THE UNIVERSITY OF
NEWCASTLE
AUSTRALIA

DISCIPLINE OF ENVIRONMENTAL SCIENCE AND MANAGEMENT

HONOURS AND UNDERGRADUATE RESEARCH PROJECTS

2024

Undergraduate Research in the Discipline of Environmental Science & Management

School of Environmental and Life Sciences

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.

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Dr Craig Evans

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 ecological function and water quality in surface water storages, monitoring and management of cyanobacterial populations, application of new technologies and improved techniques for monitoring source water quality, stormwater and wastewater impacts on receiving waterways, and biological stability in drinking water distribution networks.

Potential projects

a) Development of a molecular (qPCR) method for streamlined detection of anthropogenic impacts on benthic communities in marine environments

Quantifying the impacts of waste water outfalls and aquaculture activities in marine waters has traditionally involved morpho-taxonomic approaches involving accurate physical identification and enumeration of benthic macroinvertebrates. This approach requires collection by underwater divers of large sediment cores from multiple monitoring points, with time-consuming, labour-intensive laboratory processing of samples, dependent upon personnel skilled in taxonomic identification and enumeration. As such, there is clear potential for the exploration of less demanding and more time and cost efficient molecular approaches to quantify the extent of human-induced impacts in aquatic environments either as an alternative.

To this end, analysis of past morpho-taxonomic data has provided identification of a set of taxa that may represent potentially useful indicators of pollution impacts due to their apparent sensitivity, or conversely tolerance, to organic enrichment. The proposed study will involve use of collected specimens of these taxa within the laboratory to develop molecular primers and refine a quantitative PCR (qPCR) method that can be used to easily detect the relative abundance of those species in future sampling events, reveal meaningful community changes and better inform ongoing management. The project will involve training in qPCR techniques, exploration of bio-informatics databases and interpretation of DNA sequence information.

b) Evaluating the use of 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.

c) Event-based characterisation of stormwater inflows and development of a nutrient mass balance for Grahamstown Reservoir

Grahamstown Reservoir is the major drinking water storage for Newcastle and the Lower Hunter Region. The reservoir receives surface inflows from the Williams River by way of pumped transfers via Balickera Canal, from the Medowie catchment through pumping from Campvale Canal, and via natural inflows from Seven Mile and Nine Mile Creeks. While the water quality inputs from Balickera and Campvale Canals is well documented as a result of long term routine monitoring, little data is currently available regarding the relative contributions of Seven and Nine Mile Creeks, especially under event conditions. As nutrient dynamics within the reservoir become increasingly important in the face of increased threat of cyanobacterial blooms, development of a more comprehensive nutrient mass balance for the reservoir is needed.

A project is therefore available to conduct an event-based water quality characterisation of inflows from both Seven and Nine Mile Creeks, with particular emphasis on nutrient levels. The data will be used to evaluate the relative contributions of the four main surface inflows to the total contaminant load entering the reservoir, with a view to developing a revised mass balance model. Nutrient measures will be complemented by assessment of standard physico-chemical water quality parameters and faecal indicator counts, with potential inclusion of additional contaminant groups such as metals, hydrocarbons and PFAS. Training in the use of mass spectrometry for metals and/or hydrocarbon analysis may be included dependent upon student preference.

d) 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 in the past resulted in sporadic interruptions to pumping due to clogging of pump station inlet screens. The frequency of these episodes, which represent a significant reduction in pumping efficiency and cost associated with clearing of screens, has increased over recent years due to a proliferation of growth within the Seaham Weir pool (lower Williams River) and Balickera Canal. 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. This project will build on the previous investigation of ecological and hydrological factors influencing its proliferation within the Williams River system and Balickera Canal. Findings will be used to inform development of an effective long term management strategy.

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 using oyster shells

In response to erosion concerns of estuarine systems, oyster shells are being trialled as a mechanism of foreshore stabilisation. Oyster shells are intended to moderate wave action to reduce erosion and create habitat for fish and invertebrates. This project will investigate the effect of stabilisation methods on fish and benthic communities in Wallis Lake. This project will involve some field and laboratory work.

b) Using 3D imagery to determine morphometrics of sharks and rays

Gathering morphometric data of sharks and rays *in situ* is both problematic and dangerous. Novel techniques, such as 3D mapping using a digital camera, is capable of rendering a scaled image which enables precise morphometric measurements to be taken. This project will use sharks and rays caught in the NSW beach meshing program as subjects for 3D mapping and measurement. This project will involve laboratory and computer work.

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) Climate change effects on seagrass communities

The effects of climate change, most notably temperature increases, are likely to have significant impacts on estuaries. Seagrass is an integral habitat for estuaries providing food and refuge for a wide range of organisms. However, temperature increases are likely to affect the areal extent, density and reproductive out of seagrass. This study will look at a range of metrics to assess seagrass health across multiple estuaries in NSW. 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.

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) Particle-associated marine microbes

The ocean has become a net sink for anthropogenic carbon dioxide (CO2) since the beginning of the industrial era, significantly offsetting the effects of global warming. One of the primary mechanisms by which the ocean sequesters atmospheric CO2 is via the Biological Carbon Pump (BCP), a biologically mediated process by which CO2 is transformed into organic carbon via photosynthesis and exported from the surface waters to the deep ocean through sinking particles. It has been estimated that without the BCP, atmospheric CO2 levels would be 200 ppm higher than modern day levels, thus being a major player in the regulation of global climate.

However, quantifying the impacts of the ocean ecosystems in the Earth's carbon cycle remains one of the greatest challenges in oceanography. It is now recognised that particles, and even different sized particles, in the ocean host distinct microbial communities to those free-living in seawater. One stumbling block in examining the role of particle-associated microbes in carbon sequestration is their uncultivability. Only a fraction of the microbial diversity that is detected using molecular methodologies has been able to be successfully isolated. The aims of this project are:

- To describe microbial communities on different sized particles from different depths in coastal NSW using high-throughput genomics tools
- To develop a reliable method for isolating pure cultures of particle-associated marine microbes
- To compare the cultivated fraction of the particle-associated communities with the entire community

b) Diversity of SAR11 in NSW estuaries

The SAR11 clade account for roughly 30% of bacteria in surface ocean communities and are well known to display ecological niche partitioning, resulting in high diversity related to local environmental conditions. Application of genomic tools to seawater enables elucidation of whole microbial communities as well as their potential and active functional repertoire. However, the value of having cultivated representatives of numerically abundant groups and environmentally relevant microbial lineages such as SAR11 has recently received renewed recognition. Once obtained, isolated strains of significant marine microorganisms provide a means to definitively test key ecological and evolutionary hypotheses generated from field-based observations and experiments. Isolates are also able to be provide complete genome sequences that are crucial for informing and guiding environmental genomics, transcriptomics, and proteomics research. This project aims to:

- Characterise SAR11 dynamics across six NSW estuaries
- Apply several cultivation methods to isolate key SAR11 organisms from NSW estuaries and coastal seawater

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) 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.

b) 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 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.