WESTERN SYDNEY
UNIVERSITY

Environmental Sciences

SUITABLE FOR MASTER OF RESEARCH

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N/A - Visit our find a supervisor page for further advice.

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SUITABLE FOR MASTER OF RESEARCH OR PHD

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Assessing the Conservation Status of Australia's Invertebrates

Dr Kate Umbers: k.umbers@westernsydney.edu.au

Research area: Conservation

This project is part of a larger partnership with the IUCN and Commonwealth government to assess the conservation status of Australia's invertebrates. There are 120,000 named invertebrate species in Australia of which 58,000 have a calculable distribution allowing conservation status assessment. This project is an opportunity to drive part of this assessment, to define the major missing knowledge gaps at a broad scale, to make recommendations for research priorities, and to fill knowledge gaps with empirical research. This project may focus on a broad variety of taxa or specific taxa and include field, lab and computer-based approaches.

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Australian Alpine Conservation - How Will Species Cope Without Snow?

Dr Kate Umbers: k.umbers@westernsydney.edu.au

Research area: Conservation

This project will look at the life cycles of Australian alpine species and how they will be impacted by reduced snow depth and duration under climate change. This knowledge is both one of the most critical and poorly understood aspects of species adaptive capacity. Information on how species will respond to reduced snow will allow sound conservation planning for the many threatened species of the region. Lab, field, and computer-based approaches are possible.

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Talking Trees and their Response to Carbon Dioxide (EucFACE)

Professor David Ellsworth: d.ellsworth@westernsydney.edu.au

Research area: Plant ecology, Environment, Dendrology

Over 30% of the world's land area is forested, and over one-sixth of that forested area is mature. Wood growth in mature forests is a major component of aboveground net primary production around the world, supplies some of the world's paper and construction needs, and also stores carbon from the atmosphere as an offset for rising global atmospheric CO2 concentrations. Despite the importance of wood growth for long-term carbon storage in ecosystems, the future direction of wood growth with rising atmospheric CO2 concentration remains debated the backdrop of climate change and stresses placed on forest due to climate warming. Tree ring evidence of past changes in tree growth with rising atmospheric CO2 also provides evidence for and against a significant CO2 response over time, but what about how tree growth might change with future changes in atmospheric CO2?

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How will Climate Warming Affect the Growth and Physiology of Coffee and Tea Plants?

Dr Kristine Crous: k.crous@westernsydney.edu.au

Research area: Plant science, Global change

The goal of the project is to assess how tea and coffee plants adjust to future climate warming with a focus on physiological and structural processes that may adjust. We will investigate tea and coffee plants from several locations and examine how well they cope with warming (+2.5°C and +5°C warming), including thermal limits. Understanding how these important crops will cope with future warming will help us understand the repercussions of climate change on our economy and food supply but also gain insight into the responses of tropical plants in response to warming.

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Discovery of Genetic Mechanisms and Chemical Photoswitches that Regulate Micronutrient Levels in Plants

Dr Chris Cazzonelli: c.cazzonelli@westernsydney.edu.au

Research area: Plant molecular biology, Secondary metabolism, Biochemistry, Genetic regulation, Epigenetic, Nutrition, Horticulture, Agriculture, Crop biofortification

Plants are natural chemical factories synthesizing health-promoting micronutrients such as the carotenoid provitamin A. A daily dietary uptake of this provitamin through plant-based foods is necessary for humans and animals to make Vitamin A, that promotes good eyesight, immunity and health. Carotenoids are colourful yellow to pinkish-red plant pigments found in flowers, fruits and vegetables (Cazzonelli, Functional Plant

Biology 2011). In plants, carotenoids capture light, provide photoprotection, regulate gene expression, control chloroplast development and are involved in epigenetic memory forming processes (Cazzonelli et al., 2020 eLIFE).

We are unravelling genetic mechanisms by which carotenoids self-regulate their biosynthesis to maintain cellular and plant energy homeostasis (Anwar et al., 2021 Critical Review in Plant Science). This project aims to examine genetic and chemical photoswitch mechanisms by which carotenoid-derived metabolites confer defence against insect herbivory and promote a mutualistic plant-fungus symbiotic interaction that promotes plant growth and yield. Building upon our recent discoveries, we will discover new chemical metabolites, genetic mechanisms and photoswitches that control carotenoid biosynthesis and nutrient accumulation in horticultural crops.

Commercial and social benefits building on the expected project outcomes could include smart crop breeding programs with an end goal of enhancing national food security and Australian population health through improved nutrition. These benefits may also extend to international crop and animal management for regions where nutrient deficiency is prevalent, adding to possible commercial benefits for the Australian agricultural industry. Students will gain valuable experience in the latest physiological, molecular, biochemical and next generation sequencing technologies that are translatable for employment in agriculture, horticulture, biotechnology and educational sectors.

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Touching Plants to Prime Resistance to Insect Herbivory and Adaptation to Stress

Dr Chris Cazzonelli: c.cazzonelli@westernsydney.edu.au

Research area: Plant molecular biology, Genetic regulation, Hormone signalling, Environment stress acclimation, Insect herbivory, Horticulture, Agriculture, Crop production

Plants sense and respond to wind, rubbing, insect herbivory, acoustic vibrations, touch and mechanical stress by altering their phenotype; a phenomenon called thigmomorphogenesis. Touching plants alters their development and morphology; an adaption process that results in a stronger and hardier plant that is better acclimated to the prevailing environmental conditions and resistant to pathogen infection (Brenya et al., 2020 BMC Plant Biology). Evidence in our laboratory shows that epigenetic and memory forming processes are involved in controlling touch-induced gene expression and priming stress acclimation responses (Cazzonelli et al., 2014 Frontiers in Plant Science). The molecular mechanism(s) by which touching a plant primes gene expression and promotes long-term memory remains enigmatic.

In this project, students can investigate the molecular mechanisms by which touching a plant will prime gene expression and memory formation to promote adaptation using Arabidopsis, Brachypodium, and/or tomato as model organisms. Students can discover physical, chemical and genetic barriers induced by mechanical stress that promote resistance to biotic/abiotic stress and facilitate a stronger plant better adapted to mitigate environmental change.

Students will gain valuable experience in the physiological, molecular, biochemical and next generation sequencing technologies that can be translated into employment within areas of agriculture, biotechnology, government service and education. Knowledge generated from this project will improve horticultural strategies to harden seedling transplants for the protected greenhouse and agricultural industries to drive environmental sustainable outcomes.

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SUITABLE FOR PHD

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Feast or Famine: How Australian Plants Stay Productive Under Different Levels of Soil Phosphorus

Professor David Ellsworth: d.ellsworth@westernsydney.edu.au

Research area: Plant physiological ecology, Native plants, Environment

There is a sharp contrast between the green vegetation growing on the Australian continent and the reddish, low-nutrient soils that predominate across the continent. How do Australian plants survive and in fact thrive on ancient soils with low phosphorus (P) availability? The Ph.D. candidate will investigate this question through participation in a multi-national project funded by Australia's peak scientific body, the Australian Research Council.

We seek to identify how high phosphorus-use efficiency (PUE) is achieved in Australian plants, and resolve the role of P and its partitioning in regulating photosynthetic capacity and productivity across soil and landscape P gradients. This Ph.D. position will involve an exploration of how leaf P and its fractions are affected on geologically recent soil parent materials, and how P recycling by plants changes across soil parent material and P availability. The candidate will learn skills associated with fieldwork with plants as well as soils, and will participate in P analyses in the laboratory. The student will work with the project chief investigator to mould the work scope to relate soil P availability across sites and geological substrates to how P is used for leaf metabolism. The fieldwork will involve some travel across the ancient landscapes of Australia.

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Pushing the Envelope: Does Range Size Limit Eucalypt Tolerance to Warming?

Professor Mark Tjoelker: m.tjoelker@westernsydney.edu.au

Research area: Ecology, Environment

The average climate across Australia is projected to warm 2.8°C to 5.1°C by 2090 with an increased frequency and intensity of heatwaves. Yet, fewer than half of the more than 800 species of eucalypts in Australia have native geographic ranges spanning more than 3°C and high temperature tolerances remain largely unknown for eucalypts in general. As eucalypts are long lived, they cannot avoid these rapid increases in temperature by migration. Hence, the resilience of Australia's existing forests and woodlands to climate warming will depend on their capacity to function at both higher mean and extreme temperatures. Are species with a narrow climatic range "climate specialists" that are at great risk of negative consequences with future climate warming? This project will determine how average and extreme temperatures affect leaf and tree carbon exchange by quantifying thermal sensitivity and acclimation. Do these traits differ predictably with species inferred climatic niche based on geographic range? Filling these knowledge gaps will greatly enhance our ability to predict the future of our forests in a warmer world.

The Hawkesbury Institute for the Environment at Western Sydney University is looking for a highly motivated and qualified candidate to undertake PhD research. The successful candidate will join a vibrant multi-institutional research team led by Professor Mark Tjoelker and supported by an Australian Research Council Discovery project grant entitled "Pushing the envelope: does range size limit eucalypt tolerance to warming?" Combining experiments and biogeographic modelling, the project expects to generate new knowledge on the comparative physiological responses of diverse eucalypt taxa to warming and heat waves in a higher CO_2 world. The study is based at the Hawkesbury Campus of Western Sydney University in Richmond, New South Wales, Australia.