THE UNIVERSITY OF
NEWCASTLE
AUSTRALIA

DISCIPLINE OF ENVIRONMENTAL SCIENCE AND MANAGEMENT

HONOURS AND UNDERGRADUATE RESEARCH PROJECTS

2026

Undergraduate Research in the Discipline of Environmental Science & Management

School of Science

Environmental Science is a dynamic and multi-faceted arena, giving rise to a diversity of research interests among discipline members. Currently, the key research themes within the discipline include:

- Threatened species conservation
- Climate change impacts on terrestrial, marine & freshwater ecosystems
- Environmental contamination and aquatic ecotoxicology
- Use of molecular tools, remote sensing and new technologies for environmental monitoring
- Water quality and sustainable water resource management

We encourage undergraduates to get involved in research throughout their degree. By doing so you will learn and develop skills in searching, selecting and retrieving information from scientific sources, skills in project management, experimental research skills as well as skills in presenting scientific information in a clear and concise manner, both orally and in writing. These will provide you with a strong foundation for your future career, whether it be in the industrial, commercial or academic sector.

There are three main ways to get involved in research:

a) ***Summer research project:*** Short paid undergraduate research projects over summer. Scholarships are advertised each year

b) ***SCIE3500:*** A 10-unit undergraduate course consisting of a research project under the supervision of an academic staff member. Assessment is based on a progress report, a research notebook, a final project report and an oral presentation. The course is open to third year students who have successfully completed at least 140 units and have a cumulative GPA of at least 5.0 and is offered in both semesters. Course outline link here.

c) ***Honours research project:*** A full-year research project after completion of the Bachelor of Environmental Science and Management or another cognate degree. A minimum GPA of 5.0 is required for entry into honours. Program handbook link here.

This booklet contains a list of undergraduate research projects currently available in the discipline. Academics are listed in alphabetical order. In all cases you should discuss potential projects with prospective supervisors before trying to enrol or apply.

Table of Contents

Dr Craig Evans

Freshwater ecology & water quality science

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I work primarily in the field of water quality science, with interests extending across freshwater ecology, aquatic microbiology, microbial water quality, contamination source tracking, urban water management and holistic approaches to management of public water supply. Current areas of focus include relationships between water quality and ecological function in surface waters, monitoring and management of cyanobacterial populations, application of improved techniques for monitoring source water quality, stormwater and wastewater impacts on receiving waterways, biological stability in drinking water distribution networks, wastewater recycling and emerging contaminants.

Potential projects

a) Evaluating passive sampling for detection of pesticides in drinking water catchments

Pesticide contamination represents a potentially significant ecological and public health risk in drinking water catchments characterised by extensive agricultural activity and/or urban development. The efficacy of monitoring pesticide levels in waterways via routine grab sampling is limited, due to the typically low but potentially variable concentrations present, making accurate assessment of risk and ongoing water quality management difficult. By comparison, a passive sampling approach offers potentially greater sensitivity and time integrated capacity to better capture spikes in contaminant levels. This project will comprise deployment of passive sampling units within the Grahamstown and Gresford drinking water catchments in order to compare the efficacy of this approach with that of grab sampling methods. It is expected that the passive sampling approach will facilitate detection of a wider range of pesticides than previously observed in the routine grab sampling data and in turn benefit the ongoing risk assessment and management of pesticides in the Lower Hunter drinking water catchments.

b) Ecology and water supply implications of an invasive aquatic macrophyte

Maintenance of water supply levels in Grahamstown Reservoir, the major drinking water storage for the Newcastle and Lower Hunter region, is largely dependent upon pumped transfers from the Williams River via Balickera Canal. As ideal conditions for transfer occur infrequently, especially during low rainfall years, it is essential to maximise pumping yield when optimal conditions prevail. Colonisation of the canal by an invasive aquatic macrophyte has resulted in sporadic interruptions to pumping efficiency and cost associated with clearing of screens. Several 'engineered' approaches have been proposed to combat the problem, but there is considerable desire to find an alternative, non-engineered, long-term, natural ecological solution or management option.

A 2020 study established the extent of distribution in the Williams River system, linking colonisation of the macrophyte with several habitat conditions including flow rate and riparian degradation. Simple laboratory (tank) experiments also provided limited insight into some of the growth preferences of the plant, but further work is required to better understand its ecology under local conditions. Findings will be used to inform development of an effective long term management strategy.

c) Water sustainability, wastewater recycling and contaminants of emerging concern

Recycling of wastewater provides the potential for regional centres to increase both their water security and overall supply system sustainability. Of prime interest in relation to use of recycled wastewater is the presence of contaminants of emerging concern (CEC) including PFAS and other endocrine disrupting compounds (EDC). Reverse osmosis (RO) is considered the optimum treatment technology for removal of CEC/EDC, however, the high capital costs, energy demand and operating costs, make RO unsustainable for most regional centres. The University of Newcastle has partnered with a regional LGA to evaluate the potential of a more economically and environmentally sustainable treatment system to remove critical contaminants and provide recycled wastewater suitable for a variety of end-uses, including higher risk applications. There is potential to develop a student project in relation to various aspects of the study including: evaluating the risks posed by various contaminant groups, capacity of proposed treatment processes to remove critical contaminants, or monitoring program design for evaluating treatment performance.

A/Prof Troy Gaston

Coastal and estuarine ecology

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I am a coastal and marine ecologist interested in understanding how ecosystems function. This includes using novel chemical tracers to determine the relative importance of different nutrient sources and habitats to ecosystem functioning.

Potential projects

a) Ecological effects of foreshore stabilisation in estuaries

In response to erosion concerns of estuarine systems, there are many foreshore stabilisation options being trialled. However, the ecological effects, including benefits, of foreshore stabilisation remains

relatively unknown. This project will investigate the effect of stabilisation methods on fish and benthic communities in estuaries. This project will involve some field and laboratory work.

b) Fish communities of tropical and subtropical reefs

Fish are an integral component of reef ecosystems, however, little is known about the fish communities of subtropical reefs. Furthermore, our knowledge of fish communities of tropical pacific islands is also limited. This project will use underwater video to assess the diversity and abundance of fishes in subtropical and tropical systems. This project will involve computer work and potentially fieldwork.

c) Crustaceans as an indicator of nutrient source in coastal lagoons

Sustainable management of coastal lagoons relies upon the identification of stressors to that system. This involves the determination of nutrient sources to these coastal systems so that any adverse impacts due to nutrient loading can be mitigated. Stable isotope analysis is a tool that can identify the dominant source of nutrients to a waterway. This project focuses on using crustacean species as an indicator of nutrient source to coastal lagoons. This project will involve some field and laboratory work.

d) Indicators of habitat restoration success

As we embark on a decade of ecosystem restoration (United Nations 2021-2030), we need a range suitable indicators to determine if restoration targets have been met. One of the ecosystems most heavily impacted is saltmarsh, which has been found to provide substantial nutritional support to estuarine productivity. This project will investigate physical, chemical and biological indicators of restoring or restored habitats and compare them to reference locations to better inform restoration trajectories. This project will involve some field and laboratory work.

e) Anthropogenic effects on seagrass communities

Seagrass is an integral habitat for estuaries providing food and refuge for a wide range of organisms. Anthropogenic activities such as pollution, boats and climate change are likely to have significant effects on seagrass ecosystems. However, these effects remain relatively unknown in many estuaries. This study will look at a range of metrics to assess seagrass health across multiple estuaries in NSW that are exposed to anthropogenic activities. This project will involve field and laboratory work.

f) Drivers of fish productivity in estuarine systems

Fishing provides a range of social, cultural and economic benefits, whether it be recreational or commercial in nature. However, the drivers of fishery productivity are rarely known. This study will use stable isotope ecology to determine the relatively contribution of primary producers (seagrass, mangroves, saltmarsh, phytoplankton, benthic microalgae) to the productivity of key recreational and commercial species. This project will involve field and laboratory work.

Prof Matt Hayward

Conservation science

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I am a conservation scientist with an interest in all the multi-disciplinary aspects of conservation. I have field-based research projects available on a range of wildlife ranging from frogs to wallabies, but also have extensive desktop/literature-based studies that will solve important conservation problems.

Potential projects

Please note that Emily Jarvis (Emily.Jarvis@uon.edu.au) is the main supervisor for projects a and b, while Dr Stephen Bell (stephen.bell@newcastle.edu.au) will be supervising projects c to h. ”

To “Please note that Emily Jarvis (Emily.Jarvis@uon.edu.au) will co-supervise projects a and b, while Dr Alex Callen and Dr Stephen Bell (stephen.bell@newcastle.edu.au) will be cosupervising projects c to h.

a) Variation in activity patterns between forest macropod species

The spread of activity across a 24-hour period is central to understanding how animals utilise their environment. This knowledge is also essential in refining survey techniques to accurately detect target species. This project will compare seasonal and temporal variation in activity patterns between cooccurring forest macropod species in northern NSW. Work will be predominantly desk-based and utilise existing camera trap data.

b) Identification of macropod species by facial structure using geometric analysis

Visually similar species can be difficult to distinguish using the black-and-white images typically captured by infrared camera traps. Geometric analysis has been used previously to map morphological features and aid identification. This project will take a similar approach to determine whether cooccurring macropod species can be distinguished based on structural differences in face shape (i.e. Parma Wallaby, Red-necked Pademelon). Work will be predominantly desk-based and utilise existing camera trap data.

c) Prevalence of rachilla glands on *Acacia* (Fabaceae, Mimosoideae sect. Botrycephalae), and their potential use in taxonomic classification

Bipinnate *Acacia* species commonly support small glands along the rachillas of leaves, but there has been little study on the prevalence of these within section Botrycephalae, and the potential use of them in taxonomic classification. The Hunter Valley supports approximately 20 of the 38 known New South Wales species of bipinnate *Acacia*, and this project would commence databasing these to determine how prevalent they are both within and between the different species. Ideally, a link would be made to the current classification of bipinnate *Acacia*. Some minor plant identification skills would be preferable (or the ability to rapidly acquire these), and skills in botanical illustration or micro-photography would be of benefit to document the traits of rachillas glands encountered.

d) The impact of White-winged Choughs on terrestrial orchid populations

White-winged Choughs have been implicated in the removal of tubers and the localised extinction of two threatened orchid populations in the Hunter (*Pterostylis chaetophora* and *Pterostylis gibbosa*) and are likely to

regularly feed upon many different orchid species. Being a native bird and natural component of the landscape, this is a difficult threat to manage for. This project will attempt to quantify the extent to which Choughs predate on orchid tubers, principally through dedicated survey of selected family groups during orchid flowering season (generally Spring), augmented by camera-traps at known orchid colonies to potentially photograph the process. This would likely involve both common and threatened orchid species, with the key focus being on how regularly orchid tubers are consumed by Choughs, and if there are any preferences on species taken (*Caladenia*, *Pterostylis*, *Corybas* etc). Suitable for an experienced bird watcher willing to follow and record the activities of family groups of Choughs.

e) Population size in a threatened endemic eucalypt: *Eucalyptus parramattensis* subsp *decadens*

The Vulnerable *Eucalyptus parramattensis* subsp. *decadens* occurs only in the Hunter region. Mapping of habitat has been completed for this taxon at two meta-populations (Tomago and Kurri), however we do not yet have a handle on the magnitude of individuals present within each. This project would sample key habitats along stratified transects at one or both of these meta-populations to allow calculation of population size, together with the collection of data to document life age classes across different habitats. Data obtained would assist in applying IUCN threat criteria and determining a revised threat assessment for this taxon.

f) Is the rare cycad *Macrozamia flexuosa* undergoing a slow and protracted decline?

The rare *Macrozamia flexuosa* is relatively widespread in the Hunter region, yet there is some evidence that the species is undergoing a protracted decline. Most stands comprise widely scattered individuals where coning is a rare event, while a few support dense populations and appear to reproduce freely. This project will address one or more of the unknown ecological traits in this species, such as (1) assessing differences in population density relative to observed coning; (2) identifying likely pollinators and their habitat requirements, potentially linked to low reproductive rates; (3) assessing seed predation and dispersal within the more denser populations, and the role (if any) of synchronous masting events; and (4) assessing the population age structure of selected stands, testing the role of leaf traits identified by Borsboom et al (2015) in aging individual plants. There is also scope to contrast these same questions against the more widespread and common *Macrozamia reducta*.

g) Comparison of seed banks under the threatened *Acacia pendula* and other arid-zone *Acacia* growing in the Hunter Valley

A critically endangered population of *Acacia pendula* is currently recognised in the Hunter Valley, however there is some conjecture over the origin of this species (i.e native or introduced) and other arid-zone wattles (*Acacia harpophylla, A. homalophylla, A. melvillei, A. salicina*) in these landscapes. Previous work has shown no evidence for natural populations of *Acacia pendula* in the journals of historical explorers, nor in habitat analysis across its range, and that populations never successfully sexually reproduce but spread clonally. This project seeks to explore the nature (extent and quantum) of the soil stored seed bank beneath stands of *Acacia pendula* and related arid-zone taxa across several populations in the Hunter, including those that have been observed to freely flower and fruit (mostly horticultural or farm plantings) and those that rarely if ever flower (potential hybrids or sterile forms). It aims to determine whether *Acacia pendula* have ever successfully produced seed in the Hunter Valley, comparing these with the other arid-zone species. Samples of soil would be collected in the field, sieved for seeds and tested for viability through germination trials or other methods. A potential additional aspect may be tracking the movement of seeds by ants should enough seeds be retrieved, to help understand dispersal patterns in these species.

h) Comparison of herbarium (AVH) collections and observational (Bionet) database records

There is an ever-widening gap between the collection of voucher specimens by botanists and observations as reported to digital databases, which is detrimental to the core values of plant conservation. This project will select specific key genera or species from the Hunter region and examine the frequency and timing of collections in relation to their reported presence within the NSW Government Bionet observations database. There will likely be a focus towards the collection and reporting of listed threatened species, but other less common and common species that are unlisted are typically unrecorded and may return divergent results. This is largely a data mining project, but some field experience and botanical skills maybe advantageous.

Dr Megan Huggett

Marine ecology and microbiology

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I am a marine ecologist, with an interest in microbiology. I focus on the importance of marine microbes and their interactions with other organisms such as fish, corals, algae and penguins, as well as the roles that free-living microbes play in aquatic environments. Below are two ideas for projects, but I am open to discussing other options also.

Potential projects

a) Sea urchin recruitment and climate change

Coralline algae play a critical role in the early life stages of many marine invertebrates, including sea urchins, by providing essential biological, chemical and structural cues that facilitate larval settlement and metamorphosis. However, climate change—through ocean warming, acidification, and altered light regimes—poses significant threats to coralline algal communities, weakening their calcified structures and shifting community composition toward less inductive or non-calcifying algal forms. Despite growing evidence of these ecological shifts, a key knowledge gap remains in understanding how changes in canopy-forming macroalgae, particularly increased shading or the proliferation of turfing algae, indirectly influence sea urchin recruitment. Shading can suppress coralline algal growth and favour fast-growing turf species, potentially disrupting the settlement cues necessary for urchin larvae and altering benthic community trajectories. This project aims to determine the impacts of algal canopy and community assemblage structure on the ability of coralline algae to facilitate larval settlement in the common sea urchin *Heliocidaris erythrogramma.*

b) Estuary bacterioplankton dynamics

Bacterioplankton play a central role in estuarine ecosystems, driving key biogeochemical and nutrient cycling processes that sustain productivity and ecosystem health. They mediate the decomposition of organic matter, the remineralisation of nutrients such as nitrogen and phosphorus, and the transformation of carbon between particulate, dissolved, and gaseous forms. Through these activities, bacterioplankton underpin food web dynamics and influence water quality in these highly productive but variable environments. However, despite their ecological importance, there remains a significant knowledge gap in understanding how bacterioplankton communities respond to climate change stressors such as warming, acidification, altered freshwater inflows, and eutrophication. Estuaries are particularly vulnerable to these shifts, yet studies linking microbial community structure and function to changing environmental conditions are limited. Understanding how climate-driven alterations affect bacterioplankton composition and metabolic pathways is critical to predicting future nutrient cycling and ecosystem resilience in estuarine environments. This project aims will work with estuarine bacteria and test their growth and responses to a range of environmental fluctuations by applying lab based manipulative experiments and flow cytometry.

A/Prof Geoff MacFarlane

Estuarine and marine ecotoxicology, aquatic toxicology

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My principal research interests fall broadly into the areas of Marine Ecotoxicology and Aquatic Toxicology**.** I focus on estrogenic compounds and their impact on the reproductive system on molluscs. I am also interested in the effects of metal contaminants on endangered saltmarsh from the molecular to ecosystem level.

Potential projects

a) Effects of environmental contaminants on crab behaviour

Crabs residing in polluted environments may have impacts to biogenic amines used for neurotranismission due to contaminant exposure. Such stressors may impact cognition, spatial memory and performance required to negotiate complex environments. Crabs will be exposed to a common pollutant Lead (Pb), and then their performance in a number of different maze test tasks will be undertaken. The project will combine fieldwork with aquaria experiments at Port Stephens Fisheries Centre and behavioural assays in the laboratory. Would be a great opportunity for a student interested in both animal behaviour and toxicology.

b) PFAS in migratory waders and their food chains in the Hunter Estuary

PFAS is an issue in the Hunter estuary due to legacy inputs from Williamtown. The Hunter is also home to migratory waders who travel each year from the Northern hemisphere to feed in the estuary during the non-breeding season. This project will address whether birds are exposed to PFAS by measuring PFAS in blood and feathers and also in their invertebrate prey. Project will involve fieldwork in the Hunter estuary and laboratory analyses of PFAS. Would suit a student with strong laboratory skills.

c) Quantifying impacts of estrogenic Endocrine disrupting chemicals (EDCs) to oysters' gametes and early larval development

Endocrine disrupting chemicals (EDCs) are compounds that can mimic the female sex hormone estrogen, including natural estrogen, 17β-estradiol (E2), the synthetic estrogen, 17α-ethinylestradiol (EE2), and the industrial chemicals such as bisphenol A (BPA). Natural estrogen (E2) originates from women and livestock, however, EE2 comes from women's contraceptive practices. On the other hand, the plastic industry is solely contributing to bisphenol A (BPA) contamination. Those estrogenic contaminants are released into receiving aquatic environments through different sources, like industrial discharge and effluents via wastewater treatment works (WWTWs). Since those estrogenic compounds' have a similar structure to endocrine hormones, they can alter normal reproductive processes. Despite some evidence that environmentally relevant concentrations of those compounds can have significant perturbations of estrogen-dependent reproductive processes like the induction of vitellogenin egg yolk protein and male ovotestis to feminisation, little work has examined the effects of these compounds on gametes of broadcast spawners. Thus, the current study will expose oocytes and sperm to various estrogenic EDCs and assess the subsequent impairment of fertilisation success, embryonic retardation, deformities and total survival of d-veligers. Further work will involve flow cytometry and analysis of oxidative stress pathways in gametes and embryos generated by exposure to estrogens. Work will involve laboratory culture and analysis at the Callaghan campus.

d) Metals and metalloids accumulation and partitioning in saltmarsh

Saltmarsh is an intertidal ecosystem comprising halophytic plant communities and serving as sink of pollutants including metals and metalloids. Globally saltmarsh is declining rapidly (25-50% lost to date) due to various anthropogenic causes. Among them metal and metalloid pollution has been identified as one of the potential causes of impact to saltmarsh integrity and diversity. In the state of New South Wales, Australia, saltmarsh is listed as endangered community with metal and metalloid impacts originating from industrial activities such as coal mining, fossil fuel fired power stations, urban development and effluent release.

The current study will assess the accumulation and partitioning of metals and metalloids in the saltmarsh species *Baumea juncea*. This species will be collected across three contaminated estuaries in NSW and the uptake and distribution of metal(loid)s in various organs of the plant will be assessed. Sediment metals and particle size, salinity, pH and soil organic matter significantly influence the metal and metalloid bioavailability and thus associations among these variables will be assessed to understand metal uptake by roots. Finally plant biomass, growth and sublethal stress biomarkers in the plant will be assessed to understand the impact of metal exposure and uptake on plant health and productivity. The project will involve fieldwork in Newcastle, Lake Macquarie and Sydney and lab analysis on the Callaghan Campus.

Dr Margaret Platell

Aquatic systems, ecological processes, fishing and aquaculture impacts

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My research interests lie in aquatic coastal ecosystems, particularly invertebrates, fishes and their feeding relationships, towards assessments of ecosystem function and how coastal ecosystems respond to human-induced change.

Potential projects

a) Prey for fishes under a potential climate change scenario

Coastal estuarine ecosystems, including seagrasses, are vulnerable to the effects of climate change as manifested in increasing water temperatures. In Lake Macquarie, new evidence suggest that the diets of fishes in seagrass is at least partly related to small water temperature increases, via thermal effluent from adjacent power stations. The potential prey characteristics of these *Zostera* seagrass meadows is presently unknown, which hinders further interpretation.

This project aims to quantify the benthic macroinvertebrate fauna in seagrass meadows at a range of sites in Lake Macquarie and to relate this to habitat quality and the feeding of fishes, thereby increasing our understanding of ecosystem function in this important coastal environment. A combination of field, laboratory and analytical approaches will be used.

b) Sustainable mussel aquaculture in Jervis Bay

Globally, wild-harvest fisheries are considered to be close to fully exploited, but with increasing population growth and thus seafood demand, additional growth is expected in the aquaculture sector. Mollusc aquaculture, which includes oysters and mussels, is a form of “non-fed” aquaculture, as these filter-feeders ingest locally available phytoplankton. This form of aquaculture is generally considered to have less impact on the farmed environment than “fed aquaculture”, in which fish and/or decapod crustaceans are fed artificial diets to supplement their growth. In Jervis Bay, one lease on a mussel farm was stocked in 2018, with mussel spat suspended on long-lines and grown to harvest for approximately one year.

This coastal mussel farm provides an opportunity to (a) monitor any effect in the farmed environment and (b) to understand how epifaunal colonisation on mussels may change during the year and in the water column. A combination of field, laboratory and analytical approaches will be used.

c) Invertebrates in coastal waters

Our coastal waters undergo seasonal change, with respect to water temperature, wind and wave patterns and the extent of freshwater flow from nearby rivers, with the last two having the potential to influence the sedimentary environment. Benthic macroinvertebrates, which live within and above the seafloor, and which are often the main food for fishes, have the capacity to respond to both changes in water temperature and the sedimentary environment. At present, there is only a limited understanding of seasonal and site-specific differences in the benthic macroinvertebrate fauna in coastal waters, which has obvious implications for the impacts of any potential coastal infrastructures, such as aquaculture farms or boating facilities.

This project will take advantage of previously-collected faunal samples from a Yellowtail Kingfish farm at Port Stephens to enhance our understanding of site and seasonal differences in the benthic macroinvertebrate faunas. A combination of laboratory and analytical approaches will be used.

Dr Brooke Williams

Biodiversity conservation, restoration, planning and policy, spatial analysis, quantitative ecology

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Conservation, restoration, environmental policy, carbon and biodiversity markets, spatial planning (eg. Gurobi, Marxan, Zonation), decision science, spatial science (GIS), and quantitative ecology. I'm interested in improving conservation outcomes on the ground through policy assessment and spatial planning (see examples of my work from Colombia, the DRC, and NSW here in Australia). I'm also interested in shining a light on conservation problems at the global scale (like tracking human pressure across Earth to quantify ecosystem loss and degradation) and finding solutions (like where we can restore tropical forests cost-effectively).

Available projects

a) The impact of recent deforestation on threatened species in NSW

Recently released data shows that deforestation is increasing in NSW (see https://www.environment.nsw.gov.au/news/latest-nsw-native-vegetation-clearing-data-published and https://www.nature.org.au/slats2025). This project will show what that deforestation means for threatened species in New South Wales. Co-supervised with Professor Matthew Hayward at UON. Students will learn GIS and spatial analysis skills.

b) Proximity of coastal aquaculture sites to shorebird habitats in NSW

Terrestrial coastal aquaculture is often located near sensitive habitats such as tidal flats and wetlands, which are crucial for many species including migratory shorebirds. However, the overlap between shorebird habitat and aquaculture ponds is often poorly mapped, hampering effective management. This project will assess the potential interaction between shorebirds and terrestrial coastal aquaculture (present and future) in NSW, Australia (replicating a similar effort that was undertaken in QLD https://doi.org/10.1016/j.ocecoaman.2025.107850). Co-supervised with Associate Professor Andrea Griffin at UON. Students will gain experience in GIS and spatial analysis.

c) Assessing the financial viability of blue carbon in the carbon market

Carbon finance projects that coastal regions could support both nature conservation and climate change mitigation goals. Global demand for nature-based carbon credits is outpacing their supply, due partly to gaps in knowledge needed to inform and prioritize investment decisions. This project will model the magnitude of certifiable carbon from coastal protection projects – or 'investible coastal carbon" - and its climate mitigation potential to produce a global investible coastal carbon map (replicating a similar effort that was undertaken in tropical forests https://www.nature.com/articles/s41467-021-21560-2). Co-supervised with Senior Lecturer Megan Huggett at UON. Students will gain experience in economic analysis, GIS, and spatial analysis.

d) Identifying forest restoration priorities in the Selva Maya for improving reef health

The Selva-Maya encompasses the Maya Forest and the Mesoamerican Reef, stretching across most of Belize, half of Guatemala, and the entire Yucatan Peninsula in Mexico. It is a globally significant area marked by its rich biodiversity and cultural heritage, hosting the second-largest tropical forest in the Americas and the largest barrier reef in the Western Hemisphere. However, the area faces challenges from economic externalities, urban growth, deforestation, climate change, and weak governance, making

resilience-building and conservation efforts critical. Restoration efforts in the region are vital to reducing soil erosion and runoff, which directly threaten the health and resilience of coastal ecosystems such as the Mesoamerican Reef. In collaboration with The Nature Conservancy, this project will answer the question "Where are the priority areas for forest restoration that simultaneously maximise biodiversity conservation, maximise habitat connectivity, reduce soil erosion to prevent sediment runoff into watersheds, and enhance landholder or rightsholder livelihoods?" Students will learn conservation planning, GIS, spatial analysis, and R (or python) coding skills.

e) Costs and benefits of integrating carbon and biodiversity markets in Australia

Australia is at the forefront of global environmental market innovation, with the introduction of a new Nature Repair Market (biodiversity market) that will operate alongside its existing carbon market. Together, these markets offer an unprecedented opportunity to align climate and biodiversity goals while also creating incentives for landholders to engage in restoration and conservation. However, important questions remain about the costs and benefits of integrating carbon and biodiversity markets. Specifically, it is unclear whether it is better to have a separate carbon and biodiversity or to integrate these. What are the costs and benefits of each pathway? Co-supervised with Dr James Brazill-Boast from the NSW Biodiversity Conservation Trust. Students will gain experience in policy assessment, and land use change modelling and/or spatial planning using tools such as R or Python.

f) The potential for natural regeneration to improve tropical forest integrity

Tree planting is a popular restoration strategy and can be effective. However, implementing tree planting at large scales can prohibitively expensive, especially for developing nations. In areas where ecological conditions are such that forests can grow back on their own or with low-cost assistance, natural regeneration methods (allowing forests to grow back on their own) are less costly and often are more effective than full tree planting in terms of their long-term success rates and biodiversity outcomes. The potential benefit that natural regeneration could contribute towards improving forest integrity has not yet been explored. This project takes advantage of recent high impact datasets on natural regeneration https://www.nature.com/articles/s41586-024-08106-4 and forest integrity https://www.nature.com/articles/s41467-020-19493-3 to answer the question, "How could natural regeneration contribute to improved forest integrity across this tropics?" This project is in collaboration with Associate Professor Hedley Grantham at UNSW/Bush Heritage and Professor James Watson at UQ. Students will gain experience in GIS and spatial analysis.

g) Tracking forest gain and loss inside of known forest-based carbon projects

A new spatial dataset of carbon offset boundaries https://www.nature.com/articles/s41597-025-04868-2#citeas presents an opportunity for using remotely sensed data to assess the losses and gains of forest within their boundaries. This information is useful for evaluating the integrity and additionality of carbon credits, and monitoring compliance with offset commitments. This project is in collaboration with Assistant Professor Yiwen Zeng at the Nanyang Technological University in Singapore. Students will gain experience in GIS and spatial analysis.

Dr Richard Yu

Aquatic and molecular toxicology

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I am an ecotoxicologist interested in the effects of chemical pollutants and other anthropogenic stressors on aquatic wildlife. In particular, I am keen on understanding how endocrine disrupting chemicals (EDCs) and aquatic hypoxia affect reproduction and development of organisms at the gene level and translating this knowledge to develop molecular biomarkers to monitor their exposure and effects.

Potential projects

a) Transgenerational toxicity of the synthetic estrogen 17α-ethinylestradiol (EE2)

17α-Ethinylestradiol (EE2) is a synthetic estrogen widely used in oral contraceptives and is released into the aquatic environment via wastewater treatment work (WWTW) discharges. Previously, our research team demonstrated that parental exposure of adult Sydney rock oysters to EE2 caused developmental delays and reduced shell growth in unexposed F1 larvae. Building on these observations, we hypothesised that DNA methylation is potentially one of the epigenetic mechanisms contributing to the transgenerational toxicity of EE2. To test this hypothesis, this project will investigate the correlation between DNA methylation and mRNA expression levels of relevant genes that were shown to be differentially expressed in the oyster larvae derived from EE2-exposed parents. Molecular techniques, including DNA/RNA extraction, bisulfite sequencing, gene cloning and real-time PCR, will be employed to quantify differential DNA methylation and mRNA expression of those selected genes. The outcome of this project will advance our understanding of the transgenerational toxicity of EDCs in the context of environmental epigenetics.

b) Mechanistic understanding of sublethal toxicity of metals to saltmarsh plants

In Australia, many remnant saltmarsh communities occur in areas impacted by significant anthropogenic risk with inputs of metals from industrial processes and human activities. In order to ameliorate the impacts from legacy and extant metal contaminants, and effectively conserve saltmarsh ecosystems, the impacting processes of metals must be examined from a mechanistic perspective. Alterations in gene expression represent initial toxic impacts of contaminants soon after exposure and thus contribute important insights into understanding toxicity pathways. This project will assess the potential sub-lethal effects of metal exposure on the transcriptomes of dominant saltmarsh plant species. Molecular techniques, including RNA purification and sequencing (RNAseq) and real-time PCR, will be employed to quantify differential mRNA expression induced by metal exposure. This project will provide molecular data that can be mechanistically related to plant growth, performance and productivity of saltmarsh species impacted by environmental metal contamination.

c) Development of vitellogenin qPCR assays for monitoring endocrine disruption in the coastal environment

Estrogenic EDCs (incl. natural hormones, pharmaceuticals and industrial chemicals) typically enter aquatic environments through WWTW effluents or runoff from intensive livestock operations. Vitellogenin (Vtg) is an egg-yolk precursor protein found in sexually mature females of oviparous species and produced in response to estrogens. Induction of Vtg in males or juvenile females, therefore, can serve as a useful biomarker of exposure to estrogenic EDCs. This project will isolate Vtg gene sequences from selected aquatic taxa and from there develop species-specific quantitative (real-time) PCR assays for assessing the risk of endocrine disruption in coastal waters impacted by WWTW discharges and runoff from non-point sources.