Master of Environmental Management Research Project Opportunities

PROJECT - 1

Project title: Evaporative Water Loss and Thermoregulation in Invertebrate Animals

Description: Evaporative water loss and thermoregulation in various invertebrate animals.

Evaporative water loss (EWL) can be experimentally measured in controlled conditions that can be compared against environmental variables (such as temperature, season, etc.) or across species. Similarly, thermal selection can be measured in the laboratory and can be compared between species or evaluated against temperatures selected in the wild.

Possible:

Hermit crabs

Wolf spiders or other terrestrial spiders

Scorpions

Land snails

Millipedes, centipedes

Stag beetles

Project contact: Prof Keith Christian, RIEL keith.christian@cdu.edu.au

Project Commencement date: Semester 2 2020

PROJECT - 2

Project title: How important is evaporative water loss from the eyes of reptiles and amphibians?

Description: The eyes of most terrestrial animals are a measurable (and sometimes significant source of water loss because they are wet surfaces. As long as the eyes are open, they will be subject to evaporative water loss (EWL). For most lizards, which tend to have dry skins that have a high resistance to water loss, the eyes are a significant source of EWL. However, they have some control over this loss by having the ability to close their eyes, which greatly reduces the exposure of these wet surfaces. However, Geckos do not have eyelids and cannot close their eyes. They do, however, have scale over the eye called a "spectacle". It has been assumed that the spectacle has a resistance to EWL similar to that of the body scales. If that were true, then eyes would not be a particularly important source of EWL in geckos, and, we would expect the eye temperature of a gecko to be similar to the skin temperature of the gecko because they would both be evaporating at a similar rate.

We have been studying EWL in geckos in a bigger project comparing genetic diversity with physiological flexibility. As part of that study, we have employed the use of high-resolution infrared photography to measure skin temperature, and we have found that, for geckos in an air stream, eye temperatures are lower than nearby skin temperature. This indicates that the spectacle is not as resistant to EWL as the body integument and scales. In retrospect, this is not surprising because work from the 1960's showed that the low EWL of reptile skin was primarily due to a lipid layer in the skin, not to the scales. It therefore seems that: (1) The eyes of geckos have water loss rates greater than the water loss across their skin, (2) but gecko eye EWL is probably less than that of the open eyes of lizards with eyelids. And (3) eye EWL in geckos may be a significant source of EWL relative to their total EWL. Given that EWL from gecko eyes will occur 24 h/day as opposed to other lizards that may have their eyes shut a significant part of 24 h day, it would be interesting to compare eye EWL in different types of lizards on both an instantaneous basis and integrated across a 24 h day.

Two different projects could be developed from this:

1. The significance of evaporative water loss from the eyes of geckos. The data for this project have been collected, but not analysed. Thus, it would be a desktop study reducing the data, solving some equations for water loss from eyes and whole geckos and evaluating the relative contribution of eye water loss. Comparisons across species with different body sizes and habitats are also possible.
2. A comparison of the rates of evaporative water loss from the eyes of ectothermic vertebrates with different eye and skin characteristics, including: (1) geckos that do not have eyelids, but have a spectacle (eye scale) on their eyes, (2) lizards that do have eyelids but no spectacle, (3) frogs with low cutaneous resistance to water loss, and (4) frogs with high cutaneous resistance to water loss. The water loss of the eyes could be measured along with total water loss so that the contribution of eye

water loss could be calculated and evaluated with respect to the different eye and skin characteristics. This project would require laboratory experiments, and animal ethics approval would have to be obtained before the data could be collected (except for the geckos, which have been measured).

Project contact: Professor Keith Christian, RIEL; keith.christian@cdu.edu.au;
Project Commencement date: Semester 2 2020
Notes: The applicant should have completed (or be currently enrolled in) ENV206.

PROJECT - 3
Project title: Applying animal movement information into threatened Ecological Community assessments and Listings
Description: Under the EPBC Act, threatened ecological communities are matters of national environmental significance. This project will examine all current commonwealth government Ecological Community listings and tease out areas where animal movement information may assist in making better decisions around ecological community assessments and listing. Plus ascertain if and how the inclusion of archival movement can be better included into future assessments. This project will be a desktop exercise with no field work, and the student will learn skills around threatened species assessments, The EPBC Act and GIS. The student should have completed ENV508 and be signed up to undertake ENV518 before commencing this project.
Project contact: Dr Hamish Campbell, RIEL; hamish.campbell@cdu.edu.au; 8946 6017
Project Commencement date: Semester 2 2020/2021
Notes: The applicant should have completed ENV508 and ENV518.

PROJECT - 4
Project title: Assessing the use of Remotely Piloted Aircraft (drones) in Conservation Biology
Description: Over the last decade there has been a huge uptake in the use of autonomous technologies for Conservation Biology. This smart and exciting technology is all the rage but is it actually enabling us to make better decisions in Conservation Science. This project will review the current literature in regards to the use of drone technologies in Conservation Biology, and assess the areas where it has been most effective, and map a pathway for future research and development. The student will learn how to effectively interrogate scientific literature, data analysis and synthesis and how to better undertake scientific writing.
Project contact: Dr Hamish Campbell, RIEL; hamish.campbell@cdu.edu.au; 8946 6017
Project Commencement date: Semester 2 2020/2021
Notes: The applicant should have completed ENV508 and ENV518.

Project - 5
Project title: What do we know about changes to water availability and ecosystems in northern Australia prior to the instrumental record (anytime between 100 and 71 000 years ago)
Description: Variability in water presence and quantity has a profound effect on Australia's plants and animals. Over the long term, patterns of water availability drive changes in the distribution and abundance of the living organisms and result in local and regional vegetation shifts. Scientists use a variety of proxies to reconstruct these changes from times prior to the development instrumental rainfall databases and ecosystem monitoring. So far however, there have been fewer reconstructions undertaken for northern Australia than for other parts of the continent. This project will search the scientific literature for evidence of past change in Northern Australia's hydroclimate and associated ecological responses to construct a picture of how our environment has changed through time and to better understand the potential for future change.
Project contact: Dr Nicola Stromsoe, RIEL, nicola.stromsoe@cdu.edu.au, (08) 8946 6527
Project commencement data: from Semester 1 2020

PROJECT - 6
Project title: Natural oil analysis from Australian native plants
Description: Analytical organic chemistry
Project contact: Dr Vinuthaa Murthy, Chemistry discipline, CDU, vinutha.murthy@cdu.edu.au;
Project Commencement date: from Semester 2 2020

PROJECT - 7

Project title: **Dynamics of nitrate reductase activity in mango orchards in the Top End**

Description: Mango production is a vital primary industry to the economy of the Northern Territory. Like other crops, mangoes require an abundant amount of nitrogen (N) for growth. However, appropriate application of N fertiliser is necessary for ecologically sustainable mango production systems. Improper application of N may lead to nutrient deficiencies and toxicities which result in reduced tree growth, yields, and fruit quality. Over-application of fertiliser N, not only increases cost but also reduces profitability through excessive vegetative growth, reduced fruit quality and increased risk of disease. Moreover, it significantly increases the risk of reduced air and water quality, and increased greenhouse gas emissions.

Plants can assimilate inorganic form of N such as ammonium (NH_4^+) and nitrate (NO_3^-) and organic form such as urea. This study will focus on NO_3^- assimilation, a transient but critical physiological process in plants. At cellular level, NO_3^- is either stored in the vacuole or reduced to nitrite by enzyme NO_3^- reductase (NR). Since NO_3^- is the most significant source of N in crop, understanding the role of NR in higher plants has potential economic importance because NR activity is one local point integrating control for carbon and N metabolism.

The student will analyse the nitrate reductase activity of mango grown under greenhouse and field conditions. Treatments will be application of varying amount, time, and form of N fertiliser. This information will be used to improve N use efficiency of mango for increase productivity and provide good environmental management.

Project contact: Dr Constancio (Tony) Asis Constancio.asis@nt.gov.au

Project Commencement date: Semester 1,2 2018 or Semester 1 2019

Notes: *Honours or coursework Masters research project (possible adaptation for SID301/501 research placement). This project is part of a larger project investigating mango nutrition.*

PROJECT - 8

Project title: Analysis of amino acid components of xylem sap of mango

Description: Nitrogen (N) assimilation into carbon skeleton is an important physiological process for plant growth and development. It is a vital component of proteins that build cell materials in plant tissue. The plant's vascular system (xylem and phloem) forms pathway for transfer of N metabolites from sources to the sinks.

The composition of xylem sap can be influenced by a combination of root function and plant metabolism that occur from root to shoot. Studies have shown that changes in xylem sap components have been related to the changes in N availability and seasonal growth pattern. Moreover, the changes in amino acid in response to stimuli are good measures of N movement in trees. Thus, identifying the predominant amino acid during phenological stages of mango can be used as tool in monitoring the N nutrition and physiological status of trees.

In this study, the student will develop a protocol to extract xylem sap from the branch of mango. Extracted xylem sap will be analysed using high performance liquid chromatography to identify the amino acid components. Moreover, dynamics of xylem sap composition as influenced by application of varying levels of N will be monitored during the different growth stages of mango.

Project contact: Dr Constancio (Tony) Asis Constancio.asis@nt.gov.au

Project Commencement date: Semester 1,2 2018 or Semester 1 2019

Notes: *Honours or coursework Masters research project (possible adaptation for SID301/501 research placement). This is a protocol /method development project to be undertaken in collaboration with the University. This project is part of a larger project investigating mango nutrition.*

PROJECT - 9

Project title: Monitoring paclobutrazol persistence in the soil from mango orchards using plant bioassay method

Description: Paclobutrazol (PBZ) is a member of the triazole family of compounds that is used as growth regulator on horticultural crops. It inhibits gibberellin biosynthesis and reduces cell division. The active ingredient is taken up through the roots, stems, foliage and transported via the xylem vessel system.

Application of PBZ is an important management practice in mango production in the Northern Territory. It helps alleviate the problem of alternate bearing characteristics of mango by enhancing flowering intensity. But its high potency, hazardous nature, low mobility and regular application may raise concerns of its environmental effects in the future. Thus, it is necessary to monitor the persistence of PBZ in the soil to evaluate its impact on soil nutrient availability, plant uptake and microbial ecology.

Analysis of PBZ in the soil and plant tissues can be analysed using gas chromatography (GC), high performance liquid chromatography (HPLC) and GC-mass spectrometry (GCMS). However, chromatographic method is very expensive owing to the cost of equipment and few service providers in Australia. Thus, there is a need to develop an alternative method of monitoring PBZ content in the soil.

This study aimed at developing a plant bioassay protocol to estimate the amount of PBZ in the soil. Activities involve the screening plants that are susceptible to PBZ, collecting soil samples from different mango orchard, and conducting greenhouse experiments to estimate the amount of PBZ in the soil. Moreover, the effect of PBZ application on the soil nutrient availability and plant nutrient uptake will be studied under aeroponics and field conditions.
Project contact: Dr Constancio (Tony) Asis Constancio.asis@nt.gov.au Dr Joanne Tilbrook Joanne.tilbrook@nt.gov.au
Project Commencement date: Semester 1,2 2018 or Semester 1 2019
Notes: *Honours or coursework Masters research project (possible adaptation for SID301/501 research placement). This is a protocol /method development project to be undertaken in collaboration with the University. This project is part of a larger project investigating mango nutrition.*

PROJECT - 10
Project title: Native stingless bee ecology: can they be effective pollinators in rambutan?
Description:
Native stingless bees (*Tetragonula* spp.) are abundant in Top End environments. Locally they are also known as sugar bag or sweat bees and they can regularly be found nesting wall cavities and upturned containers as well as trees and termite mounds. To date, ecological research has focused on stingless bee species restricted to the east coast of Australia where they are cultivated in home gardens and used commercially in the pollination of macadamias and other crops. Our research program is investigating stingless bee ecology of NT endemics, flowering phenology of rambutans and developing apiculture techniques to build stingless bee numbers for managed pollination in rambutan orchards. If you're interested in learning to identify stingless bees, measuring hive activity, learning apiculture practices or monitoring flower receptivity and fruit set please get in touch. Student projects can be tailored to interests and time available.



Project contact: Dr Mary Finlay-Doney mary.finlay-doney@nt.gov.au and Mark Traynor mark.traynor@nt.gov.au
Project Commencement date: Semester 1, 2 2018
Notes: *Honours or coursework Masters research project*

PROJECT - 11a, b, c
Project title: Tropical crops and plant pathology
Description: There are opportunities to work in the plant pathology team at NT Department of Primary Industries and Resources, using both classical and genetic techniques. Projects available include:

- Identification and pathogenicity of Botryosphaeriaceae species associated with dieback on mango trees and stem-end rot on mango fruits in Northern Australia.
- Aetiology of Mango malformation disease in the Northern Territory.
- Taxonomy and identification of plant pathogenic fungi: microscopy, morphometry, photomicrography, phylogenetics.

Project contact: Dr Jose Liberato, NT DPIR; jose.liberato@nt.gov.au; 08 8999 2264;
Project Commencement date: Negotiable

PROJECT - 12
Project title: Remotely sensing an ecological tipping point: mass mangrove tree dieback in the Gulf of Carpentaria and possible causality
Description: While mangroves are superbly adapted to the intertidal zone, there was an unprecedented mangrove dieback event stretching 1000 km across the Gulf of Carpentaria in 2015/2016. This project will use historic remote sensing since 1987and correlate mangrove cover change with climatic extremes. This will inform adaptive coastal management in a warming world where mangroves provide crucial ecosystem services maintaining coastal biodiversity, livelihoods and stability as seas rise.
Project contact: Prof Lindsay Hutley, RIEL (Lindsay.hutley@cdu.edu.au) and Dr Shan Levick
Project Commencement date: Semester 2 2018
Notes: *Experience in managing and analysis of remote sensing imagery essential.*

PROJECT - 13
Project title: Sensitivity of riparian tree flora to magnesium sulphate associated with the Ranger Uranium mine closure, Kakadu NP
Description: Current understanding of ecohydrological properties of Top End vegetation suggests spring-feed monsoon vine forests and riparian vegetation have a high groundwater dependence. Contamination of surface groundwater post-rehabilitation of the Ranger site could therefore have significant impact on riparian vegetation and thus impact stream health. Environmental isotopes and tritium analysis will be used to quantify groundwater dependence of riparian vegetation in the Magela Creek catchment, Kakadu NP / Ranger Project Area. This knowledge will be coupled with sensitivity testing of common riparian woody species to $MgSO_4$ to provide a risk assessment of impact from surface and/or groundwater egress of mine-related contaminants.

Project contact: Prof Lindsay Hutley, RIEL (Lindsay.hutley@cdu.edu.au) and A/Prof Sam Setterfield (UWA)
Project Commencement date: negotiable
Notes: Experience in managing and analysis data

PROJECT – 14
Project title: Season vs Tides: What drives water quality in Darwin Harbour?
Description: Datacubes of satellite imagery are available and compiled. The student will be required to select key parameters and run climatology. Student to access BOM data (& other suitable metadatasets), compare intensity of wet season with response seen in satellite imagery
Project contact: Dr David Blondeau-Patissier (CSIRO/CDU); David.Blondeau-Patissier@cdu.edu.au ; Dr Ian Leiper (CDU) ian.leiper@cdu.edu.au
Project Commencement date: Semester 2 2018, Semester 1 2019
Notes: *David is a CDU adjunct, who works with CSIRO, Brisbane. For this reason David would supervise externally, unless a student is also based in Brisbane. This project can be modified to suit a MEM or Hons project. Candidates will require knowledge/interest in biology and water quality, remote sensing, programming e.g., MATLAB, IDL ; 3 months or more; Desktop-based only*

PROJECT – 15
Project title: What drives the reoccurring algal bloom off Tiwi Islands?
Description: Datacubes are ready and available. The student will be required to produce climatology and time-series analysis based on various parameters, such as fluorescence, Chlorophyll, sea surface temperature, etc
Project contact: Dr David Blondeau-Patissier (CSIRO/CDU); David.Blondeau-Patissier@cdu.edu.au ; Dr Ian Leiper (CDU) ian.leiper@cdu.edu.au
Project Commencement date: Semester 2 2018, Semester 1 2019
Notes: *David is a CDU adjunct, who works with CSIRO, Brisbane. For this reason David would supervise externally, unless a student is also based in Brisbane. This project can be modified to suit a MEM or Hons project. knowledge/interest in biology and water quality, remote sensing, programming in e.g., MATLAB, IDL ; statistical knowledge would be a plus; 3 months or more; Desktop-based*

PROJECT - 16
Project title: Population trends of a grassland migratory shorebird in northern Australia
Description: The aim of this project is to examine the trends in Little Curlew (*Numenius minutus*) populations across northern Australia using records from online databases, atlases and counts from historic literature.
The global population estimate for the Little Curlew is currently 141,000 (Hansen et al. 2016), with some suggestion that the species may be declining. However without robust monitoring data it is difficult to confirm any trend predictions (Bellio et al. 2016). Like other migratory shorebirds, the species faces many threats: effects from climate change, alteration of habitat on breeding grounds,

reduction in the availability of food resources, development of habitat on core staging grounds in the Yellow Sea region, pesticides and fertilisers on agricultural grounds where birds feed, and hunting (Bellio et al. 2016).
Grassland shorebirds such as the Little Curlew are difficult to monitor because of their nomadic movements across the non-breeding grounds in response to rainfall events and food availability; consequently these shorebirds have received less monitoring attention (Bellio et al. 2016). Because of this and the lack of knowledge on this species, using records from online databases, bird atlases and historic literature allows an inexpensive method of assessing the species' trends over time.
Project contact: Ms Amanda Lilleyman (Amanda.lilleyman@cdu.edu.au) and Professor Stephen Garnett (Stephen.garnett@cdu.edu.au)
Project Commencement date: negotiable
Notes: *May be suitable for MEM research project or Hons project*

PROJECT - 17
Project title: Assessment of the effects of climate change on the catchment hydrology of a top-end sand-bed stream.
Description: Across Australia there are few jurisdictions that are not updating their flood risk assessments in urban and rural areas and incorporating a climate change effect. This is largely due to a complete update of the Australian Rainfall and Runoff Guidelines 1987. The NT Government's stream gauging network is a vast data resource with high quality data that are available to calibrate hydrology models. This project will use online DEM data, NTG stream gauging data and Bureau of Meteorology rainfall data to calibrate an open source hydrology model. The model will be used to predict catchment peak discharges for a selection of current day Annual Exceedance Probability (AEP) rainfall events. A climate change model will be applied, and peak discharges predicted for the same catchment and AEPs and the changes assessed. Although beyond the scope of this study, the results can be used to the assess changes to flood inundation levels due to climate change.
Project contact: Prof Ken Evans, CDU (ken.evans@cdu.edu.au) and Dr Silvia Tonyes (RIEL)
Project Commencement date: Semester 1, 2 2020
Notes: Experience in GIS and an understanding of the concepts of catchment hydrology, and environmental modelling

PROJECT 18
Project title: Agronomy and commercialisation of Australian native rice
Description: This project is currently focussing on the agronomy of Australian native rice, via a series of nursery experiments focussing on soil properties and agronomic performance, seedling establishment, etc. There is also scope for other projects focussing on supply chain development, markets etc.
If you are interested in more information email one of the contacts below and CC the whole team.
Project contacts: Dr Sean Bellairs, RIEL (sean.bellairs@cdu.edu.au) and Dr Penny Wurm, RIEL (penny.wurm@cdu.edu.au), Dr Tony Asis, NT Department of Primary Industry and

Resources (constancio.asis@nt.gov.au) **Project Commencement date**: from Semester 2 2020

PROJECT 19

Project title: Darwin Harbour Water Quality

Description: The tropical, macro-tidal estuary of Darwin Harbour is in good condition and supports a rich biodiversity. However, urban and industrial development pressures are increasing in many parts of the catchment. In 2010 and 2011, local beaches were closed on multiple occasions in the dry season due to elevated counts of E. coli and entero- cocci. There were concerns about sewage discharges and other suspected inputs, such as urban rivers and drains. The contamination may have originated from a point source, such as a waste treatment plant, or a diffuse, intermittent and indirect route, that is, contamination from surrounding urban areas and agricultural land that may include faeces from humans and other animals. Furthermore, environmental strains may have contributed to elevated counts. Identifying pollution hotspots will allow a more targeted approach to harbour water quality monitoring.

This project will use existing bacterial and nutrient data from the 2010-2011 beach closure event to explore water quality in Darwin Harbour, identify pollution hotspots, critically analyse the use of E. coli and enterococci for water quality assessment and compare to other harbours. The student will be responsible for understanding and analysing the data within the broader context of harbour-scale water quality assessment. Critical analysis will be a key part of this project which will require an extensive analysis of relevant literature and a willingness to pose questions and hypotheses.

Project contact: Professor Karen Gibb; karen.gibb@cdu.edu.au ; 0421194455

Project Commencement date: 2020-21

Notes: *There is no requirement for students to participate in field work to undertake this project.*