted in elements such as potassium from decades of plant uptake from subsoils. In addition, additions or losses of elements are possible from changes to soil water balance due to land use change. In this project you will take soil samples and perform analyses to allow calculation of absolute mass fluxes of elements such as phosphorus, potassium and sodium. This is becoming a standard technique for understanding processes of soil formation in geochemistry and Critical Zone science. Absolute mass fluxes have seldom been calculated for agricultural systems, or used to assess agricultural soil nutrient fluxes. Co-supervised by TBC.

#### Prof. Zed Rengel (Zed.rengel@uwa.edu.au)

#### Plant physiology of nutrient uptake and transport (multiple projects)

Multiple projects on offer including (i)Transport pathways of root- and leaf-supplied micronutrients into developing cereal or legume grains; (ii) Fertilizer placement and nutrient uptake by various crops; (iii) Modelling 3D root growth nutrient uptake and determining optimal fertilization; (iv) P nutrition and root exudation by various crops and genotypes and (v) Characterise N-use efficiency of selected wheat and barley genotypes, specifically looking at potential mechanisms underlying differential efficiency (eg. root growth, stem carbohydrates, N remobilisation from leaves into developing grain, etc). Co-supervised by TBC.

#### **Effectiveness of various elemental S fertilizers**

CSBP would support the project financially, and their staff would be involved in supervision. Many soils in WA are testing low in sulphur (S). Canola has particularly high S requirement. One to two soils will be used in testing various sources and rates of S fertilisers. Co-supervised by TBC.

#### Biology and chemistry of rhizosphere

Projects on offer include (i) Role of root exudates in acquisition of micronutrients and phosphorus and (ii) Isolating bacteria and fungi capable of increasing availability of phosphorus in the rhizosphere. Co-supervised by TBC.

#### Effectiveness of liquid and granular Zn fertilizers

CSBP would support the project financially, and their staff would be involved in supervision. A large proportion of crop samples in WA tests are low in Zn. Around 1/3 of the human population in the world is deficient in Zn, resulting in various disorders and in critical cases even death. Biofortification of crops via Zn fertilisation is an effective way to increase Zn intake in the human diet. Co-supervised by TBC.

# Exploring the effects of a carbon supply on performance of feremycorrhizal symbiosis in wheat (*Triticum aestivum*)

Feremycorrhiza (FM) is a beneficial plant-fungus symbiosis. Due to lack of root colonisation in the FM symbiosis, host plants presumably feed the fungus by exuding sugars or other organic compounds into the rhizosphere (main fungal habitat). This project will (i) characterise the effects of different carbon sources (including glucose and sucrose) on growth of wheat inoculated with the FM fungus, and (ii) determine whether soil sugar application influences the P nutritional benefits provided by the FM fungus via monitoring P nutrition of plants, soil pH, and carboxylates exudation. Co-supervised by Khalil Kariman.

#### Exploring the role of native leaf fungal endophytes on heat stress tolerance in wheat (Triticum aestivum)

Endophytes are microbial endosymbionts that colonise different plant organs without causing any visible symptoms. Endophyte-plant associations are driven by environmental constraints e.g. hot climates would potentially favour the evolution/selection of plants adapted to forming connections with beneficial endophytes. This research project will (i) isolate fungal endophytes from leaves of several Australian native plants growing in high temperature environments and (ii) determine the effects of foliar application of fungal endophytes or their exudates on heat tolerance of wheat grown in a glasshouse. Co-supervised by Khalil Kariman.

# Characterising the functional mechanisms of sand-binding roots in the Australian native plant *Lyginia imberbis* Sand-binding roots (SBR) are found in certain plant species including the Australian native plant *Lyginia imberbis*

Sand-binding roots (SBR) are found in certain plant species including the Australian native plant *Lyginia imberbis* (Restionaceae). Improved plant nutrition and drought tolerance have been proposed as some of the potential benefits provided by SBR. This project will (i) explore the potential nutritional function of SBR in L. imberbis seedlings growing under nutrient deficiency/sufficiency conditions; via monitoring their morphology, amount of sand bound to roots (as a mineral nutrient source), and carboxylate exudations, and (ii) determine whether soil microbes are involved in SBR formation. Co-supervised by Khalil Kariman.

#### Long-term effects of gypsum, lime and dolomite on topsoil and subsoil acidity

This project would utilise a long-term CSBP trial in Bonnie Rock. CSBP would support the project financially, and their staff would be involved in supervision. The project would involve (i) Root growth and distribution assessment in the field, (ii) Soil properties measurements and (iii) Modelling based on multi-year grain yield data. Co-supervised by TBC.

#### The potential for ameliorating subsoil acidity with gypsum

For this project you will (i) Identify the levels, species and activity of aluminium found in subsoils across the Wheatbelt and relate this back to potential limitations to crop growth, and (ii) Test for potential responsiveness to gypsum based on pH changes and sorption of gypsum using the method of Sumner (1993). Does this test apply to WA Wheatbelt soils? Assess changes in aluminium and pH levels associated with sites where gypsum has been applied to overcome subsoil activity. Co-supervised by TBC.

#### Role of Mg in alleviating Al toxicity and soil acidity

CSBP would support the project financially, and their staff would be involved in supervision. A range of Mg sources and rates will be tested in layered soil profiles (topsoil/subsoil) and/or nutrient solution with various levels of acidity and Al toxicity stresses. Wheat would be a preferred crop, but other choices are available depending on interest. Co-supervised by TBC.

#### Prof. Megan Ryan (Megan.ryan@uwa.edu.au)

#### Fine root endophytes: friend or foe?

UWA research recently showed that a group of arbuscule-forming fungi formerly thought to be arbuscular mycorrhizal fungi, the fine root endophytes, are in fact part of a different sub-phylum; that is, they are phylogenetically distinct. However, it is currently unknown if they are ecologically distinct. In this project, you will investigate the role of these fungi in the nutrition of weeds, agricultural crops and native species. Cosupervisors: Felipe Albornoz (CSIRO), Rachel Standish (Murdoch University).

# **Biotechnology**



The table below shows which supervisors have projects listed under two ('AQUAtech' and 'Environmental & Agricultural Biotechnology') of the four 'Specialisations' that are offered within the Master of Biotechnology. There is a separate research project booklet produced by the School of Molecular Sciences that lists projects in the other two 'Specialisations'.

POTENTIAL SUPERVISOR	AQUAtech	Biochemistry & Molecular Biology	Environmental & Agricultural Biotechnology	Genetics & Genomics
Rob Atkin			٧	
Janine Croser			٧	
Theo Evans			٧	
Deirdre Gleeson	٧			
Sasha Jenkins			٧	
Parwinder Kaur			٧	
Judith Lichtenzveig			٧	
Talitha Santini	٧		٧	
Phil Vercoe			٧	



- Studies that involve field sampling of biota and/or field measurement of environmental parameters.

# **AQUAtech**

Specialisation coordinator: Dr Sasha Jenkins

Dr Deirdre Gleeson (Deidre.gleeson@uwa.edu.au)

#### Biodiversity of living, non-marine, thrombolites of Western Australia



Microbialites are biosedimentary structures formed by the interaction of microorganisms with their environment. Living microbialites, including stromatolites and thrombolites, are found in just a few select locations worldwide. This project will investigate the microbial populations present in the thrombolites at Lake

Clifton in the Peel-Yalgorup region to determine if they are still living, and investigate how they might be affected by climate change. The project will involve sampling of thrombolites and lake water at Lake Clifton and the use of DNA and RNA based tools to assess the microbes and functions that maintain the thrombolites. Co-supervised by Gavan McGrath (DBCA); Rick James (Peel Harvey Catchment Council).

# Fish movement along the Canning River



The Canning River is a habitat for four native freshwater fishes, four that are considered estuarine and four feral fish species. This project has two main goals; (1) to provide an overview of the fish present in the Canning River and to see if a single Lamprey sample collected previously was evidence of the species truly being present in the system and (2) to provide an assessment of the extent to which the barriers in the system inhibit fish migration upstream. This project will involve collecting multiple water samples along the Canning River and the use of eDNA tools to assess the presence of fish at different sites. Co-supervisor: Josie Hyde (DBCA).

#### Presence of Rakali and Carter's Mussel in SW Western Australia



Rakali (Hydromys chrysogaster) is listed as a 'priority four' species in Western Australia that can be found near fresh or brackish waterbodies but has suffered a localized decline in Western Australia. This project aims to map the distribution of rakali in the SW of Western Australia as well as a preferred food source, Carter's Freshwater mussel (Westralunio carteri). This project will involve collecting water samples from multiple locations and using eDNA tools to test these water samples along with previously collected water samples to assess the presence of rakali at different sites. The project will also refine protocols to maximise the effectiveness of eDNA survey for this species. Co-supervisor: Josie Hyde (DBCA).

#### Dr Talitha Santini (Talitha.santini@uwa.edu.au)

#### Bioremediation of tailings and wastewaters

Microbially-driven approaches for remediation of tailings, mineral processing wastes, and contaminated waters provide novel pathways to address the challenging chemical and physical properties of these materials. Use a variety of methods including laboratory or glasshouse leaching columns, laboratory experiments, and geochemical, microbial, and physical laboratory analysis methods, this project will test microbially-driven approaches for remediation of tailings or leachates. Specific remediation targets may include pH neutralisation, metals removal, nutrient fixation, and/or structure development or dust suppression, for a range of different tailings and wastewaters/leachates. Potential co-supervisors: Sasha Jenkins, Deirdre Gleeson, Dan Murphy.

# **Environmental and Agricultural Biotechnology**

Specialisation coordinator: Dr Sasha Jenkins (Sasha.jenkins@uwa.edu.au)

#### Dr Rob Atkin (Rob.atkin@uwa.edu.au)

#### Could plastic eating insects help save our environment?

Polystyrene is a non-biodegradable persistent plastic that is accumulating at alarming rates on land and in rivers, lakes and oceans. Australia's government is committed to a 70% reduction of plastic pollution by 2020. To address this, UWA together with Woodside Energy Ltd are investigating the use of insect technology as a means of converting polystyrene waste into high value protein products. Preliminary studies suggest that larvae of yellow mealworms (Tenebrio molitor), superworms (Zophobas atratus), and wax moths (Galleriinae species) are capable of degrading polystyrene and polyethylene via enzymatic processes in the gut. The plastics are either incorporated into the biomass of the insect or converted into insect castings (frass). However, the full extent of their capacity to degrade plastic and feasibility of adopting intensive insect farming for plastic removal is still unknown. Students should pick one plastic-eating insect farming related project to focus on. Potential projects include (i) *Economic evaluation of plastic-eating insect farming including mealworm, wax moth, superworms or other plastic-eating insects.* Students will evaluate the potential markets for the plastic-eating insect farm by-products - insect larvae (protein, glycerol and oil) and insect castings or frass (fertiliser, soil improvers). This could include: evaluating the price of other products and market shares; determination of what features would make the protein, oil, glycerol, fertiliser and soil improver more desirable and identify any gaps in the market that the products could fill; (ii) *Lab experiment comparing the various plastic eating insects, and viability as digestors of different plastic types.* Students will investigate the ability of insects to degrade polystyrene and other plastics (i.e. polyethylene) and explore the factors influencing larval rearing on plastics (e.g. temperature, larval density and dietary factors) and conversion rates to insect biomass (larvae) and insect castings (frass); (iii) *Evaluation of the microbiome of the mealworm/waxmoth/superworm* — what is known, what are the knowledge gaps? Can we selectively breed insects and/or gut microbiome to increase conversion rates? Cosupervised by TBC.

#### Dr Janine Croser (Janine.croser@uwa.edu.au)

# Size matters: plant miniaturisation with anti-gibberellins to facilitate high throughput systems under controlled conditions

Plant miniaturization is required for efficient resource use under controlled environment conditions. Antigibberellin-treated plants can flower and set seed at a much-reduced height, enabling growth in multi-tier units. This project will determine the exact concentration and timing of application of the antigibberellin across a range of crop species. Co-supervised by Maria Pazos-Navarro and Richard Bennett.

#### From the glass to the pot: precious seed germination in faba bean leads to faster breeding

Precious seed germination leads to faster generation turnover. This project will determine a protocol for robust in vitro germination for faba bean. This will involve learning sterile tissue culture protocols, microscopy and embryology. Co-supervised by Maria Pazos-Navarro.

#### Numbers matter: how cell division and seed size are affected by growing conditions

Growth of plants under intensive controlled environment conditions alters the hormone content within the developing seed, compressing embryo maturity. Changes in the hormones are likely to affect the kinetics of cell division and seed filling. This project will determine the effect of plant growing temperature and photoperiod on cell division and DNA content during early stages of pea seed development and how this might be translated to changes in seed size and germination ability. Involves learning flow cytology and biochemical measurements, as well as general sterile laboratory skills. Co-supervised by Maria Pazos-Navarro.

#### Quality matters: how storage protein profiles of developing seeds are affected by growing conditions

Access to high quality and affordable plant-based protein is a key requirement to feed a burgeoning population. Exposure to intensive plant growth conditions alters the hormone content within the developing seed. The hormone profile in turn affects the kinetics of cell division and seed filling. The increased DNA synthesis results in the accumulation of storage proteins. This project will study how controlled environment growing conditions alter the storage protein profiles of developing seeds, and ultimately seed quality. Co-supervised by Maria Pazos-Navarro.

#### A/Prof. Theo Evans (Theo.evans@uwa.edu.au)

#### **Evaluating dung beetles**

By burying cattle dung, dung beetles can enrich our soils and protect us from pest species. 50 years ago one of the most famous biocontrol experiments in the world began with the release of exotic dung beetles into Australia to bury cattle dung. They were an immediate success, reducing dung in fields, and nuisance bush fly populations. However, the ecosystem services were not quantified in either ecological or economic terms, or over large temporal or spatial scales. Furthermore, the success is patchy, as dung beetle populations vary across Australia, likely due to a combination of differing ecophysiological requirements, dispersal and farm management. Available projects include (i) Ecological functions of dung beetles: effects on soils and plant growth; (ii) Interspecific interactions between dung eating animals, including beetles, flies, worms, termites, and nematodes; (iii) Economic value of dung beetle ecosystem services; (iv) Effects of farm management, such as tillage and drenches, on dung beetles and (v) Population genetics of widespread vs restricted congeneric dung beetles. Co-supervised by TBC.

#### Dr Sasha Jenkins (Sasha.jenkins@uwa.edu.au)

#### Black Soldier Fly castings as a high quality fertiliser product

This project is part of a larger, interdisciplinary and industry-funded project that is developing novel ways to process agricultural waste using Black Soldier Fly (BSF) larvae. The BSF larvae convert waste into high quality fertiliser (BSF casting residues or frass) and/or protein for animal feed (BSF larvae). Adoption of BSF technology and its products has potential to increase productivity and profitability on farms by reducing input costs and generating alternative revenue streams. However, the BSF fertiliser products cannot be used as a fertiliser in Australia until the environmental, agronomic and economic value of this product is fully evaluated. For this project you will conduct a glasshouse pot trial study to determine whether BSF larvae castings could be used as fertilisers. You will measure crop nutrition, growth and yield responses to BSF larvae residues and frass applied to soil as a fertiliser. Additionally, you will use a variety of molecular tools to determine how the soil microbial communities and their function respond to frass applications. Co-supervised by Deirdre Gleeson, Kadambot Siddique.

# Quantifying the leaching potential of applying Black Soldier Fly castings residue (a novel fertiliser product) to soils

This project is part of a larger, interdisciplinary and industry-funded project that is developing novel ways to process agricultural waste using Black Soldier Fly (BSF) larvae. The BSF larvae convert waste into high quality fertiliser (BSF casting residues or frass) and/or protein for animal feed (BSF larvae). Adoption of BSF technology and its products has potential to increase productivity and profitability on farms by reducing input costs and generating alternative revenue streams. However, the BSF fertiliser products have a high ammonium content which could result in nitrogen (N) loss following its application to land via leaching. For this project, you will conduct a glasshouse pot trial study to determine the leaching potential of BSF larvae castings when it is applied to a soil as a fertiliser. You will measure leaching behaviour of N and other nutrients (elements/heavy metals) as well as crop nutrition, growth and yield responses to BSF larvae residues and frass applied to soil as a fertiliser. Additionally, you will use a variety of molecular tools to determine how the microbes involved in N cycling are impacted by frass applications. Co-supervised by Deirdre Gleeson, Talitha Santini.

#### **Bioenergy: Converting household waste into biogas**

In Western Australia the preferred disposal method for municipal solid waste (MSW) is landfill. However, this is not necessarily the most effective means of disposing of such waste and there is growing interest in finding alternative uses that solve both waste excesses and energy shortages. One option is to convert MSW into biogas (methane) and compost via a process called anaerobic digestion. The biogas can then be used to provide

renewable energy by the generation of electricity. However, anaerobic digestion is a complex process performed by microbes and consequently the ecology, prevailing environmental conditions and mechanisms involved remain poorly understood. This project will develop more efficient anaerobic digestion by investigating the relationship between microbial degradation, environmental parameters and biogas production during the anaerobic digestion of MSW. Co-supervised by TBC.

#### Converting piggery waste into biogas

Currently most pig farmers put their pig waste into large ponds where the waste is gradually broken down by microbes within the pond. However, these microbes release both odours and methane that upset local residents and contribute to global warming. One solution is to cover these ponds with an impermeable cover resulting in reduced gas emissions since the methane is retained under the cover. Although, the prospect of covered ponds is attractive, initial start-up costs are high. This could be overcome by capturing the methane under the cover and using it to off-set start-up costs by providing on-farm heating or electricity. However, methane recovery from covered ponds is not very efficient, and covers on the ponds could alter the waste degradation process and reduce biogas yield. Our research aims to increase biogas production from covered ponds by optimising the waste degradation process through different management practices and provide advice on interventions required to prevent pond failure. Co-supervised by TBC.

#### Flies as alternative pollinators

Flies can be just as efficient as honey bees in transferring pollen for various crops. However, the key issue is that flies often aren't as abundant as honey bees and other insects. This project will look at ways of increasing their abundance we can have flies which are just as efficient as honey bees at pollinating on all sorts of crops. Cosupervised by Dr David Cook (DPIRD).

### A/Prof. Parwinder Kaur (Parwinder.kaur@uwa.edu.au)

### Gene editing for climate smart crops

The United Nations continues to raise the alarm on climate change, with the International Panel on Climate Change releasing a report focusing on agriculture's impact on the environment and the need to make the most use of our current farmlands to prevent further damage. Today, around 75% of the earth's usable land is dedicated to feeding the world's population. As the world population increases, the strain on farmland will intensify. However, ag biotech innovations like gene editing hold tremendous promise to slow the expansion of farmland by enabling farms to grow more food on less land—and with less resources. Multiple projects are available across legume and cereal crops for traits like improving yield potential, biofortification, root hair architecture manipulations for better nutrient acquisition etc. Co-supervised by TBC.

# Exploration of alternative synthetic production platforms for bio-synthetic pathways using microbial cell factories

An increasing world population augmented with fast industrialisation has significantly increased global energy consumption per capita. This increasing energy demand is usually met using conventional, non-renewable energy sources such as fossil fuels, associated with environmental degradation and health issues. Many studies have estimated that the demand for energy is going to escalate 50% by 2030, demonstrating the urgent need for non-conventional, renewable and sustainable energy resources. The demand for pharmaceutical proteins and other high value products is being fulfilled by industrial biotechnology by employing yeast, mammals and insects. Concepts and technologies provided by synthetic biology and biotechnology are inspiring and encouraging researchers to re-imagine bio-based materials. Multiple projects available. Co-supervised by TBC.

#### **DNA Zoo - Understanding Evolution**

With the climate emergency exacerbating natural disasters, as evidenced by the Australian wildfires having killed >1 billion animals, we have a very short time to document and support our unique biodiversity. Living on an island continent, Australian biota have evolved in isolation, which has given rise to Australia's unique biodiversity. All three lineages of mammals are found on the continent including monotremes (egg-laying), marsupials (pouched) and eutherians (placental). Monotremes were the earliest diverging mammalian lineage and it is estimated marsupials and eutherians diverged ~150mya. Marsupials have a unique biology, giving birth to extremely under-developed young and having a complex lactation system. Genomic studies of marsupials are limited compared to eutherians. However, given their phylogenetic position and unusual biological features, genomic studies of marsupials will provide important insights into mammalian evolution, disease and development. Co-supervised by TBC.

### Dr Judith Lichtenzveig (Judith.Lichtenzveig@uwa.edu.au)

#### Adaptation and secondary metabolites gene-clusters of the Didymellaceae

Adaptation of plant-pathogenic fungi is fundamentally and economically important yet the process remains poorly understood. This project aims to evaluate the role of secondary metabolites (SM) in adaptation at the pathogenic and resting phase (i.e. in between infection cycles) of species in an important fungal family of plant pathogens, the Didymellaceae. One way to go about it is identifying signature of selective sweeps in SM gene clusters. A pre-requisite to undertaking this project is participation at a bioinformatics course (e.g. SCIE4002\_SEM-2). If taken face-to-face, the project offers an opportunity to gain experience in molecular biology. Co-supervisor: TBC.

#### **Fungal effectors of disease in legumes**

Ascochyta blight pathogens (ABP) of legume crops produce necrotic symptoms, parasitize the host in parallel ways, over-summer on stubble and spread via rain-splashed spores in autumn-winter, form a close phylogenetic group, and probably all secrete small molecules which determine the disease outcome (also known as effectors). Preliminary observations based on comparative genome analyses, transcription profiling and biochemical analyses of fungal cultures support the hypothesis that the ABP secrete multiple effectors. Your task will be to identify and characterise effectors and evaluate them as selection tools for AB-resistance breeding. Cosupervisor: TBC.

### Dr Talitha Santini (Talitha.santini@uwa.edu.au)

#### Bioremediation of tailings and wastewaters

Microbially-driven approaches for remediation of tailings, mineral processing wastes, and contaminated waters provide novel pathways to address the challenging chemical and physical properties of these materials. Use a variety of methods including laboratory or glasshouse leaching columns, laboratory experiments, and geochemical, microbial, and physical laboratory analysis methods, this project will test microbially-driven approaches for remediation of tailings or leachates. Specific remediation targets may include pH neutralisation, metals removal, nutrient fixation, and/or structure development or dust suppression, for a range of different tailings and wastewaters/leachates. Potential co-supervisors: Sasha Jenkins, Deirdre Gleeson, Dan Murphy.

### In situ remediation of bauxite residue



In situ remediation is increasingly being adopted in mine closure and rehabilitation plans. Bauxite residue, produced from alumina refining, is a globally significant tailings stream, with 120 MT produced worldwide annually. In situ remediation of bauxite residue may use a combination of inorganic and organic amendments, and biological approaches to transform it into a medium that is chemically, physically, and biologically suitable for plant growth. This project will optimise the combination of amendments and approaches applied to bauxite residue to achieve sustainable in situ remediation to support a variety of post-mine closure land uses. The project involves field sampling and analysis, and/or laboratory trials. Potential co-supervisors: Sasha Jenkins, Deirdre Gleeson, Dan Murphy.

### Enabling reuse of tailings through in situ remediation



In situ remediation is an increasingly popular approach for tailings rehabilitation and closure. The coupled abiotic-microbial strategies developed for rapid in situ remediation of tailings also opens the door for development of a new reuse pathway for tailings. Large scale utilization of tailings as a soil product requires transformation of its properties to meet specified targets demanded by potential consumers. Focusing on bauxite residue, this project will identify the opportunities for remediation and reuse as a soil product in agricultural activities around several pilot refinery sites globally. The project involves market analysis and consideration of bauxite residue properties and evidence for efficacy of various amendments to transform residue properties to achieve desired targets for the soil product. Potential co-supervisors Michael Burton, Marit Kragt, Fran Hoyle.

### Hitching a ride: contributions of dust deposition to nutrient accumulation and microbial community succession in tailings 🖑

Dust is a poorly quantified but widely acknowledged source of biological nutrients and potential source of microbial inoculants in natural environments. This role of dust has been almost entirely overlooked in mining environments. Recent laboratory experimental work by Santini et al (2018) demonstrated that dust is a significant source of microbial inoculants in tailings, and suggested that limited dust inputs likely underpin the delayed microbial community succession observed in tailings when compared to natural primary successional environments. This project will use field samples from dust traps to identify and quantify dust sources, total dust inputs, microbial community biomass, and dust nutrient content in a tailings site and adjacent non-mining site, and will evaluate microbial community functions to better explain the delayed succession and limited function that is commonly observed in tailings. Potential co-supervisors: Sasha Jenkins, Deirdre Gleeson, Dan Murphy.

### Blended waste caps for sustainable closure of tailings facilities



Blended waste caps, using tailings mixed with other waste materials present on site to create both an impermeable (capillary break) layer and a plant growth (soil) layer, are a new approach to tailings management that offers opportunities to eliminate risks and costs associated with capping and in situ remediation approaches (capillary rise, expense/effort of importing capping materials and amendments, etc.). This project will identify the optimal blend of wastes available onsite at an alumina refinery to create a plant growth medium capable of supporting plant growth. Subsequent stages of the project will involve running flume trials to optimise water balance between the plant growth layer and capillary break layer. Potential co-supervisors: Dan Murphy, Matt Hipsey.

### Prof. Phil Vercoe (Philip.vercoe@uwa.edu.au)

#### Reducing methane emission from sheep and cattle

Mitigating methane emissions from sheep and cattle through manipulating the feed base, exploring the antimethanogenic properties of plant secondary compounds in Australian native plants, and genetic selection. This work includes plants, feed additives and grazing management practices that are relevant to the northern WA beef industry (northern and southern rangelands, fodder from pivot irrigation) as well as southern sheep and beef systems and is part of the approach to addressing the goal of the red meat industry to be carbon neutral by 2050. Potential co-supervisors: Zoey Durmic, Peter Hutton, Dean Revell.

# **Environmental Science**



The table below shows which supervisors have projects listed under each of the six 'Specialisations' in the Master of Environmental Science. All projects are suitable as Honours projects.

POTENTIAL	Catchments	Environmental	Environmental	Environmental	Marine and	Sensing and
SUPERVISOR	and Water	Economics	Management	Rehabilitation	Coastal	Spatial Data
						Science
Louise Barton	V					
Roberta Bencini			٧	٧		
Jason Beringer	٧					√
Michael Burton		٧			٧	
Nik Callow	٧		٧			٧
Paul Close	٧		V			
Barbara Cook	√		√	√	٧	
James Fogarty		√	٧		٧	
Deirdre Gleeson	٧					
Atakelty Hailu	٧		٧		٧	
Sharon Hickey					٧	V
Matthew Hipsey	٧			٧	٧	<b>√</b>
Steve Hopper			٧			
Sasha Jenkins	٧		٧			
Marit Kragt		٧	٧	٧		
Mathias Leopold	٧		٧		٧	√
Amin Mugera		٧				
Dan Murphy	٧					
Ram Pandit	٧	٧	٧	٧		
David Pannell		٧				
Natasha Pauli			٧			
Andrew Rate	٧		٧		٧	
Zed Rengel	٧		٧			
Abbie Rogers		٧				
Talitha Santini				٧		
Steven Schilizzi		٧				
Peter Speldewinde	√		٧	٧		
Ben White		٧				

<sup>-</sup> Studies that can be taken using a 'desktop' approach, and thus not requiring field or laboratory work. These studies can be undertaken remotely.

<sup>-</sup> Studies that involve field sampling of biota and/or field measurement of environmental parameters.

### **Catchments and Water**

Specialisation coordinator: Dr Paul Close (Paul.close@uwa.edu.au)

### A/Prof. Louise Barton (Louise.barton@uwa.edu.au)

### Examining the suitability of critical cation exchange capacities for predicting risk of NH<sub>3</sub> volatilisation losses from limed soils

Volatilization is the loss of surface-applied fertilizer N to the atmosphere as ammonia gas (NH₃). Emitted NH₃ represents a loss of N fertilizer and can impact on air and water quality, as well as ecosystem biodiversity. In south-western Australia, there has been a tendency for growers to simultaneously lime and apply N fertilizer so as to reduce operating costs. Anecdotal evidence suggests this has resulted in decreased N use efficiency, presumably due to loss of N fertiliser via NH<sub>3</sub> volatilisation. This laboratory-based project will examine the potential for NH<sub>3</sub> volatilisation to occur under varying liming rates and from soils that range in cation exchange capacity (CEC). Co-supervised by Dan Murphy.

#### Revisiting drying techniques for assessing soil water repellence in soils

Soil water repellency (SWR) is widespread globally and is expected to increase with climate change. Soil water repellency inhibits soil water infiltration, which can have a negative impact on plant production, and also promotes soil water erosion. Soil preparation is critical for accurate assessment of SWR. A recent study recommended vacuum drying-water repellent sandy soil under anoxic conditions at 20 °C and 1.3 kPa prior to measuring soil water repellence, however it is unclear if this is suitable for other soil textures. The aim of this project would be to assess the effect of soil drying temperature and vacuum drying on soil water repellence for a range of soil textures. Co-supervisor: Dan Murphy.

### Dr Jason Beringer (Jason.beringer@uwa.edu.au)

# Land-use change in the wheatbelt





The Western Australian Wheatbelt includes a vast 15.4 million hectares of agricultural land with remnant native forest woodland that together are significant for cropping and grazing, and for their wilderness value but most native vegetation has been cleared. This UWA project investigates how land-use change from native woodlands to agricultural systems modifies the fluxes of water, carbon and heat with the atmosphere. The aims of this project will be accomplished through contrasting the water and carbon balance of a paired flux tower observations at Boyagin Nature Reserve and the UWA Future Farm. Potential co-supervisor: Caitlin Moore.

# Water use of understorey and overstorey trees in a Wandoo woodland



Extensive land use clearing for agriculture has left only small patches of remnant native Wandoo woodland that has significant value for providing ecosystem service but is under threat from environmental change. This UWA project investigates the seasonal water use of the Wandoo forest at the TERN Supersite at Boyagin Nature Reserve and drivers of ecosystem water use in a changing climate. The aims of this project will be accomplished through examining the water use of both the whole ecosystem and the understorey in a changing climate using flux tower observations. Potential co-supervisors: Caitlin Moore.

### A/Prof. Nik Callow (Nik.callow@uwa.edu.au)

### Spatial control and covariates on snow depth and density



Runoff from the Australia Alps sustains the Snowy Mountains Hydroelectric Scheme, inflows to the Murray-Darling system and environmental flows to alpine and downstream ecosystems. Records of snow depth are only collected in a very limited locations, and do not necessarily accurately record the actual distribution of snow and stored water through the Australia Alps. This project will combine satellite and drone data of snow depth to look at factors such as vegetation and terrain sheltering, and assimilate ground observation and satellite data on snow presence/absence to improve estimates of stored snow and water in the seasonal alpine snowpack. Cosupervised by Dr Shane Bilish (Snowy Hydro Limited).

### Impacts of hydrological connectivity on valley-floor salinity



Interventions to improve flow connectivity have been implemented at locations across the Western Australian Wheatbelt. These have reduced surface water ponding, with the aim of disconnecting fresher surface water from salinity in the soil profile. This project will use cloud satellite computing platforms (Google Earth Engine) to explore the changes in the patterns of salinity impacting vegetation health adjacent to the intervention structures. Lakes Toolibin and Bryde will be a focus. While predominantly desktop, there is an opportunity for fieldwork to be incorporated. Co-supervised by Matt Hipsey.

### Remote area hydrology – studying hydrology with no hydrological data



The north and inland of Australia contains important river systems, but has very little hydrological data. The traditional approach to remote-area hydrology has been to construct models with large uncertainty, however, multiple satellite products contain useful hydrological information. This project will advance data assimilation and uncertainty techniques (Markov-Chain Monte Carlo Bayesian framework) developed by the supervisors, to combine multiple different satellite data to allow prediction of floods in remote and ungauged river basins. Cosupervised by Matt Hipsey and Ben Jarihani.

### Runoff and catchment performance in our future climate



Southwestern Australia has seen a ~10-15% reduction in rainfall, but the decline in streamflow and runoff has been much more significant, around 50-60%. Future projections are that our climate will dry further, but the hydrological behaviours and scaling of changes in runoff in relation to rainfall have very high uncertainty. This project will look at improving our understanding of runoff processes, the response of streamflow components, and catchment performance. While predominantly desktop, there is an opportunity for fieldwork to be incorporated. Co-supervised by Matt Hipsey.

# Monitoring Fringing Vegetation with Drones



Drones are an emerging environmental monitoring tool, particularly powerful for monitoring ecosystem processes and responses to stressors such as climate change, water quantity and water quality decline. Perth's wetlands have undergone unprecedented changes from urbanization since European settlement and are also vulnerable to the significant change in the climate of southwestern Australia since the 1970s, compounded by water abstraction. This project will explore, evaluate and develop methods to monitor fringing vegetation surrounding one of the Swan Coastal Plains most significant wetlands - Lake Joondalup and the Yellagonga Regional Park. There is an opportunity to work with an industry partners (City of Joondalup and Sentient Hubs Pty Ltd) and your research will be used to influence and inform how drones are used for environmental monitoring and evaluating things such as drone citizen science opportunities. Co-supervised by Matt Hipsey.

### Dr Paul Close (Paul.close@uwa.edu.au)

# Microplastic ingestion by aquatic fauna



Pollution of aquatic ecosystems by plastic is a growing worldwide problem. Ingestion of microplastics by freshwater biota can be influenced by feeding strategies and habitat use. This project will examine how microplastic ingestion varies among taxa and functional feeding groups, and will target fish and invertebrates such as mussels and crayfish. The project will involve field sampling. Co-supervised by Barbara Cook.

# Influence of climate change on fish life cycles





A study of a freshwater fish that occurs near Albany showed that these animals are capable of shifting the timing of reproduction to match suitable environmental conditions. Over the past 20 years, a period of significant drying, these fish delayed spawning and migration to match stream discharge. There are a number of opportunities for projects aimed at further exploring whether flexibility in life history characteristics in aquatic fauna offers some resilience to changes in climate. Co-supervised by Barbara Cook.

### Environmental influence of mussel growth



Long-lived species experience variations in environmental conditions over temporal scales ranging from decades to days. In some animals, bone-like structures formed over the animal's entire life contain structure that provide information on age and growth rates. Where historical environmental data exists, these structures can provide detailed information on an animal's response to a chronology of environmental change. This project will use growth structure in the shells of freshwater mussels (Westralunio carteri) to investigate environmental influence on growth over the life of animals that span a period of major change in climate. Co-supervised by Barbara Cook.

# Has salinisation decreased mussel population connectivity?



Freshwater mussels are an important functional component of freshwater ecosystems. The only representative of this group in southwestern Australia (Westralunio carteri) is threatened by secondary salinization. Freshwater tributaries in salt affected catchments provide refugia for mussels, yet the distribution of these refugia disconnects mussel populations. This project will assess the degree of genetic structuring occurring among mussel populations in remnant tributaries. Co-supervised by Barbara Cook.

### Mussel habitat preference



An understanding of the habitat requirements for imperiled species can inform conservation and restoration activities. Current knowledge of southwestern Australia's only freshwater mussel (Westralunio carteri) is limited, and derived from field survey of habitats where mussels are most abundant. Whether mussels actively select these habitats, or passively accumulate there during periods of high river flow is unclear. This project will investigate the movement capabilities of a freshwater mussel, assess their capacity to actively 'select' spatially distributed microhabitats and identify those habitats likely to support the species. Co-supervised by Barbara Cook.

# What eats mussels?



Freshwater mussels can be highly abundant, and exceed the combined biomass of all other benthic aquatic fauna by orders of magnitude. It is possible, where abundances are high, that they contribute substantially to the diet of terrestrial-based predators such as water rats. In turn, they may contribute to broader ecosystem processes by contributing aquatic sourced energy to riparian/terrestrial food webs. This project will use camera traps to identify predators and stable isotope analysis to investigate their contribution to energy flux/foodwebs. Cosupervised by Peter Speldewinde.

### Dr Barbara Cook (Barbara.cook@uwa.edu.au)

### Stock watering (troughs/ dams) refuges



Many waterways and wetlands in the Wheatbelt of Western Australia have become salinized due to past land clearing, leading to the loss of many freshwater species. Freshwater troughs and dams used for livestock are 'islands' of suitable habitat surrounded by inhospitable environments, and are likely to be the only refuges remaining for obligate freshwater species. This project will investigate the distribution of aquatic invertebrates in stock watering troughs and dams in the light of habitat size and degree of isolation. Co-supervised by Peter Speldewinde.

### Development of biological indicators of environmental degradation of WA aquatic ecosystems



Biomonitoring has become a standard tool for assessing the 'health' of rivers worldwide, with the use of macroinvertebrates such as mayflies, stoneflies and caddis flies well documented. Using existing data, this project will evaluate the responses of these and other groups such as chironomids to gradients of environmental degradation in order to assess their potential capacity as indicators of waterway degradation in southwestern Australia. Co-supervised by Paul Close.

### Sensitivity of aquatic macroinvertebrates to acidity



Extensive networks of deep drains have been built in Western Australia to reduce the effects of dryland salinity on agricultural lands. Most of these drains discharge highly saline and acidic waters into natural river and wetland systems, with little consideration given to environmental impacts. Using existing data, this project will investigate pH tolerances of aquatic biota to identify threshold levels associated with significant changes in biodiversity composition in Wheatbelt streams. Co-supervised by Paul Close.

# Phylogeography of endemic fish species



Freshwater mussels require a host fish for development and dispersal, and the distribution of mussels is tightly tied to that of their host-fish. Westralunio carteri is host generalist, so dispersal by any SW fish species should promote mussel connectivity, but populations of W. carteri from the west coast, Capes region, and south coast are genetically distinct enough to warrant consideration as separate species. Despite the uniqueness of the region's freshwater fish, region-wide phylogeographic studies are rare. This project would assess the connectivity between populations of one or more native fish species with a hypothesis that the west coast, Capes and south coast are separate MOTUs. Co-supervised by Paul Close.

### Dr Deirdre Gleeson (Deidre.gleeson@uwa.edu.au)

### Biodiversity of living, non-marine, thrombolites of Western Australia



Microbialites are biosedimentary structures formed by the interaction of microorganisms with their environment. Living microbialites, including stromatolites and thrombolites, are found in just a few select locations worldwide. This project will investigate the microbial populations present in the thrombolites at Lake Clifton in the Peel-Yalgorup region to determine if they are still living, and investigate how they might be affected by climate change. The project will involve sampling of thrombolites and lake water at Lake Clifton and the use of DNA and RNA based tools to assess the microbes and functions that maintain the thrombolites. Co-supervised by Gavan McGrath (DBCA); Rick James (Peel Harvey Catchment Council).

### Fish movement along the Canning River



The Canning River is a habitat for four native freshwater fishes, four that are considered estuarine and four feral fish species. This project has two main goals; (1) to provide an overview of the fish present in the Canning River and to see if a single Lamprey sample collected previously was evidence of the species truly being present in the system and (2) to provide an assessment of the extent to which the barriers in the system inhibit fish migration upstream. This project will involve collecting multiple water samples along the Canning River and the use of eDNA tools to assess the presence of fish at different sites. Co-supervisor: Josie Hyde (DBCA).

### Presence of Rakali and Carter's Mussel in SW Western Australia



Rakali (Hydromys chrysogaster) is listed as a 'priority four' species in Western Australia that can be found near fresh or brackish waterbodies but has suffered a localized decline in Western Australia. This project aims to map the distribution of rakali in the SW of Western Australia as well as a preferred food source, Carter's Freshwater mussel (Westralunio carteri). This project will involve collecting water samples from multiple locations and using eDNA tools to test these water samples along with previously collected water samples to assess the presence of rakali at different sites. The project will also refine protocols to maximise the effectiveness of eDNA survey for this species. Co-supervisor: Josie Hyde (DBCA).

### A/Prof. Atakelty Hailu (Atakelty.hailu@uwa.edu.au)

### Designing better auctions for water buybacks



Water markets and auctions are being used to reallocate water and restore environmental flows. Although the sums involved can be huge, the thinking behind the markets or auctions used can be too simple. In this project, you will use computational models (agent-based models) to analyse how alternative and more flexible auction types (e.g. similar to those used in financial markets) can be developed to allocate water more efficiently and to improve budgetary performance. Co-supervised by Steven Schilizzi.

### A/Prof. Matthew Hipsey (Matt.hipsey@uwa.edu.au)

#### Climate change impacts on wetland ecosystems

The drying trend in south-western Western Australia has caused a loss of suitability of critical wetlands that support the requirements of the critically endangered Western Swamp Tortoise. In this project you will explore the future suitability of wetlands in different regions of the south-west using a lake modelling tool and climate change forecasts, in order to find suitable sites for translocation of captive animals. Co-supervised by TBC.

# Ecosystem metabolism of urban wetlands



The metabolism of aquatic ecosystems (defined as the balance between photosynthesis and respiration) varies at the system scale in response to changes in hydrology, nutrients and other factors. This project will look at how changes in metabolism influences water quality and the implications for warming lakes in a changing climate. The project will involve using in situ sensors and modelling of a wetland on the Swan Coastal Plain (Lake Monger or Lake Yellagonga). Co-supervised by TBC.

#### Dr Sasha Jenkins (Sasha.jenkins@uwa.edu.au)

#### Recycling waste as organic fertilisers: Are they safe?

Many organic fertilisers are derived from waste products that may contain contaminants or undesirable elements resulting in adverse environmental impacts. Manure is often directly spread onto agricultural land without treatment and there are growing concerns over this practice with respect to pathogens and nutrient contamination of surface and groundwater, Greenhouse Gas (GHG) emissions, salinity and phyto-toxicity. This project will quantify the environmental risks associated with the re-use of different waste byproducts, with specific focus on (i) pathogen survival (ii) salinity & toxicity (iii) N and P leaching to surface and groundwater's and (iv) GHG emissions. Co-supervised by TBC.

#### Recycling waste as organic fertilisers: Do they enhance soil quality?

It has been claimed that organic farming enhances soil health & quality in terms of biodiversity, nutrient cycling, organic matter content, soil structure & stability, water holding capacity and disease suppression. However, the true extent to which organic management 'enhances' nutrient cycling and other soil functions remains largely unexplored. This project will quantify whether soil quality is 'enhanced' in soils subject to organic waste inputs. It will initially investigate how organic management impacts on soil biology by developing biological indicators. These bio-indicators in combination with other conventional indicators will then be used to assess whether soil quality is being gained, maintained or has been lost in soils receiving organic waste. Co-supervised by TBC.

#### Converting piggery waste into biogas

Currently most pig farmers put their pig waste into large ponds where the waste is gradually broken down by microbes within the pond. However, these microbes release both odours and methane that upset local residents and contribute to global warming. One solution is to cover these ponds with an impermeable cover resulting in reduced gas emissions since the methane is retained under the cover. Although, the prospect of covered ponds is attractive, initial start-up costs are high. This could be overcome by capturing the methane under the cover and using it to off-set start-up costs by providing on-farm heating or electricity. However, methane recovery from covered ponds is not very efficient, and covers on the ponds could alter the waste degradation process and reduce biogas yield. Our research aims to increase biogas production from covered ponds by optimising the waste degradation process through different management practices and provide advice on interventions required to prevent pond failure. Co-supervised by TBC.

### A/Prof. Mathias Leopold (Matthias.leopold@uwa.edu.au)

# Ecohydrology of thrombolites, Lake Clifton, WA



Lake Clifton, south of Perth, harbours one of the biggest non marine thrombolite colonies in the southern hemisphere. Recent changes in groundwater levels and salinity challenge the ecohydrological parameters necessary to sustain a healthy grows of the thrombolites. The project will use environmental geophysics and sediment probing to establish initial parameters for an ecohydrological model of the area. Both, field and laboratory based work is required. The project is in cooperation with the Peel Harvey Catchment Council and the Department of Biodiversity, Conservation and Attractions. Co-supervisors: Gavan McGrath (DBCA) and Rick James (Peel Harvey Catchment Council).

### Swan River and Urban Interactions with a Fringing Wetland



The Department of Biodiversity Conservation and Attractions (DBCA) is undertaking a 2-year study of the hydrology and water quality of Ashfield Flats Reserve in Bassendean. The aims of the project are to assess the hydrological processes governing the wetland water balance as well as the geochemical factors contributing to heavy metal, nutrient and pH impacts from urban drains and groundwater. Student projects available include (i) the acquisition of near-surface geophysics and drilling, for the development of a conceptual hydrogeological model; (ii) experiments and monitoring to identify Swan River – Wetland interactions and Urban drain – wetland interactions; and (iii) experiments and field sampling to assess the geochemistry of urban runoff/sediments to untangle why pH drops when flows increase. Co-supervised by Dr Gavan McGrath (DBCA).

### Environmental geophysics to study soils in the context of agriculture and environmental science

Soil plays an important role in agriculture and/or environmental science. A number of novel and innovative techniques allow the 3D mapping of various soil properties via environmental geophysical methods. There are a number of projects available for students who are specifically interested in developing and applying these methods to map and assess soils and their properties and constraints. Co-supervised by Andrew Rate.

### **Ecohydrology of trees**



Many trees in the Perth metropolitan area were continuously stressed over the past decades and many of the older trees such as Banksia or Norfolk Pine trees died in the recent past. Water stress was identified as a key factor. Understanding and monitoring the pathways of water uptake from the soil zone into the tree is the key aim for this project. A combination of different methods such as dendrometers, sap flow meters, environmental geophysics and soil studies is required. Co-supervisor Erik Veneklass / Paul Drake.

### Prof. Dan Murphy (Daniel.murphy@uwa.edu.au)

### Soil biological fertility

Investigation of biological factors associated with soil fertility, especially their interactions with other components of soil fertility, including factors associated with the soil habitat. Co-supervised by Lyn Abbott and Frances Hoyle.

### Dr Ram Pandit (Ram.pandit@uwa.edu.au)

#### **Effectiveness of wetland restoration**

Wetland degradation is a serious environmental issues in Australia. A range of actions have been taken to restore degraded wetlands. It is not always clear that whether these actions are effective from economic, social, and ecological perspectives. This project aims to evaluate the effectiveness of such actions in restoring identified wetlands (case studies) based on an Effectiveness Analysis Framework. The project involves stakeholders consultation, developing and implementing questionnaire to understand public perception and preferences. Cosupervised by Michael Burton.

#### Dr Andrew Rate (Andrew.rate@uwa.edu.au)

#### Using trace elements as tracers: What are the forms of trace elements in sulfidic estuarine sediments?

Trace elements represent potential contaminants in aquatic sediments, but may also be useful in determining the origin of sulfidic minerals in these systems. You would collect monosulfide-rich sediments from the Swan-Canning or Peel-Harvey estuarine areas, or use archived samples. You would measure the concentrations of different forms of trace elements using chemical and spectroscopic analytical techniques, to understand the spatial patterns in the sediments. Potential co-supervisor: Dr Bree Morgan (University of Sydney).

#### **Environmental geochemistry at Ashfield Flats Reserve**

Ashfield Flats is an urban reserve abutting the Swan River estuary, having high conservation value. The area is underlain by alluvial sediments, with many having a high risk of acid sulfate soils. Our studies found contamination of water, soils and sediments reflecting the site history and influx of industrial stormwater. DBCA(WA) has collected some deep cores which contain a record of the site's history, but are incompletely analysed. You would conduct mineralogical and chemical analyses on these cores to reconstruct Ashfield's

sedimentary and anthropogenic history. Potential co-supervisors: Adjunct A/Prof Gavan McGrath (DBCA), Deirdre Gleeson.

### Effect of woody Corymbia and Eucalyptus fruits on soil hydraulic properties

Solid, low permeability fragments ("clasts") in soils such as gravels are known to cause preferential water flow and reduce the effective soil pore volume. In Australia, persistent woody fruits such as those produced by Corymbia and Eucalyptus tree species (i.e. gumnuts) may also behave like mineral clasts, with the added complication that their properties may change with time as biological degradation proceeds. This project will measure the effect of woody Australian native tree fruits on (i) hydraulic conductivity and (ii) soil water retention of soil of contrasting textures. Potential co-supervisor: Adjunct Dr Gavan McGrath (DBCA), Matthias Leopold.

# Assessing contaminated urban environments



Soils and sediments in urban environments are known to contain localised instances of contamination with metals, related to different sources. These sources include: emissions from industry, inputs from road traffic, stormwater, and other anthropogenic or natural sources. Your project would be based at a specific site in metropolitan Perth, and explore different ways of assessing inorganic contamination and contaminant fluxes in sediments, soils, or water. Depending on your interests, you could also investigate aeolian transport of contaminants or uptake of contaminants by vegetation. Potential co-supervisor(s): Adjunct Dr Gavan McGrath (DBCA), Adjunct Dr Ursula Salmon (DWER).

# Transects of soil properties across the urban-periurban-rural gradient in Perth



Urbanization is known to affect the quality and composition of soils, which show gradients in nutrient, trace element, and organic pollutant concentrations from city centres through suburban and peri-urban environments to rural areas. Perth's unique soils, developed on dunes of Holocene to Pleistocene age, may show gradients which are atypical compared with other cities, but this has never been assessed. This project will attempt to detect an Anthropocene signature along urban-rural transects in metropolitan Perth, Western Australia and the surrounding non-urbanized areas. Potential co-supervisors: Matthias Leopold.

### Environmental geochemistry desktop projects



A number of sources of data exist in the public domain, for example: the WA Department of Water's WiR database; WA Department of Mines and Petroleum's Data and Software Centre; and multiple international (USA, European) data repositories. Many of these datasets are a rich and in some case under-utilised source of geochemical, spatial, and temporal data. Depending on your interest, your project could involve using one or more of these databases to deduce environmental chemical processes and environmental effects. Potential cosupervisors: Adjunct Dr Gavan McGrath (DBCA), Adjunct Dr Steve Appleyard (DWER), Dr Patrice de Caritat (Geoscience Australia).

### Prof. Zed Rengel (Zed.rengel@uwa.edu.au)

### Using constructed wetlands for purification of wastewater and stormwater



This project will (i) Identify WA wetland species suitable for accumulation of nutrients from wastewater, (ii) optimise conditions for biofiltration of stormwater using constructed wetlands and (iii) characterise interactions between heavy metals (e.g. cadmium) and organic contamination (e.g. hydrocarbons) in constructed wetlands purifying wastewater. Co-supervised by TBC.

### Dr Peter Speldewinde (Peter.speldewinde@uwa.edu.au)

### Ross River virus and livestock watering points



Ross river virus is a debilitating disease spread mainly by the Aedes camptorhynchus mosquito. This mosquito is highly tolerant to saline conditions and dominates saline landscapes, as other mosquito species (and their predators) are unable to survive in these conditions. This project will examine if livestock watering points provide habitat for other species of mosquito that would otherwise not be present in the salinized environment. Co-supervised by Barbara Cook.

### **Environmental Economics**

Specialisation coordinator: A/Prof. Ben White (Benedict.white@uwa.edu.au)

### A/Prof. Michael Burton (Michael.burton@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. Co-supervised by Abbie Rogers, Belinda Cannell.

### The existence value of traditional crafts



There is a 'Red List" of endangered species. What might come as a surprise is that there is a Red List of endangered crafts. These are traditional crafts, the practice of which are at risk of dying out. In the same way that one can identify values for the existence of species (which may be independent of ever actually interacting with them), this project will investigate whether there are existence values for the preservation of crafts, independent of whether one actually wants to purchase the products. If interested in this project, contact me early, as it will require some coordination with partners in the UK. Co-supervised by TBC.

#### **Public preferences for Biosolids management**

Biosolids are the solid outputs from waste water treatment plants. The management of these present some issues for water utilities, as they need to be disposed of in a way that is safe, and supported by the public. One means is as a soil conditioner for agriculture. This study will examine peoples' understanding of biosolids, and their preferences for different means of treating and disposing of them. Co-supervised by TBC.

### A/Prof. James Fogarty (James.fogarty@uwa.edu.au)

### Mining exploration incentives: a systematic review



Mining exploration is associated with externality issues that result in those undertaking exploration investment not receiving all the benefit of their investment. This situation has led to government providing subsidies for mineral exploration. This project will: (i) review the case for the theoretical evidence for providing exploration subsidies and (ii) conduct a systematic review and meta-analysis of the existing literature on the return to government of mining exploration subsidies. Co-supervised by TBC.

### Waste management in Western Australia



Local governments across Western Australia have implemented a range of different waste management technologies and waste collection systems. This research will: (i) describe the different waste management systems used in Western Australia; (ii) use ANOVA models to examine the waste diversion performance of different technology and collection systems; and (iii) use regression analysis to estimate the price elasticity of demand for waste services. Co-supervised by TBC.

### Fisheries management issues



The Western Australian government is responsible the overall management of coastal fisheries, which are common property resources. The management input of the government involves the issue of cost recovery from the beneficiaries of that management, which are generally taken to include both fishing operators and the broader community. Current policy for determining the contribution of industry in each managed fishery requires information on the Gross Value of Product (GVP) from the fishery. This research project will: (i) review fisheries management policy and approaches across Australia; (ii) identify any practical issues with current approaches to collecting charges from industry; (iii) evaluate the impact of alternate cost recovery options. Cosupervised by TBC.

### A/Prof. Atakelty Hailu (Atakelty.hailu@uwa.edu.au)

#### Analysing the value and management of recreational fishing

The management of recreational fishing is a source of controversy in many jurisdictions. Those who are interested in conservation argue that governments are not doing enough to protect fish and fishing sites. Angling communities, on the other hand, argue that recreational fishers are more responsible than conservationists suggest, and that their activities generate significant economic and social benefits. Governments try to balance the interests of these two groups but need good research based evidence. In this project, you would use either secondary or primary data to develop models of recreational site choice and use those models, possibly together with ecological or fish stock models, to analyse different management strategies in terms of their economic, social and ecological benefits. Co-supervised by Abbie Rogers, Michael Burton.

### Developing quality indicators for soil, land, parks, and all that

Developing indicators or quality measures to compare apple and orange type problems is fun. Soil scientists have wanted to summarise diverse soil quality variables into summary measures. The problem applies to many other cases, e.g. comparing park quality, cities, countries, etc. The focus depends on the interest of the student. Economic models can be used to provide sound basis for quality indicator construction. This project is relevant to researchers in agriculture, environmental science or development economics. For example, in development economics, the researcher might be interested in comparing different countries (e.g. in a single continent or more broadly). A researcher interested in conservation might want to focus on developing quality indicators for natural habitats. Co-supervised by Michael Burton, Chunbo Ma, Steven Schilizzi.

### Dr Marit Kragt (Marit.kragt@uwa.edu.au)

### Biodiversity offsets for mine site rehabilitation



Mining companies are required to rehabilitate old mine sites after use. Typically, this rehabilitation aims to recreate a native ecosystem or productive pastoral land use. However, full ecosystem restoration is practically infeasible on most mine sites. Biodiversity offsets could provide an alternative. In this project, a talented student will investigate the opportunities for biodiversity offsets for mine site rehabilitation. You will identify what types

of offsets are currently used in mining approvals and mine closure plans, and discuss the effectiveness of such offsets to compensate for the environmental impacts of mine developments. Co-supervised by Prof. Ben White.

### Evaluating Australia's restoration economy



Ecosystem restoration activities have the potential to contribute to significantly to economic activities in (remote) regions of WA. This study will (i) map and document key supply chains involved in the delivery of restoration goods and services in Western Australia; (ii) evaluate the current and anticipated size of the restoration industry and key drivers of its development; and (iii) consider the future outlook and opportunities for jobs and growth of Western Australia's restoration economy. Co-supervised by Dr Ram Pandit.

### Socio-economic costs of agricultural waste management



This project is part of a large interdisciplinary and industry-funded project that is developing novel ways to process livestock waste using Black Soldier Flies (BSF). The student will evaluate the non-marketed costs of current livestock waste management strategies. You will conduct a meta-analysis of the literature to quantify the costs of current waste treatment strategies, including direct financial costs, environmental costs, and impacts on human and animal health. Co-supervised by Dr Fiona Dempster.

#### Black Soldier Fly meal and oil as a high quality animal feed product

This project is part of a large interdisciplinary and industry-funded project that is developing novel ways to process livestock waste using Black Soldier Flies (BSF). The student will evaluate whether BSF products from approved waste materials could be used as animal feed. Based on desktop research, data from the BSF project, and industry consultation, you will write a research report that describes how well BSF meal and oil could meet the feed specifications, diet formulations and other requirements for monogastrics. Co-supervised by Dr Sasha Jenkins.

### Dr Amin Mugera (Amin.mugera@uwa.edu.au)

### Research in international development



Research projects in development economics field emphasize the economics of agricultural growth and development with a focus on the analysis of food and nutrition security, poverty and vulnerability to poverty, farm household efficiency and productivity, marketing policy, and performance of food systems in developing countries. Given the geographical diversity of students in our course, those research projects are tailored to the specific research interest of the student subject to availability of data and financial resources where necessary. Often, the projects involve analysis of large survey dataset available in the public domain - such as the World Bank Living Standard Survey - using econometric techniques to address specific issues in international development.

### Dr Ram Pandit (Ram.pandit@uwa.edu.au)

#### Valuing threatened species

Monetary values of the benefits of threatened species are not currently available for most species listed in the Threatened Species Strategy (TSS) or state/territory-specific conservation strategies in Australia. Such estimates are valuable for setting management priorities and assessing proposed investments, as well as underpinning the value of investment in actions to save species. This project will involve developing a choice experiment survey to estimate values people place on conserving selected threatened species in Western Australia. Co-supervised by Prof David Pannell.

### Biodiversity offsets in practice: challenges and mitigating strategies



Biodiversity offsets have increasingly been used as a policy tool to balance economic development and biodiversity conservation. The effectiveness of this tool in achieving intended outcomes is contested for a variety of reasons, including how offsets have dealt with like-for-like, ecological equivalency, uncertainty and risks in offsets plans. Effectiveness of offset plans remains unclear. Understanding of the performance of the offset plan is important to design effective offsets in the future. This project looks at the offset process from planning to generating outcomes and highlights challenges and mitigating strategies at various stages of the offset process. Co-supervised by Dr Marit Kragt.

### Development Infrastructure and biodiversity offsets: Lessons from Jandakot Airport development



Infrastructure development such as airport affect natural environment, sometimes threatened species or matters of national significance. Jandakot airport redevelopment impacted the habitat of Carnaby's Black Cockatoo. To compensate for impacts, biodiversity offset was planned and implemented. However, it is unclear what level of costs was allocated to offset project and how much success the offset project had. In other words, how cost effective the offset project was remains unclear. This project aims to evaluate the offset outcomes from this offset project and explore cost effective options to enhance effectiveness of offsets applicable to infrastructure development projects. Co-supervised by Dr Ben White.

### Housing development and biodiversity offsetting: Lessons from Perth



Growth of Perth city impacts its surrounding natural environment in many ways. New housing development to accommodate increased city population directly impacts the habitat of threatened species. Examining a particular housing development project and associated offset plans, this project aims to examine the costeffectiveness of offsets plans in generating environmental outcomes due to the impact of housing development. In particular, it aims to examine whether mitigation hierarchy had been applied and properly documented in relation to the project and the outcome of the offset implementation. Co-supervised by Dr Ben White.

### **Effectiveness of wetland restoration**

Wetland degradation is a serious environmental issues in Australia. A range of actions have been taken to restore degraded wetlands. It is not always clear that whether these actions are effective from economic, social, and ecological perspectives. This project aims to evaluate the effectiveness of such actions in restoring identified wetlands (case studies) based on an Effectiveness Analysis Framework. The project involves stakeholders consultation, developing and implementing questionnaire to understand public perception and preferences. Cosupervised by Michael Burton.

#### Does COVID-19 shifted our use and views of public open spaces/urban forests in metropolitan areas

COVID-19 has forcefully changed our behaviour and possibly the way we value natural environment. Local parks, urban forests and public open spaces have been the places of attractions for individuals. Has COVID-19 shifted the use and views of these spaces? It is important to know public preferences on what else and how should we manage urban green spaces. Such information would help to design nature-based solutions to address health or environmental problems by city councils. This project will investigate urban greening strategies of selected city councils in Perth (Cockburn and Sterling) for such purposes. Co-supervised by Michael Burton.

#### Valuing threatened plant species and ecological communities

Monetary valuation of threatened species has been mostly focused on animal species (fauna). Threatened plant species and ecological communities do not receive similar attention despite they play equally important roles in providing ecosystem services. So this project aims to value a set of priority plant species and ecological communities of Western Australia that needs conservation actions. Knowing social preference would help in prioritising conservation actions and associated investments. This project will involve developing a choice experiment survey to estimate values people place on conserving priority threatened plants and ecological communities of Western Australia. Co-supervised by Michael Burton.

### Prof. David Pannell (David.pannell@uwa.edu.au)

### The economics of additionality for environmental projects



In policy programs that pay people or businesses to improve their environmental management (e.g. Australia's climate change policy), there is a high risk that money will be paid to people to do things that they were going to do anyway – that is, things that are not "additional". Some environmental programs do a poor job of checking for additionality. This is a problem because it means the policy is not actually helping to solve the environmental problem. On the other hand, rules that get tough on additionality can mean that participation in the program is reduced. How can policy makers strike the best trade-off between participation and additionality? Potential cosupervisor: Dr Abbie Rogers.

### Dr Abbie Rogers (abbie.rogers@uwa.edu.au)

### Do non-market values change the outcome of prioritising natural hazard mitigation?



Natural hazard managers need to be able to prioritise mitigation actions to reduce the impact of bushfire, flood and other hazard events, so that they get the best bang for their buck. Benefit-cost analyses can be used to weigh up the economic costs and benefits of different mitigation programs, including non-market costs and benefits. This project will explore the efficiency of different natural hazard mitigation programs depending on whether non-market values are included in benefit-cost analyses. Co-supervised by Dr Veronique Florec.

### The Great Southern Reef: is it more valuable than the Great Barrier Reef?



Kelp forests are a key ecosystem in Australia's temperate waters. The Great Southern Reef, an interconnected system of kelp forests, spans roughly from Kalbarri in WA around to the northern border of NSW, and is likely to contribute significantly to our economy through tourism and provision of fish habitat for commercial and recreational fisheries. This project aims to estimate the value of ecosystem services provided by Australian kelp forests through analysis of available data. Co-supervisors: Michael Burton, Karen Filbee-Dexter.

### Prof. Steven Schilizzi (Steven.schilizzi@uwa.edu.au)

# Economics of renewable energies



This can be a survey-based or modelling based study regarding the economic viability of, or policies on, renewable energy sources. Students can investigate the effect of taxes, buyback rates, cost-sharing and subsidies. In particular, comparisons between renewable and non-renewable options can be examined. Cosupervised by Dr. Chunbo Ma.

### What policy tools can help economic agents reduce, reuse and recycle waste, and in particular plastic waste?



This is a 'hot topic' which is being addressed by a new PhD student who started in mid-March 2020 in collaboration with the WA DPC (Dept of Premier & Cabinet). A Masters or Honours project would complement some of the work for the PhD project and in collaboration with it. The methodology will include aspects from behavioural economics. Co-supervised by Dr. Marit Kragt.

# Are competitive tenders a good policy tool for achieving environmental outcomes?



This topic will not start from scratch but can build on existing analyses from an ARC project. It will involve either statistical analysis or experimental work, or both. The student may choose from several possible questions. This project is an opportunity for the student to learn first-hand from the ARC project leader how to run economic experiments, by designing then running a simple experiment (in our BEL Lab). Co-supervised by Dr Sayed Iftekhar (Griffith Univ), A/Prof Ben White.

#### Is insurance an effective tool for landholders for providing environmental services to the community?

This question was investigated by a PhD student in connection with an ARC project from a theoretical point of view, leaving much room for asking whether the answers found would really be observed in reality. This project would focus on designing and running a simple experiment and/or carrying out a survey in an agricultural community. Co-supervised by Dr Toto Olita (Curtin) or A/Prof. Ben White.

### Equity and fairness for disaster relief in developing countries



The point of departure could be the housing reconstruction program in Pakistan after the disastrous 2010 floods, but the problem could be adapted to other countries for other types of disasters. The focus would be on tradeoffs between economic efficiency and social equity, which often create the most difficult decisions for disaster managers to make. Co-supervised by Dr. Amin Mugera and/or Dr. Masood Azeem (UNE)

#### Solving the equity-efficiency trade-off in paying for environmental services

Ecosystem or environmental services (ES), such as biodiversity or carbon sequestration, do not carry a market price, yet have value to society. Underpaying yields too little ES; overpaying wastes tax-payers' money. Competitive tenders can provide a market-mechanism solution which, though efficient, raise strong community concerns about their fairness - this can lead to reduced participation, which destroys the sought-after efficiency. The project would involve designing and running a lab experiment to address an aspect of this important question. Co-supervised by TBC.

# The switch to electric vehicles - in Perth, WA or Australia



Electric vehicles are the future, we are told, but there are few around. Why? Cars, buses, trucks, trains may also have different electrical futures - What are they? Do conditions differ between cities and countryside? How do they link with PV panels on rooftops? What are people's perceptions and how much do they value this switch? Who is influential in what is (not) happening? These and other questions have become a hot topic that can be explored using economic analysis, surveys or even lab experiments. Co-supervised by Dr. Chunbo Ma.

### A/Prof. Ben White (benedict.white@uwa.edu.au)

### The economics of the new Department of Mines Fidelity Fund



The Department of Mines, Industry Regulation and Safety (DMIRS) introduced an environmental charge on mines to cover rehabilitation costs. This has replaced environmental bonds, but it is unclear how mining firms responded in terms of the rate and quality of rehabilitation. The study will develop a model of how rehabilitation responds to the policy and the link between firm financial performance and environmental performance. Cosupervised by Dr Marit Kragt.

### The economics of beneficial honey bees



This study will explore the value of honey bees to a number of pollinator depended industries possibly avocados and cherries. Managed honey bees are good pollinators, but so are feral honey bees and some native insects. This Masters or Honours project will be linked to the Honey Bee products Cooperative Research Centre. Cosupervised by Dr Liz Barbour.

## **Environmental Management**

Specialisation coordinator: Dr Nik Callow (Nik.callow@uwa.edu.au)

### A/Prof. Roberta Bencini (Roberta.bencini@uwa.edu.au)

Translocation of the ash-grey mouse (Pseudomys albocinereus) from Cataby to Woodland Reserve,

### Whiteman Park



The project will involve the translocation of this native mouse from a mine site in Cataby to Whiteman's Park Woodland reserve. Animals will be sourced from the minesite by pitfall trapping and moved to Whiteman Park where there will be follow up monitoring via camera trapping and radio tracking to see how the animals are establishing in the new environment. Statistical analysis of results and submission of a report to the Park at completion of the study is required, as well as a presentation to stakeholders. Whiteman Park will assist with covering the costs of all consumables, support with report writing and field assistance, including any necessary training. Co-supervised by Mike Bamford (Bamford consulting) and Chris Rafferty (Whiteman Park).

### Dr Nik Callow (Nik.callow@uwa.edu.au)

### Impacts of hydrological connectivity on valley-floor salinity



Interventions to improve flow connectivity have been implemented at locations across the Western Australian Wheatbelt. These have reduced surface water ponding, with the aim of disconnecting fresher surface water from salinity in the soil profile. This project will use cloud satellite computing platforms (Google Earth Engine) to explore the changes in the patterns of salinity impacting vegetation health adjacent to the intervention structures. Lakes Toolibin and Bryde will be a focus. While predominantly desktop, there is an opportunity for fieldwork to be incorporated. Co-supervised by A/Prof. Matt Hipsey.

### Remote area hydrology – studying hydrology with no hydrological data



The north and inland of Australia contains important river systems, but has very little hydrological data. The traditional approach to remote-area hydrology has been to construct models with large uncertainty, however, multiple satellite products contain useful hydrological information. This project will advance data assimilation and uncertainty techniques (Markov-Chain Monte Carlo Bayesian framework) developed by the supervisors, to combine multiple different satellite data to allow prediction of floods in remote and ungauged river basins. Cosupervised by A/Prof. Matt Hipsey and Ben Jarihani.

# Monitoring Fringing Vegetation with Drones



Drones are an emerging environmental monitoring tool, particularly powerful for monitoring ecosystem processes and responses to stressors such as climate change, water quantity and water quality decline. Perth's wetlands have undergone unprecedented changes from urbanization since European settlement and are also vulnerable to the significant change in the climate of southwestern Australia since the 1970s, compounded by water abstraction. This project will explore, evaluate and develop methods to monitor fringing vegetation surrounding one of the Swan Coastal Plains most significant wetlands - Lake Joondalup and the Yellagonga Regional Park. There is an opportunity to work with an industry partners (City of Joondalup and Sentient Hubs Pty Ltd) and your research will be used to influence and inform how drones are used for environmental monitoring and evaluating things such as drone citizen science opportunities. Co-supervised by Matt Hipsey.

### Dr Paul Close (Paul.close@uwa.edu.au)

### Microplastic ingestion by aquatic fauna



Pollution of aquatic ecosystems by plastic is a growing worldwide problem. Ingestion of microplastics by freshwater biota can be influenced by feeding strategies and habitat use. This project will examine how microplastic ingestion varies among taxa and functional feeding groups, and will target fish and invertebrates such as mussels and crayfish. The project will involve field sampling. Co-supervised by Dr Barbara Cook.

### Wildlife conservation outside reserves but inside the city limits



There is growing evidence that urban landscapes could offer substantial opportunities for wildlife conservation. The distribution of many species, both common and threatened, overlap urban areas; wildlife can occur not only in the network of reserves, but also in a diverse array of other, highly modified habitats. This project will investigate the potential conservation value of highly modified habitats such as street verges, cemeteries, parks and gardens using wildlife surveys to determine the presence and/or abundance of a variety of taxa. Cosupervised by Drs Barbara Cook and Peter Speldewinde, Bronte Van Helden.

# City slickers or stressed relics: is urban wildlife healthy?



The transition of natural landscapes to highly modified 'urbanscapes' is accelerating globally. While many native species appear to be able to persist within urbanized landscapes, little is known about more subtle impacts of landscape change on animal stress and health. This project will investigate whether animals in urbanized habitats display compromised health using a variety of possible indicators including parasite loads and stress hormone levels. Co-supervised by Dr Barbara Cook, Bronte Van Helden.

### Is bigger really better: influence of city characteristics on urban biodiversity



While urban landscapes can support numerous species, how animal communities respond to differences in the urbanized landscape (e.g. city size, population density, 'greenness') is poorly understood. This project will undertake a meta-analysis of studies that compare biodiversity in urban areas to natural habitats. It will identify the city factors that influence urban animal assemblages and investigate whether these vary among taxonomic groups. This knowledge will identify which types of cities may offer the greatest opportunities for biodiversity conservation for particular groups of animals. Co-supervised by Dr Barbara Cook, Bronte Van Helden.

# What is the best approach for determining arboreal mammal abundance?



Different approaches have been used to estimate the abundance of arboreal mammals using spotlight surveys. How these compare and which method is most appropriate to estimate abundance remains a question for many field ecologists. This project compares transect and quadrat spotlight surveys to estimate the abundance of a critically endangered marsupial. This will include a comparison of these techniques in different vegetation structures and in habitats with different animal densities. Co-supervised by Dr Barbara Cook, Bronte Van Helden.

### Dr Barbara Cook (Barbara.cook@uwa.edu.au)

#### Measuring participation in outdoor recreation

According to the Australian Bureau of Statistics, bushwalking and cycling are the most popular forms of exercise and recreation. However, unlike traditional, club-based competitive sports, outdoor recreation is generally undertaken outside of organised groups, making it difficult to develop a fine-grained understanding of participation rates and trends. This project will develop a detailed picture of participation in outdoor recreation

in Albany by surveying people recreating on hiking and cycling trails. It will determine what kinds of activities people are involved in, whether they are involved in clubs, how they improve their skills, what trails they use, and what types of infrastructure or support they need. Co-supervised by Dr Lenore Lyons (GSCORE).

### Impact of phosphite spraying on invertebrates communities



Phosphite is a biodegradable fungicide that has been used to slow down the spread of Phytophthora dieback in southwestern Australia. To date, the main focus of aerial spraying of phosphite has been on protecting critically endangered and endangered plants such as *Dryandra montana*, *Leucopogon gnaphilioides* and *Andersonia axilliflora* in the Stirling Ranges and *Lambertia echinata* ssp. *echinata* in ironstone shrubland near Busselton. Of concern is the impact that this control measure might be having on native flora and fauna. This project will assess the impact of this phosphite spraying on benthic invertebrate communities. Co-supervised by Dr Peter Speldewinde.

### Improving rock fishing safety: Has the communication of the dangers of rock fishing been effective?

Recreational fishing is a popular activity globally. Although an enjoyable pastime, recreational fishing, particularly rock fishing, can be dangerous, with many deaths recorded in Australia and New Zealand. Although Recfishwest has invested in extensive fishing safety campaigns, knowledge of how much of this communication is accessed by high risk fisher groups is limited. Measurement of the performance of this rock fishing safety strategy is critical. Using intercept surveys, this project will identify what forms of communication are commonly used by fishers, how much of the fishing safety material has been viewed, and how this has affected risk taking behaviours. Co-supervised by Dr Paul Close.

#### Understanding market demand for mountain biking

Interest in mountain biking is a growing rapidly around the world. Despite this interest, we know little about who mountain bikers are and what types of trail experiences they are interested in. This project will develop a detailed profile of mountain biking in Western Australia. Who participates in MTB? Where do they ride? What style of riding do they prefer? What grades of trail do they ride (green, blue, black)? How often do they ride? What are the demographics of these riders? This project will use surveys to collect information from MTB riders in several locations in Perth and the South West, including Albany and sites such as Margaret River and Kalamunda. Co-supervised by Dr Lenore Lyons (GSCORE).

# Developing protocols for assisted migration of threatened flora

In recent years, a number of threatened flora translocations have been undertaken in the South Coast region whereby flora species have been introduced to novel habitat due to difficulty finding suitable natural habitat free from threats within the species' known range. In addition, future translocations are likely to focus more on 'assisted migration' to potentially higher rainfall habitat in the face of a drying climate, this is also likely to be outside the known historical range and habitat for the species. This project will develop protocols for future assisted migrations taking into consideration species biotic and abiotic requirements, using a selection of South Coast Threatened Flora as case studies. Co-supervised by Dr Sarah Barrett (DBCA).

### Long term phosphite application to manage dieback in Banksia shrubland at Gull Rock National Park



Banksia shrubland communities in Gull Rock National Park are significantly threatened by the introduced root pathogen *Phytophthora cinnamomi* and have been sprayed with the fungicide phosphite since the late 1990s to slow the spread of the disease and reduce its impact. Observations suggest that susceptible proteaceous species have re-established in long-infested areas that were demarcated in the late 1990s by a pegged 'dieback front'. This project will investigate plant species richness and structure in plant communities sprayed with phosphite and plant communities not sprayed in Gull Rock NP in areas previously designated as dieback-infested. Cosupervised by Dr Sarah Barrett (DBCA) and Prof. Steve Hopper.

### The effect of Phytophthora dieback on species richness and vegetation structure



The Stirling Range has unique plant communities with high levels of plant endemism. Many of these communities are poorly documented and are highly threatened by the introduced root pathogen Phytophthora cinnamomi. This project will investigate the changes brought about by Phytophthora dieback and document the plant biodiversity before it is irrevocably altered. The project will document floristics, species richness and plant structure in a healthy plant community compared with the same habitat infested by dieback, with a focus on the Proteaceae-dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia. Co-supervised by Dr Sarah Barrett (DBCA) and Prof. Steve Hopper.

# The role of inter-fire recruitment in maintaining populations of long-unburnt obligate seeding species



Fire is an integral part of the Australian landscape and plays a significant role in plant community dynamics and regeneration. Obligate seeding (serotinous), woody species typically release seed with the passing of a fire which subsequently germinates. However, many serotinous species are capable of low levels of recruitment between fire. It is unclear for many Kwongkan plant communities whether inter-fire recruitment is sufficient to prevent local extinction of serotinous obligate seeders due to senescence. This project will investigate the role of interfire recruitment on plant community dynamics in long-unburnt vegetation on the South Coast. Co-supervised by Dr Sarah Barrett (DBCA) and Prof. Steve Hopper.

#### Pollination biology of the critically endangered Banksia montana



The critically endangered Stirling Range endemic Banksia montana is known from eight mature individuals in the wild but has been successfully translocated to a seed orchard south of the Stirling Range. However, little is known of the pollination biology of this species. This project will identify pollinators and will investigate their behaviour and visitation rates in ex-situ populations. The study will determine whether pollination or other factors are limiting reproductive success and whether the species is self-compatible. Co-supervised by Drs Sarah Barrett (DBCA) and Peter Speldewinde.

### Development of biological indicators of environmental degradation of WA aquatic ecosystems



Biomonitoring has become a standard tool for assessing the 'health' of rivers worldwide, with the use of macroinvertebrates such as mayflies, stoneflies and caddis flies well documented. Using existing data, this project will evaluate the responses of these and other groups such as chironomids to gradients of environmental degradation in order to assess their potential capacity as indicators of waterway degradation in southwestern Australia. Co-supervised by Dr Paul Close.

### A/Prof. James Fogarty (James.fogarty@uwa.edu.au)

### Waste management in Western Australia



Local governments across Western Australia have implemented a range of different waste management technologies and waste collection systems. This research will: (i) describe the different waste management systems used in Western Australia; (ii) use ANOVA models to examine the waste diversion performance of different technology and collection systems; and (iii) use regression analysis to estimate the price elasticity of demand for waste services. Co-supervised by TBC.

### Prof. Steve Hopper (Steve.hopper@uwa.edu.au)

#### **Ethnobiology studies with Noongar people**

A series of projects is on offer, tailored to your skills and interests exploring Traditional Ecological Knowledge (TEK) with Elders on the South Coast and or at Dryandra near Narrogin. The aim is to capture TEK through oral history interviews on country, and test hypotheses derived from such investigations, before elders pass on. Culturally important plants, animals and ways of caring for country are the focus. Co-supervised by Dr Alison Lullfitz.

### Noongar stories and traditional ecological knowledge of Albany's Ring Road precinct

This project involves documenting the oral history and traditional ecological knowledge (TEK) of Noongar elders for the northern Ring Road precinct (including Mount Melville, Mount Elphingstone and Willyung Hill). The project will establish the level of detail to which oral history of Elders records traditional knowledge of the precinct, especially its TEK. The project involves obtaining necessary permits and working with UWA's cultural heritage team and Elders willing to share stories, and consultants from Decmil. Intellectual property remains with Elders. The student will help ensure this is respected, and learn various techniques in cross-cultural and biological research. Decmil has sponsored the costs for consultation with Elders and a \$2500 student stipend. Co-supervised by Dr Alison Lullfitz.

#### Dr Sasha Jenkins (Sasha.jenkins@uwa.edu.au)

### Recycling waste as organic fertilisers: Are they safe?

Many organic fertilisers are derived from waste products that may contain contaminants or undesirable elements resulting in adverse environmental impacts. Manure is often directly spread onto agricultural land without treatment and there are growing concerns over this practice with respect to pathogens and nutrient contamination of surface and groundwater, Greenhouse Gas (GHG) emissions, salinity and phyto-toxicity. This project will quantify the environmental risks associated with the re-use of different waste byproducts, with specific focus on (i) pathogen survival (ii) salinity & toxicity (iii) N and P leaching to surface and groundwater's and (iv) GHG emissions. Co-supervised by TBC.

#### **Bioenergy: Converting household waste into biogas**

In Western Australia the preferred disposal method for municipal solid waste (MSW) is landfill. However, this is not necessarily the most effective means of disposing of such waste and there is growing interest in finding alternative uses that solve both waste excesses and energy shortages. One option is to convert MSW into biogas (methane) and compost via a process called anaerobic digestion. The biogas can then be used to provide renewable energy by the generation of electricity. However, anaerobic digestion is a complex process performed by microbes and consequently the ecology, prevailing environmental conditions and mechanisms involved remain poorly understood. This project will develop more efficient anaerobic digestion by investigating the relationship between microbial degradation, environmental parameters and biogas production during the anaerobic digestion of MSW. Co-supervised by TBC.

### Recycling waste as organic fertilisers: Do they enhance soil quality?

It has been claimed that organic farming enhances soil health & quality in terms of biodiversity, nutrient cycling, organic matter content, soil structure & stability, water holding capacity and disease suppression. However, the true extent to which organic management 'enhances' nutrient cycling and other soil functions remains largely unexplored. This project will quantify whether soil quality is 'enhanced' in soils subject to organic waste inputs. It will initially investigate how organic management impacts on soil biology by developing biological indicators. These bio-indicators in combination with other conventional indicators will then be used to assess whether soil quality is being gained, maintained or has been lost in soils receiving organic waste. Co-supervised by TBC.

### Converting piggery waste into biogas

Currently most pig farmers put their pig waste into large ponds where the waste is gradually broken down by microbes within the pond. However, these microbes release both odours and methane that upset local residents and contribute to global warming. One solution is to cover these ponds with an impermeable cover resulting in reduced gas emissions since the methane is retained under the cover. Although, the prospect of covered ponds is attractive, initial start-up costs are high. This could be overcome by capturing the methane under the cover and using it to off-set start-up costs by providing on-farm heating or electricity. However, methane recovery from covered ponds is not very efficient, and covers on the ponds could alter the waste degradation process and reduce biogas yield. Our research aims to increase biogas production from covered ponds by optimising the waste degradation process through different management practices and provide advice on interventions required to prevent pond failure. Co-supervised by TBC.

#### Dr Marit Kragt (Marit.kragt@uwa.edu.au)

### Biodiversity offsets for mine site rehabilitation



Mining companies are required to rehabilitate old mine sites after use. Typically, this rehabilitation aims to recreate a native ecosystem or productive pastoral land use. However, full ecosystem restoration is practically infeasible on most mine sites. Biodiversity offsets could provide an alternative. In this project, a talented student will investigate the opportunities for biodiversity offsets for mine site rehabilitation. You will identify what types of offsets are currently used in mining approvals and mine closure plans, and discuss the effectiveness of such offsets to compensate for the environmental impacts of mine developments. Co-supervised by Prof. Ben White.

### Evaluating Australia's restoration economy



Ecosystem restoration activities have the potential to contribute to significantly to economic activities in (remote) regions of WA. This study will (i) map and document key supply chains involved in the delivery of restoration goods and services in Western Australia; (ii) evaluate the current and anticipated size of the restoration industry and key drivers of its development; and (iii) consider the future outlook and opportunities for jobs and growth of Western Australia's restoration economy. Co-supervised by Dr Ram Pandit.

### Socio-economic costs of agricultural waste management



This project is part of a large interdisciplinary and industry-funded project that is developing novel ways to process livestock waste using Black Soldier Flies (BSF). The student will evaluate the non-marketed costs of current livestock waste management strategies. You will conduct a meta-analysis of the literature to quantify the costs of current waste treatment strategies, including direct financial costs, environmental costs, and impacts on human and animal health. Co-supervised by Dr Fiona Dempster.

### Black Soldier Fly meal and oil as a high quality animal feed product

This project is part of a large interdisciplinary and industry-funded project that is developing novel ways to process livestock waste using Black Soldier Flies (BSF). The student will evaluate whether BSF products from approved waste materials could be used as animal feed. Based on desktop research, data from the BSF project, and industry consultation, you will write a research report that describes how well BSF meal and oil could meet the feed specifications, diet formulations and other requirements for monogastrics. Co-supervisored by Dr Sasha Jenkins.

### A/Prof. Mathias Leopold (Matthias.leopold@uwa.edu.au)

### **Ecohydrology of thrombolites, Lake Clifton, WA**



Lake Clifton, south of Perth, harbours one of the biggest non marine thrombolite colonies in the southern hemisphere. Recent changes in groundwater levels and salinity challenge the ecohydrological parameters necessary to sustain a healthy grows of the thrombolites. The project will use environmental geophysics and sediment probing to establish initial parameters for an ecohydrological model of the area. Both, field and laboratory based work is required. The project is in cooperation with the Peel Harvey Catchment Council and the Department of Biodiversity, Conservation and Attractions. Co-supervisors: Gavan McGrath (DBCA) and Rick James (Peel Harvey Catchment Council).

### Swan River and Urban Interactions with a Fringing Wetland



The Department of Biodiversity Conservation and Attractions (DBCA) is undertaking a 2-year study of the hydrology and water quality of Ashfield Flats Reserve in Bassendean. The aims of the project are to assess the hydrological processes governing the wetland water balance as well as the geochemical factors contributing to heavy metal, nutrient and pH impacts from urban drains and groundwater. Student projects available include (i) the acquisition of near-surface geophysics and drilling, for the development of a conceptual hydrogeological model; (ii) experiments and monitoring to identify Swan River – Wetland interactions and Urban drain – wetland interactions; and (iii) experiments and field sampling to assess the geochemistry of urban runoff/sediments to untangle why pH drops when flows increase. Co-supervised by Dr Gavan McGrath (DBCA).

#### Environmental geophysics to study soils in the context of agriculture and environmental science

Soil plays an important role in agriculture and/or environmental science. A number of novel and innovative techniques allow the 3D mapping of various soil properties via environmental geophysical methods. There are a number of projects available for students who are specifically interested in developing and applying these methods to map and assess soils and their properties and constraints. Co-supervised by Dr Andrew Rate.

### **Ecohydrology of trees**



Many trees in the Perth metropolitan area were continuously stressed over the past decades and many of the older trees such as Banksia or Norfolk Pine trees died in the recent past. Water stress was identified as a key factor. Understanding and monitoring the pathways of water uptake from the soil zone into the tree is the key aim for this project. A combination of different methods such as dendrometers, sap flow meters, environmental geophysics and soil studies is required. Co-supervisor Erik Veneklass / Paul Drake.

### Dr Ram Pandit (Ram.pandit@uwa.edu.au)

#### Valuing threatened species

Monetary values of the benefits of threatened species are not currently available for most species listed in the Threatened Species Strategy (TSS) or state/territory-specific conservation strategies in Australia. Such estimates are valuable for setting management priorities and assessing proposed investments, as well as underpinning the value of investment in actions to save species. This project will involve developing a choice experiment survey to estimate values people place on conserving selected threatened species in Western Australia. Co-supervised by Prof David Pannell.

### Biodiversity offsets in practice: challenges and mitigating strategies



Biodiversity offsets have increasingly been used as a policy tool to balance economic development and biodiversity conservation. The effectiveness of this tool in achieving intended outcomes is contested for a variety of reasons, including how offsets have dealt with like-for-like, ecological equivalency, uncertainty and risks in offsets plans. Effectiveness of offset plans remains unclear. Understanding of the performance of the offset plan is important to design effective offsets in the future. This project looks at the offset process from planning to generating outcomes and highlights challenges and mitigating strategies at various stages of the offset process. Co-supervised by Dr Marit Kragt.

#### Housing development and biodiversity offsetting: Lessons from Perth

Growth of Perth city impacts its surrounding natural environment in many ways. New housing development to accommodate increased city population directly impacts the habitat of threatened species. Examining a particular housing development project and associated offset plans, this project aims to examine the cost-effectiveness of offsets plans in generating environmental outcomes due to the impact of housing development. In particular, it aims to examine whether mitigation hierarchy had been applied and properly documented in relation to the project and the outcome of the offset implementation. Co-supervised by Dr Ben White.

### Does COVID-19 shifted our use and views of public open spaces/urban forests in metropolitan areas

COVID-19 has forcefully changed our behaviour and possibly the way we value natural environment. Local parks, urban forests and public open spaces have been the places of attractions for individuals. Does the COVID-19 has shifted the use and views of those parks, forests and open spaces? It is important to know public preferences on what else and how should we manage urban green spaces. Such information would help to design nature-based solutions to address health or environmental problems by city councils. This project will investigate urban greening strategies of selected city councils in Perth (Cockburn and Sterling) for such purposes. Co-supervised by Michael Burton.

#### Valuing threatened plant species and ecological communities

Monetary valuation of threatened species has been mostly focused on animal species (fauna). Threatened plant species and ecological communities do not receive similar attention despite they play equally important roles in providing ecosystem services. So this project aims to value a set of priority plant species and ecological communities of Western Australia that needs conservation actions. Knowing social preference would help in prioritising conservation actions and associated investments. This project will involve developing a choice experiment survey to estimate values people place on conserving priority threatened plants and ecological communities of Western Australia. Co-supervised by Michael Burton.

#### Dr Natasha Pauli (Natasha.pauli@uwa.edu.au)

#### Perceptions of climate change-linked mobility among young people in Asia-Pacific

Mobility and migration linked to the social, economic and environmental factors associated with climate change are gaining increasing attention. Climate-forced displacement and migration may replace conflict as the main driver of mass migration in the coming decades. Young people today will live through perhaps the greatest change in climatic conditions ever experienced by a single generation. Exposed to knowledge of the causes and impacts of climate change from a young age, young people's heightened awareness of climate change may have a substantial influence over their current and future plans. This study will gather evidence of climate-linked mobility among young people in Asia-Pacific, and develop an online questionnaire on youth perceptions of climate change and its impact on decision-making about travel, mobility and choices about where to live. Cosupervised by TBC.

#### Perceptions and values of different types of residential street verges and streetscapes

Residential street verges can make up a substantial proportion of open space in Australian cities. Amidst growing concerns around climate change, water use, population growth, urban planning, urban heat islands and biodiversity, the humble front verge is gaining increasing attention and in some cases, becoming contested

space. Street trees, turf, native gardens, edible gardens, footpaths, driveway crossovers, parking spaces, paving, utilities and astroturf are now jostling for limited space. In this project, you will implement and analyse an online survey on the values attached to residential street verges in Perth, building on existing research in this space. The results of this study will be unique and contribute to an important conversation around the future of streetscapes in Australian cities. Co-supervised by TBC.

#### Dr Andrew Rate (Andrew.rate@uwa.edu.au)

#### Using trace elements as tracers: What are the forms of trace elements in sulfidic estuarine sediments?

Trace elements represent potential contaminants in aquatic sediments, but may also be useful in determining the origin of sulfidic minerals in these systems. You would collect monosulfide-rich sediments from the Swan-Canning or Peel-Harvey estuarine areas, or use archived samples. You would measure the concentrations of different forms of trace elements using chemical and spectroscopic analytical techniques, to understand the spatial patterns in the sediments. Potential co-supervisor: Dr Bree Morgan (University of Sydney).

#### **Environmental geochemistry at Ashfield Flats Reserve**

Ashfield Flats is an urban reserve abutting the Swan River estuary, having high conservation value. The area is underlain by alluvial sediments, with many having a high risk of acid sulfate soils. Our studies found contamination of water, soils and sediments reflecting the site history and influx of industrial stormwater. DBCA(WA) has collected some deep cores which contain a record of the site's history, but are incompletely analysed. You would conduct mineralogical and chemical analyses on these cores to reconstruct Ashfield's sedimentary and anthropogenic history. Potential co-supervisors: Adjunct A/Prof Gavan McGrath (DBCA), Dr Deirdre Gleeson.

# Microplastics in urban airborne dusts



Microplastics are now known to be near ubiquitous across multiple environments on Earth. Some microplastic particles are generated from weathering of larger plastic waste, and some are released from synthetic textiles as fibres. The size and geometry of microplastic particles makes them susceptible to airborne transport by wind, but to date this is an under-researched pathway for terrestrial microplastics. This project would develop methods for sampling urban air for microplastics, and quantify and characterize the airborne microplastic particles which are collected. Potential co-supervisor(s): Prof Allan McKinley (MCS), A/Prof Matthias Leopold.

# Magnetic particles in street dusts and soils as pollution proxies



The magnetic properties of many urban soils, sediments and related materials may represent a simple and cost effective screening technology, since parameters like magnetic susceptibility or the content of ferromagnetic particles are known to be correlated with pollutant indices. This project would assess the relationships between magnetic properties and pollutant (e.g. potentially toxic trace element) contents in soils, sediments and street dusts from metropolitan Perth, Western Australia. Potential co-supervisors: Prof. Allan McKinley (MCS), A/Prof. Matthias Leopold.

### Transects of soil properties across the urban-periurban-rural gradient in Perth 🧈



Urbanization is known to affect the quality and composition of soils, which show gradients in nutrient, trace element, and organic pollutant concentrations from city centres through suburban and peri-urban environments to rural areas. Perth's unique soils, developed on dunes of Holocene to Pleistocene age, may show gradients which are atypical compared with other cities, but this has never been assessed. This project will attempt to detect an Anthropocene signature along urban-rural transects in metropolitan Perth, Western Australia and the surrounding non-urbanized areas. Potential co-supervisors: A/Prof. Matthias Leopold.

# Effect of woody Corymbia and Eucalyptus fruits on soil hydraulic properties



Solid, low permeability fragments ("clasts") in soils such as gravels are known to cause preferential water flow and reduce the effective soil pore volume. In Australia, persistent woody fruits such as those produced by Corymbia and Eucalyptus tree species (i.e. gumnuts) may also behave like mineral clasts, with the added complication that their properties may change with time as biological degradation proceeds. This project will measure the effect of woody Australian native tree fruits on (i) hydraulic conductivity and (ii) soil water retention of soil of contrasting textures. Potential co-supervisor: Adjunct Dr Gavan McGrath (DBCA), A/Prof. Matthias Leopold.

### Assessing contaminated urban environments



Soils and sediments in urban environments are known to contain localised instances of contamination with metals, related to different sources. These sources include: emissions from industry, inputs from road traffic, stormwater, and other anthropogenic or natural sources. Your project would be based at a specific site in metropolitan Perth, and explore different ways of assessing inorganic contamination and contaminant fluxes in sediments, soils, or water. Depending on your interests, you could also investigate aeolian transport of contaminants or uptake of contaminants by vegetation. Potential co-supervisor(s): Adjunct Dr Gavan McGrath (DBCA), Adjunct Dr Ursula Salmon (DWER).

### Environmental geochemistry desktop projects



A number of sources of data exist in the public domain, for example: the WA Department of Water's WiR database; WA Department of Mines and Petroleum's Data and Software Centre; and multiple international (USA, European) data repositories. Many of these datasets are a rich and in some case under-utilised source of geochemical, spatial, and temporal data. Depending on your interest, your project could involve using one or more of these databases to deduce environmental chemical processes and environmental effects. Potential cosupervisors: Adjunct Dr Gavan McGrath (DBCA), Adjunct Dr Steve Appleyard (DWER), Dr Patrice de Caritat (Geoscience Australia).

#### Prof. Zed Rengel (Zed.rengel@uwa.edu.au)

# Using constructed wetlands for purification of wastewater and stormwater



This project will (i) Identify WA wetland species suitable for accumulation of nutrients from wastewater, (ii) optimise conditions for biofiltration of stormwater using constructed wetlands and (iii) characterise interactions between heavy metals (e.g. cadmium) and organic contamination (e.g. hydrocarbons) in constructed wetlands purifying wastewater.

#### Dr Peter Speldewinde (Peter.speldewinde@uwa.edu.au)

# Who watches the watchers? What are motion triggered wildlife cameras missing?



Motion triggered cameras are now a common method of sampling and monitoring native fauna and feral species (e.g. Comer et al. 2018). These cameras may be baited or unbaited. The issue is that cameras only face in one direction and have a limited field of view and fauna may not being detected due to this limitation. This study will utilise motion triggered cameras to attempt to quantify the proportion of detections using standard techniques in relation to what could be detected when the area surrounding the camera trap is monitored. Cosupervised by Sarah Comer (DBCA).

# Are native wildlife eating plastic?



Waste disposal sites are often situated in places where small to medium sized native fauna have access. Much of the waste disposal consists of plastic. So the question to be asked is how much plastic do the native animals in the area consume and how far does this plastic contamination extend from the waste site? Co-supervised by Dr Harriet Paterson.

# Landuse change and zoonotic disease vectors



A recent publication (Mendoza et al. 2019) highlighted how land use change can increase the abundance of zoonotic reservoirs (particularly rodents). The 2019 meta-analysis was based on studies in tropical ecosystems. This study will test the hypothesis that land use change will increase the abundance of rodent hosts of zoonotic diseases in temperate ecosystems. The study could also examine the impact of restoration on rodent communities. The study will involve small mammal trapping in the Great Southern region of Western Australia. Co-supervised by Dr Barbara Cook.

### Impact of infrastructure construction on native wildlife



The city of Albany has a major infrastructure development planned in the form of a ring road to carry heavy vehicles to and from the port. This new major road will pass through sections of remnant bushland. This presents the potential for multiple projects (depending on the stage of development) on the impact of the existing road, the construction phase and completed road on fauna. The project can also focus on fauna use of specially constructed tunnels and overhead bridges designed to allow transit of animals. Co-supervised by Drs Paul Close and Barbara Cook.

### Using historical photos to track environmental changes in urban landscapes

Since European colonization, Australia's landscape has undergone dramatic change. In many long established regional towns, there exists a historical photographic record of the changes to the surrounding landscapes. This project will utilise these historical photos to test whether they are effective as a tool for documenting environmental change. Co-supervised by Dr Barbara Cook.

### Making use of digital technologies for monitoring fauna and flora



As digital technologies advance, these tools have become more affordable and feasible to use for monitoring biodiversity. For example, they can be used to enhance animal welfare when using traps. Using sensors and data loggers, this project will measure environmental conditions in fauna traps with and without animals present to assess conditions faced by these animals during capture. Co-supervised by Sarah Comer (DBCA).

### Rewilding to optimise human and ecosystem health in regional Western Australia



Many introduced species such as rats, mice and foxes can thrive in urban environments. These species can potentially carry zoonotic diseases. Many native animal species such as bushrats, possums and bandicoots can also thrive in urban environments. This study will examine disease burden in native and introduced species, in both urban and wild settings to determine if introduced species pose a higher disease risk in urban areas than native species. Co-supervisors-Dr Paul Close and Dr Angus Cook (School of Population Health).

### **Environmental Rehabilitation**

Specialisation coordinator: Dr Talitha Santini (Talitha.santini@uwa.edu.au)

### A/Prof. Roberta Bencini (Roberta.bencini@uwa.edu.au)

Translocation of the ash-grey mouse (Pseudomys albocinereus) from Cataby to Woodland Reserve,

### Whiteman Park



The project will involve the translocation of this native mouse from a mine site in Cataby to Whiteman's Park Woodland reserve. Animals will be sourced from the minesite by pitfall trapping and moved to Whiteman Park where there will be follow up monitoring via camera trapping and radio tracking to see how the animals are establishing in the new environment. Statistical analysis of results and submission of a report to the Park at completion of the study is required, as well as a presentation to stakeholders. Whiteman Park will assist with covering the costs of all consumables, support with report writing and field assistance, including any necessary training. Co-supervised by Mike Bamford (Bamford consulting) and Chris Rafferty (Whiteman Park).

### Dr Barbara Cook (Barbara.cook@uwa.edu.au)

# Impact of phosphite spraying on invertebrates communities



Phosphite is a biodegradable fungicide that has been used to slow down the spread of Phytophthora dieback in southwestern Australia. To date, the main focus of aerial spraying of phosphite has been on protecting critically endangered and endangered plants such as Dryandra montana, Leucopogon gnaphilioides and Andersonia axilliflora in the Stirling Ranges and Lambertia echinata ssp. echinata in ironstone shrubland near Busselton. Of concern is the impact that this control measure might be having on native flora and fauna. This project is aimed at assessing the impact of this phosphite spraying on benthic invertebrate communities. Co-supervised by Dr Sarah Barrett (DBCA).

# Developing protocols for assisted migration of threatened flora



In recent years, a number of threatened flora translocations have been undertaken in the South Coast region whereby flora species have been introduced to novel habitat due to difficulty finding suitable natural habitat free from threats within the species' known range. In addition, future translocations are likely to focus more on 'assisted migration' to potentially higher rainfall habitat in the face of a drying climate, this is also likely to be outside the known historical range and habitat for the species. This project will develop protocols for future assisted migrations taking into consideration species biotic and abiotic requirements, using a selection of South Coast Threatened Flora as case studies. Co-supervised by Dr Sarah Barrett (DBCA).

# Long term phosphite application to manage dieback in Banksia shrubland at Gull Rock National Park



Banksia shrubland communities in Gull Rock National Park are significantly threatened by the introduced root pathogen Phytophthora cinnamomi and have been sprayed with the fungicide phosphite since the late 1990s to slow the spread of the disease and reduce its impact. Observations suggest that susceptible proteaceous species have re-established in long-infested areas that were demarcated in the late 1990s by a pegged 'dieback front'. This project will investigate plant species richness and structure in plant communities sprayed with phosphite and plant communities not sprayed in Gull Rock NP in areas previously designated as dieback-infested. Cosupervised by Dr Sarah Barrett (DBCA) and Prof. Steve Hopper.

### A/Prof. Matthew Hipsey (Matt.hipsey@uwa.edu.au)

#### Climate change impacts on wetland ecosystems

The drying trend in south-western Western Australia has caused a loss of suitability of critical wetlands that support the requirements of the critically endangered Western Swamp Tortoise. In this project you will explore the future suitability of wetlands in different regions of the south-west using a lake modelling tool and climate change forecasts, in order to find suitable sites for translocation of captive animals. Co-supervised by TBC.

### Dr Marit Kragt (Marit.kragt@uwa.edu.au)

### Biodiversity offsets for mine site rehabilitation



Mining companies are required to rehabilitate old mine sites after use. Typically, this rehabilitation aims to recreate a native ecosystem or productive pastoral land use. However, full ecosystem restoration is practically infeasible on most mine sites. Biodiversity offsets could provide an alternative. In this project, a talented student will investigate the opportunities for biodiversity offsets for mine site rehabilitation. You will identify what types of offsets are currently used in mining approvals and mine closure plans, and discuss the effectiveness of such offsets to compensate for the environmental impacts of mine developments. Co-supervised by Prof. Ben White.

### Evaluating Australia's restoration economy



Ecosystem restoration activities have the potential to contribute to significantly to economic activities in (remote) regions of WA. This study will (i) map and document key supply chains involved in the delivery of restoration goods and services in Western Australia; (ii) evaluate the current and anticipated size of the restoration industry and key drivers of its development; and (iii) consider the future outlook and opportunities for jobs and growth of Western Australia's restoration economy. Co-supervised by Dr Ram Pandit.

### Dr Ram Pandit (Ram.pandit@uwa.edu.au)

### Development Infrastructure and biodiversity offsets: Lessons from Jandakot Airport development



Infrastructure development such as airport affect natural environment, sometimes threatened species or matters of national significance. Jandakot airport redevelopment impacted the habitat of Carnaby's Black Cockatoo. To compensate for impacts, biodiversity offset was planned and implemented. However, it is unclear what level of costs was allocated to offset project and how much success the offset project had. In other words, how cost effective the offset project was remains unclear. This project aims to evaluate the offset outcomes from this offset project and explore cost effective options to enhance effectiveness of offsets applicable to infrastructure development projects. Co-supervised by Dr Ben White.

# Housing development and biodiversity offsetting: Lessons from Perth



Growth of Perth city impacts its surrounding natural environment in many ways. New housing development to accommodate increased city population directly impacts the habitat of threatened species. Examining a particular housing development project and associated offset plans, this project aims to examine the costeffectiveness of offsets plans in generating environmental outcomes due to the impact of housing development. In particular, it aims to examine whether mitigation hierarchy had been applied and properly documented in relation to the project and the outcome of the offset implementation. Co-supervised by Dr Ben White.

#### **Effectiveness of wetland restoration**

Wetland degradation is a serious environmental issues in Australia. A range of actions have been taken to restore degraded wetlands. It is not always clear that whether these actions are effective from economic, social, and ecological perspectives. This project aims to evaluate the effectiveness of such actions in restoring identified wetlands (case studies) based on an Effectiveness Analysis Framework. The project involves stakeholders consultation, developing and implementing questionnaire to understand public perception and preferences. Cosupervised by Michael Burton.

### Dr Talitha Santini (Talitha.santini@uwa.edu.au)

#### Bioremediation of tailings and wastewaters

Microbially-driven approaches for remediation of tailings, mineral processing wastes, and contaminated waters provide novel pathways to address the challenging chemical and physical properties of these materials. Use a variety of methods including laboratory or glasshouse leaching columns, laboratory experiments, and geochemical, microbial, and physical laboratory analysis methods, this project will test microbially-driven approaches for remediation of tailings or leachates. Specific remediation targets may include pH neutralisation, metals removal, nutrient fixation, and/or structure development or dust suppression, for a range of different tailings and wastewaters/leachates. Potential co-supervisors: Drs Sasha Jenkins and Deirdre Gleeson, Prof. Dan Murphy.

### In situ remediation of bauxite residue



In situ remediation is increasingly being adopted in mine closure and rehabilitation plans. Bauxite residue, produced from alumina refining, is a globally significant tailings stream, with 120 MT produced worldwide annually. In situ remediation of bauxite residue may use a combination of inorganic and organic amendments, and biological approaches to transform it into a medium that is chemically, physically, and biologically suitable for plant growth. This project will optimise the combination of amendments and approaches applied to bauxite residue to achieve sustainable in situ remediation to support a variety of post-mine closure land uses. The project involves field sampling and analysis, and/or laboratory trials. Potential co-supervisors: Sasha Jenkins, Deirdre Gleeson, Dan Murphy.

# Modelling water balance and salt export during tailings rehabilitation



In situ remediation is an increasingly popular approach for tailings rehabilitation and closure, the end goal being the transformation of tailings into a suitable plant growth medium. Geochemical and physical data collected from field trials can be used to model the progress of rehabilitation fronts and changes in leachate chemistry, demonstrating to regulators and other stakeholders that the trajectory of the tailings system is on track to achieve remediation and closure goals. This project will use chemical and physical data collected from field trials of in situ remediation in bauxite residue to model water movement and mineral dissolution/ precipitation processes, and predict future behaviour of the tailings as it continues its transformation into soil. Modelling programs (HYDRUS1D, PHREEQC, and/or MIN3P) and provided field trial data will be used. Potential cosupervisors: Matt Hipsey, Andrew Rate.

### Enabling reuse of tailings through in situ remediation



In situ remediation is an increasingly popular approach for tailings rehabilitation and closure. The coupled abiotic-microbial strategies developed for rapid in situ remediation of tailings also opens the door for development of a new reuse pathway for tailings. Large scale utilization of tailings as a soil product requires transformation of its properties to meet specified targets demanded by potential consumers. Focusing on bauxite residue, this project will identify the opportunities for remediation and reuse as a soil product in agricultural activities around several pilot refinery sites globally. The project involves market analysis and consideration of bauxite residue properties and evidence for efficacy of various amendments to transform residue properties to achieve desired targets for the soil product. Potential co-supervisors Michael Burton, Marit Kragt, Fran Hoyle.

## Hitching a ride: contributions of dust deposition to nutrient accumulation and microbial community

### succession in tailings



Dust is a poorly quantified but widely acknowledged source of biological nutrients and potential source of microbial inoculants in natural environments. This role of dust has been almost entirely overlooked in mining environments. Recent laboratory experimental work by Santini et al (2018) demonstrated that dust is a significant source of microbial inoculants in tailings, and suggested that limited dust inputs likely underpin the delayed microbial community succession observed in tailings when compared to natural primary successional environments. This project will use field samples from dust traps to identify and quantify dust sources, total dust inputs, microbial community biomass, and dust nutrient content in a tailings site and adjacent non-mining site, and will evaluate microbial community functions to better explain the delayed succession and limited function that is commonly observed in tailings. Potential co-supervisors: Sasha Jenkins, Deirdre Gleeson, Dan Murphy.

### Blended waste caps for sustainable closure of tailings facilities



Blended waste caps, using tailings mixed with other waste materials present on site to create both an impermeable (capillary break) layer and a plant growth (soil) layer, are a new approach to tailings management that offers opportunities to eliminate risks and costs associated with capping and in situ remediation approaches (capillary rise, expense/effort of importing capping materials and amendments, etc.). This project will identify the optimal blend of wastes available onsite at an alumina refinery to create a plant growth medium capable of supporting plant growth. Subsequent stages of the project will involve running flume trials to optimise water balance between the plant growth layer and capillary break layer.

Potential co-supervisors: Dan Murphy, Matt Hipsey.

#### Pulse or drip? Irrigation intensity in leaching salts from mine wastes

After processing, mine wastes and tailings materials can contain substantial amounts of salt in both pore water and as sparingly soluble minerals. The slow dissolution of these minerals poses problems for long-term management as salinity is maintained during rainfall leaching. Supplementing rainfall leaching with irrigation is one method of accelerating salt removal, but it is unclear whether rapid, pulsed flow or slow, continuous leaching removes more salt per pore volume of water or unit of time. This project will use laboratory leaching columns and geochemical and physical laboratory analysis methods to identify whether continuous, slow leaching or episodic, intense leaching is more effective at removing salts from pore water and solid phases in tailings. Potential co-supervisors: Matt Hipsey, Andrew Rate.

### Transforming agricultural wastes into high quality fertilisers and proteins with black soldier fly

Black soldier fly farming (BSF) is an emerging industry that provides a low-cost waste management solution for converting agricultural waste into high quality fertiliser (BSF casting residue or frass) and protein (BSF larvae as animal feed). This project will focus on the use of BSF casting residue and frass as fertilisers for crop and/or pasture growth in a variety of soil types. Nutrient and heavy metal leaching and uptake will be quantified and form the basis of an ecotoxicological risk assessment. This will directly inform the future potential use of casting residue and frass at field scale. Potential co-supervisors: Sasha Jenkins, Megan Ryan.

### Dr Peter Speldewinde (Peter.speldewinde@uwa.edu.au)

# Impact of infrastructure construction on native wildlife



The city of Albany has a major infrastructure development planned in the form of a ring road to carry heavy vehicles to and from the port. This new major road will pass through sections of remnant bushland. This presents the potential for multiple projects (depending on the stage of development) on the impact of the

existing road, the construction phase and completed road on fauna. The project can also focus on fauna use of specially constructed tunnels and overhead bridges designed to allow transit of animals. Co-supervised by Drs Paul Close and Barbara Cook.

### Marine and Coastal

Specialisation coordinator: A/Prof. Matt Hipsey (Matt.hipsey@uwa.edu.au)

### A/Prof. Michael Burton (Michael.burton@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. Co-supervised by Dr Abbie Rogers, Dr Belinda Cannell.

### Dr Barbara Cook (Barbara.cook@uwa.edu.au)

#### Improving rock fishing safety: Has the communication of the dangers of rock fishing been effective?

Recreational fishing is a popular activity globally. Although an enjoyable pastime, recreational fishing, particularly rock fishing, can be dangerous, with many deaths recorded in Australia and New Zealand. Although Recfishwest has invested in extensive fishing safety campaigns, knowledge of how much of this communication is accessed by high risk fisher groups is limited. Measurement of the performance of this rock fishing safety strategy is critical. Using intercept surveys, this project will identify what forms of communication are commonly used by fishers, how much of the fishing safety material has been viewed, and how this has affected risk taking behaviours. Co-supervised by Dr Paul Close.

### A/Prof. James Fogarty (James.fogarty@uwa.edu.au)

### Fisheries management issues



The Western Australian government is responsible the overall management of coastal fisheries, which are common property resources. The management input of the government involves the issue of cost recovery from the beneficiaries of that management, which are generally taken to include both fishing operators and the broader community. Current policy for determining the contribution of industry in each managed fishery requires information on the Gross Value of Product (GVP) from the fishery. This research project will: (i) review fisheries management policy and approaches across Australia; (ii) identify any practical issues with current approaches to collecting charges from industry; (iii) evaluate the impact of alternate cost recovery options. Cosupervised by TBC.

### A/Prof. Atakelty Hailu (Atakelty.hailu@uwa.edu.au)

#### Analysing the value and management of recreational fishing

The management of recreational fishing is a source of controversy in many jurisdictions. Those who are interested in conservation argue that governments are not doing enough to protect fish and fishing sites. Angling communities, on the other hand, argue that recreational fishers are more responsible than conservationists suggest, and that their activities generate significant economic and social benefits. Governments try to balance the interests of these two groups but need good research based evidence. In this project, you would use either secondary or primary data to develop models of recreational site choice and use those models, possibly together with ecological or fish stock models, to analyse different management strategies in terms of their economic, social and ecological benefits. Co-supervised by Abbie Rogers, Michael Burton.

### Dr Sharon Hickey (Sharon.hickey@uwa.edu.au)

### Drones for coral reef monitoring



Increasing sea surface temperature (SST) is the single largest threat to coral reefs globally. Advancing remote sensing technological capabilities (e.g., drones) have the potential to provide relatively fine-scale information on a reef flat across a large spatial area. This project would utilise existing drone and infield data from the Rowley Shoals to model broadscale coral reef communities. Co-supervisor: Dr Ben Radford (AIMS).

### Remotely monitoring mangroves



Mangroves provide an opportunity for climate change mitigation and adaptation through their ability to store and sequester large quantities of carbon, and protect the coast from wave and storm surge, while sustaining fisheries through the provision of habitat. This project will utilise spatial modelling, cloud processing, and remote sensing techniques to develop a West Australian assessment of mangrove condition. Ther is potential for fieldwork opportunities. Co-supervisor: Dr Ben Radford (AIMS).

### A/Prof. Matthew Hipsey (Matt.hipsey@uwa.edu.au)

#### Swan-Canning real-time water quality reporting system

In this project the candidate will work on the development of an automated workflow for synthesis of real-time water quality data being collected in the Swan Canning estuary system, and work on developing real-time predictions of hydrology and water quality. Novel outputs for reporting estuary condition will be developed, related to estuary metabolism, nutrient cycling and harmful algal bloom risk. Co-supervised by TBC.

### A/Prof. Matthias Leopold (Matthias.leopold@uwa.edu.au)

#### Landscape evolution and early Aboriginal occupation of the archipelago west of Dampier, WA

Timing of early Aboriginal occupation along the west coast of Western Australia is still under discussion, with known camp sites dating back about 30,000-40,000 years ago. Holocene sea level rise has altered the coast lines at the area west of Dampier and as a consequence multiple Islands have formed, setting challenging conditions for the interpretation and reconstruction of these oldest camp sites. This project explores the landscapeecological conditions during the time of early occupation on Enderby and Rosemary Island in collaboration with UWA Archaeologists. Multiple soil and sediment samples have been collected in the past and these await analysis and interpretation. Additionally, shallow geophysical data are available to process and incorporate into a landscape model.

# Palaeosols as a valuable source for ancient microbial communities



Investigation of buried soils (Palaeosols) on the coast of WA (Hamelin Bay) and their comparison with the modern soil. Work includes fieldtrip with mapping and sampling of soils (2 days), characterisation of physical and chemical soil parameters (particle size distr., C/N, pH EC etc.,). Additionally, the microbial community composition (16S rRNA next generation sequencing) and biomass (quantitative PCR) of the different soil horizons will be analysed.

### Dr Andrew Rate (Andrew.rate@uwa.edu.au)

### Using trace elements as tracers: What are the forms of trace elements in sulfidic estuarine sediments?

Trace elements represent potential contaminants in aquatic sediments, but may also be useful in determining the origin of sulfidic minerals in these systems. You would collect monosulfide-rich sediments from the Swan-Canning or Peel-Harvey estuarine areas, or use archived samples. You would measure the concentrations of different forms of trace elements using chemical and spectroscopic analytical techniques, to understand the spatial patterns in the sediments. Potential co-supervisor: Dr Bree Morgan (University of Sydney).

#### **Environmental geochemistry at Ashfield Flats Reserve**

Ashfield Flats is an urban reserve abutting the Swan River estuary, having high conservation value. The area is underlain by alluvial sediments, with many having a high risk of acid sulfate soils. Our studies found contamination of water, soils and sediments reflecting the site history and influx of industrial stormwater. DBCA(WA) has collected some deep cores which contain a record of the site's history, but are incompletely analysed. You would conduct mineralogical and chemical analyses on these cores to reconstruct Ashfield's sedimentary and anthropogenic history. Potential co-supervisors: Adjunct A/Prof Gavan McGrath (DBCA), Dr Deirdre Gleeson.

# Transects of soil properties across the urban-periurban-rural gradient in Perth



Urbanization is known to affect the quality and composition of soils, which show gradients in nutrient, trace element, and organic pollutant concentrations from city centres through suburban and peri-urban environments to rural areas. Perth's unique soils, developed on dunes of Holocene to Pleistocene age, may show gradients which are atypical compared with other cities, but this has never been assessed. This project will attempt to detect an Anthropocene signature along urban-rural transects in metropolitan Perth, Western Australia and the surrounding non-urbanized areas. Potential co-supervisors: A/Prof. Matthias Leopold.

### Environmental geochemistry desktop projects



A number of sources of data exist in the public domain, for example: the WA Department of Water's WiR database; WA Department of Mines and Petroleum's Data and Software Centre; and multiple international (USA, European) data repositories. Many of these datasets are a rich and in some case under-utilised source of geochemical, spatial, and temporal data. Depending on your interest, your project could involve using one or more of these databases to deduce environmental chemical processes and environmental effects. Potential cosupervisors: Adjunct Dr Gavan McGrath (DBCA), Adjunct Dr Steve Appleyard (DWER), Dr Patrice de Caritat (Geoscience Australia).

# Sensing and Spatial Data Science

Specialisation coordinator: Dr Bryan Boruff (Bryan.boruff@uwa.edu.au)

### Dr Jason Beringer (Jason.beringer@uwa.edu.au)

# Remote sensing of plant productivity and stress



New satellites are measuring plant productivity from space using Solar-induced chlorophyll fluorescence (SIF). This has begun to be measured in recent years using satellite remote sensing yet it has not yet been fully exploited but it is the focus of upcoming space missions. We have recently deployed infrastructure to measure the SIF signal from 3 ecosystems at tower masts at TERN Supersites in WA (Boyagin, GWW and GinGin). Your project would examine this brand new data to interpret how SIF relates to photosynthesis and stress across at a given ecosystem and compare that with satellite remotely sensed data. Potential co-supervisors: Caitlin Moore.

# Laser scanning to characterise ecosystems structure 🚛 🤚





Vegetation structure and leaf area are crucial drivers of ecosystem production (carbon uptake) and water use. Currently at ecosystem monitoring sites across Australia, that are part of TERN, they measure leaf area annually but there is a great need to measure this much more frequently. We have recently deployed infrastructure to measure the canopy using laser scanners that are deployed and scan every day at 3 ecosystems at tower masts at TERN Supersites in WA (Boyagin, GWW and GinGin). Your project would examine this brand new laser data to interpret how to determine canopy structure and leaf area and compare that with on ground measurements to validate the approach. Potential co-supervisors: Caitlin Moore.

#### A/Prof. Nik Callow (Nik.callow@uwa.edu.au)

### Spatial control and covariates on snow depth and density



Runoff from the Australia Alps sustains the Snowy Mountains Hydroelectric Scheme, inflows to the Murray-Darling system and environmental flows to alpine and downstream ecosystems. Records of snow depth are only collected in a very limited locations, and do not necessarily accurately record the actual distribution of snow and stored water through the Australia Alps. This project will combine satellite and drone data of snow depth to look at factors such as vegetation and terrain sheltering, and assimilate ground observation and satellite data on snow presence/absence to improve estimates of stored snow and water in the seasonal alpine snowpack. Cosupervised by Dr Shane Bilish (Snowy Hydro Limited).

### Impacts of hydrological connectivity on valley-floor salinity



Interventions to improve flow connectivity have been implemented at locations across the Western Australian Wheatbelt. These have reduced surface water ponding, with the aim of disconnecting fresher surface water from salinity in the soil profile. This project will use cloud satellite computing platforms (Google Earth Engine) to explore the changes in the patterns of salinity impacting vegetation health adjacent to the intervention structures. Lakes Toolibin and Bryde will be a focus. While predominantly desktop, there is an opportunity for fieldwork to be incorporated. Co-supervised by A/Prof. Matt Hipsey.

# Monitoring Fringing Vegetation with Drones



Drones are an emerging environmental monitoring tool, particularly powerful for monitoring ecosystem processes and responses to stressors such as climate change, water quantity and water quality decline. Perth's wetlands have undergone unprecedented changes from urbanization since European settlement and are also vulnerable to the significant change in the climate of southwestern Australia since the 1970s, compounded by water abstraction. This project will explore, evaluate and develop methods to monitor fringing vegetation surrounding one of the Swan Coastal Plains most significant wetlands - Lake Joondalup and the Yellagonga Regional Park. There is an opportunity to work with an industry partners (City of Joondalup and Sentient Hubs Pty Ltd) and your research will be used to influence and inform how drones are used for environmental monitoring and evaluating things such as drone citizen science opportunities. Co-supervised by Matt Hipsey.

### Remote area hydrology – studying hydrology with no hydrological data



The north and inland of Australia contains important river systems, but has very little hydrological data. The traditional approach to remote-area hydrology has been to construct models with large uncertainty, however, multiple satellite products contain useful hydrological information. This project will advance data assimilation and uncertainty techniques (Markov-Chain Monte Carlo Bayesian framework) developed by the supervisors, to combine multiple different satellite data to allow prediction of floods in remote and ungauged river basins. Cosupervised by A/Prof. Matt Hipsey and Ben Jarihani.

### Runoff and catchment performance in our future climate



Southwestern Australia has seen a ~10-15% reduction in rainfall, but the decline in streamflow and runoff has been much more significant, around 50-60%. Future projections are that our climate will dry further, but the hydrological behaviours and scaling of changes in runoff in relation to rainfall have very high uncertainty. This project will look at improving our understanding of runoff processes, the response of streamflow components, and catchment performance. While predominantly desktop, there is an opportunity for fieldwork to be incorporated. Co-supervised by A/Prof. Matt Hipsey.

# Scouting for pests using smartphone applications and drone-based crop assessment of plant stress



Scouting grain crops for pests and diseases is time consuming and often inaccurate. Random sampling hopes to find pest hotspots in parts of paddocks, but often miss them. This means growers are either losing money on unnecessary pesticide application or yield loss in parts of crops which are missed. Spatial data such as remote sensing using near infrared and infrared spectra have been shown to be able to detect and map regions of crop which are experiencing biotic or abiotic stress. Our prior research has shown the potential for using NDVI nod other indices to identify stressed areas of canola crops impacted by biotic (e.g. aphid) and abiotic (e.g. potassium deficiency) processes. Pests can cause a crop stress response and the student will work with industry to use new remote sensing technologies to live-stream remote sensing indices like Normalised Difference Vegetation Index (NDVI) video from a drone, to inform where to sample for agricultural pests and evaluate the use of this new, cutting-edge approach. Jointly supervised with A/Prof. Ken Flower and Dr Dustin Severtson (DPIRD).

### Dr Sharon Hickey (Sharon.hickey@uwa.edu.au)

### Drones for coral reef monitoring



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