une University of New England

School of Environmental and Rural Science

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Projects 2023

Undergraduate, honours and coursework masters research projects

Agronomy

Animal Science

Botany

Ecology

Environmental Science

Genetics

Geoscience

Zoology

University of New England

School of Environmental and Rural Science

Projects 2023

Contact: BSc Honours (SCI400)
Course Co-ordinator
Dr Susan Wilson
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Contents

Projects are grouped broadly according to discipline. Many are collaborative across different research areas and there is flexibility in the Honours major used for enrolment. We encourage discussion of research ideas and student preferences across the disciplines.

The University of New England supports a diverse community and welcomes flexible working arrangements. UNE strives to be an equal opportunities employer, and supports a diverse and equitable workplace through a range of policies and support mechanisms.

ERS acknowledges that all our domestic projects are conducted on the traditional lands of the Aboriginal and Torres Strait Islander Peoples.

Agronomy encompasses both soil and plant sciences associated with field crops and pastures and is directly responsible for the production of most food and fibre consumed and utilised by people and livestock.

Agronomy

Discipline contact Chris Guppy: **cguppy@une.edu.au | 02 6773 3567**

Supervisors:

Dr Chris Guppy: cguppy@une.edu.au

Dr Richard Flavel: rflavel3@une.edu.au

Dr Jonathon McLachlan: jmclach7@une.edu.au

Mr Craig Birchall: cbirchal@une.edu.au

Students with an interest in soil fertility, crop nutrition, plant nutrition, horticulture, or farming systems resource use efficiency or nutrient cycling can see us for ideas on topics. A few are listed below.

Current research topics include:

- Mitigation of aluminium toxicity using silicon
- Effect of C4 grass species on the availability of soil P to pasture legumes
- Deep placement of P fertilizer in pasture systems
- Root proliferation responses of legumes to patches of P in soil
- Does prolonged flooding result in increased K and P dissolution in Vertisol soils?
- Peanut root system responses to banded P in sandy soils
- Grazing preferences studies in pastures using cameras
- Sodic soil impacts on establishment of tropical legume pasture including amelioration strategies
- Alleviating subsoil constraints on crop and pasture production

Cotton Production and Soil Biology

Supervisor: Dr Oliver Knox

oknox@une.edu.au | 02 6773 2946

Have you ever wanted to look more closely at cropping systems and their associated soil biology? If so I'd be willing to offer or discuss projects in this general area. Currently we work on investigating how root tips sense their environment and interact with pathogens via processes mediated by their border cells. There is a range of projects available looking at how these cells behave when stressed or altered and even new methods to enumerate them. We have projects looking at the importance of mycorrhizae in cotton cropping systems as well as several looking at pathogen control and suppression.

Soil biology is also closely linked to soil health, which is a great engagement term, but how well does it fit the wider farm landscape? There is opportunity most years to work with us and our colleagues in Narrabri, possibly on a CSIRO/CRDC Summer scholarship looking at how soil health assessments fit agricultural soils and crop productivity.

If you are interested in cotton, rotations in general, soil biology or soil health please get in touch.

Weed ecology and management

Supervisor: Prof Brian Sindel

bsindel@une.edu.au | 02 6773 3747

Students with an interest in weed ecology and management can see me for ideas or if you have your own ideas I am happy to hear those. I have a few research projects that could be undertaken on the ecology of fireweed (*Senecio madagascariensis*), the ecology of blue heliotrope (*Heliotropium amplexicaule*), using X rays to measure soil weed seed banks, assessing weed impacts (e.g. thistles) in pastures, and the effects of weed seed shape and morphology on weed dynamics.

Weed management in agricultural systems

Supervisor: Dr Paul Kristiansen

paul.kristiansen@une.edu.au | 02 6773 2962

Contact me if you are interested in exploring invasive weeds in agricultural systems, urban settings or natural environments.

We have a range of potential projects related to weed management in agriculture. Topics include:

- weed seed bank assessment and management
- herbicide resistance of weeds in vegetable farming systems
- impact of strategic tillage, seasonal rotations, cover crops, cultural practices (planting, fertilising, irrigating) and hand weeding on weed infestations in vegetable production
- biology, ecology and management of weeds in tea tree oil plantations.
- post-drought weed population dynamics in pastures or woodlands (depends on drought breaking)

Sub-Antarctic weeds projects

Supervisors:

Brian Sindel
bsindel@une.edu.au | 02 6773 3747

Dr Paul Kristiansen
paul.kristiansen@une.edu.au | 02 6773 2962

Several weed species such as *winter grass (Poa annua), Stellaria media* (chickweed) and Cerastium fontanum (mouse-ear chickweed) have invaded sub-Antarctic Islands (e.g. Macquarie Island), impacting on native biodiversity. These same and other weeds are now also threatening the Antarctic mainland. Given high conservation values, and threats from disturbance & climate change, the development of targeted control measures for invasive species is vital. A range of potential projects could be conducted, but one example is listed below.

Can winter weeds germinate and grow in the Antarctic?

Description: While winter grass (*Poa annua*) has invaded the peninsula of the Antarctic mainland, little is known about the potential for a range of other cool season weeds to invade and survive in the Antarctic. This project will generate results of the resilience of a range of species to survive freezing temperatures and germinate and grow in Antarctic conditions utilising UNE's freezers and sub-Antarctic cool room facilities.

Horticulture science and technology

Supervisors:

Dr Paul Kristiansen
paul.kristiansen@une.edu.au | 02 6773 2962

We have a range of research projects based on basic crop science or on industry-based challenges related to horticultural production, including crop nutrition, crop protection, and post-harvest management, as well as supply chain development and farmer capacity building. We have strong national industry links across various annual and perennial crops.

Crop Physiology

Supervisor:

Dr Onoriode Coast: ocoast@une.edu.au

02 6773 1592

1. Exploring relationships between photosynthesis and the critical temperature of photosystem II function.

Photosynthesis is negatively impacted by high temperature stress. Variations in the photosynthetic ability of crops to tolerate or acclimate to high temperature might provide avenues for selecting genotypes better suited to a future warmer world. Photosynthetic acclimation to high temperature has been routinely assessed by the critical temperature (Tcrit) of photosystem II (the temperature where minimum chlorophyll a fluorescence rises abruptly, signifying damage to photosystem II).

However, the relationship between measures of photosynthesis and Tcrit has not been robustly explored. This project will involve generating data from controlled environments experiments, extracting data from published literature, and combining these with data from previous experiments conducted by the Coast Lab to explore the relationship between photosynthesis and Tcrit. The project will provide students training in gas exchange measurements, chlorophyll fluorescence assays, experimental designs and data analysis. There will be opportunities to use advanced plant science tools such as Licor 6400XT and FluoroCam, and get hands-on training in experimental design, data collection and management, and statistical analysis (using R).

2. Can we save wheat from the heat of the night?

In major crop growing regions across the world mean minimum daily temperature is rising faster than mean maximum. For crops already growing near or above their optimum temperature, exposure to higher daily maximum temperature reduces photosynthesis and photosynthetic capacity, with consequent negative impact on yield. Responses of crop photosynthesis and more so photosynthetic capacity to high night temperature are less established.

There are suggestions that night warming can limit photosynthesis by altering photosynthetic capacity. Quantifying and understanding how these traits in crops respond to high night temperature will be necessary to ensure global food security. This project aims to examine responses of wheat photosynthesis and photosynthetic processes to high night temperature. The project will involve treating multiple wheat lines to a range of high night temperature conditions. Measures of leaf-level physiological traits (photosynthesis, stomatal conductance), alongside morphological traits (leaf area, LMA, stomata area and density) traits will be undertaken. The potential student will work with a PhD student on the project and have opportunity to gain skills in plant tissue gas exchange analysis, microscopy, and experimental design and data analysis.

PARG – Precision Agriculture

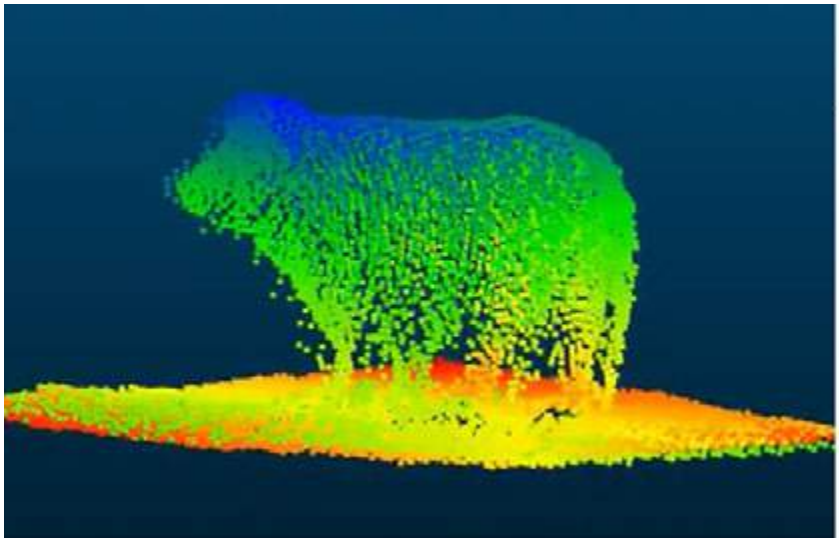
Supervisors:

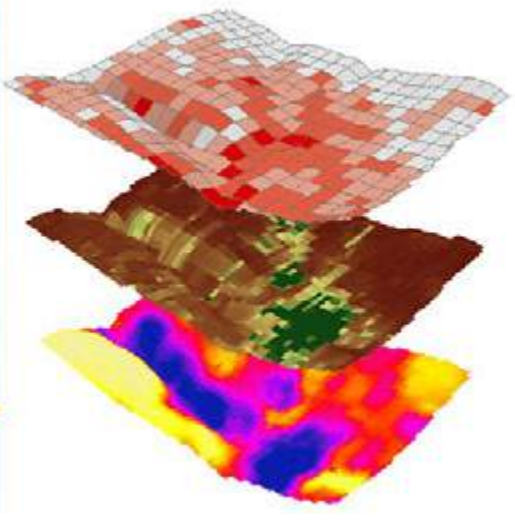
Dr Jamie Barwick and Professor Andrew Robson
jbarwic2@une.edu.au | 0428 694 239

Students with and interest precision agriculture, ag-tech, precision livestock technologies and practices or remote sensing in horticulture, tree crops or pastures can see Jamie or Andrew for ideas on topics. Some topics include:

- Detection of lambing and pre-lambing behaviour in ewes using GPS tracking technologies and behaviour monitoring systems (collaborative project with NSW DPI).
- Investigation of water and fertiliser use efficiency in crops using soil EM38 sensors and plant vigour sensors .
- Applications of GPS tracking and behaviour monitoring systems in livestock production for disease prediction.
- UAV based pasture assessment technologies for precision fertiliser management in grazing systems.
- Calibration of active optical sensors for pasture biomass assessment, both quantity and quality

If you have other project ideas or areas of interest, please get in touch with Jamie or Andrew.





The science of livestock production, wildlife management, or horses and dogs.

Animal Science

Discipline contact Sam Clark: **sam.clark@une.edu.au**

Sheep and Wool

Supervisor: Emma Doyle
edoyle3@une.edu.au | 02 6773 3094

We have a close link with Australian Wool Testing Authority and they are always willing to provide UNE students with an Honours project that can be conducted in the summer break and will also employ students to conduct the project. If you are interested we can contact AWTA to discuss project options.

A number of Australian Wool EducationTrust Honours scholarships may be available Applications available at www.woolwise.com. Consult your supervisor to apply. These will be awarded in any discipline linked to sheep and wool production.

Animal welfare and behavior

Supervisors:
Dr Amy Tait: ltait2@une.edu.au
and Dr Amelia de Almeida

Enrichment for sheep and cattle in confined housing.

This Project will investigate different objects as environmental enrichment for sheep and cattle housed in confined situations such as scientific experiments.

Meat Science

Supervisor: Dr Peter McGilchrist
pmcgilc2@une.edu.au

Happy to discuss possibilities associated with aspects of Meat Science.

Animal Nutrition

Supervisor: Fran Cowley
fcowley@une.edu.au

1. Assessment of key issues and constraints in the Australian feedlot industry

Chicks can survive without their mother hen, but what are the implications for their behaviour and welfare when they are provided with particular components of the maternal environment.

2. Precision feeding to improve the efficiency, health and welfare of free range layer hens.

Layer hens have a daily cycle of developing egg yolk, egg albumin and egg shell which happens at routine times throughout the day. Thus, we can feed the layer hen a different diet in the morning and evening to account for their different nutrient requirements throughout the day. This project involves precisely meeting the nutrient requirements in layers and measuring the impacts on performance and egg quality, hen health and bone strength, and hen welfare and behaviour (using behavioural tests, RFID tracing and camera footage). This will be a large project spanning 6 months, and so one aspect of this project may be chosen as an honours project depending on the student's interests. For example, the bone strength analysis or analysis of behaviour.

3. Nutritional strategies to mitigate coccidiosis challenge without the use of coccidiostats which are being banned along with AGP's

Coccidiostats have been banned in Australia for broiler production but other methods to prevent coccidiosis burden are lacking. Therefore, multiple nutritional strategies (such as whole grain feeding, inclusion of fibre) which may help prevent coccidiosis infection will be explored to enhance the bird's own natural immunity by aiding the development of their gastrointestinal tract and support proper gut function.

4. Inorganic vs organic minerals in layers and broilers

The Australian poultry industry currently uses inorganic sources of minerals for poultry diets. However, organic mineral sources may be more bioavailable to the bird and therefore would improve skeletal health and reduce excess excretion of minerals into the environment. Thus, we will explore the use of organic mineral supplements for poultry in one layer and one broiler trial.

Supervisor: Dr Nishchal Sharma

nsharma4@une.edu.au

Evaluation of recycled food wastes in pig feed

The estimated amount of food waste in Australia is 7.3 million tonnes annually which costs approximately $20 billion to the Australian economy and contributes to more than 5% of Australia's greenhouse gas emissions. Some of this wasted food can be processed into valuable products for use in pig feed. We have a pilot food waste processing plant at UNE that can be used to produce processed food wastes for pigs. This project will investigate the nutritional composition of different processed food waste streams and evaluate them in pigs. The project will start on 14 Dec 2021 and run until 14 March 2022. The project will involve laboratory work (20%) and live animal work- feeding study (80%).

Animal Health

Supervisor: Prof Steve Walkden-Brown

swalkden@une.edu.au

Happy to discuss possibilities associated with aspects of animal health.

Poultry gut health and disease

Supervisor: Professor Shubiao Wu

swu3@une.edu.au

Antibiotic alternatives to improve gut health and performance of broiler chickens under necrotic enteritis challenge.

Animal Breeding and Genetics

Supervisors:

Dr Sam Clark: sam.clark@une.edu.au

Prof. Julius van der Werf: jvanderw@une.edu.au

The team in animal breeding and genetics offers a wide range of options for students wanting to undertake an honours project. We currently work in key areas relating to animal breeding these include:

- The design and evaluation of livestock breeding programs
- The development and analysis of breeding objectives and selection indexes
- The analysis of data to produce breeding values
- The use of genomic technologies in animal breeding
- Testing the validity of breeding values

If you have any questions or would just like to chat about completing an honours project in Animal breeding and genetics, please contact us

AGBU projects: The Animal Genetics and Breeding Unit (AGBU) is a joint venture of NSW Department of Primary Industries and University of New England. AGBU is a team of approximately 20 researchers and professional staff who develop genetic evaluation systems for livestock industries. Researchers at AGBU work closely with industry and students can tackle a range of research topics relevant for commercial breeding programs. All projects would use data from current research or industry breeding programs from sheep, beef cattle pigs and trees.

Understanding how plants have evolved, how they interact, how we can conserve them and how their genomes are structured.

Botany

Discipline contact Rose Andrew: **rose.andrew@une.edu.au**

Plant Systematics – N.C.W. Beadle Herbarium

Supervisors:

Rose Andrew: rose.andrew@une.edu.au
Prof. Jeremy Bruhl: jbruhl@une.edu.au

Students interested in undertaking **Honours in Botany, including Plant Ecology, Molecular Ecology and Systematics should contact us.**

Projects in bryophytes (mosses), Asteraceae (daisies), Cyperaceae (sedges) and Rutaceae (e.g. *Boronia, Phebalium* and *Asterolasia*) are particularly welcome. Most taxonomic projects involve one or more of the following:

- Resolving taxonomic questions about species: 'what are the species?' (often resulting in the student being able to co-author the description of new species).
- Resolving phylogenetic relationships: what are the evolutionary relationships of a group of species.
- Understanding character homology: what is the variation in particular characters across a study group. This could be combined with production of an interactive identification dataset.

Depending on the topic and approaches, co-supervisors may include people from another institution (e.g., Australian National University, University of Technology Sydney, or the National Herbarium of NSW) or from within UNE (e.g., Emeritus Prof. Jeremy Bruhl, Dr. Nigel Warwick, and Adjunct Assoc. Prof. John Hunter) as best fits the needs of the project.

Students will have access to the N.C.W. Beadle Herbarium, the Herbarium database (NEdb), and our kit for collecting and preparing plant specimen vouchers.

Plant Ecology

Supervisor: Boyd Wright

bwright4@une.edu.au

Boyd has research interests in fire ecology, arid zone plant ecology, and ethnobotany.

Botany UNE has recently acquired a plant ignitability testing unit that would be ideal for use in plant ecological research projects to:

- Compare the community-level flammability of fire-sensitive vs. pyrophylic plant communities in north-western NSW and elsewhere.
- Experimentally test the ignitability of native NSW shrub and tree species for 'green firebreak' plantings.
- There may be opportunities for collaborating on plant flammability projects with researchers from Lincoln University (New Zealand) and the University of Technology Sydney.

Rader Community Ecology Lab

Supervisor: Dr Romina Rader

rrader@une.edu.au
www.raderlab.com

Plant-focused research:

Developing new methods to determine the impact of pollen viability in a changing climate.

Temperature is one of the major environment factors affecting the growth, reproductive development and yields of many crops. This project will investigate which parts of a flower are most at risk from high and low temperatures by evaluating how temperature can affect stigma receptivity, the viability of pollen and germination of pollen tubes using several model crops.

Molecular Ecology Laboratory

Supervisor: Rose Andrew

rose.andrew@une.edu.au
www.roseandrewlab.com

We do research on the following topics, typically in collaboration with UNE staff or experts elsewhere.

- Conservation genetics of threatened species, especially clonal plants
- Plant mating systems and pollination
- Hybridisation and speciation
- Eucalypt molecular ecology, including landscape genetics and genomics

Your project can focus on field studies, greenhouse work, population genetics or bioinformatics (see the Genetics major).

Some potential projects

- **Reproductive biology and speciation mechanisms in *Xerochrysum* paper daisies:** A recent plant taxonomy project with Prof. Jeremy Bruhl and others has identified several new species. We are now looking for a student who likes greenhouse work to identify which reproductive barriers have evolved between these species. *On-campus preferred.*
- **Recruitment and regeneration of dominant eucalypts in Threatened Ecological Communities:** What are the barriers to recruitment and establishment of eucalypts in agricultural landscapes? This project uses a combination of experimental plantings and field observations to study the success of early growth in three eucalypts of conservation significance. *On-campus preferred.*
- **Phytochemical variation in native plants:** Eucalypts and many other native plants pack their leaves and flowers with a range of smelly and bitter compounds. These 'phytochemicals' shape many ecological interactions, such as herbivory, pollination and competition, yet they often vary dramatically across the range of a species or between species. Several opportunities exist for projects with a taxonomic or ecological focus. *Visits to UNE required.*

The interrelationships between organisms and their environments.

Ecology

Discipline contact Manu Saunders: **manu.saunders@une.edu.au**

Laboratory of Applied Zoology and Ecological Restoration (LAZER)

Supervisor: Dr Debbie Bower

dbower3@une.edu.au

The research completed by the Laboratory of Applied Zoology and Ecological Restoration (LAZER) strives to understand and mitigate threats to wildlife through experimental and empirical ecology, and community engagement. Our research helps manage land and water for biodiversity and enable ecosystem function in a state of continuing environmental change. Our study systems occur within the New England Tablelands, Murray-Darling Basin and Papua New Guinea and we focus on vertebrates, particularly reptiles and amphibians, as our models. We encourage participation by students from underrepresented groups in science.

You can choose from one of several research programs, or get in touch with your own ideas:

1. Ecology of freshwater turtles

Numerous Honours projects available looking at the role of turtles in the food web, acoustics of turtles, sociality of turtles, water quality preference of turtles, or physiology of turtle populations and threats of climate change.

2. Conservation agriculture in wetlands

A community ecology study determining differences in frog ecology and insects between permanent and ephemeral wetlands are affected by drought and management. It will be a hands-on project with a lot of field work in the Armidale region and requires a student who appreciates the joys of identifying aquatic animals and applying statistical analyses to complex data sets.

3. Effect of floodplain connectivity on freshwater turtles

The Gwydir wetlands is listed as a Ramsar site of national significance. Management for the wetlands includes flows released for the environment. This project looks at the response of various target taxa (squamates, turtles, frogs) to the floodplain management of the wetlands.

4. Effects of disease on threatened frogs in New England

The rainforests of New England have experienced environmental changes including logging, severe drought, and fire. This project builds on a larger project to quantify how rainforest frogs are responding to changes in their habitat including their disease load and survivorship.

Aquatic Ecology

Supervisor: Dr Adrienne Burns

aburns@une.edu.au | Rm 208, BLD W077

Opportunities for motivated, independent students who are interested in undertaking research on unravelling the complex aquatic processes that drive aquatic ecosystem function. Specific research interests are focused on algal and microbial ecology, aquatic foodwebs, and the development of monitoring and restoration programs to assess ecosystem and biodiversity change in response to river management.

Canine and Feline ownership and movement

Supervisor: Brooke Kennedy

bkenne27@une.edu.au

1. Reducing cat numbers in Aboriginal communities in the Northern Territory

Territory Natural Resource Management (Territory NRM) have been funded through the Australia Government's National Landcare Program to deliver a two-year project to reduce the absolute number of breeding cats in community, and to improve the uptake of feral cat management activities by Indigenous ranger groups. Cat management in remote Indigenous communities may protect critical weight range species that live in the habitat surrounding community. The project will operate in two regions in the Northern Territory, the Tiwi Islands and the Northern Tanami. Community input is essential for the uptake of community animal management, and the project will engage with community members through surveys activities. Survey questions will be designed to collect data on the relationship of community members to cats and their attitude towards feral cat management strategies. This work has already begun. These data will be used to develop community specific community and feral cat management strategies that are societally appropriate. The identified strategy for community cat management will be implemented in the two regions (by student and the TNRM Team), and the community engagement will be monitored in the final period of the project. The identified strategy for feral cat management will be further developed in collaboration with Indigenous ranger groups in the two regions, and training will be provided to the ranger on the finalised strategy. This project has two interconnected research projects; the community survey activities, and monitoring of the community cat management strategy. Territory NRM are collaborating with UNE to provide an opportunity for students to participate on the project. Territory NRM are offering to support the students on research related expenses.

2. Keeping cats safe at home Project – Tweed Heads and Byron

In a joint project with the NSW RSPCA, 10 Local Government Areas (LGAs) have been selected to participate in the Keeping Cats Safe at Home (KCSAH) Project. The project aims to reduce the negative impacts that cats have on wildlife and encourages cat owners to keep their cats safely contained at home. It was designed to change attitudes and behaviours in the community towards responsible cat ownership. As a part of the education strategy, we are seeking an Honours student to monitor the roaming behaviours of domestic cats in the Tweed Heads and Byron Shire LGAs using GPS loggers to track where, when and how often cats leave their household yards.

Potential Project Areas:

- Pet ownership
- Dog or cat roaming behaviours (domestic or feral)
- Indigenous Communities (social science)
- Or any combinations of the three

Reptile Ecology and Environmental Disturbance (REED) lab

Supervisor: Dr Eric Nordberg

eric.nordberg@une.edu.au

People in the REED lab are interested in how wildlife populations, particularly reptiles, respond to natural and human-mediated disturbances. Both natural (e.g., wildfires, severe storms) and human-induced disturbances (e.g., agriculture, urbanization, habitat fragmentation) have impacts on wildlife communities. Our lab works at the intersection of disturbance ecology, resource use, and wildlife conservation. The research in our lab aims to identify win-win strategies among industries to enhance anthropogenic outputs as well as wildlife conservation. We use community ecology, species interactions, predator-prey dynamics, competition, and behavioural ecology to answer ecological questions. We are looking for students to join the lab with an interest in collecting AND ANALYSING data. Familiarity with R is a bonus :-)

Possible research projects:

1. Impacts of climate change (flooding and extreme weather events - heatwaves) on the nest survival of endangered Bell's turtles.

This will involve a combination of field work (to collect/process gravid female turtles) and lab work (incubating eggs). At the conclusion of this project we will be able to inform land managers and conservation groups about when nests should be relocated due to predicted flooding or extreme heat events to improve survival.

2. Can solar farms support local wildlife?

This project will investigate how 'green' *green energy* is by comparing the community composition of wildlife between solar farms and adjacent farmland. This project will take place at the UNE Solar Farm behind the Armidale campus and involve a lot of field work, conducting fauna surveys (birds, mammals, amphibians, and reptiles), conducting vegetation surveys, and processing data. Strong identification skills (especially birds) would be a benefit.

3. Biodiversity around farm dams

In collaboration with the LAZER lab (Dr Deb Bower), measure the impacts of cattle access to farm dams effects the biodiversity (aquatic and terrestrial). This project will involve field work and fauna surveys (setting and checking traps, identifying animals, and assessing habitat quality).

4. Thermal and movement ecology in reptiles

In collaboration with HDR students in the REED lab, identify the movement patterns and behavioural ecology of temperate rainforest reptiles. Skills or interest in radio telemetry, spatial ecology/mapping.

5. Open to student ideas as well!

Please contact me to discuss opportunities and interests.

Rader Community Ecology Lab

Supervisor: Dr Romina Rader

rrader@une.edu.au | www.raderlab.com

Research topics of interest:

1. How effective are wild insects in pollinating our favourite fruits?

Wild pollinators, such as flies, beetles and butterflies, currently provide "free" pollination to a wide range of crops, and several studies across the world have even shown that wild pollinators can improve crop yields and fruit quality. Wild pollinators support farm productivity by allowing plants to produce fruits and seeds, especially when honeybee numbers are insufficient or unfavourable weather conditions prevent honeybees from flying. This project will investigate the contribution and effectiveness of wild insect pollinators in pollinating several high value fruit crops around Australia.

2. Facilitation or competition between crop and wild flowers on a local scale

Wild floral communities flowering simultaneously with crops could either facilitate pollination of crops or compete with crop flowers for pollinators depending on the pollinator species and its floral preference. This project will investigate if pollinators alter their potential as crop pollinators depending on the available alternative floral resources and if this differ between different pollinator species. This will be investigated by surveying flower visits by different pollinators before crop bloom starts (when only wild flowers are available) and during blueberry bloom in settings with few to many alternative floral resources.

3. The winners and losers of species interactions on flowers

Have you ever wondered what happens when more than one pollinator arrives at a flower and another insect is already there? Sometimes the new arrival leaves again and other times they stay. Different species of flower visitors seem to vary in their decision to stay or go and this likely depends on many factors that we need to explore including the type, arrangement and resources available in the flower, other species in the community, the surrounding environmental and landscape context. This project will watch lots of insects and the flowers they visit to determine what the mechanisms are in driving species interactions. Ultimately relationships with plant reproduction would be great to explore if this is of interest.

4. Pollinator health in a changing landscape: How do nectar and pollen resources vary in different plants and land use types?

Pollinators rely on nectar and pollen to get the nutrition they need for flight and reproduction. While we know crude protein is one component that is important to bee foraging and plant selection, there are other factors that may influence pollinator health such as elemental ratios of nutrients, carbohydrates and other forms of protein. We don't really know much about the range of different resources within nectar and pollen or if different resources are used by different pollinators. This project will investigate which resources are found in which plants and the extent to which pollinators are able to balance the resources they need for good health.

5. Developing new methods to determine the impact of pollen viability in a changing climate.

Temperature is one of the major environment factors affecting the growth, reproductive development and yields of many crops. This project will investigate which parts of a flower are most at risk from high and low temperatures by evaluating how temperature can affect stigma receptivity, the viability of pollen and germination of pollen tubes using several model crops.

Saunders Ecology Lab: Biodiversity and Ecosystem Services

Supervisor: Dr Manu Saunders

manu.saunders@une.edu.au
www.saundersecologylab.com

- **Community ecology** (plant and insect interactions and networks, pollination ecology)
- **Insect ecology** (how landscape, vegetation, management and disturbance affect insect distributions and population dynamics)
- **Ecosystem services** (quantifying how biodiversity and ecological interactions contribute to different services)
- **Science communication** (framing of conservation and ecology issues in media and policy)

Available projects:

1. Mozzies

Mosquito fauna on the Northern Tablelands are understudied and there is limited knowledge of their distribution and ecological functions. What species are found in different habitats of the New England region? Co-supervisor: A/Prof Cameron Webb, NSW Health.

2. Mistletoe

Mistletoe abundance and diversity in urban and rural areas around the Armidale region. What environmental factors influence mistletoe distribution? Co-supervisor: Prof David Watson, Charles Sturt Uni.

3. Pollinators

Plant-pollinator community networks in different habitats (e.g. urban, woodland, roadsides, wetlands).

4. Wetland insects

What terrestrial insect communities use wetlands in the New England region? The student will work as part of the Dynamic Lagoons project.

5. Other ideas

Contact me to chat about any other ideas relevant to community ecology, biodiversity or ecosystem services.

Practical Ecology, Science and Technology (PEST) Research Group

Supervisors:

A. Prof Guy Ballard: gballar3@une.edu.au

Dr Annalie Dorph: annalie.dorph@une.edu.au

Dr Jaime Heiniger: jaime.heiniger@environment.nsw.gov.au

Dr Deane Smith: dsmith@une.edu.au

Dr Paul Meek: paul.meek@dpi.nsw.gov.au

Wildlife ecology and management, invasive species, conservation, predator ecology, predator-prey interactions, camera trapping, movement ecology, quantitative ecology and modelling.

We focus on monitoring and managing wildlife, especially predators (dingoes, foxes, feral cats, quolls) but other species too; rock wallabies, malleefowl, possums, bandicoots and many more!

Our current research projects include:

- NSW Feral Cat Management Project,
- Preparing 4 RESET – Predator, Prey, Plant interactions
- Measuring the abundance of brush-tailed rock wallabies at sentinel colonies
- Evaluating the safety and efficacy of Doggone baits
- Monitoring spotted-tailed quolls
- Spatial ecology and energetics of dingoes

Contact us:

To discuss possible Honours projects, including ones that overlap with other areas of UNE research; we're always happy to work with other people.

Tackling some of the major world environmental challenges such as food security, pollution, climate change and conserving threatened species.

Environmental Science

Discipline contact Susan Wilson: **swilso24@une.edu.au**

Pollution Science Research Group

Supervisors:

Dr Susan Wilson: swilso24@une.edu.au

Dr Matt Tighe: mtighe2@une.edu.au

www.une.edu.au/pollutionscience

Pollution and contamination results in lost productivity, hazards to humans and the environment and billions of dollars spent on clean up. In the New England area we have over 3000 contaminated derelict mine sites with a range of metal pollutant dispersing to the wider environment. In Newcastle, NSW, water can't be used for drinking because it is contaminated with persistent fire-fighting foam chemicals. In agricultural areas overuse of pesticides effects ecosystem service organisms, production animals and humans utilising the services. Microplastics are turning up through all our ecosystems. Even sites not used for hundreds of years such as ancient archaeology sites may harbour a legacy of contaminant liability. These are just some of the issues our group is working on. We aim to quantify the form and fate and behaviour of contaminants to understand effects and then work out methods that can be applied to effectively manage and remediate to soils.

If a student has an interest in a particular area this can be discussed but alternatively, the project areas in which we are working now are described below with potential projects

- Biogeochemical cycling of arsenic and antimony including foodchain transfer
- Rehabilitation strategies at mine sites: managing leaching, phytoremediation, plant based management strategies – to remove risks.
- Towards a circular economy – reusing municipal waste composts, biochar and other amendments on soils – researching the constraints and benefits to safe reuse
- Fate, persistence and effects of herbicides (glyphosate)
- Microplastics - where do they go and what do they effect in terrestrial systems
- Archaeological contamination and the timeline of bioavailability
- Contaminant monitoring and analysis – speciation analysis to quantify risk
- Bioavailability and risk – PAHs and other organic pollutants
- Remediation strategies for contaminated soils

Specifc research projects:

1. Rehabilitation of Sb and As contamination in the Hillgrove Mine

Through this field and lab-based project you will examine remedial options for contaminated soil at the Hillgrove Mine.

2. Microplastics in soils

A range of projects exist in this area. The microplastic load to terrestrial systems is significant yet almost nothing is understood about the consequences for soils, the organisms that live in it or us. We are considering microplastic movement in soils, influence on soil water dynamics and plant root structure, as well as ecotoxicity to terrestrial organisms.

3. Microplastics in NSW estuaries

This project will be based in estuary systems of northern NSW and will explore inputs, type and load of microplastics detected through longitudinal study and extend this to impacts on estuary oyster fisheries.

4. Reusing organic wastes for beneficial outcomes in soils as part of a circular economy

This project, undertaken with an industry partner, will examine options for reusing organic wastes as soil amendments. The student will characterise the wastes as fit for purpose and examine options for soil application (rates/methods) for optimal soil improvement and plant production. Potential CRC Future Food Systems scholarships are available.

4. Can plants be used to clean up contaminated soil? The role of Australian native plants for soil rehabilitation

In this trial the student will grow a range of Australia native plants in mine site contaminated soils to assess efficacy for soil remediation and rehabilitation. NSW Legacy Mines Division are a partner for this project.

5. Is our sushi harming us? The role of seaweed in foodchain exposure to metals and metalloids

Seaweed and algae can accumulate high contaminant concentrations depending on the quality of the growth medium. This project will examine metal concentrations in a range of different seaweed species, understand the contaminant concentrations, the bioavailability and any risk for foodchain transfer.

6. Predicting Antimony and Arsenic cross catchment movement in a contaminated catchment

This project will quantify the spatial and temporal dispersion of As and Sb contamination from the Macleay River Estuary and transfer to adjacent coastal areas using sampling and a modelling framework to provide for the management of contamination in coastal alluvial rivers.

7. The uptake of metalloids by homegrown vegetables

In this trial the student will grow a range of important vegetables in metalloid contaminated soils and assess the risk for foodchain accumulation and exposed populations.

8. Domestic water filters and metal contamination

Thousands of domestic water filters are used in homes across Australia. However, little is known about efficacy for different water sources and contaminant breakthrough, nor the loading of metals on the filter media which are disposed to landfill. In this project the student will collect water filters and test metal breakthrough for different water sources to gather the data to support safe water supply and filter disposal.

Environmental and Agricultural Modelling

Supervisor: Dr Fiona Tang

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Modelling is the development and use of mathematical descriptions to represent a simplified version of a system, be it soil, forest, wetland, pasture, or cropland. Modelling is used to improve understanding of how natural and managed ecosystems respond to changing conditions and make predictions on the future states of ecosystems under various scenarios, such as climate change, implementation of certain management strategies, or a specific environmental policy.

If you are interested in exploring environmental or agriculture-related problems using mathematical or computational approaches, I am happy to hear your ideas and discuss potential projects. We have a range of research projects around the modelling of soil water, soil carbon and nitrogen cycles, greenhouse gas emissions, and pesticide contamination. Below are examples of some potential projects.

1. Effect of future climate on grape production

The impacts of climate change are already felt by grape growers, with grape growing season being compressed and harvest date being brought forward. In this project, you will use UNFAO-AquaCrop model to estimate how shifts in rainfall patterns can affect the production of wine grapes in Australian wine regions.

2. Propagation of climate impacts from grape growers to wine tourism

Changes in climate patterns can reduce grape production and alter wine quality. The impacts of climate change on local wineries can reduce inflow of visitors to wine-producing regions, propagating the impacts to other hospitality sectors. In this project, you will use a two-equation recursive econometric model to estimate wine quality and price. Propagation of the impacts to tourism sector will then be determined using multi-region input-output analysis. This project is in collaboration with tourism sustainability group at the University of Queensland, led by Dr. Ya-Yen Sun.

3. Impact of pesticides on soil nitrogen cycle

Pesticide residues in soil can decrease microbial growth and enzymatic activities, potentially affecting the microbes responsible for transforming nitrogen into forms available for plant uptake. In this project, you will conduct a meta-analysis based on data compiled through literature surveys to study the effects of pesticides (e.g., glyphosate, 2-4 D, trifluralin) on ammonification, nitrification, denitrification, and nitrogen fixation.

4. Modelling of the fate and transport of microplastics in soil

Microplastics are accumulating at a fast rate in agricultural soil as a result of the use of compost/sewage sludge as fertilizers, plastic mulches, and protective seed coatings. In this project, you will develop a process-based, spatial-explicit, and time-dynamic model to describe the degradation and transport of microplastics in soil. This project will involve close collaboration with Pollution Science research group at UNE, led by A/Prof Susan Wilson and A/Pro Matt Tighe.

Terrestrial Carbon Research Group

Supervisor: Professor Brian Wilson

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www.une.edu.au/about-une/academic-schools/school-of-environmental-and-rural-science/research/plant-soil-and-environment-systems/terrestrial-carbon-research-group

1. Impact of nutrient import by seabirds to soil processes on offshore islands on NSW

Between 2005-2009 offshore Islands in NSW were the focus of a programme to eradicate mice, rats and rabbits which had been introduced as a consequence of human habitation. The ecology of the islands since 2009 has therefore progressed along a quite different trajectory. One of the key changes on the islands has been the re-establishment of large seabird colonies.

These seabirds import very substantial quantities of oceanic derived nutrient to the islands and this is having a very significant effect on ecological (and particularly soil) processes.

This project will assess the quantities, distribution and importance of these nutrient additions on the island ecosystems and the impacts on ecosystem function with a view to informing future management of the islands for optimum ecological outcomes.

Collaborators: NSW NPWS.
Location: Broughton Island Group, NSW

2. Impact of "ecosystem engineering" by seabird colonies on soil physical properties on offshore islands of NSW

Between 2005-2009 offshore Islands in NSW were the focus of a programme to eradicate mice, rats and rabbits which had been introduced as a consequence of human habitation. The ecology of the islands since 2009 has therefore progressed along a quite different trajectory. One of the key changes on the islands has been the re-establishment of large seabird colonies.

Seabirds, particularly shearwaters, are burrowing birds that displace large quantities of soil as part of their annual breeding cycle. This has the effect of "ecologically engineering" the landscape on a regular basis. This project will investigate the quantities of soil displaced annually and the effect of this on soil physical, chemical and biological properties with a view to informing NPWS regarding ongoing management of the island ecosystem.

Collaborators: NSW NPWS, U Wollongong.
Location: Broughton Island Group, NSW

3. The nature and function of soils in the Australian Alps (Kosciuszko National Park) and their vulnerability to climate change

The Australian Alps represent an environment that is unique on the Australian continent and the region contains an assemblage of soil types that is unique on the Australian continent. Although the above-ground ecosystems of the Australian Alps have received considerable scientific attention, research relating to the nature of their soils has been much more limited. Soils are the foundation of all terrestrial ecosystems and the soils of the Alpine region are uniquely high in organic matter and biota by comparison with the remainder of the continent. A fuller understanding of the nature, role and vulnerability of soils in these ecosystems is required to inform effective management strategies.

Working with the Terrestrial Carbon Research Group in this unique environment along with a range of research partners including State Government, and National Parks and Wildlife Service, you will join an established team working on a long-term project in Kosciuszko National Park to evaluate the nature and functions of soils and to assess their vulnerability to climate change. The work is varied and can accommodate all soil science disciplines including soil carbon, soil condition and

health, nutrient cycling, soil water relationships, soil biology etc. The work will inform the current and future management of this iconic environment. .

Collaborators: NSW Department of Planning, Industry and Environment, NSW NPWS, NSW LLS
Location: Kosciuszko National Park, NSW

4. Soil response to rehabilitation of alpine and sub-alpine sites of the Snowy Hydro Scheme

The Snowy Hydro Scheme was one of the most significant civil engineering projects in Australian. The project, a major engineering success, resulted in a range of sites with significant ecological disturbance. The NSW National Parks and Wildlife Service (NPWS) now have responsibility for restoring and rehabilitating these sites. Although native vegetation can be restored on disturbed sites, it is not clear how and at what rate ecological (and particularly soil) function can be restored at these sites and therefore at what stage rehabilitation can be considered to be successfully achieved.

This project will assess soil condition at a range of Snowy Hydro sites of different age and treatment types with the aim of assessing the success or otherwise of rehabilitation efforts in restoring soil function.

Collaborators: NSW National Parks and Wildlife Service
Location: Kosciuszko National Park, NSW

5. Vulnerability of alpine, sub-alpine and montane forest soils in NSW to climate change

Ecosystems of the alpine and sub-alpine zones of NSW are the most vulnerable to projected climate change with progressive warming and drying of these environments leading to likely significant change in these systems. Although much work has been conducted to examine and model the effects of climate change on above-ground ecosystems, limited work has considered the effect of climate change on the soil resource.

This project will utilize a range of alpine, sub-alpine and montane forest sites to examine the vulnerability of soils and particularly the soil organic matter cycle, to climate change. The impacts of climate change on the nature and extent of these soils and their character will be assessed to guide planning and management of these ecosystems into the future.

Collaborators: NSW NPWS
Location: New England National Park, Kosciuszko National Park, Mt Kaputar National Park, NSW

Soil Biology

Supervisor: Dr Oliver Knox

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Have you ever wanted to look more closely at cropping systems and their associated soil biology? If so I'd be willing to offer or discuss projects in this general area. Currently we work on investigating how root tips sense their environment and interact with pathogens via processes mediated by their border cells. There is a range of projects available looking at how these cells behave when stressed or altered and even new methods to enumerate them. We have projects looking at the importance of mycorrhizae in cotton cropping systems as well as several looking at pathogen control and suppression.

Soil biology is also closely linked to soil health, which is a great engagement term, but how well does it fit the wider farm landscape? There is opportunity most years to work with us and our colleagues in Narrabri, possibly on a CSIRO/CRDC Summer scholarship looking at how soil health assessments fit agricultural soils and crop productivity.

If you are interested in cotton, rotations in general, soil biology or soil health please get in touch.

Soil Health and Land Management

Supervisor: Lisa Lobry de Bruyn

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In order for farmers to maintain or improve soil health through their management they need to access and use good quality, local soil information, including identification of soil types and their soil health status (here using available soil testing as a proxy). Tracking of soil health status, at the local level, largely falls to farmers. Despite recurrent language, in policy and other documents, suggesting farmers' monitoring of soil health is necessary to guide decision-making and land management practices, the reality of their practice, is relatively unknown. It appears that we have assumed what motivates farmers to soil test but have not asked them. This project would work with landholders undertaking soil testing workshops on soil testing and interpretation of their own soil test results, and examine what they do with the soil data they collect and how it influences their land management decisions.

Skills: analysing surveys, undertaking a qualitative analysis and follow-up interviews. Data is currently being collected, Human Research Ethics application already undertaken.

Sub-Antarctic weeds projects

Supervisors:

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Paul Kristiansen: paul.kristiansen@une.edu.au

Sub-Antarctic weeds projects

Several weed species such as winter grass (*Poa annua*), *Stellaria media* (chickweed) and Cerastium fontanum (mouse-ear chickweed) have invaded sub-Antarctic Islands (e.g. Macquarie Island), impacting on native biodiversity. These same and other

weeds are now also threatening the Antarctic mainland. Given high conservation values, and threats from disturbance & climate change, the development of targeted control measures for invasive species is vital. A range of potential projects could be conducted, but one example is listed below.

Can winter weeds germinate and grow in the Antarctic?

Description: While winter grass (*Poa annua*) has invaded the peninsula of the Antarctic mainland, little is known about the potential for a range of other cool season weeds to invade and survive in the Antarctic. This project will generate results of the resilience of a range of species to survive freezing temperatures and germinate and grow in Antarctic conditions utilising UNE's freezers and sub-Antarctic cool room facilities.

Aquatic Ecology and Restoration

Supervisor:
Dr Sarah Mika: sarah.mika@une.edu.au | 6773 2146

Other supervisors and staff:
Dr Adrienne Burns: aburns@une.edu.au | 6773 3957
Dr Manisha Shakaya (aquatic ecotoxicology)
Dr Ivor Growns (invertebrate ecology)
Dr Rob Rolls (fish ecology)
Dr Leah McIntosh (fish ecology)
Ben Vincent (plant ecology)
Lindsey Frost (basal resource quality in aquatic food webs)
Samuel Lewis (fish and invertebrate ecology)

Aquatic ecosystems are complex, beautiful, fascinating and absolutely necessary for human survival. Managing these systems effectively for long term ecosystem health requires an understanding of the biotic and abiotic processes driving biodiversity and ecosystem function in them. The Aquatic Ecology Lab at UNE comprises nine researchers who specialise in aquatic plants, invertebrates, fish and biogeochemistry.

The lab is offering several HDR projects starting in summer 2021 or early 2022 aligned with our major research projects:

1. Spatial and temporal dynamics of New England montane lagoons

The ephemeral lagoons in the New England tablelands are classified as endangered ecological communities (EEC) and several are listed on the Ramsar convention for the conservation and wise use of wetlands.

- Aquatic invertebrates are an important ecological component of the lagoons and act as food for many waterbird species. However, there is little information of how, when and why invertebrate communities change over time and/or between lagoons. This project will test the Baas Becking hypothesis that "everything is everywhere but the environment selects" and will be important foundation for the continued management of these EECs.
- When wet, lagoons support diverse and abundant aquatic invertebrate communities. However, we don't know the key food sources of these invertebrates and how reliant they are on locally produced aquatic carbon or carbon subsidies from adjacent terrestrial ecosystems. This project will investigate lagoon metabolism and the origins of dissolved organic carbon to improve our understanding of the basal resources that drive aquatic food webs in lagoons.

2. Vegetation community dynamics in the Gwydir Wetlands

The Gwydir Wetlands are a biodiverse, highly fertile inland floodplain wetland system located west of Moree in northern central NSW. The wetlands are dynamic ecosystems driven by inundation and support substantial areas of floodplain and wetland vegetation communities that are floristically and functionally diverse and poorly conserved in NSW, including; water couch - marsh - grasslands. Maintaining and improving the condition of vegetation communities in these systems is an ongoing aim of the Commonwealth Environmental Water Office through the provision of water for the environment (e-water).

- Vegetation condition can be used to assess the effectiveness of a management activity, such as e-water delivery, by comparing vegetation against reference sites or 'benchmarks'. While some areas of the dominant water couch – marsh – grassland wetland community are inundated frequently, other areas remain dry for long periods. This project will compare existing benchmark data against seven years of collected data to gain a better understanding of the vegetation condition response to differing watering regimes over time. Findings can assist land and water managers in making future decisions surrounding implementation of future watering regimes in this floodplain system.

3. Aquatic food webs in the northern Murray Darling Basin

This project is focused on understanding how long- and short-term hydrological regimes, including management with environmental water, influences energy transfer through aquatic food webs. This includes understanding links between aquatic food web structure and function, and plant, soil microbe, and terrestrial communities.

- It is well understood that food resources of poor quality inhibit growth in consumers, but is there a link between a consumer's diet quality and how valuable they then become as a resource? Following on from current lab-based mesocosm trials, this project would comprise a field experiment to investigate the effects of diets of varying quality on zooplankton growth, reproduction and value as a food resource for higher order consumers, including investigating whether there is a link between diet quality and energy density of consumer biomass.
- The soil microbial community plays an important role in nutrient cycling and basal resource production in wetlands. Understanding how this community changes in space and time in response to inundation improves our understanding of processes supporting the base of the aquatic food chain, which drives productivity in higher levels. This project would be largely laboratory based, using existing soil samples collected previously to characterise the microbial communities in differently inundated wetland soils and their nutritional quality for aquatic invertebrate consumers.
- Long-term hydrological regimes (including drying cycles) influence the structure and function of different types of habitat patches in wetlands. In areas that remain permanently or near permanently saturated, anoxic soil conditions promote the formation of highly organic soils or peats, that promote biogenic production of methane which can act as a food resource for aquatic consumers. Patches in wetlands naturally change over time, and the distribution of peaty soils and their associated plant communities changes in response to changes in hydrology, such as through patterns of environmental watering. Can we determine recent changes by investigating the soil organic matter composition of wetland soils? This project would involve some fun field work plus laboratory work.

4. Strengthening the use of non-lethal methods to facilitate the inclusion of fish in stable isotope studies of food webs

Fish are an important component of aquatic food webs as they often represent the highest trophic levels. Stable isotopes are widely used to understand food web structure. However, standard methods for the collection of samples from fish require the animal to be killed. In river systems with naturally small populations that are frequently under stress, invasive or lethal sample collection methods are undesirable. The use of non-lethal sample collection methods will allow us to include fish in food web studies with minimal impact to the ecosystem.

- This project will build upon existing research that establishes the isotopic relationship between fish muscle tissue and fin tissue. This research will focus on species present in the northern Murray-Darling Basin and will likely include field work to collect tissue samples, and lab work to prepare samples for isotopic analysis.

5. Developing biological indicators of estuary health using invertebrates

Estuaries and estuarine lagoons are under significant anthropogenic stress. Many indicators of estuary or lagoon health use the physical and chemical indicators of water quality, or the biological indicator of phytoplankton biomass. However, these physical and chemical indicators change rapidly and do not directly monitor impacts on estuarine biota. Aligned with existing water quality monitoring undertaken in the Coffs Harbour coastal catchments, two projects will focus on developing biological indicators.

- Benthic macroinvertebrates are exposed to sediment conditions and integrate water quality impacts over longer time periods than would be measured in regular water sampling. This project will examine benthic macroinvertebrate communities in estuaries and estuarine lagoons covering a range of anthropogenic disturbance to determine whether they can be used to develop a reliable biological indicator of estuarine health. This project involves fieldwork and labwork.
- Estuarine zooplankton fluctuate in response to water quality and phytoplankton abundance. This project will examine estuarine zooplankton communities in estuaries and estuarine lagoons covering a range of anthropogenic disturbance and salinity gradients to determine whether they can be used to develop a reliable biological indicator of estuarine health. This project involves fieldwork and labwork.

6. Nutrient colimitation in aquatic ecosystems

Carbon, nitrogen and phosphorus are the three key macronutrients in aquatic ecosystems and together they drive aquatic primary productivity. Water managers have national and state guidelines for nitrogen and phosphorus, above which concentrations are predicted to negatively impact the health of aquatic ecosystems, often in the form of harmful algal blooms. However, many of our freshwater and estuarine systems regularly exceed these concentrations without suffering from harmful algal blooms.

- A project will examine the concept of nutrient colimitation as a means of understanding why high individual nutrient concentrations may not be leading to excessive aquatic primary production. The project will involve a field experiment using nutrient-amended diffusing substrates to determine the limiting macronutrients in northern NSW catchments, and whether these relationships change temporally.
- A second project will investigate the threshold concentrations of the macronutrients required to trigger excessive algal growth, and whether these thresholds change with increasing water temperatures. This project will involve fieldwork and a lab experiment using nutrient-amended diffusing substrates to identify critical nutrient concentrations in northern NSW catchments.

7. Surface water – groundwater interactions in coastal rivers: bushfire impacts to thermal and nutrient regimes

Water quality in gravel-bed rivers is regulated by hydrological exchange between the surface water and shallow aquifer. This exchange occurs over multiple temporal and spatial scales and is critical to regulating nutrients and temperature in the surface water. Bushfires result in ash and fine-sediment inputs to rivers. Ash impacts water and sediment chemistry and fine-sediments are transported into the gravel sediments, clogging them and reducing hydrological exchange between groundwater and surface water. The 2019-20 fire season saw extensive areas of northern NSW catchments burn, but nothing is known about how this impacts the hydrological exchange between surface water and shallow groundwater, and what the results are for surface streams.

- Groundwater inputs to surface water stabilises river temperatures. This creates localised thermal refuge patches that are very important for juvenile fish, as well as regulating reach-scale thermal regimes in rivers. This project involves fieldwork to analyse temperature patterns and surface water - groundwater exchange in unburnt and burnt reaches of a northern NSW river.
- The shallow aquifer underlying gravel-bed rivers regulates nutrient remineralisation and has been termed the ‘river’s liver’ due to its role in processing organic matter and nutrients. This project involves fieldwork to analyse surface water – groundwater exchange and nutrient dynamics in unburnt and burnt reaches of a northern NSW river.
- Re-establishing topographic relief through the use of log-sills is a method commonly used to restore surface water – groundwater exchanged in gravel-bed rivers. This project involves a field experiment to test the effectiveness of small log-sills as a strategy to improve surface water – groundwater exchange and nutrient regeneration in unburnt and burnt reaches of a northern NSW river.

Making the most of genomic technologies to tackle applied and blue-sky questions for agriculture, evolution and conservation.

Genetics

Rose Andrew: rose.andrew@une.edu.au or Sam Clark: sam.clark@une.edu.au

Molecular Ecology Laboratory

Supervisor: Contact Rose Andrew

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www.roseandrewlab.com

Some potential projects

- **Modeling of *Eucalyptus* diversification using genomic data:** We have a wealth of sequence data that is ripe for demographic modelling of speciation and adaptation. These data would be perfect for an off-campus student with an interest in bioinformatics.
- **Conservation genetics of woodland eucalypts:** Quantifying the risks of inbreeding and hybridisation in eucalypts requires novel high-throughput techniques. This project lays the groundwork for more effective management of the dominant species in Threatened Ecological Communities. *Visits to UNE required.*
- **Speciation genomics in native plants:** Building on recent taxonomy projects, we can now study the process of genome divergence in native plant genera such as *Eucalyptus*, *Phebalium* (Rutaceae) and *Xerochrysum* paper daisies (Asteraceae). Disentangling the roles of natural selection and admixture can help us to understand the fundamental process that produces biodiversity.

Rader Community Ecology Lab

Supervisor: Dr Romina Rader

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www.raderlab.com

Some of the projects available in this laboratory (see Ecology projects) will involve evolutionary, population and conservation genomics. Please contact Dr Rader for more information.

Animal Breeding and Genetics

Supervisors:

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Prof. Julius van der Werf: jvanderw@une.edu.au

The team in animal breeding and genetics offers a wide range of options for students wanting to undertake an honours project with a focus on genetics in the Animal Sciences (refer to projects in Animal Science). We currently work in key areas relating to genetics of animal breeding along with the team at The Animal Genetics and Breeding Unit (AGBU), a joint venture of NSW Department of Primary Industries and University of New England.

If you have any questions or would just like to chat about completing an honours project in Animal breeding and genetics, please contact us.

Understanding our planet's geological and prehistoric past and the cataclysmic processes that shaped the earth.

Geoscience

Discipline contact Luke Milan: **lmilan@une.edu.au**

Litholab UNE

LLUNE is a multidisciplinary geoscientific research group at the University of New England Armidale.

We continue a strong tradition of world-class Earth Science at UNE, bringing together diverse expertise to tackle geoscientific questions across the timescale and nuture the next generation of Earth scientists.

To find out more about projects and other postgraduate opportunities with LLUNE **head to the website**.
We can also tailor a project to your liking!

A mafic enclave (in the shape of Australia!) hosted within a granite from the New England region.

1. Late Permian magmatism and super eruptions (multiple projects)

Supervisors:

Luke Milan: luke.milan@une.edu.au

Tim Chapman: timothy.chapman@une.edu.au

The late Permian period in the New England Orogen experienced a significant spike in magma production. The local region is now host to large tracts of granite plutons and thick sequences of volcanics and calderas. These catastrophic eruptions produced air fall spread as far as central Queensland and Wollongong. Several projects exist in exploring the processes that produced the heightened magma production and super-eruptions. These include mapping out poorly understood volcanics and plutons, establishing the timing, extent, drivers, and linking the volcanics to the batholith and related tin deposits. The projects can involve geological mapping and geophysical interpretation, petrography, geochronology, and geochemistry.

Opportunities to work with NSW Geological survey.

We can tailor a project to you! We have numerous opportunities.

Keywords: Field mapping; geochemistry, petrography, airborne geophysics, geochronology, volcanology, igneous petrology.

2. Magma cycles and critical metals

Supervisors:

Luke Milan: luke.milan@une.edu.au
Tim Chapman: timothy.chapman@une.edu.au
Nicholas Tailby:

The Great Serpentinite Belt is a unique belt of interesting rocks that represent fragments of ophiolites. Ophiolites represent rare segments of oceanic crust that have been thrust onto a continent. These research projects represent a unique chance to work on well preserved oceanic crust on land. The serpentinite belt is also host to high-pressure fragments of subduction zone complexes such as eclogites, blueschist and diamonds which may be of interest as little is known about their genesis and links to the broader tectonic history of the region. Little detailed mapping of the Great Serpentinite Belt has been undertaken in recent decades. We have lots of projects available to investigate the serpentinite belt, including a focus on the processes that formed the oceanic crust (ophiolite) blocks or high-pressure metamorphism. We can tailor a project to suit you – typical aspects may include

field mapping, petrology, rock and mineral geochemistry, geochronology and isotope geochemistry.

We can tailor a project to you! We have numerous opportunities.

Keywords: Field mapping; geochemistry, petrography, geochronology, igneous petrology.

3. Great Serpentinite Belt (multiple projects)

Supervisors:

Luke Milan: luke.milan@une.edu.au
Tim Chapman: timothy.chapman@une.edu.au
Nicholas Tailby:

The Great Serpentinite Belt is a unique belt of interesting rocks that represent fragments of ophiolites. Ophiolites represent rare segments of oceanic crust that have been thrust onto a continent. These research projects represent a unique chance to work on well preserved oceanic crust on land. The serpentinite belt is also the host to high-pressure fragments of subduction zone complexes such as eclogites, blueschist and diamonds which may be of interest as little is known about their genesis and links to the broader tectonic history of the region. Little detailed mapping of the Great Serpentinite Belt has been undertaken in recent decades. We have lots of projects available to investigate the serpentinite belt, including a focus on the processes that formed the oceanic crust (ophiolite) blocks or high-pressure metamorphism. We can tailor a project to suit you – typical aspects may include field mapping, petrology, rock and mineral geochemistry, geochronology, and isotope geochemistry.

We have numerous opportunities, and this is part of ongoing research with geology staff!

Keywords: Devonian-Carboniferous volcaniclastics and volcanics, geochronology, palaeontology, stratigraphy, provenance studies, petrology, whole rock geochemistry, geological mapping.

4. Tracking the evolution of a Devonian-Carboniferous arc

Supervisors:

Luke Milan: luke.milan@une.edu.au
Marissa Betts: marissa.betts@une.edu.au
Tim Chapman: timothy.chapman@une.edu.au

Does tracking the evolution of an ancient Devonian to Carboniferous arc over time sound exciting? These projects will refine and re-evaluate the evolution of the Tamworth belt of rocks. This belt preserves a diverse suite of strata shedding off volcanic arcs. Their strata and fossil record change over time reflecting the changing tectonic setting and geological record over time. This project will work to refine key periods in the belts history to reveal and expand on the geological processes that have been ascribed to the belt. There are multiple projects available, and they typically involve a multifaceted approach that starts with field mapping, sampling, and a wide variety of laboratory work.

Macrofossils and microfacies of the Kyndalyn Member, Somerton. Limestones in the Tamworth Belt record evidence of fluctuating tropical marine palaeoenvironments that were influenced by island-arc volcanism on the margin of Gondwana. Apply classic and cutting-edge laboratory and

imaging techniques to rock, mineral and fossil samples you collect in the field in order to reconstruct big-picture sedimentation processes in an early Carboniferous basin.

We can also tailor a project to your taste!

Keywords: Devonian-Carboniferous volcaniclastics and volcanics, geochronology, palaeontology, stratigraphy, provenance studies, petrology, whole rock geochemistry, geological mapping.

5. Other projects

Supervisors:

Luke Milan: luke.milan@une.edu.au
Tim Chapman: timothy.chapman@une.edu.au
Nicholas Tailby:

A variety of ongoing research projects are available in diverse specialities including field geology, igneous and metamorphic petrology, structural geology, geochemistry, mineralisation, and environmental aspects. Some of these can be industry supported. Please reach out to the staff to discuss possibilities.

6. Nymbodia and its secrets

Supervisors:

Luke Milan: luke.milan@une.edu.au
Marissa Betts: marissa.betts@une.edu.au

This project is based In the Southern end of the Clarence Moreton Basin. Little recent work has been done on this Triassic sedimentary basin. The basin is important and covers the recovery of the forests post the end Permian extinction. Projects could involve geological mapping on the margins of the basin to understand sedimentology, stratigraphy, and age, and ultimately the provenance and tectonic setting of the rocks. Possible drill core inspection at Londonderry to obtain additional samples through the known coal measures.

Keywords: Field Mapping, palaeontology, Stratigraphy, Nymboida coal measures, sedimentology, petrology, geochronology.

7. Stratigraphy and the fossil record

Supervisors:

Marissa Betts: marissa.betts@une.edu.au
Luke Milan: luke.milan@une.edu.au

Early Cambrian chronostratigraphy of South Australia. This interdisciplinary project will primarily use small shelly fossils to determine the ages of key lower Cambrian successions in the Flinders Ranges, South Australia. Build your palaeontological knowledge of early Cambrian fossil fauna and their biostratigraphic applications, and complement this work with stable isotope chemostratigraphy and lithologic data. This is a great opportunity to contribute to building the geological timescale, and regionally and globally correlate rocks from South Australia during the Cambrian Explosion of life. Skills acquired via this project are widely used in both academia and industry. Contact Marissa Betts.

Reconstructing the skeletons of some of the earliest armoured animals. Use cutting-edge 3D scanning technologies to reconstruct the oldest complex skeletons in the fossil record and resolve the functional morphology, palaeoecology and evolutionary relationships of the enigmatic animals who made them. Contact Marissa Betts.

Carbonate microfacies and early Cambrian palaeoenvironmental reconstructions. This project aims to reconstruct the kinds of ancient marine environments in which early animals evolved and diversified. This includes the world's oldest animal-built reefs and the palaeoenvironments that flanked them. This work is key for understanding the interplay between ancient marine environments and the evolution of early animals. This multi-faceted project will also incorporate investigation of how fossils are preserved in carbonates, and the effects preservation style has on fossil recovery and ecosystem reconstructions. Contact Marissa Betts.

Tuffs and Trilobites; high-resolution zircon dating of the lower Cambrian Billy Creek volcanics. In the Flinders Ranges, the Billy Creek Formation contains a series of (up to 12) individual volcanic ash deposits interleaved within fossiliferous siliciclastics. This is a very exciting interdisciplinary project that incorporates regional chronostratigraphic development with volcanology (quantifying eruption style and duration), tectonics (assembly of Gondwana) and palaeontology (early Cambrian trilobites). Contact Marissa Betts or Luke Milan.

Understanding the prehistoric life forms (or fossils) preserved in rocks and ancient sediments and the evolution of life on Earth.

Palaeoscience

Discipline contact Phil Bell: **pbell23@une.edu.au** or supervisor

1. Cambrian trilobites and other shelly fossils from allochthonous limestone blocks in the Murrawong Creek Formation, Gamilaroi Terrane, southern New England Orogen

Supervisor: Prof. John Paterson

jpater20@une.edu.au
www.une.edu.au/staff-profiles/ers/jpater20

Fossiliferous limestone clasts within the Murrawong Creek Formation appear to have been derived from a carbonate platform fringing an island arc, outboard of the East Gondwanan coastline during Cambrian times. The shelly fossils from these clasts, including a diverse trilobite assemblage, are rather unusual and, in some cases, endemic, likely due to this exotic palaeogeography. This project will document the trilobites and other shelly fossils from a locality near Tamworth, NSW, with the aim of better understanding the diversity and biogeographic signature of this distinctive fauna.

This project will be co-supervised by:
Dr Marissa Betts: marissa.betts@une.edu.au
Dr Luke Milan: luke.milan@une.edu.au

2. Taphonomy and palaeoecology of a deep-water early Cambrian trilobite assemblage from the Elder-Chace Range area of the Flinders Ranges, South Australia

Supervisor: Prof. John Paterson

jpater20@une.edu.au
www.une.edu.au/staff-profiles/ers/jpater20

The Mernmerna Formation is a widespread stratigraphic unit in the Flinders Ranges and hosts a huge diversity of early Cambrian shelly fossils from a range of palaeoenvironments. In the Elder-Chace Range area, the Mernmerna Formation is particularly thick and contains a deep-water trilobite assemblage in the upper part of the unit. This project will document the diversity, taphonomy and palaeoecology of this trilobite assemblage and its implications regarding specific environmental conditions (e.g. water depth and light levels) at the time of deposition.

This project will be co-supervised by:
Dr Marissa Betts: marissa.betts@une.edu.au

3. Shelly fossils from the lower Cambrian Aroona Creek Limestone, Flinders Ranges, South Australia

Supervisor: Prof. John Paterson

jpater20@une.edu.au
www.une.edu.au/staff-profiles/ers/jpater20

The Aroona Creek Limestone and correlates in the Arrowie and Stansbury basins of South Australia contain shelly fossil assemblages that are important for stratigraphic correlation with other Australian sedimentary basins and may prove critical for defining important boundaries of the Cambrian timescale. This project will document trilobites and 'small shelly fossils' from the Aroona Creek Limestone near Leigh Creek in the Flinders Ranges, South Australia to provide a better temporal constraint on this unit and resolve taxonomic issues surrounding key index fossils.

This project will be co-supervised by:
Dr Marissa Betts: marissa.betts@une.edu.au

4. Cambro-Ordovician trilobites from Mt Arrowsmith, western New South Wales. Early Palaeozoic strata in western New South Wales are highly fossiliferous, yet poorly documented

Supervisor: Prof. John Paterson

jpater20@une.edu.au
www.une.edu.au/staff-profiles/ers/jpater20

The Cambrian and Early Ordovician successions at Mt Arrowsmith are no exception. This project will focus on the diverse trilobite assemblages from this area, including the description of new species, and will place these important faunas in biostratigraphic and biogeographic contexts.

This project will be co-supervised by:
Dr Patrick Smith, Australian Museum, Sydney

5. "Shedding light on Dark Corner": the diversity, taphonomy and palaeoecology of the Silurian Tanwarra Shale fauna, NSW

Supervisor: Prof. John Paterson

jpater20@une.edu.au
www.une.edu.au/staff-profiles/ers/jpater20

Early to mid-Silurian fossils are reasonably rare in eastern

Australia. This is partly due to the preceding Hirnantian glaciation, which occurred during one of the largest extinction events in Earth's history, at the end of the Ordovician Period. A new fossil site in the mid-Silurian (ca. 427-million-year-old) Tanwarra Shale near Dark Corner, NSW contains a well-preserved marine fauna that gives a rare glimpse into ecosystem recovery after this mass extinction event. This project will look at the diversity and taphonomy of fossils from this site, with the aim of reconstructing the palaeoecology of this important post-extinction fauna.

This project will be co-supervised by:
Dr Patrick Smith, Australian Museum, Sydney

6. Hunting for predatory holes in the Cambrian fossil record: Drill holes within the shells of the 520 million-year-old microfossil *Micrina etheridgei from South Australia*

Supervisor: Prof. John Paterson

jpater20@une.edu.au
www.une.edu.au/staff-profiles/ers/jpater20

Holes in the shells of Cambrian organisms present strong evidence for the early evolution of drilling predation. However, such holes are apparently rare and this rarity has hindered the understanding of important predator-prey interactions in the Cambrian. A large collection of *Micrina etheridgei* specimens that have been acid-etched from Cambrian limestones of South Australia, and currently housed at UNE, can be studied to: (a) document the features of the holes preserved in the shells, and attempt to identify the predator and elucidate its behaviour; and (b) show how this species responded to drilling predation over a short period of geologic time.

This project will be co-supervised by:
Dr Marissa Betts: marissa.betts@une.edu.au
Dr Russell Bicknell: rbickne2@une.edu.au

7. Morphological trends in Cambrian trilobites

Supervisor: Prof. John Paterson

jpater20@une.edu.au
www.une.edu.au/staff-profiles/ers/jpater20

Trilobites are one of the most diverse and morphologically complex animal groups that lived during the Cambrian. For decades, trilobite experts have noted various morphological trends in their exoskeletons over time, such as reducing the number of thoracic segments and an increase in the size of the pygidium. However, very few studies have tried to quantify these supposed evolutionary patterns. This project aims to test these ideas and assess whether certain biological "rules" (e.g. Cope's Rule and Williston's Law) apply to the macroevolutionary trends in trilobites. The project will utilise a previously generated morphological and phylogenetic dataset of Cambrian trilobites and apply a combination of phylogenetic comparative and time-series analyses (e.g., macroevolutionary model fitting, ancestral state estimation, and autoregressive linear models). The ideal applicant may have some experience with programming languages but, at minimum, should be interested in learning them and their application to analytical palaeobiology.

This project will be co-supervised by:
Dr Nic Campione: ncampion@une.edu.au

1. Early Cambrian chronostratigraphy of South Australia

Supervisor: Dr Marissa Betts

marissa.betts@une.edu.au
www.une.edu.au/staff-profiles/ers/marissa-betts
www.marissajbetts.wordpress.com/

This interdisciplinary project will primarily use small shelly fossils to determine the ages of key lower Cambrian successions in the Flinders Ranges, South Australia. The student will build palaeontological knowledge of early Cambrian fossil fauna and their biostratigraphic applications. They will complement this work with stable isotope chemostratigraphy and lithologic data. This is a great opportunity to contribute to building the geological timescale, and regionally and globally correlate rocks from South Australia during the Cambrian Explosion of life. Skills acquired via this project are widely used in both academia and industry.

2. Reconstructing the skeletons of some of the earliest armoured animals

Supervisor: Dr Marissa Betts

marissa.betts@une.edu.au
www.une.edu.au/staff-profiles/ers/marissa-betts
www.marissajbetts.wordpress.com/

Use cutting-edge 3D scanning technologies to reconstruct the oldest complex skeletons in the fossil record and resolve the functional morphology, palaeoecology and evolutionary relationships of the enigmatic animals who made them.

3. Carbonate microfacies and early Cambrian palaeoenvironmental reconstructions

Supervisor: Dr Marissa Betts

marissa.betts@une.edu.au
www.une.edu.au/staff-profiles/ers/marissa-betts
www.marissajbetts.wordpress.com/

This project aims to reconstruct the kinds of ancient marine environments in which early animals evolved and diversified. This includes the world's oldest animal-built reefs and the palaeoenvironments that flanked them. This work is key for understanding the interplay between ancient marine environments and the evolution of early animals. This multi-faceted project will also incorporate investigation of *how* fossils are preserved in carbonates, and the effects preservation style has on fossil recovery and ecosystem reconstructions.

4. Tuffs and Trilobites; high-resolution zircon dating of the lower Cambrian Billy Creek volcanics

Supervisor: Dr Marissa Betts

marissa.betts@une.edu.au
www.une.edu.au/staff-profiles/ers/marissa-betts
www.marissajbetts.wordpress.com/

In the Flinders Ranges, the Billy Creek Formation contains a series of (up to 12) individual volcanic ash deposits interleaved within fossiliferous siliciclastics. This is a very exciting interdisciplinary project that incorporates regional chronostratigraphic development with volcanology (quantifying eruption style and duration), tectonics (assembly of Gondwana) and palaeontology (early Cambrian trilobites).

This project will be co-supervised by:
Dr Luke Milan:

Semi-articulated trilobite from Pinyatta Creek, eastern Flinders Ranges.

1. Histology of opalised dinosaur bones from Lightning Ridge

Supervisor: Dr Phil Bell

pbell23@une.edu.au
www.une.edu.au/staff-profiles/ers/pbell23

Palaeohistology is the study of the microscopic structure of fossilised bones and teeth, offering insights into their growth and types of tissue present. Lightning Ridge in northern NSW, is the only place in the world where dinosaur bones are routinely preserved in opal. Opal typically obliterates these microscopic details, although it is preserved in rare cases. This project will be the first to apply palaeohistological techniques to the study of opalised dinosaur bone and an exploration of the effects of opalisation on the histology of these unique fossils.

2. Toes and scales as a clue to feeding ecology in predatory dinosaurs and birds

Supervisor: Dr Phil Bell

pbell23@une.edu.au
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Modern birds of prey that use their feet for hunting are equipped not only with large talons, but also specific toe pad and foot scale types that better enable them to grasp struggling prey. Superb fossils of *Microraptor* and other theropod dinosaurs that preserve skin and scales on their feet are providing new clues as to how these animals behaved. This study will examine a broad set of modern birds to compare foot shape with feeding ecology as a proxy for understanding behaviour in extinct dinosaurs.

Note: Other projects can be discussed and arranged by contacting Dr Bell.

1. Do shark teeth serve as morphological indicators of ecology?

Supervisor: Nic Campione

ncampion@une.edu.au
www.une.edu.au/staff-profiles/ers/dr-nicolas-campione

Shark teeth play an obvious role in the procurement and processing of food, which suggests they should serve as ecomorphological proxies. However, their shape follows the 'many-to-one mapping' dilemma, whereby one type of tooth morphology serves multiple functions and, conversely, multiple morphologies may serve the same function. Using dental topological mapping procedures, this project will assemble a 3D digital library of teeth from living sharks to explore the relationship between topological functional traits, biomechanics, and diet. This project will include travel to various museum collections to collect 3D scan data.

This project will be co-supervised by:
Dr Mohamad Bazzi, University of Zurich, Switzerland

2. Heterodonty and the evolution of tyrannosaur teeth

Supervisor: Nic Campione

ncampion@une.edu.au
www.une.edu.au/staff-profiles/ers/dr-nicolas-campione

Tyrannosaurids were iconic carnivores of the Cretaceous, considered to have been predators, scavengers, and cannibals. Their typical teeth are large, labiolingually broad and often considered adapted to bone-crushing. However, notable shape variation along the tooth row may relate to functional differences (i.e., true heterodonty). This project will test the occurrence of true heterodonty in tyrannosaurids by apply biomechanical and dental topological mapping techniques to 3D scan data of the tyrannosaurids *Albertosaurus* and *Daspletosaurus*. Time permitting, datasets from other tyrannosaurids or tyrannosauroids may be acquired by travelling to museum collections to investigate and understand the functional significance of tyrannosaurid dental variation on a macroevolutionary level.

3. The taxonomy and diversity of sharks from the Griman Creek Formation, Surat Basin (southern Queensland)

Supervisor: Nic Campione

ncampion@une.edu.au

www.une.edu.au/staff-profiles/ers/dr-nicolas-campione

The Griman Creek Formation has revealed the greatest diversity of vertebrates from the mid-Cretaceous of Australia (~93 Ma), including ornithopod, ankylosaur, theropod, and sauropod dinosaurs, along with mammals, crocodiles, turtles, pterosaurs, bony fish, lungfish, and plesiosaurs. The lithological and taxonomic makeup of the formation, especially in the opal mines of Lightning Ridge, support a largely terrestrial nature. However, rare occurrences of lamniform sharks indicate some marine incursions. Comparatively, outcrops of the Griman Creek Formation near Surat, Queensland, ~270 km NW of Lightning Ridge, recently produced a collection of nine shark teeth from two different sites. This project will describe the anatomy and taxonomy of these teeth to infer the diversity of sharks from this formation. Context will be provided by shark occurrences from other mid-Cretaceous Australian formations (e.g., the marine Mackunda Formation) to discuss the possible source of these teeth and their implications for interpreting the palaeoenvironmental context of the Griman Creek Formation. Additionally, this project will include at least one first season in southern Queensland to continue exploring and collecting from these shark-bearing sites.

This project will be co-supervised by:
Dr Phil Bell and PhD candidate Timothy Frauenfelder.

4. On the biogeographical conundrum that is *Serendipaceratops*

Supervisor: Nic Campione

ncampion@une.edu.au

www.une.edu.au/staff-profiles/ers/dr-nicolas-campione

The taxonomic affinities of the Australian dinosaur *Serendipaceratops arthurcclarkei* remain a long-standing biogeographical conundrum. Based on an isolated ulna, *S. arthurcclarkei* was identified as a Gondwanan ceratopsian, a clade otherwise endemic to Laurasia. If valid, an Australian ceratopsian occurrence implies either a presently unknown diversity of Late Jurassic/Early Cretaceous ceratopsians across Gondwana or a mid-Cretaceous dispersion event from southern Asia to southern Australia. Morphologically, the ulna has a proportionally tall midshaft ratio, consistent with many ceratopsians, yet also exhibits a relatively narrow glenoid region, more consistent with ankylosaurs and possibly theropods (e.g., megaraptorids). This project will incorporate a combination of linear measurements and 3D morphometric data to explore ulnar variation and allometry (the relationship between size and shape) in ceratopsian, thyreophorans, and megaraptorid dinosaurs to test the standing ceratopsian affinities of *S. arthurcclarkei*.

This project will be co-supervised by:
Dr Phil Bell, Dr Matt White, with input from Dr Michael Ryan, Carleton University, Canada.

The science of animals living on land, in freshwater or in the sea.

Zoology

Discipline contact Tommy Leung: **tleung6@une.edu.au**

Insect Ecology Lab

Supervisor: Nigel Andrew

nigel.andrew@une.edu.au
www.insectecology.une.edu.au

In the Insect Ecology Lab at UNE, we are answering questions relating to how exposure to extreme events and land-use change impacts on insect ecology, behaviour, physiology, and insect community structure. Projects can be carried out in both natural and agricultural systems; in the field and the lab. Currently, we have projects working with ants, dung beetles, stick insects, agricultural pests (aphids, bollworms) and beneficial insects (parasitoids, insects as poultry feed) among others. If you are interested in combining mathematical modelling with insect research, we are also using Individual-Based Models and Dynamic Energy Budgets. Please get in touch with Nigel for more details on potential projects.

Native dung beetles in NSW National Parks

Supervisor: Dr Alfonsina Arriaga-Jimenez

aarriaga@une.edu.au

- species richness and composition along an elevation gradient
- their effect on ecosystem functioning and services
- dung beetle traits
- bait preferences
- laboratory breeding of native dung beetles

Key questions/s:

- How does species composition changes along an elevation gradient?
- How does the reintegration of organic matter (dung) changes along the gradient?
- How do the traits of the species found at different elevation change?
- Which bait (macropod dung, mushroom and insect carrion) attracts more native dung beetles?
- What is the natural history and development behaviour of native dung beetles in the lab?

1. Dung beetles as a mitigant of drought stress in Australian pastures

Supervisor: Dr Zac Hemmings
zhemmin2@une.edu.au

Dung beetles provide several important ecosystem services and contribute to ecosystem function by digging tunnels beneath a dung source moving dung below the soil surface. Creating these tunnels changes the structure of the soil, altering how water and nutrients flow through the system and facilitating the growth of plants.

Use a combination of glasshouse pot experiments and data gathered in the field to determine how dung beetle influence the hydrological characteristics of different soils and whether they reduce they are effective at reducing the effects of drought in Australian pastures.

Key questions/s:

- How do dung beetles influence the hydrological characteristics of different soils?
- Do dung beetles reduce the effect of drought on Australian pasture plants?

2. Differentiation or dominance, resource utilisation in the introduced dung beetle *Onthophagus taurus* and its competitors

Supervisor: Dr Zac Hemmings
zhemmin2@une.edu.au

Within hours a single dung pat may be colonised by hundreds, or even thousands, of hungry dung beetles. This intense competition has spurred extensive diversification with dung beetle species utilising a variety of seasonal, climatic, and trophic niches.

Onthophagus taurus is one of 43 species of exotic dung beetle released in Australia in the 1970s to reduce the build-up of livestock dung in pastures. The species is now widespread across the country, being the dominant species in many areas – there are even instances of releases of *O. taurus* outcompeting previously established species. Despite sheep dung being lower quality than cattle dung large numbers of *Onthophagus taurus* can be found in sheep dung, to what extent is the species able to use sheep dung as a resource and how has this contributed to its success?

Key questions/s:

- Does *O. taurus* prefer cattle or sheep dung and is this choice influenced by the presence of competitors?
- Is *O. taurus'* capacity to reproduce using sheep dung limited by the size and quality of the droppings?

Animal Behaviour and Ecology Lab

Supervisor: Paul McDonald

paul.mcdonald@une.edu.au

www.abel.une.edu.au

Some potential projects are outline below, but I'm always happy to discuss different ideas based on student's interests and desired skillsets. I am interested in supervising projects that cover a spectrum from lab to fieldwork, and these can include the full spectrum of either focusing on one specific species or group, through to projects that more broadly cover diversity as a whole:

Potential project areas:

- Woodland birds: options exist for conservation-based projects looking at interactions between Noisy Miners and threatened species (e.g., Regent Honeyeater, small birds).
- Bioacoustics: examining a range of topics from identifying key species of interest in an area, through to behavioural budgets, or utilising acoustic recordings to monitor site diversity.
- Animal behaviour in a broad context: projects seeking to understand why species behave the way that they do, when they do.

Example Projects:

- What factors limit reproductive success of birds of prey (raptors) on the New England Tablelands? Our region is home to three threatened species, and information on the importance of factors such as diet, weather or competition on success is currently lacking.
- When should we manage miners? Despite being native species, Noisy Miners have a negative impact on biodiversity in areas that they occupy. Understanding the most effective way/s to limit miner populations is a key area of management concern. This could be investigated through field observation and also some lab-based work examining molecular data.
- Can passive acoustic monitoring (PAM) generate the same information as on-ground, visual surveys? Whilst setting up an automated recording unit is easier than finding a skilled expert to sample vertebrates at a site of interest, considerable uncertainty remains over exactly how acoustic data can be reliably used. This project would examine these relationships by focusing on local habitats to determine if newly developed acoustic techniques can offer a reliable alternative to traditional surveys for at least some taxa.

Behavioural Ecophysiology

Supervisor:
Dr Zenon Czenze | zczenze@une.edu.au

Co-Supervisor:
Dr Heidi Kolkert | hkolker2@une.edu.au

The Team focuses on behavioural/physiological ecology of mammals and birds. Broadly, we are interested in how aspects of a species natural history and ecology (i.e., roost preferences, drinking behaviour, and diet) influence thermoregulation and quantifying this using physiology. Specifically, we are interested whole-organism thermal physiology and energy budgets of small endotherms.

Research Questions

Our research is divided in to three themes. Our projects mainly involve bats, birds, gliders, and other small terrestrial marsupials, and take place in the field or in the lab. We collaborate with Local Land Services, Indigenous groups, Government, Industry, and other members of ERS. There are potential projects available in each theme so, if you're interested, contact Zenon to discuss opportunities.

Impacts of heatwaves:

Radio tracking in the field and open-flow respirometry in the lab to record the physiological responses of birds and bats to high temperatures and heatwaves.

- Evaporative cooling capacity of birds and mammals
- Foraging and thermal biology of free-ranging mammals, birds, and reptiles
- Hyperthermic torpor in native mammals and marsupials
- Thermal roost preferences in captive and free-ranging mammals
- Response of bats and threatened mammals to cultural burning

Insect pest control (wine, blueberries, and macadamia):

Acoustic identification, radio tracking, and molecular diet analysis of insectivorous bats and birds in agroecosystems.

- Insectivorous bat diversity in agriculture
- Insectivorous bat diet and pest-control in agriculture
- Enhancing degraded agroecosystems with artificial roosts

Climate change predictions:

Biophysical models and dynamic energy budgets in R using NicheMapR to identify vulnerable populations and mitigate the effects of climate change.

- Modelling the direct effects of climate change on mammals and birds
- Designing artificial roosts to prevent overheating

Marine Ecology

Supervisor: Christopher Goatley
christopher.goatley@une.edu.au

Several projects are available looking at the ecology and distribution of small fishes from coral reefs and possibly temperate intertidal systems. Students with an interest in ecology, natural history and marine biology should contact Chris Goatley to discuss ideas.

Potential projects:

1. The Biodiversity of Coral Sea Reefs

Using an existing collection of fishes, the student would develop skills in taxonomy, ichthyology, micro-CT scanning and scientific writing. The project would revolve around identifying new species records of small cryptobenthic fishes collected from coral reefs 500km offshore, in the coral sea (see sample images attached). Trips to the Australian Museum Ichthyology Collection would likely be associated with this project.

2. Biodiversity and Habitat Use of Intertidal Organisms

Pending permitting and ethics approvals, this project would involve regular field trips to rocky shore areas in Northern NSW, using micro-BRUVS (baited remote underwater video stations) to quantify the diversity, residency and patterns of occupation of marine organisms in intertidal pools. The student would gain skills in data collection and analyses, field trip organisation and scientific writing.

Evolutionary Ecology of Parasitism Lab

Supervisor: Tommy Leung
tleung6@une.edu.au

Evolutionary ecology of host-parasite interactions, Evolutionary significance of parasite life history, Comparative analysis of parasite macroecology, Components and interactions within parasite communities.

Parasitism is by far the most common way of life on this planet - all types of organisms are infected with parasites of some sort at some stage of their lives, and parasitism has independently evolved multiple times in many different lineages of life. Parasites also play key (but hidden) roles in shaping the ecology and evolution of their hosts as well as how they interact with their environment.

The research projects we conduct in this lab seek to understand how parasites live and what effects they have on their hosts. If you have a research/project idea about evolutionary ecology of parasitism that you are interested in exploring.

Potential Project:

Parasite fauna of commercial and recreational fish species

This is an ongoing project series looking at parasites which are found in various fish species of commercial and recreational interests.

Australia is a continent surrounded by coastlines and the many fish species which are found in its waters form an important part of this country's ecology, culture, and economy. Like other wild animals, many of these fish are host to a wide variety of parasites, some of which are potential pest or zoonotic species which pose a concern to fisheries or public health. Additionally, the composition of parasite communities can also provide insights into the ecology of their fish host.

If you are interested in a project on fish parasites, you can contact me via my email and we can discuss potential fish species which can be the focus of such a project.

Function, Evolution & Anatomy Research Lab (FEARlab)

Supervisor: Prof Stephen Wroe
swroe@une.edu.au
www.facebook.com/zoology.une

In the FEARlab we study the relationships between how differences in anatomy in living and fossil animals influence their function and evolution.

Much of the work we do is based on CT scans, which allows us to build 3D models that we can digitally 'crash-test' to see how different behaviours affect them relative to other animals. We can also apply analyses of shape to find whether different shapes correlate with different behaviours and reconstruct fossil animals.

A big advantage of these approaches is that they are non-invasive, allowing us to study delicate fossils, as well as rare living species, without the risk of damaging them. Another major plus is that, as well as acquiring our own CT, we can tap into and share with fast growing databases from around the world.

Because the basic principles of mechanics and relationships between shape and function are pretty much universal we can apply these approaches to almost any group of animals, vertebrate or invertebrate.

To date we have completed and published projects on a very wide range of animals including:

> Sabre-toothed 'tigers', Neanderthals and other fossil humans, sauropod dinosaurs, Komodo dragons, the giant moa of New Zealand, great white sharks, crocodiles, living and giant extinct kangaroos, Tasmanian Tigers and Devils, birds of prey, horseshoe crabs and many more, including medical projects...

Our approaches lend themselves to answering a very wide range of questions on a very wide range of taxa. So, if you are interested in studying any particular group of animals, we can almost certainly develop a project to suit you, but below are a few potential ones:

Example Projects:

1. Do big biting mammalian carnivores need thicker skulls?

Research on large and small cat species has suggested that as carnivores get bigger their skulls get relatively thicker, but the amount of stiff, cortical bone decreases. If so this has important, very publishable ramifications which may extend to all vertebrate groups. The project involves collecting and analysing data from three-dimensional skull models that have already been generated from CT scans of species ranging from ferrets to sabretooth tigers.

2. Feeding behaviour of an extinct tree-climbing 'wombat'

Nimbadon lavarackorum is an extinct diprotodontid from the Miocene of north-western Queensland, related to the giant wombat-like marsupials of Ice Age Australia. It has been suggested that Nimbadon was arboreal, but at this point we have little information regarding its diet. Based on CT of exquisitely well-preserved fossils of a female and her pouch young, this project involves generating 3D models to simulate feeding behaviour and compare it with other marsupial herbivores in order to better understand its ecology.

3. Carnivore evolution

Carnivory evolved multiple times among mammals and mammalian carnivores, living and extinct, occupy a very wide range of ecological niches. However, the repeated convergent evolution of similar morphotypes is a hallmark of these lineages, offering an ideal opportunity to identify the selective pressures that drive evolution, and better understand the processes shaping the variability of living organisms. This project will address these questions based on a large 3D dataset of dozens of species combining 3D shape analysis and biomechanics.

4. Primate feeding ecology

Feeding ecology is a central component of a species' biology. Humans and other primates occupy a wide range of habitats and exhibit a huge diversity of grouping patterns and behaviors. The aim of this project is to answering two main questions: Why do primates have the diets that they do? And why do primates behave as they do? Important fossil primates, including close human relatives will be included in the analyses using shape analysis and comparative methods based on CT scan data already acquired for a large species sample.

5. Anatomy of the cassowary

The Australian cassowary is an iconic but very vulnerable bird. We have recently obtained the only complete CT scan of this species known, offering the opportunity to map out its anatomy in detail. The taxidermized skin of this particular specimen is now a feature of UNE's Natural History Museum. Previous students of the Function, Evolution and Anatomy Research lab have produced and published 3 Dimensional atlases of morphology in species ranging from the saltwater crocodile to the horseshoe crab. In this project the student will do the same for the cassowary, providing an important source of information for researchers and conservationists.

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