University of New England

School of Environmental and Rural Science

School of Environmental and Rural Science

Projects 2024

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 2024

Contact: BSc Honours (SCI400)
Course Co-ordinator: Dr Eric Nordberg
Eric.Nordberg@une.edu.au

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**

Pasture Weed Ecology and Management

Supervisors:
Prof Brian Sindel: bsindel@une.edu.au
Dr Jonathan McLachlan: jmclach7@une.edu.au

Students with an interest in weed ecology and management in pastures can see either of us for ideas or if you have your own ideas we are happy to hear those. We have a few topics around assessing the impacts of weeds such as thistles on pastures, the wick wiping of pasture weeds, e.g. fireweed, the ecology of blue heliotrope (*Heliotropium amplexicaule*), using X rays to measure soil weed seed banks, and the effects of seed shape and morphology on their movement in soils.

Sub-Antarctic Weeds Projects

Supervisors:
Prof Brian Sindel: bsindel@une.edu.au
A/Prof Paul Kristiansen:
paul.kristiansen@une.edu.au

Several weed species such as *Poa annua* (winter grass), *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? 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.

Weed Management in Agricultural Systems

Supervisor: A/Prof Paul Kristiansen
paul.kristiansen@une.edu.au

Contact me if you are interested in exploring invasive weeds in agricultural systems or natural environments. We have a range of potential projects related to weed management in agriculture.

Topics include:

- Biology, ecology and management of specific weeds
- Weed seed bank assessment and management
- Herbicide resistance of weeds in vegetable farming systems
- Invasive plants in protected areas (e.g. National Parks)

Horticulture Science and Technology

Supervisors:
A/Prof Paul Kristiansen: Production
paul.kristiansen@une.edu.au

Dr Onoriode Coast: Crop physiology
ocoast@une.edu.au

Prof Shubiao Wu: Breeding and genetics
swu3@une.edu.au

Dr Priyakant Sinha: Remote sensing
psinha2@une.edu.au

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

Food Systems & Rural Development

Supervisor: A/Prof Paul Kristiansen
Farming systems, international development
paul.kristiansen@une.edu.au

In collaboration with colleagues in the UNE Business School and the Faculty of HASSE, staff in the School of Environmental and Rural Science (ERS) conduct a wide range of rural development projects nationally and internationally, especially in the Asia-Pacific region. These projects involved research, development and extension activities across diverse sectors including crop and livestock production, fisheries, forestry, tourism, conservation and protected area management. Building on the strong technical expertise in ERS, these projects address critical aspects of adoption, training & extension, socio-economic impacts, gender studies, capacity building, governance and policy development. The research methodologies we use are also diverse, including farmer household surveys, key informant interviews, policy analysis, and participatory activities such as focus group discussions, workshops, field days. The data collected may be analysed using qualitative or quantitative methods, or both.

Please feel free to contact any of the staff listed above if you would like to discuss what opportunities are available.

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

Animal Science

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

Suggestions for 4th year Honours projects

Supervisors:
Dr Kirsty Moore: kmoore7@une.edu.au
Dr David Johnston: djohnsto@une.edu.au

All three proposed projects would be supervised by Dr Kirsty Moore (kmoore7@une.edu.au) and use data collected on tropical breeds as part of the Repronomics project led by Dr David Johnston (djohnsto@une.edu.au). Both Kirsty and David are scientists at AGBU. For over 45 years, AGBU has been researching the genetics of livestock and how to breed better animals and plants, and we are regarded as one of the world leaders in the R&D of genetic evaluation systems for cattle and sheep.

Project 1: Is foetal aging a suitable predictor of birth date?

Date of birth can be time-consuming to record and is required for genetic evaluation to adjust for age effects. The difficulty in recording the date of birth limits the number of phenotypes available for genetic evaluation. This project will explore if foetal age assessed from pregnancy ultrasound can predict the date of birth and thus potentially allow more records to be included in genetic evaluation.

Project 2: Effect of myostatin mutations on the performance of tropical beef cattle

Myostatin mutations may lead to an overgrowth of muscle tissue and have been well-researched in temperate beef breeds. This project would consider a data set of nine myostatin mutations in tropical beef breeds. It would consider which mutations segregate in the population and whether they are associated with birth and calf traits, female reproduction traits, carcase and meat quality traits.

Project 3: Is there a relationship between rumination traits and production traits

Remote sensor collars can measure age at puberty in beef, but the potential to measure other traits is currently unexplored. This project would explore if rumination data from remote sensor collars predicts other production traits and has further potential for use in genetic evaluations.

Animal Behaviour and Welfare:

Supervisors:
Dr Dana Campbell: dana.campbell@csiro.au
Dr Kosar Gharib-Naseri: kosar.naseri@une.edu.au

This project will use existing video footage to assess the behaviour of day-old turkeys following body alteration husbandry treatments such as beak-trimming and how behaviour may change following administration of pain relief. Analgesics following painful procedures can improve the welfare and performance of young animals. The student will develop an ethogram to decode archived video footage and analyse whether the administered drug can mitigate the behavioural response to pain.

There are also other video-based projects in animal behaviour and welfare available across different livestock species. Please reach out for further information.

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

Botany

Discipline contact David Perović: **dperovic@une.edu.au**

UNE has a rich history in teaching and researching botany as well as providing botanical leadership in Australia. UNE has its own herbarium (a collection of pressed and identified plants) with a collection of over 110000 plants. The Beadle herbarium is part of the Australian and world network of herbaria and has links across the country and globe. Much of the herbarium work involves investigating and describing native Australian plants, the science of taxonomy and systematics. UNE Botany also specialises in Plant and Molecular Ecology, as well as plant-animal interactions especially pollination ecology. The following is what UNE Botany has to offer students interested in undertaking Honours. Potential students are also welcome to contact Botany staff with subjects that they are interested in that are not listed below.

Plant Systematics and the N.C.W. Beadle Herbarium

Supervisor: Dr Andrew Thornhill
Andrew.Thornhill@une.edu.au

Documenting new plant species

Many new plant species have been described at UNE through research conducted by honours and PhD students in the N.C.W. Beadle Herbarium. In fact, there are still many new species waiting to be described that occur on the tablelands and coastal forests of northern New South Wales. Our students have access to the whole collection housed in the Beadle Herbarium as well as loans that can be requested from anywhere in the world. The Beadle Herbarium database (NEdb) offers students the opportunity to learn real herbarium techniques, and our kit for collecting and preparing plant specimen vouchers are the same that are used all major Australian and world herbaria.

Researchers at the herbarium have expertise in eucalypts (*Angophora, Corymbia,* and *Eucalyptus*), bryophytes (mosses and liverworts), Asteraceae (daisies), Cyperaceae (sedges), and Rutaceae (e.g. *Boronia, Phebalium* and *Asterolasia*). Most taxonomic projects involve one or more of the following:

1. **Resolving taxonomic questions about species:** 'what are the species?' (often resulting in the student being able to co-author the description of new species).
2. **Resolving phylogenetic relationships:** what are the evolutionary relationships of a group of species?
3. **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 other institutions (e.g., Australian National University, CSIRO, University of Technology Sydney, or the National Herbarium of NSW) or from within UNE (e.g., Emeritus Prof. Jeremy Bruhl, and Adjunct Assoc. Prof. John Hunter) as best fits the needs of the project.

Spatial phylogenetics

Spatial phylogenetics is a "big data" field of science that combines large-scale molecular phylogenetics, geospatial information obtained from collection data, and randomisation tests to identify unique areas of diversity and endemism to enable evolutionary, ecological, and biogeographic interpretations of these patterns. This research can be applied to any biological group at any geographic level. Andrew has been at the forefront of this research and potential honours projects can investigate plants of interest at a fine geographic scale. Spatial phylogenetics is not limited to plant studies and any organism or groups of organisms can be studies.

Plant systematics

The field of plant systematics is not limited to describing new species, and there are many potential projects that could focus on other aspects of botany. Our group have a broad interest in botanical subjects including palynology, paleobotany, biogeography, bryology, and the phylogenetics of large Australian plant groups such as the eucalypts and Australian *Acacia*. If you have an interest in anything to do with plant systematics, then contact us. Our network is expansive, and we can create a project with experts to suit your interests.

Potential projects

- Taxonomic and systematics of many Australian plant groups native to the northern NSW tablelands (list provided if interested in this kind of work).
- Pollen and fossil pollen morphology and its systematic use in Australian plant groups
- The taxonomy and species delimitation of many moss and liverwort groups
- Species delimitation in the eucalypts
- Building interactive identification keys of the Australian flora
- Spatial phylogenetics of many different groups

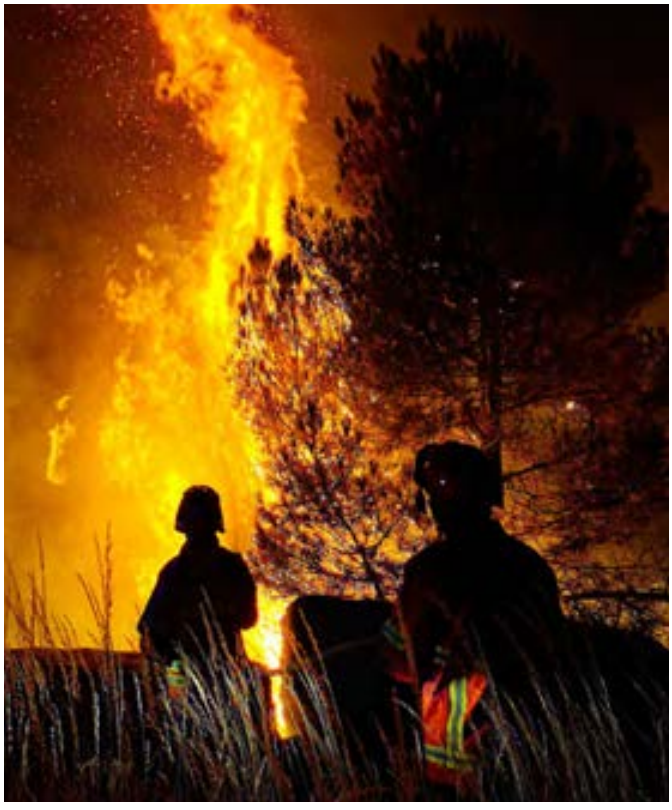
Plant Ecology

Supervisor: Dr 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:

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



Pollination Ecology

Supervisor: Dr David Perović
dperovic@une.edu.au

David has a research focus on the effects of landscape diversity and habitat manipulation on the functional diversity of arthropod communities and ecosystem functions, particularly related to pollinators, predators and parasitoids.

Potential Honours project themes include:

- Using pollen traits – such as protein and lipid levels, and pollen morphology – to design habitat manipulation, through companion planting, to encourage pollinator health and pollinator services
- Investigating how habitat manipulation to encourage pollination, through provision of companion plantings, affects other ecosystem service providers – including predators and parasitoid (of herbivores)
- Investigating how habitat manipulation to encourage pollination, through provision of nesting sites, affects the population dynamics of natural enemies of pollinators – including parasitoids, cuckoo bees and bee-wasps
- Does gut-health equal colony health? Testing probiotic pollen supplementary feeding for managed bees
- Investigating the use of plant volatiles to attract pollinators to plants, and to encourage recruitment of foragers to target crops and hygienic behaviour within the hive
- Spill-over of species and functions across managed and protected areas
- Drivers of colour polymorphism in eucalypts and associations with bird, bat and insect pollinators
- Do sympatric (spatially co-occurring) everlasting daisies (*Chrysocephalum* spp.) share pollinators? Do species boundaries align with pollinator isolation?

Molecular Ecology Laboratory

Supervisor: A/Prof 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:

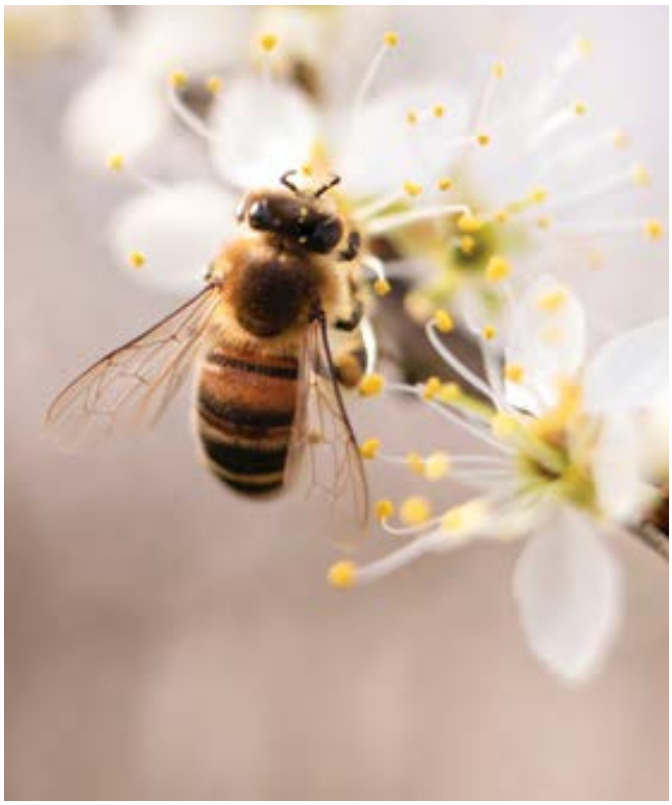
1. **Reproductive biology and speciation mechanisms in native daisies**
   We are now looking for a student who likes greenhouse work to identify which reproductive barriers have evolved in paper and everlasting daisies. They are a great playground: they're easy to grow and fun to cross!
   On-campus preferred.
2. **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.
3. **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.

Rader Community Ecology Lab

Supervisor: A/Prof 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.



The interrelationships between organisms and their environments.

Ecology

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

Reptile Ecology and Environmental Disturbance (REED) Lab

Supervisor: Dr Eric Nordberg
Eric.Nordberg@une.edu.au
https://sites.google.com/view/ericjnordberg/updates

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. Successful honours projects are often associated with existing HDR projects which give you someone to work with in the lab and field and who can provide guidance with data collection, analyses, and writing. 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. Ecology of freshwater turtles

Ecology, conservation, and behaviour of reptiles

Projects may include field or lab studies on a variety of topics, species, or systems including but not limited to Western saw-shelled turtles, Eastern long-neck turtles, leaf-tail geckos, red-bellied black snakes, or other local species. Projects may be related to conservation, spatial ecology, behavioural ecology, or thermal ecology. Project ideas are always evolving so please contact me with your ideas and interests.

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 (and potentially others) and involve a lot of field work, conducting fauna surveys (birds, mammals, amphibians, reptiles, inverts), conducting vegetation surveys, and processing data. Strong identification skills (especially birds) would be a benefit.

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).

Open to student ideas as well!

Please contact me to discuss your own ideas!

Saunders Ecology Lab: Biodiversity and Ecosystem Services

Supervisor: Dr Manu Saunders
manu.saunders@une.edu.au
https://saundersecologylab.com/

- **Community ecology** (species interactions and networks, pollination ecology)
- **Insect ecology** (how landscape, vegetation, management and disturbance affect insect distributions and population dynamics)
- **Biodiversity and 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:

- **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
- **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
- **Urban pollinators in the country:** Plant-pollinator community networks in regional/rural urban areas. (pollinator projects also available in non-urban habitats)
- **Wetland insects:** What terrestrial insect communities use wetlands in the New England region? The student will work as part of the Dynamic Lagoons project.

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
www.pest.une.edu.au (in development)

Collaborations with:
Dr Amy Edwards
Adj A/Prof. Andrew Claridge
Adj Prof. Peter Fleming
Dr Jaime Heiniger
Adj. Dr Paul Meek
Adj. Dr Deane Smith

Keywords: dingo, fox, feral cat, quolls, rock wallabies, feral pigs, camera traps, telemetry, management, monitoring, quantitative ecology, applied ecology, pests, conservation, analysis.

Our team is comprised of field ecologists with extensive practical experience in wildlife research and management.

We work across public and private lands to deliver practical research outcomes for understanding and managing wildlife at local to landscape scales.

Together with industry-leading wildlife monitoring, animal-capture and handling skills our team conducts professional data management and analysis and expertise in stakeholder engagement and facilitation.

Available projects:

- Testing new audio / visual lures for monitoring feral cats
- Collecting / analysing large-scale camera trap datasets on threatened / invasive wildlife
- Monitoring native swamp rats (*Rattus lutreolus*) on Muttonbird Island, Coffs Harbour
- Developing / testing Artificial Intelligence models to aid monitoring of invasive species
- Other interests in monitoring / managing pests or native fauna?

Contact us to discuss them.

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**

Anthrozoology and Indigenous Knowledge Lab

Supervisors: Dr Brooke Kennedy
bkenne27@une.edu.au

The Anthrozoology and Indigenous Knowledge Lab uses a multidisciplinary approach to research, where animal, human and environmental factors are collectively observed to gain a whole picture. Our One Health approach ensures all stakeholders are involved from the beginning and that we are addressing root causes rather than symptoms.

Anthrozoology centres around animal-human interactions. Our lab focusses on owned, domestic dogs and cats, particularly the ecology of those that are free-roaming. We are working in Urban areas; Greater Sydney (Blue Mountains, Campbelltown and Northern Beaches), Northern NSW (Tweed and Byron), and remote areas; Central NSW (Walgett and Brewarrina) and the remote Indigenous community of the Tiwi Islands in the Northern Territory.

Indigenous Knowledge is built in everything the lab does. Not only to make sure Indigenous stakeholders are involved, but to ensure we are utilising both Western and Indigenous sciences to improve how we plan, act, monitor and revise our research.

Potential Project Areas:

- Pet ownership
- Dog or cat (domestic)
  - Ecology
  - Roaming behaviours
  - Impacts on wildlife
- Indigenous Communities
  - social science
  - Indigenous Knowledge i.e. cultural burning

Or any combinations of the above

If you are interested in researching in any of these topics, or have an idea of our own, please get in touch.

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

metal pollutants 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 harbor 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 are described below with potential projects:

- Biogeochemical cycling of arsenic and antimony including food chain 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

Research projects:

1. **Rehabilitation of Sb and As contamination in the Hillgrove Mine**
   In this field and lab-based project you will examine remedial options for contaminated soil at the Hillgrove Mine.

2. **Raging fires, wild storms: Metalloid contamination in fire impacted landscapes**
   In this field and lab-based project you will examine how metalloid contaminants move and behave in fire effected soil - do they become more or less mobile, do they volatilize. What are the drivers?

3. **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.

4. **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.

5. **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.

   CRC Future Food Systems scholarships may be available.

6. **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.

7. **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.

8. **Predicting antimony and arsenic movement across catchments in a changing climate world**
   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.

9. **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.

10. **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.

11. **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: Prof Brian Wilson
brian.wilson@une.edu.au

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.

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 and Environment, NSW NPWS, NSW LLS

Location: Kosciuszko National Park, NSW

4. **Movement of pyrogenic carbon in soils subject to fire**

   Soils of many environments are subject to the Influence of fire but the Impact on carbon dynamics and storage remain unclear.

   This project aims to Investigate the impacts of fire on soils, how carbon (charcoal) Is added to, and stored, in the soil.

   The work has considerable significance to the behaviour and management of soils, particularly in protected environments, and how these impacts might relate to climate change mitigation.

Collaborators: NSW Department of Planning and Environment, NSW NPWS, NSW LLS

Location: New Egland National Parks, NSW Coastal Headland ecosystems

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

UNE Earth Observation Laboratory

We observe the earth, on the ground, from drones and aircraft and all the way from space! We use sensors to gather information on the condition, composition and rates of change of our ecosystems. This allows us to estimate the state, flux and change of our earth over time. Today, we can monitor the entire earth in this way. We use aircraft and drones, we can image individual plans and animals, narrow rivers and small water bodies. From space, we can capture data right across the globe. Our mission is to use these data to better inform those who work on the ground, with us, to increase global biodiversity, feed the world and make sure that our rivers and wetlands are healthy. We specialise in collaborative research in Remote Sensing (RS) for Earth Observation (EO), Geographical Information system (GIS), Aquatic and Coastal Ecology, Precision Agriculture and Crop Physiology, Spatial data analysis and modelling for both natural and agricultural environments. The specific applications include vegetation species mapping and change detection; agriculture environmental monitoring and assessment; land use change and prediction modelling; landscape characterization; UAV/Photogrammetry and LiDAR-based 3D image analysis; hyperspectral imaging spectroscopy, crop and native vegetation physiology and GIS modelling.

If you are passionate about the environment, wildlife, and synergy between the environment and agriculture, and want to make a difference -with photographic evidence - then you should be in Earth Observation!

Team currently includes:

A/Prof Bradley John Evans: bradley.evans@une.edu.au

Dr Priyakant Sinha: psinha2@une.edu.au

Dr Adam Roff: Adjunct Senior Lecturer at NSW DPE Adam.Roff@environment.nsw.gov.au

Dr Sarah Mika: Director of the Aquatic Ecology Laboratory smika2@une.edu.au

Professor Karl Vernes: Collaborator in Wildlife Ecology kvernes@une.edu.au

Dr Onoirode Coast: Collaborator in Crop Science ocoast@une.edu.au

Dr Richard Flavel: Collaborator in Crop Science rflavel3@une.edu.au

and maybe you!

Projects:

- Koala (and wildlife generally) Habitat Mapping – Using Hyperspectral imagery, and satellite data, to enhance our ability to identify, and monitor our precious and threatened koala habitat, and try and save the Koala's (and wildlife). Projects led by A/Prof Bradley Evans in collaboration with NSW DPE and Professor Karl Vernes (Wildlife Ecologist).
- Saving our rivers – Using hyperspectral imagery from drones to estimate water quality properties, working towards doing this with CSIRO and NASA's new satellites. Taking water samples with drones, using imagery and observations to model riverine properties. Projects led by Dr Sarah Mika in collaboration with A/Prof Bradley Evans.
- Enhancing our geospatial models using GIS and Remote Sensing – Using satellite, hyperspectral and lidar to improve the way we model our natural and farmed ecosystems. Project led by Dr Priyakant Sinha.
- Remote sensing and machine learning based agriculture crop monitoring, pest and disease and precision agriculture applications. Project led by Dr Priyakant Sinha.
- Climate change impacts and future scenario modelling for agriculture and natural systems. Project led by Dr Priyakant Sinha.
- Natural Hazard impact modelling – bushfire, floods, and droughts. Project led by Dr Priyakant Sinha.
- Hyperspectral crop and ecophysiology studies– Using hyperspectral spectroscopy and imagery, and satellite data, to estimate plant traits, rates of growth and more broadly plant productivity and grazing potential. Projects led by Dr Onoriode Coast in collaboration with A/Prof Bradley Evans.
- Wildlife Remote Sensing – Using the state-of-the-art technology to find and observe our most threatened wildlife species and establishing better ways to record their presence and absence in their native habitat. Projects led by Dr Adam Roff (NSW DPE, Adjunct Senior Lecturer at UNE).
- Monitoring our precious crops from drones, aircraft and space – Find novel ways to monitor our crops better, model them, predict their yields and feed the world! Projects led by Dr Richard Flavel (Crop Scientist).
- Species distribution and habitat suitability modelling – understanding pattern and process for species habitat conditions, connectivity, and fragmentation – human and climate change impacts. Project led by Dr Priyakant Sinha.
- Watershed condition assessment and management. Project led by Dr Priyakant Sinha.

Aquatic Ecology and Restoration Laboratory

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 eight researchers who specialise in aquatic plants, invertebrates, fish and biogeochemistry:

- Dr Sarah Mika (biogeochemistry and basal resources in aquatic food webs)
- Dr Ivor Growns (invertebrate ecology)
- Dr Adrienne Burns (aquatic botany and algal dynamics)
- Dr Rob Rolls (fish ecology)
- Dr Leah McIntosh (fish ecology)
- Dr Manisha Shakaya (aquatic ecotoxicology)
- Dr David Mackay (plant ecology)
- Dr Lindsey Frost (basal resource quality in aquatic food webs)

The lab is offering several HDR projects aligned with our major research projects:

1. **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.

2. 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.

3. 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.

4. 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. 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.

5. **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.

Natural Resource Management

Supervisor: Dr Rhiannon Smith
rsmith66@une.edu.au

Are you passionate about sustainable agriculture and reducing the environmental footprint of food, fibre and fuel production? This research field focuses on environmental stewardship and management for biodiversity conservation and ecosystem service provision on farms. Projects are available focusing on the development of cost-effective revegetation protocols for farms, eucalypt dieback on the New England Tablelands as a result of insect herbivory and drought, and environmental stewardship and reward mechanisms for farmers who conserve biodiversity and natural capital, and sequester carbon on private land. If this sounds like your gig, please get in touch.

Soil Biology

Supervisor: Dr Oliver Knox
oknox@une.edu.au

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: Dr Lisa Lobry de Bruyn
llobryde@une.edu.au

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.

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

Genetics

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

Molecular Ecology Laboratory

Supervisor: Rose Andrew
rose.andrew@une.edu.au
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Some potential projects
(see Botany for more plant-focused projects)

- **Genomics and biogeography of *Eucalyptus***
  Several possible projects involving new and existing data, ranging from conservation genetics to molecular demography and phylogenomics. We are particularly interested in extending spatial phylogenetic methods to make use of linking whole-genome, multi-population data.
  Online or on-campus.
- **Speciation genomics in native plants**
  Building on recent systematics 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.
  Online or on-campus.

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 train 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.

Great Serpentinite Belt (multiple projects) ARC funded

Supervisors:

Dr Luke Milan: luke.milan@une.edu.au
Dr Tim Chapman: timothy.chapman@une.edu.au
Dr Nicholas Tailby: ntailby@une.edu.au
Dr Ria Mukherjee: rmukherj@une.edu.au

The Great Serpentinite Belt is a unique belt of interesting rocks that are known as ophiolites. Ophiolites represent rare segments of oceanic crust that have been thrust onto a continent. This ancient ocean is poorly understood, and we would like to know the size, age and tectonic setting of this ancient ocean. These research projects represent a unique chance to work on fragments oceanic crust outcropping on land. The serpentinite belt is also the host to high-pressure fragments of subduction zone complexes such as eclogites, blueschist that can provide a detailed record of subduction and give a broader tectonic history of the region. Little detailed mapping of the Great Serpentinite Belt has been undertaken in recent decades. These rocks also host metal deposits of 'critical metal' interest. We have a variety of projects available to investigate the serpentinite belt, including a focus on the timing and 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 project opportunities, and this is part of ongoing research project with The Australian Research Council and Universities of UQ, QUT and Geological Survey of NSW and QLD.

Keywords: Field mapping, petrology, whole rock geochemistry, geochronology, tectonic discrimination, critical metals mineralisation

Late Permian magmatism and super eruptions (multiple projects)

Supervisors:
Dr Nicholas Tailby: ntailby@une.edu.au
Dr Luke Milan: luke.milan@une.edu.au
Dr 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 tungsten and "critical metal" 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.

Tracking the evolution of a Devonian-Carboniferous arc

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

Supervisor: Dr Marissa Betts
marissa.betts@une.edu.au

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 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.

Nymbodia and its secrets

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

Other projects

Supervisors:
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Dr Ria Mukherjee: rmukherj@une.edu.au

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.

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

TRILO Lab @UNE (Timing, Record and Inception of Life Origins)

Supervisors:
Prof John Paterson jpater20@une.edu.au
Dr James Holmes jholme28@une.edu.au
Dr Marissa Betts marissa.betts@une.edu.au

The TRILO Lab focuses on the early evolution of animals, particularly Cambrian (ca. 539 to 485 million-year-old) marine faunas of Gondwana, and using these important fossils to answer major questions relating to their evolutionary history, biogeography and palaeoecology during the biggest animal radiation in the history of life – the Cambrian 'Explosion'. Research programs also include the use of fossils in the relative dating and correlation of strata around the globe in order to refine the geologic timescale, as well as understanding the mechanisms behind exceptional fossil preservation (e.g. soft tissues).

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

   Prof John Paterson: jpater20@une.edu.au
   Dr Marissa Betts: marissa.betts@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**
   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.

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   Dr Marissa Betts: marissa.betts@une.edu.au

3. **Trilobites and other shelly fossils from the lower Cambrian Aroona Creek and Wirrealpa limestones, Flinders Ranges, South Australia**
   The Aroona Creek and Wirrealpa limestones in the Arrowie Basin of South Australia contain 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 these formations at various sites in the Flinders Ranges, South Australia to provide a better temporal constraint on this unit and resolve taxonomic issues surrounding key index fossils.

   John Paterson: jpater20@une.edu.au
   Marissa Betts: marissa.betts@une.edu.au
   James Holmes: jholme28@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. 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).

   Prof John Paterson: jpater20@une.edu.au

5. **"Shedding light on a Dark Corner": the diversity, taphonomy and palaeoecology of the Silurian Tanwarra Shale fauna, New South Wales**
   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).

Prof John Paterson: jpater20@une.edu.au

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**
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.

Prof John Paterson: jpater20@une.edu.au
Dr Marissa Betts: marissa.betts@une.edu.au

7. **Morphological trends in Cambrian trilobites**
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).

Prof John Paterson: jpater20@une.edu.au
Dr Nic Campione: ncampion@une.edu.au

8. **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. 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.

Dr Marissa Betts: marissa.betts@une.edu.au
Prof John Paterson: jpater20@une.edu.au
Dr James Holmes: jholme28@une.edu.au

9. 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.

Dr Marissa Betts: marissa.betts@une.edu.au
Prof John Paterson: jpater20@une.edu.au

10. 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.

Dr Marissa Betts: marissa.betts@une.edu.au
Prof John Paterson: jpater20@une.edu.au

11. Getting to the 'core' of the Cambrian in northern Australia

The Thorntonia Limestone and Arthur Creek Formation are Cambrian units from the Georgina Basin in Queensland and Northern Territory that contain some of Earth's oldest fossils. This project will focus on extracting and describing fossils from drill core from western Queensland. You will learn how to: (a) collect samples and log drill core (in Brisbane, QLD); (b) extract fossils from these using different methods; (c) photograph and describe fossils; and (d) place these in a broader biostratigraphic context. There are several potential Honours topics associated with this broader project, and these can be tailored to your specific interests.

Dr James Holmes: jholme28@une.edu.au
Prof John Paterson: jpater20@une.edu.au
Dr Marissa Betts: marissa.betts@une.edu.au

12. Trilobites from the Wirrealpa and Aroona Creek limestones, South Australia

Redlichia is an iconic genus of Gondwanan trilobite (Palaeozoic arthropods similar to modern crustaceans) but is in much need of revision. In this project, you will conduct fieldwork in South Australia's Flinders Ranges to collect specimens of *Redlichia* from the Wirrealpa and Aroona Creek limestones. You will then describe these to reveal what species they belong to. You will also conduct a geometric morphometric (statistical shape) analysis of Australian *Redlichia* species, in order to place your material in a broader context and resolve long-standing taxonomic issues associated with this genus in Australia. This project would suit someone interested in palaeontological fieldwork and learning the basics of the 'R' statistical programming environment.

Dr James Holmes: jholme28@une.edu.au
Prof John Paterson: jpater20@une.edu.au

13. Cambrian shape-shifting arthropods

The Cambrian Period was when many of the first animal groups appeared on Earth, including the first arthropods (the group containing crustaceans, spiders and scorpions). One of the only ways we can analyse evolutionary patterns through deep time is by quantifying morphological diversity (or 'disparity'). This project will quantify disparity in Cambrian artiopodan arthropods (including trilobites and their soft-bodied relatives) using geometric morphometrics (statistical shape) analysis. This will reveal how disparity changed through time and across different lineages in some of Earth's earliest arthropods. This project would suit someone interested in more theoretical aspects of palaeontology and evolution, and in learning/consolidating skills in the 'R' statistical programming environment.

Dr James Holmes: jholme28@une.edu.au
Prof John Paterson: jpater20@une.edu.au

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

The DinoLab@UNE

Led by Drs Phil Bell and Nic Campione, the DinoLab@UNE represents one of the main research groups within the Palaeoscience Research Centre. We are a vibrant lab, currently with 10 members, and although given the "dino" moniker, our interests include many aspects of vertebrate evolution, particularly across the Mesozoic Era (~250 to 66 million years ago). Of course, Dinosaurs were a major component during that time interval; however, our ongoing projects include fossil reptiles in general, sharks, mammals, and amphibians. The following are some available projects, but we encourage you to seek us out, as projects can be developed in collaboration with you.

Primary Supervisor: Dr Phil Bell
pbell23@une.edu.au

1. **Histology of opalised dinosaur bones from Lightning Ridge**
   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**
   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.

Primary Supervisor: Dr Nic Campione
ncampion@une.edu.au

1. **Do shark teeth serve as morphological indicators of ecology?**
   (with Dr Mohamad Bazzi [Uppsala University])
   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.

2. **On the biogeographical conundrum that is Serendipaceratops**
   (with Dr Matt White)
   The taxonomic affinities of the Australian dinosaur *Serendipaceratops arthurcclarkei* remain a longstanding 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*.

3. On the function of the ceratopsian syncervical
(with Drs Michael Ryan [Carleton University] and Erich Fitzgerald [Melbourne Museum])

This project seeks to understand the function of the ceratopsian syncervical (first three, typically fused cervical vertebrae), using *Triceratops horridus* (Melbourne Museum) as a model. Previous work demonstrated that the syncervical did not adapt to support large heads or in association with antagonistic behaviours, although it certainly may have been exapted for such a function. This project has several objectives, one of which could be tackled as part of an honours. These include, (1) describing the histological properties of the syncervical using high-resolution CT (Computerized Tomography) scans of the element, (2) using finite element modelling to compare and test specific functional scenarios (e.g., head weight, head pull-up, head budding), and (3) building a neck muscular model to reconstruct overall head movement (e.g. range of motion).

4. A *Bothriceps australis* (Brachyopidae, Temnospondyli) bonebed from the Early Triassic of Tasmania.
(with Drs Ben Kear [Uppsala University] and David Hocking [Tasmian Museum and Art Gallery])

Bothriceps australis was the first Mesozoic vertebrate fossil from Australia to get a name. Its gross anatomy was recently revised, but the site where these specimens were collected (Koonya) remains under investigated. We visited Koonya in March 2023 and found several more vertebrate fossils, spanning an ~50-metre rock platform. The density of bones and the multiple skulls indicates it is a bonebed, potentially the first of its kind in Australia. In addition, several specimens in the TMAG collection remain unprepared, including a partial skull growth series. This project will prepare fossils form the collection, include field work in Tasmania to map the bonebed, and reconstruct the palaeoenvironment and conditions that led to its formation.

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

Zoology

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

Behavioural Ecophysiology

Supervisors:
Dr Zenon Czenze: zczenze@une.edu.au
Dr Heidi Kolkert: hkolker2@une.edu.au

We focus 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.

1. Evaporative cooling capacity of birds and mammals
2. Foraging and thermal biology of free-ranging mammals, birds, and reptiles
3. Hyperthermic torpor in native mammals and marsupials
4. Thermal roost preferences in captive and free-ranging mammals
5. 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.

6. Insectivorous bat diversity in agriculture
7. Insectivorous bat diet and pest-control in agriculture
8. 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.

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

Animal Behaviour and Ecology Lab

Supervisor: Prof Paul McDonald
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abel.une.edu.au

Some potential projects are outlined 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 range of topics from the 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 biodiversity as a whole.

Potential project areas:

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

Example Projects:

1. 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.
2. 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.
3. 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.

Insect Ecology Lab

Supervisor: Dr Alfonsina Arriaga Jiménez
aarriaga@une.edu.au

In the Insect Ecology Lab at UNE, we are dedicated to unraveling the complex dynamics of insect ecology, behavior, and community structure in response to the ever-evolving challenges of land-use and climate change. Our research initiatives span both natural and agricultural environments, encompassing both fieldwork and laboratory investigations.

Our ongoing research endeavors primarily revolve around the captivating world of dung beetles, both introduced and native species. We explore native dung beetle biodiversity along diverse gradients, including elevation, human activity, fire history, and more.

Specific areas of investigation include:

1. **Species Richness and Composition**
   Analyzing how native dung beetle communities vary across different environmental gradients, shedding light on their distribution and abundance patterns.
2. **Ecosystem Functioning and Services**
   Investigating the critical role dung beetles play in ecosystem processes and services, such as nutrient cycling and soil health improvement.
3. **Dung Beetle Traits**
   Exploring the unique traits and behaviors that enable dung beetles to thrive in their specific ecological niches.
4. **Laboratory Breeding**
   Developing and refining techniques for the laboratory breeding of native dung beetles to support research and conservation efforts.

In addition, we are actively engaged in research related to the **Red Listing, Taxonomy,** and **Conservation** of native dung beetles. Our collaborative spirit extends beyond our lab walls as we work closely with colleagues, curators, and entomologists from institutions such as UQ and Queensland Museum.

We welcome inquiries and collaboration proposals related to insect ecology, biodiversity, conservation, and any other innovative projects centered around the fascinating world of insects.

Supervisor: Dr Anna Probert
anna.probert@une.edu.au

I am an entomologist and invasion scientist with a special interest in social insects. I am part of a large international collaborative effort understanding economic impacts of non-native species and a member of the IUCN's EICAT authority, which is responsible for assessing the global impacts of non-native taxa to native biodiversity. I aim to create inclusive and equitable research opportunities so projects can be developed around whether you want to conduct research with a larger emphasis on field-, lab-, or desk-based activities. Opportunities where potential research projects could be developed are outlined below; however, I welcome students to identify their own research interests and come and discuss project ideas.

Areas of research for potential students include:

- How do ant communities (or other insect communities) respond to wildfire and other environmental disturbances
- The trophic ecology of ants in mallee ecosystems
- The ecology of bat flies and their relationships with hosts (in collaboration with Dr Zenon Czenze and Dr Heidi Kolkert)
- The impacts (ecological, social or economic) of pest insects at local, regional, national and/or international scales. These can include impacts to native biodiversity, cultural activities and ways of life, human health and well-being, and economic activities.

Evolutionary Ecology of Parasitism Lab

Supervisor: Dr Tommy Leung
tleung6@une.edu.au

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, feel free to contact me: tleung6@une.edu.au

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 tleung6@une.edu.au and we can discuss potential fish species which can be the focus of such a project.

Laboratory of Applied Zoology and Ecological Restoration (LAZER)

Supervisor: A/Prof Deb Bower
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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 Tropical Australia and we focus on vertebrates, particularly reptiles and amphibians, as our models.

Available research topics:

1. **Freshwater turtle behaviour**
   Explore the cognition, personality, or sociality of freshwater turtles to learn more about their preferences and needs (Lab or field).
2. **Reproductive methods for freshwater turtles**
   Explore turtle sperm and help improve conservation methods in artificial reproduction (Lab-based).
3. **Developing methods for turtle conservation**
   Compare methods for monitoring turtles and help understand how conservation programs are contributing to turtle populations (Field-based).
4. **Fox control**
   Test strategies to protect turtle nests from predation by invasive and native species (Field-based).
5. **Frog ecology and conservation**
   Better understand the effectiveness of captive release of tadpoles for threatened rainforest frogs (Field-based)

Come along to a lab meeting, volunteer with our Masters and Doctoral students, or make a meeting with Deb to learn more about the research in our lab. We often work in partnership with NSW Government Local Land Services and Department of Planning and Environment, or Qld Government Department of Environment and Science, so opportunities for inter-agency collaboration are high.

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