Department of Environment and Genetics

School of Agriculture, Biomedicine and Environment

Scientists working across ecology, evolution, biodiversity, botany, zoology and environmental science

Contents

Cover Photo:
Working in the Alpine region, Victoria (Photo Credit: John Morgan)

About the School of Agriculture, Biomedicine and Environment

The School of Agriculture, Biomedicine and Environment is one of the largest in the University, with more than 170 continuing and fixed term staff across multiple campuses. Over the last three years the School has seen significant growth in both research and teaching revenue. Staff in the School currently generate a significant proportion of the University's teaching revenue and research income, and supervise more than 270 higher degree research students. The School is responsible for 7 undergraduate degree courses at the main Bundoora campus in Melbourne, and our regional campus at Albury-Wodonga. It is a leader in teaching innovation and student satisfaction within the university.

The School undertakes teaching and research across a broad range of disciplines, including: Agriculture, Botany, Soil Science, Animal Science, Plant Science, Ecology, Environmental Geoscience, Evolution and Genetics, Conservation Biology, Zoology, Neurobiology, Microbiology, Physiology, Pathophysiology, Pharmacology and Anatomy, Biochemistry, Chemistry and Cardiovascular Physiology. The School is a major contributor to research strengths in both the Biological and Agricultural Sciences, achieving the highest possible rating '5 - well above world standing' from the Australian Research Council in the fields of Ecology, Zoology, Plant Biology, Physiology, Microbiology, Biochemistry and Cell Biology, Crop and Pasture Production, Genetics, Soil Science, and Veterinary Science, and rated as '4 - above world standing' in Ecological Applications.

The 5 departments in the School are:

- Animal, Plant and Soil Sciences
- Baker Department of Cardiovascular Research, Translation and Implementation
- Biochemistry and Chemistry
- Environment and Genetics
- Microbiology, Anatomy, Pharmacology and Physiology

The School of Agriculture, Biomedicine and Environment research environment is dynamic and growing, and includes these major research centres:

- La Trobe Institute of Agriculture and Food (LIAF)
- ARC ITRH (Industry Transformation Research Hub) for Medicinal Agriculture
- ARC CoE (Centre of Excellence) Plant Energy Biology
- Centre for Livestock Interactions with Pathogens (CLiP)
- Centre for Cardiovascular Biology and Disease (collaboration with the Baker Heart and Diabetes Institute)
- Research Centre for Extracellular Vesicles
- Centre Research Biomedical and Environment Sensor Technology (BEST)
- Research Centre for Molecular Cancer Prevention
- La Trobe Institute for Molecular Science
- Research Centre for Future Landscapes (collaboration with the Arthur Rylah Institute of DELWP)
- Centre for Freshwater Ecosystems (formerly the Murray-Darling Freshwater Research Centre)
- Research Centre for Applied Alpine Ecology
- Mallee Regional Innovation Centre (MRIC)(a joint venture with The University of Melbourne)

Professor Shaun Collin
Dean, School of Agriculture, Biomedicine and Environment,
Co-Director of AgriBio

Department of Environment and Genetics

The Department of Environment and Genetics consists of 30 continuing and fixed-term academic staff, including one ARC Future Fellow, one ARC DECRA Fellow and six Postdoctoral and Research Fellows.

The Department has a dynamic higher degree by research program that reflects the disciplinary interests of the staff. We are currently training 60 PhD students and 20 Honours (4th year Research) students from Australia and overseas.

Staff and postgraduate students work in a range of environments 'from the sea to the mountains', including arid and semi-arid deserts and woodlands, alpine and subalpine landscapes, grasslands, tall wet forests and rainforests, and marine and freshwater habitats.

We teach >3000 undergraduate students enrolled in 32 subjects.

Our courses include:

- Bachelor Biological Sciences
- Bachelor of Wildlife and Conservation Biology
- Bachelor of Science
- Bachelor of Agriculture
- Bachelor of Animal & Veterinary Biosciences

We also maintain close relationships with external research partners in state, federal and non-government agencies.

Research carried out in the Department is world leading. The Department underpins a rating of '5 – well above world standard' in the disciplinary areas of Ecology and Zoology, and underpins a rating of '4 – above world standard' in Ecological Applications. The Department also contributes to similarly high ratings in the areas of Genetics, Plant Biology and Soil Science.

The Department maintains a diverse portfolio of research programs encompassing the full range from fundamental to highly applied, with particular strengths in terrestrial ecology encompassing plant and animal ecology, landscape ecology, conservation, ecological genetics, invasion biology and fire ecology and management (https://www.latrobe.edu.au/ecology-environment-evolution).

Members of the Department are also key contributors to La Trobe's new Research Themes (five cross-disciplinary research areas that address some of the most pressing questions affecting the future of human societies and their environments), particularly 'Protection and restoration of vulnerable ecosystems and community resilience in the face of environmental and climate threat.

The Department's research environment is dynamic and growing, and includes several major Research Centres:

- Research Centre for Applied Alpine Ecology
- Research Centre for Future Landscapes (collaboration with the Arthur Rylah Institute of DELWP)
- Centre for Freshwater Ecosystems (formerly the Murray-Darling Freshwater Research Centre)

Research Centres

Research Centre for Future Landscapes
Centre for Freshwater Ecosystems
Research Centre for Applied Alpine Ecology

Research Centre for Future Landscapes

The Research Centre for Future Landscapes (RCFL) was established in 2017 and is a multi-disciplinary environmental research centre.

Our goal is to generate knowledge and solutions that address the global challenge of sustaining and restoring natural ecosystems in modified landscapes, and empowering people and communities to create more sustainable landscapes.

To do this, the we foster research into:

- the drivers and outcomes of landscape change for nature and people;
- understanding ecological function in modified landscapes;
- solutions to improve environmental sustainability and community resilience; and
- land-use planning and management options for people, communities and future landscapes.

Landscapes sustain nature; provide people with food, fibre and fuel; shape cultural identity; and inspire creativity. Worldwide, the transformation of land and water to meet the demands of a growing human population, together with the impacts of a changing climate, are driving a global biodiversity crisis. The consequences of past, present and emerging human-induced landscape change pose enormous threats for nature and challenges for human society.

In Australia, land-use decisions over the last two centuries have profoundly transformed many landscapes. This has generated economic prosperity for the nation but at a significant cost to our native wildlife and plants, soil health, and land and water resources. Just as the legacy of our forbears' decisions are felt today, the way in which we manage the land and water will shape the landscapes of the future for generations to come.

We undertake research that addresses the global challenge of sustaining nature in human-dominated landscapes.

Our research equips communities with knowledge and solutions to increase ecological, economic and social sustainability in rural and regional landscapes.

We strive to be:

- Globally relevant; by producing world-class research into the drivers and outcomes of landscape change for nature and people. Collaborative; by
- partnering with government, industry, NGOs and communities to tackle the issues that matter to them.

- Applied; through conducting solution-orientated research to enhance biodiversity, sustainable production and human wellbeing in rural and regional landscapes.
- Multi-disciplinary; through integrating a range of disciplines to generate new insights and fresh ideas.
- Future-focused; we want to recruit, support and train the next generation of scientists committed to solving pressing environmental problems.

We have research expertise in:

- Landscape ecology
- Fire ecology
- Animal-plant interactions
- Behavioural ecology
- Insect ecology
- Plant ecology
- Environmental geoscience
- Agronomy
- Microbial ecology
- Conservation genetics
- Landscape planning
- Social science

https://www.latrobe.edu.au/research/centres/environmental/future-landscapes

Centre for Freshwater Ecosystems

The Centre for Freshwater Ecosystems (CFE) has been established to conduct high quality research to support the sustainable management of freshwater ecosystems. The centre brings together a wealth of expertise from a range of disciplines to better understand and to solve significant challenges in river and catchment management. It builds on a long history of research under the auspices of the Murray Darling Freshwater Research Centre.

The Centre operates from La Trobe's Albury-Wodonga campus, and also has strong links across the university's other campuses in Melbourne, Bendigo, Shepparton and Mildura. Our regional locations provide ready access to field sites across the southern Murray Darling Basin and are a vital connection with local communities.

The Centre's work directly supports decision making regarding maintenance and restoration of the long-term health of rivers, catchments, floodplains and wetlands.

Healthy freshwater ecosystems support immense biodiversity as well as providing highly valued goods and services that support human wellbeing and economic prosperity.

We seek to provide the critical knowledge to support the sustainable management of these important ecosystems across several key themes:

- measuring and conserving freshwater biodiversity
- balancing water allocations between communities, production systems and nature
- addressing the effects of catchment management and chemical pollutants on water quality
- understanding the influences of hydroclimatic variability and climate change on refuges and ecosystem resilience.

In striving to deliver world-leading research, the centre performs a role well beyond the Murray-Darling Basin, with research links nationally in Southern and Northern Australia, and internationally in southeast Asia, Europe and the Americas.

The centre also plays a key role in training the next generation of water managers and scientists through its contribution to both undergraduate and postgraduate teaching within the university.

The Centre is a strategic initiative of La Trobe University, which operates commercially and strives to conduct high impact scientific research.

Our expertise is in:

- Ecosystem monitoring and assessment
- Environmental chemistry and contaminants
- Fish ecology and management
- Genetics and DNA analysis
- Invertebrate community ecology
- Quantitative modelling and forecasting
- Conservation biology
- Social and environmental policy
- Spatial modeling and GIS analysis
- Water management
- Wetlands and floodplains
- Climate adaptation
- Social research
- Sustainable communities
- Sustainable agricultural production
- Terrestrial ecology

We have facilities for:

- Field surveys on a range of biota and ecosystems
- Analytical chemistry laboratory for water quality and nutrient testing
- A macro-invertebrate laboratory with sampling and taxonomic skills
- Biogeochemical analysis in aquatic ecosystems and waste treatment
- Aquarium facilities and ecophysiology laboratory for studying fish and invertebrate behaviour
- Taxonomy, population genetics, metabarcoding and eDNA studies

www.latrobe.edu.au/freshwater-ecosystems

Research Centre for Applied Alpine Ecology

The Research Centre for Applied Alpine Ecology (RCAAE) provides national leadership in the study of the ecology of alpine landscapes. Current members are professional scientists and academics from La Trobe University, University of Melbourne, Australian National University, Charles Darwin University and Deakin University.

Our scientific research includes ecological processes, rare and endangered species conservation, effects of fire, exotic plants and animals, human activities, and the management of these ecosystems in response to climate change.

Recent focus has been on the collation and publication of long-term datasets (e.g. 70+ year datasets examining the impact of, and recovery from, cattle grazing). This is one of the most important roles of the RCAAE. Ecological monitoring data (on animals, threatened species, weeds, pests) are all held in one database, making data retrieval simple and long-term analyses possible.

The RCAAE trains land managers and students via its long-term commitment to the Alpine Ecology Course and the Summer Studentship programme.

The Alpine Ecology Course (AEC) was initiated in 1989 by Victorian Department of Conservation to:

(i) teach basic ecology to land managers so that land management would be based on ecological principles, and
(ii) for active researchers in the alps to communicate their findings and the state of ecological knowledge to land managers.

La Trobe University has been involved in a teaching role since 1991, and became responsible for the course delivery in 2000. The course is held in the Alpine areas of Victoria on the Bogong High Plains. The format of the course is two days of formal instruction in geomorphology, soils and plant ecology, followed by four days of project-based work.

The RCAAE supports long-term Mountain Pygmy Possum (*Burramys parvus*) research through a collaboration between La Trobe University, University of Melbourne, UNSW and Mt Buller Resort. In 2018, the long-term monitoring of *Burramys* populations indicated that the Mount Buller central population was almost half of that recorded in 2004 and was experiencing events that could drive further declines, even local extinction. Introduction of male *Burramys* from another location prevented the local extinction of this isolated population, increasing genetic diversity and fitness. RCAAE ecologists have raised the alarm about the potential decline in Bogong Moths in the high country and it’s potential to negatively affect the critically endangered *Burramys*. Declines of this nature are likely due to drought in the Bogong moth's breeding grounds highlighting the need for better understanding of the ecology of Bogong Moths and a better network of observation stations in the alps to understand year-to-year variations.

The RCAAE has also monitored the presence and impacts of Sambar deer since 2016 on long-term plots in snowpatches and herblands across the Bogong High Plains. These vegetation communities are listed for protection under Victoria's Flora & Fauna Guarantee Act and feral deer present substantial threats to their state and ecological functions. In 2018, the RCAAE worked closely with Parks Victoria to design new deer-proof fences to facilitate ongoing protection from deer and horses.

Recently, wildfires in 2020 have placed further pressure on alpine ecosystems and the RCAAE will use its long-term data to assess these recent impacts, while providing guidance of recovery.

https://rcaae.org/

Research Groups

Animal Behaviour Group (Richard Peters)

Applied Animal Physiology Group (James van Dyke)

Applied Aquatic Ecology Research Group (Alison King)

Biodiversity Science and Application Group (Melodie McGeoch)

Biogeochemistry and Ecotoxicology Lab (Ewen Silvester and Aleicia Holland)

Botany and Plant Ecology Research Group (John Morgan)

Comparative Genomics (Jenny Graves)

Ecological Genomics Group (Bill Ballard)

Ecology and Conservation Group (Pete Green)

Fire and Avian Ecology Group (Mike Clarke)

Fish Ecology and Fisheries Group (David Crook)

Insect Ecology Group (Heloise Gibb)

Landscape Ecology Group (Andrew Bennett)

La Trobe University Herbarium (Alison Kellow)

Molecular Ecology Group (Nick Murphy)

Nematode Genomics Group (Warwick Grant)

Plant Reproduction and Conservation Genetics Group (Susan Hoebee)

Plants and Pollinators Group (Ryan Phillips)

Riverine Landscapes Research Group (Nick Bond)

Water Geochemistry and Landscape Evolution Group (John Webb)

Animal Behaviour Group

Research in the Animal Behaviour Group (ABG) covers broad interests in animal behaviour,with both theoretical and applied benefits. Our research involves a combination of field and captive studies, and has focused on 60+ species across three continents.

Motion vision in real environments

Our aim is to understand how animals detect biologically meaningful movements in natural environments. Motion vision is crucial in the life of animals. However, information on the conditions for motion vision in natural environments is limited.

Virtual Lens Project
We use 3D animation to determine how habitat structure, weather and motion vision influence animal behaviour. The use of virtual environment reconstruction encourages a fresh look at the physical world. A future project will implement novel methods to record neural signals from living lizards to identify potential neural signatures consistent with visual detection of whole animal movements in environmental noise.

Ecology and behaviour of lizards across the globe

Lizards of Ecuador
Behavioural work in Ecuador is vital for conservation and species management. Our research investigates the behaviour of *Microlophus* and *Anolis* lizards from the Amazonian tropical forests, mountain and cloud forests to coastal habitats and islands of the Galapagos archipelago.

Chinese Dragons
Both male and female Qinghai toad-headed agamas (*Phrynocephalus vlangalii*) defend burrows using tail displays, which encode information about signallers. We are investigating this behaviour across the genus along with the Chengdu Institute of Biology and others.

Microlophus grayii of Floreana Island (Photo credit: Richard Peters)

Dragons of Oz
Our group focuses on territoriality, camouflage and thermal biology. We examine the structure of territorial displays in relation to habitat structure, weather and intra- and inter-species competition, as well as Jacky dragon (*Amphibolurus muricatus*) dorsal patterns as a function of geographic location due to habitat differences, and ontogenetic changes in appearance. A future project examining thermal adaptation strategies dragon lizards implement to endure environmental climatic conditions will provide data that can be applied to assess lizard populations in the face of climate change.

Multimodal signalling of anurans

Signalling by *Litoria fallax* across its distribution from the tropical north to cool temperate regions is being studied. These frogs combine visual signals with acoustic calls and we are examining whether behaviour is influenced by habitat, climate and/or genetics.

Lab Head: Dr Richard Peters.

Postdoctoral Associates:
Dr Nicole Butler; Dr Xue Bian; Dr Jose Ramos.

PhD Students:
Ms Bhagya Herath; Ms Estefania Boada; Ms Estefany Guerra; Mr Jon Salisbury.

Fields of Study:
Behaviour; Ecology; Neuroethology; Thermoregulation; Vision.

Capabilities and Techniques:
Motion graphic technologies (3D animation); Matlab; Computer vision algorithms; Full spectrum image capture and analysis; Sound recording and analysis; Video analysis; Behavioural observations.

Translational Opportunities:
Climate change effects on animal behaviour; Conservation and species management; Species responses to environmental change.

Twitter: abg_ltu
YouTube: user = eriophora
Website: www.peterslab.info
Facebook: Animal-Behaviour-Group

Applied Animal Physiology Group

We are broadly interested in how animals "work". Animals must balance demands of competing physiological functions to maintain homeostasis and survive. They also need to be able to consume enough energy and biomolecules in order to grow and reproduce. We study how environmental changes impact on these processes to determine how individual animals are affected by environmental change.

Murray River Turtle (Photo credit: La Trobe University)

Freshwater Turtle Conservation

Currently, one of our focal areas of research is to understand the causes of freshwater turtle declines in Australia, and to develop novel ways of stopping those declines. Many freshwater turtle populations are composed primarily of older adult turtles, indicating that there is a lack of juvenile recruitment. So far, the evidence points to invasive red foxes (Vulpes vulpes) as being a major driver of turtle declines. Foxes destroy over 90% of most turtle nests, and this could mean that very few hatchlings reach the water. We are testing this hypothesis by developing a number of methods to protect turtle nests. We work closely with local community groups to implement these approaches throughout south-eastern Australia, and citizen science is becoming a major forefront of our research. If these methods work, we should see a corresponding increase in the number of juvenile turtles in the system. Alternatively, if these methods do not work, then they indicate that some other factor is killing juvenile turtles between the time that they hatch, and the time that they would reach sexual maturity. We are testing this hypothesis using medium-term mark-recapture and telemetry methods. At the same time, we are examining the effects of pollution and climate change on turtle reproduction and development. We are especially interested in how changes in the foodweb may be impacting the food available to turtles, with consequences for their growth, survival, and reproduction.

Evolution and function of vertebrate placentas

Another field of our research is the evolution and physiology of the placenta in live-bearing vertebrates. The placenta connects a mother to embryos that are not genetically identical to her (half of their genes are from their father), and there is a risk that her immune system might kill them. How placentas provide nutrition to embryos, despite this immune challenge, has major implications for understanding how reproduction, development, and immune function are regulated so that both mother and baby survive. More broadly, all animals deal with similar immune and environmental challenges, and use many of the same molecular and physiological mechanisms to survive. Hence, animals are excellent models for discovering novel therapies for humans. The complex dynamic between placental and immune function may even explain why men and women suffer different rates of autoimmune diseases and cancer. We use a range of molecular and physiological techniques to study these mechanisms to improve environmental outcomes, with potential to help human health as well.

Reproduction and environmental change

Animals must successfully deal with a number of environmental challenges in order to survive and reproduce the next generation. Our research aims to discover the novel mechanisms animals use to deal with environmental impacts on reproduction, development, and immune function. We are particularly interested in nutritional and pollution impacts. The nutrients animals eat provide both the energy and chemical building blocks animals need to produce new molecules, cells, and tissues. Pollutants, including heavy metals, interact with molecular processes and cause breakdowns in reproduction, development, and immunity. Two examples of our research focus on freshwater turtles, which have remarkable immune systems. Adults use a powerful innate immune response to prevent systemic bacterial infections after injuries. Eggs resist fungal infections despite not having an immune system aside from the immune factors provided by their mother during egg production. We use molecular and physiological approaches to determine how these functions work, and how they are maintained despite food restrictions and pollution.

LabHead: Dr James van Dyke

Fields of Study:
Physiology; Ecology; Evolution; Conservation

Capabilities and Techniques:
Animal respirometry and performance; Field ecology; Stable isotope analysis; Histology; Endocrinology; Compositional analysis.

Translational Opportunities:
Wildlife ecology and conservation; Environment change impacts on individuals; Pollution impacts; Novel trait evolution.

Applied Aquatic Ecology Research Group

Our group conducts applied and fundamental research on the ecology of freshwater, estuarine and near-shore marine ecosystems, and applies this knowledge to aquatic environmental problems. Located in the Centre for Freshwater Ecosystems, we research species biology and community interactions, traits and life history, food webs, ecosystem processes, impacts of human induced threats (particularly flow regime change, land use changes, invasive species), and technological advances in monitoring of aquatic ecosystems.
We maintain active collaborations with a diverse range of stakeholders, industry and research partners to ensure that our research contributes to the development of policy and management to support conservation and sustainable aquatic resources.

Murray River, Barah-Millewa Forest (Photo credit: Alison King)

Water Management and Environmental Flows

The natural flow regime of rivers, wetlands and estuaries in many regions of the world has been substantially altered to meet human water needs. This extraction and regulation of flows has had major impacts on aquatic ecosystems by decreasing the amount of water available, altering flow patterns and connectivity of aquatic habitats. The science of environmental flows - the water required to sustain aquatic ecosystems - has emerged as an important tool for water resource planners and managers to better manage the trade-offs between water for the environment, people and the economy. Our researchers work on environmental flow and water management issues in Australia, especially the Murray-Darling Basin, and similar issues in Asia, Europe, South America and the USA. Our research spans fundamental science on flow-ecology relationships, impacts of detrimental water management outcomes (e.g. managed low or high flows, hypoxic waters) through to supporting river operations and water resource policy. Our multidisciplinary teams incorporate Indigenous values and perspectives.

Aquatic Biodiversity and Ecosystem Monitoring

Monitoring and assessment are critical components of adaptive and responsive management for aquatic ecosystems. Our studies determine the status of aquatic fauna, flora and ecosystem processes in response to environmental events (e.g. environmental watering, infrastructure changes, water quality) and evaluate the achievement of management objectives and expected outcomes. We also study the development and implementation of monitoring techniques, (eDNA, underwater video and high-resolution sonar).

Improving aquatic restoration and management outcomes

Natural aquatic environments have had significant loss, degradation and habitat fragmentation due to human activities. Restoration activities are being undertaken to protect aquatic biodiversity (wetland watering, riparian planting, woody debris reintroduction, habitat and connectivity improvements). We study ecological processes influences on aquatic habitat restoration outcomes to minimise threat impacts, and understand how managed flow regimes and infrastructure affect the movement of aquatic species.

Aquatic invasive species

Aquatic invasive species invade ecosystems beyond their natural ranges and are common in Australian freshwater systems. Their presence may harm native species and affect ecosystem processes. We study their potential impact and spread and the impact and usefulness of mitigation strategies and management actions.

Theme Head: Assoc Prof Alison King.

Theme Members: Prof Nick Bond; Assoc Prof David Crook; Dr Michael Shackleton; Dr Luke McPhan; Dr Nicole Thurgate; Dr Andre Siebers.

Fields of Study:
Ecology; Hydrology; Restoration Ecology; Conservation Biology; Ecosystem Science.

Capabilities and Techniques:
Field-based aquatic sampling; Field & lab experiments; Experimental design & monitoring; Quantitative & predictive modelling; Food-web ecology (using stable isotopes); Population genetics; eDNA.

Translational Opportunities:
Water resource management & policy; Fisheries; Catchment and invasive species management; Environmental impact assessment; Habitat restoration.

Biodiversity Science and Application Group

Plant and animal populations and communities, in natural and managed landscapes, are changing. Some species are becoming more abundant, (e.g. pests and diseases). Others are becoming more rare and are disappearing from local landscapes. These changes are a result of interactions between climate change, biological invasion and habitat transformation. In order to secure biodiversity and ecosystems and their contribution to human well being, our research measures and models the abundance and distribution of species, turnover in communities and what this means for ecosystem services. Our research advises environmental policy and management. We work at scales from protected areas to continents and globally, on plants, birds, insects and microbes, and from Australia to the Antarctic.

Sweet pittosporum – native to parts of Australia, but invasive in others (Photo credit: Melodie McGeoch)

The role of common species in biodiversity change and function

Common species are often iconic and play important roles in maintaining resilient ecosystems. We study how common species change across regions and how this affects the functions that biodiversity provides across natural and managed landscapes. Our research includes problem species on the increase and common native species in rapid decline. We are developing new theory and improved biodiversity models for quantifying the dynamics of common species and their contribution to sustaining life on land.

Biodiversity observation networks and sustainable knowledge management

Bioindicator systems assess and monitor biodiversity performance and ecosystem policy worldwide. Biodiversity informatics and Essential Biodiversity Variables research aim to design and deliver policy-relevant information that is findable, accessible, interoperable and retrievable by countries, policy makers and researchers. Our research, with worldwide collaboration, builds and supports country-level Biodiversity Observation Networks and biodiversity information systems (www.geobon.org).

We identify minimum data sets that are scientifically robust with uncertainty measures, for example, for assessing and monitoring the state of biological invasion states at sub-national to global scales.

Analysing and predicting biodiversity change

Changes in species population and ecological communities composition affect human wellbeing in many ways – including plant productivity via plant pollinators, natural enemy networks, disease, and soil function. Our research uses properties of presence-absence data to design metrics and methods to estimate species abundance from occupancy, scale species distributions, quantify multispecies compositional change and its drivers (multi-site generalized dissimilarity modelling) for species and interaction networks.

Antarctic science for a sustainable future

Our research for Securing Antarctica's Environmental Future (SAEF) on biodiversity status and trends uses downscaled climate and environmental information, novel biodiversity data, and integrated biological and geochemical proxies, to produce transformative insights about the structure, function and drivers of biodiversity across the region.

We inform conservation planning and provide a scientific basis for Antarctica's environmental stewardship.

Lab Head: Prof Melodie McGeoch.

Fields of Study:
Population Ecology; Community Ecology; Ecological Applications; Invasive Species Ecology; Climate Change Ecological Impacts.

Capabilities and Techniques:
Monitoring system design; Indicator development; Measurement, modelling and analysis of living systems; Biodiversity informatics; Risk assessment; Invasive Alien Species Impact assessment; Sustainable Development for life on land.

Translational Opportunities:
Biodiversity & policy monitoring; Environmental change indicators for policy monitoring; Evidence-based policy & reporting assessments; Invasive alien species; Risk assessment; Sustainable biodiversity knowledge management.

Biogeochemistry and Ecotoxicology Group

Our research investigates biogeochemical processes in aquatic ecosystems, the bioavailability and toxicity of contaminants, the response of aquatic ecosystems to natural and anthropogenic stressors and the effects of abiotic factors on aquatic biota. We use a range of field and laboratory techniques to address specific research questions. Our field sites span tropical, temperate and alpine environments including alpine streams, rivers, lakes and wetlands, both nationally and internationally. We also use controlled laboratory experiments to understand chemical processes, interactions of biota with their chemical environment, and the bioavailability and toxicity of contaminants

Goobarragandra River (Murray-Darling Basin, near Tumut, NSW) (Photo credit: Ewen Silvester)

Alpine aquatic ecology and Peatlands

Our research is critical for future management of the Australian alpine environment. Alpine peatlands are important in regulating stream flows and water quality and will be adversely impacted by climate change. Our work investigates chemical regulation processes that occur in alpine peatlands and associated headwater streams as well as the aquatic communities in these environments. Our recent projects include the response of alpine peatlands and aquatic communities to high intensity rain events.

Characterisation and bioavailability of Dissolved Organic Matter (DOM)

DOM has an important role in regulating abiotic and biotic processes in aquatic ecosystems. We use a range of spectroscopic and analytical techniques to characterise the chemical composition and bioavailability of DOM in aquatic ecosystems. Our current research investigates the influence of tributary inflows on DOM cycling in regulated systems; metabolic dynamics in dryland lowland rivers, and characterisation of DOM in naturally acidic, circumneutral and groundwater fed systems.

Bioavailability and contaminant toxicity

Contamination of aquatic ecosystems is increasing globally. We use chronic toxicity bioassays coupled with a range of analytical and speciation techniques to assess the toxicity and bioavailability of contaminants (e.g. metals) in aquatic systems. Our current research is directed towards understanding the influence of water quality in modifying the toxicity of metals and the use of field data to derive habitat guideline values.

Effects of abiotic factors on aquatic biota

Environmental and anthropogenic factors (temperature, salinity, pH and contaminants) affect aquatic organisms and biological communities. We use molecular techniques, (metagenomics and eDNA) to study responses of organisms and communities to these factors. Examples include: the effects of water type on fish gill microbiome in the Amazon basin; influence of water quality on moss distributions; biofilm responses to DOM composition; metals and environmental stressors effects on the amino acid profiles and proteome of aquatic biota.

Synchrotron-based techniques

We use Infrared Microspectroscopy (IRM), and X-ray Absorption Spectroscopy (XAS) to study elemental and chemical distributions in sediments and organisms.

Lab Heads: Assoc Prof Ewen Silvester and Dr Aleicia Holland.

Lab Members: Dr Michael Shackleton; Dr Andre Siebers; Dr Luke McPhan; Ms Manisha Shakya; Ms Suman Acharya; Mr Lucas Morais; Mr Francesco Colombi; Ms Oliviah Lines; Ms Gabriella Macoustra; Ms Lakmini Egodawatta; Mr Gwilym Price.

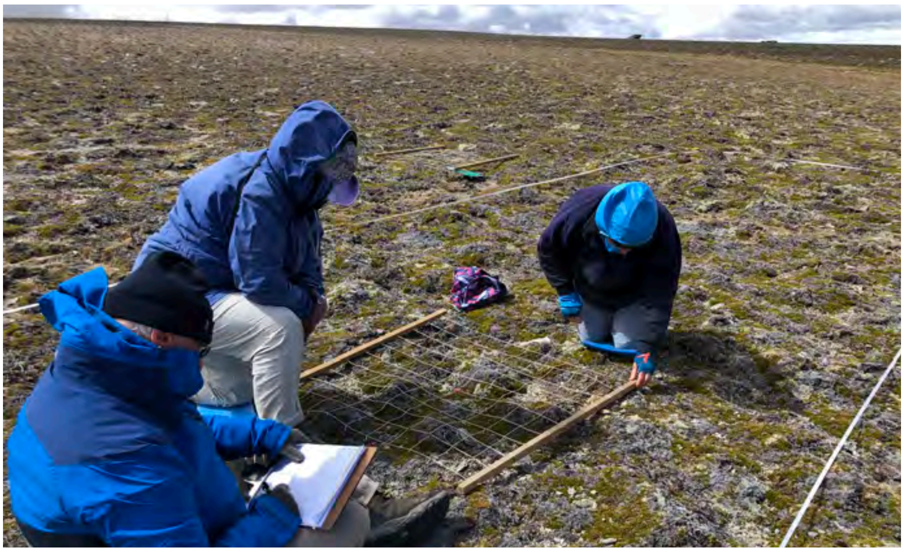
Fields of Study:
Freshwater Ecology; Environmental Chemistry; Biogeochemistry; Ecotoxicology.

Capabilities and Techniques:
Aquatic ecosystems field sampling; Water & soil analysis; Aquatic system productivity (GPP & ER); Laboratory risk assessment of contaminants; Liquid chromatograph mass spectrometry; Fluorescence and absorbance spectroscopy (FEEM); Synchrotron IRM & XAS; Metagenomics; Chemical speciation & thermodynamic modelling; Statistical modelling; Bayesian stable isotope mixing models.

Translational Opportunities:
Climate adaptation; Aquaculture stress and animal welfare; Agriculture, mining and urban effects on freshwater fauna; Species conservation; environmental perturbation; Environmental policy and management; Ecological restoration; Risk assessment.

Botany and Plant Ecology Research Group

In the Botany & Plant Ecology Research Group, we study aspects of the structure, function and change of native ecosystems in Australia –threatened alpine, woodland and grassland ecosystems are where we do most of our work. Our research intersects with the ecological fields of regeneration ecology – disturbance ecology – interaction biology. We work to understand how species coexistence is maintained, how humans impact on these patterns, and how to apply ecological science to management and conservation of natural ecosystems. We are particularly interested is understanding how plant traits – the attributes of species such as seed mass, leaf area, plant height – shape the responses of plants to key drivers. A feature our work is to understand the long-term dynamics of ecosystems.



Field work (Photo credit: John Morgan)

How did warm season (C4) grasses invade Australia - a land of shrubs and trees?

Forty million years ago Australia was connected to Antarctica then it broke away and drifted north along with plants (eucalypts, banksia and casuarina) and distinctive marsupials that had evolved at high latitudes. Australia was isolated until it collided with the Asian plate, 10-15 M yrs ago, by then it was undergoing aridification. As Australia drifted closer to the equator and Asia, a range of plants and animals dispersed from the northern hemisphere into ecosystems dominated by species of Gondwanan origin. Warm season (C4) grasses arrived about 3.5 M yrs ago but now cover 25 % of mainland Australia. Our research hypothesises that Australia's eucalypt woodlands function differently to northern hemisphere woodlands where tree shade is too dense for C4 grasses to grow. Eucalypts have the lowest leaf area of all trees. We are investigating whether the dappled shade of Australian eucalypts might affect what can grow underneath. With the absence of large grazing herds to curb C4 grass growth, fire became more frequent in ecosystems that had hitherto evolved within multi-decadal fire regimes.

Optimizing current-day fire management f or biodiversity conservation

For at least 60 M years fire regimes have shaped the structure and function of Australian natural ecosystems. Understanding fire history, including >40,000 yrs of aboriginal management, is crucial for managing the biodiversity of contemporary landscapes. Floral adaptations allowed some plants to prosper when fire became more common. Other species retreated into refuges where fire was less common. The spread of the new grasses played an important role in the flammability of the country and contemporary distribution of species.

Maintaining Australia's rich biological heritage into the future

Since Europeans arrived in Australia – exotic invasive species (plants and animals), climate change and land use change (agriculture, urbanization) – all threaten our native plant and animal biodiversity. Today native grasslands and alpine flora are endangered ecosystems. We seek to quantify the vulnerability of such species, and examine strategies - like assisted migration - to ensure their persistence.

Lab Head: Assoc Prof John Morgan

Lab Members:
Adj Prof Ian Mansergh; Dr James Shannon; Ms Sue Bryceson; Ms Steph Johnson; Mr Paul Foreman; Mr Dan Nugent; Mr Simon Heyes; Ms Merinda Day-Smith; Ms Claire Hutton; Mr Alex Blackburn-Smith; Ms Amy Buckner; Ms Hayley Sime.

Fields of Study:
Ecological Applications; Global Change Biology; Landscape Ecology; Long-term Ecological Research.

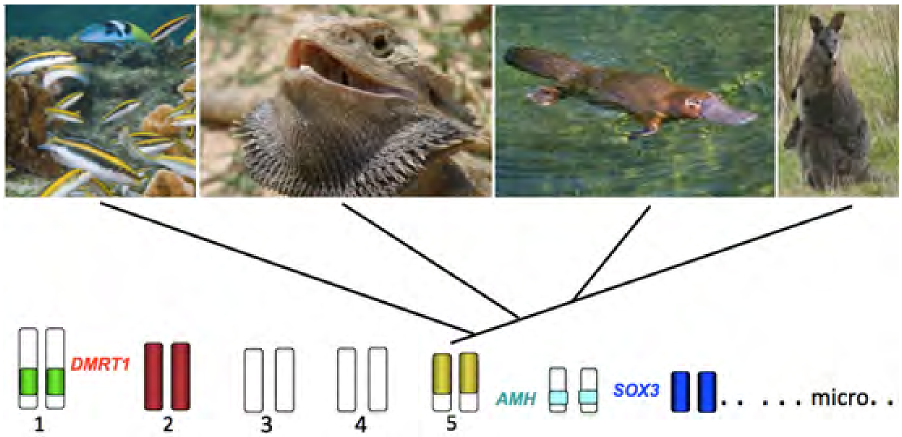
Capabilities and Techniques:

- Long-term ecological research (LTER) sites & associated field infrastructure in alpine environments;
- Data repository (Alpine Database, spanning >70 yrs of ecological research in the Australian alps);
- Co-ordinated Distributed Experiment Research (CDE) sites.

Translational Opportunities:
Assisted migration; Climate adaptation; Fire management; Species conservation; Environmental policy; Ecological restoration; Threatened species recovery; Invasive species management; Impact assessment.

Comparative Genomics

Prof Jenny Grave's comparative genomics research is via national and international collaborations.



Comparative genomics cladogram (Diagram credit: Jenny Graves)

Sex in Dragons

Since 2003, in collaboration with Prof Arthur Georges, and Prof Janine Deakin and Prof Tariq Ezaz (Institute of Applied Ecology, University of Canberra), we have been studying sex determination in the Australian lizard *Pogona vitticeps* (the central bearded dragon). We discovered a ZZ male ZW female chromosomal sex determining system with SF1 as the sex determining gene which delivers 50% male and 50% female hatchlings at physiological temperatures. At higher temperatures, all hatchlings are female; half of these are ZW (normal) female and half ZZ sex reversed female. By mating ZZ sex reversed females to normal ZZ males, we can completely swap the sex determining system from genetic to environmental in one generation. We are using this system to discover how environmental sex determination works, by examining transcription in normal and sex reversed animals, finding unique transcripts of epigenetic modifying genes, and upregulation of stress markers at sex reversing temperatures. We aim to explore the pathways by which epigenetic changes modify gonad and germcell development.

Platypus sex and sex chromosomes

An ongoing collaboration with Prof Frank Grutzner (University of Adelaide) includes Dr Paul Waters (UNSW), and scientists in China (Shenzhen and Hangzhou) and Germany (Heidelberg). Building on our demonstration that platypus sex chromosomes share homology with birds, and our high quality platypus genome sequence, we can use new –omics techniques to explore how different autosomes became sex chromosomes in mammals, and examine a rare case of an autosome that is either an ex-sex chromosome, or a "wannabe" proto-sex chromosome. We will discover how different sex chromosome dosages in platypuses are compensated by epigenetic modifications to gene expression, and explore how different systems of dosage compensation evolved independently in monotremes and therian mammals.

The origin of vertebrate chromosomes

Recent collaboration with the University of Canberra and scientists in Japan and Austria compares the DNA sequences of chromosomes of reptiles (including birds) to those of chordates such as *Amphioxus*. Sequence comparison is identifying extraordinary homology between chordate chromosomes and the gene-dense microchromosomes of birds and reptiles, implying that they, rather than the classical large vertebrate chromosomes, represent the original vertebrate chromosomes. The large, repeat-rich chromosomes of mammals seem to have been puffed up by insertion of transposable elements, and by duplications and amplification, allowing them to be greatly rearranged in evolution.

The Earth Biogenome Project (EBP)

A large international collaboration costing USD14.6 billion, aims to sequence the genomes of all complex life on earth (1.5M identified eukaryote species) in ten years. By changing the way biology is done, reducing reliance on a few model species and facilitating studies of any species, it will solve questions of phylogeny, provide new opportunities for agriculture, and inform wildlife conservation and management. EBP is headed by scientists at UC Davis (USA) and the Sanger Centre (UK). As one of the pioneers of comparative genomics, who was involved in the first international vertebrate sequencing consortium (Genome 10K), Prof Jenny Graves has been on the frontline for launching this project, and is on the EBP Advisory Council. At the national level Jenny is involved in the Oz Mammal Genome (OMG) consortium that aims to sequence all Australian mammals, as well as new moves to gain support to sequence all Australian reptiles.

Lab Head: Prof Jenny Graves.

Fields of Study:
Genetics; Genomics; Epigenetics; Evolution; Development.

Capabilities and Techniques:
Cytogenetic tools (chromosome sorting and chromosome painting; Gene localization by *in situ* hybridization, gene mapping), and –omics technologies (DNA sequencing, RNA transcriptomics, methylomics, metabolomics, chromosome conformation capture).

Translational Opportunities:
Discovery of new genes; New products; Generation of data useful in breeding domestic species and management of wildlife.

Ecological Genomics Group

Our Laboratory has state-of-the-art facilities to study genes through to genomes of vertebrates and invertebrates. Our highly collaborative research involves local, national and international partners. We use first, second and third generation sequencing techniques to decipher the genome and determine how it has changed over time due to selection and demographic effects. We link RNA expression with the epigenome to recognise and link genomics with fundamental features of basic ecology and behaviour. Our ability to detect and recognise these cues is critical to each species' health and survival – including our own. We use model species to understand and unravel basic processes that influence an organisms' ability to survive and reproduce in a fluctuating environment.

Evolutionary history of Australian native animals

Australian scientists have an obligation to learn more about our native species. Focused research projects can help us understand how they fit into the ecological landscape. Evolutionary history studies can resolve and quantify the genomic variations of animals enabling a precise genomic definition of species and buttress future conservation efforts. We are eager to collaborate on genomic studies of all native animals. Over the past decade we have worked on the Australian dingo. After winning the International "World's Most Interesting Genome Competition" in 2017, we determined the genome of "Sandy" the Desert dingo. Deciphering her genome is our first step to understanding the evolutionary history of the four dingo ecotypes' and determining when and how they came to Australia.

Landscape genomics of apex predators

The first step towards adaptation to future climate change is diminishing vulnerability to present climate variability. One component of conferring resilience against globally threatening processes is to develop our understanding of apex predator responses to change because they are drivers of ecosystem dynamics and biodiversity conservation. We are developing our genomic understanding of all apex predators. In Australia, dingoes are the terrestrial vertebrate apex predator, and influence the behaviour, spatial distribution and abundance of prey populations. Dingoes are a part of Australian culture's fabric, and are considered a "lightning- rod" of the land, generating heartfelt and often polarised opinions from Aboriginal people, tourism operators, pastoralists, ecologists, and conservationists. The unclear distinction of dingoes from feral dogs is the main controversy leading to differing opinions of conservation efforts' value. We conduct behavioural, metabolomics, microbiome, and nutrigenomic studies on Sanctuary dingoes.

Domestic animal genomics: One genome at a time

There are over 100 horse, cattle, pig and chicken breeds. In Australia, there are 195 dog breeds, 22 sheep breeds, 21 cat breeds and two alpaca types. A reference genome should be developed for each and every domestic breed and type to help maximise productivity and enable targeted identification of breed specific genetic diseases. It will also help to group genomic regions that are similar between breeds and allow future proofing the genome. We have sequenced the entire genomes of a German Shepherd Dog and a Basenji dog. Next, we will determine an optimal protocol for assembling three dog breeds' genomes: Chow Chow, Australian Cattle Dog (ACD), and Bernese Mountain dog (BMD). We selected these three morphologically distinct breeds as they span the currently proposed dog breed phylogeny. These canine genomes will enable hypothyroidism studies in Chow Chow, deafness in the Australian Cattle Dog and histiocytic sarcoma in the Basenji Mountain Dog.

Nutrigenomics: it's all in the genes

When we look online for foods that help to make us healthy or fit, they are the same for females and males, all ages, races, and body types. Yet, the suggestion that our genomes are the same is simply untrue. Science has determined that our genomes are not identical, and the expression of many genes changes as a person ages. Soon, elite athletes' genomes will be unraveled to construct diets that

Sandy (Photo credit: Barry Eggleton)

maximise energy production and reduce disease riskThe same will occur for primary production animals to determine how diet can be optimised for each genome, energetic requirement, and age. We have studied the influence of diet on energy production in Drosophila flies and have shown that a single mutation in the mitochondrial genome can influence developmental time. We are researching whether this metabolomic difference will then determine the frequencies of flies in the population when specific foods are available.

Lab Head: ProfJ. William O. Ballard.
Lab members: Dr Sonu Yadav.

Fields of Study:
Genomics; Evolution; Nutrigenomics; Metabolomics; Behaviour; Ecology.

Capabilities and Techniques:
Whole genome sequencing and assembly; Molecular Biology; Metabolomics; Epigenomics; Detecting selection; Statistical testing for genetic subdivision; Behavioural assays.

Translational Opportunities:
Testing whether dingo scent-marking can develop a chemical fence that excludes pure dingoes from farmland; Developing a test for severity and reducing prevalence of canine hip dysplasia in German Shepherd Dogs.

Ecology and Conservation Group

The Ecology and Conservation laboratory addresses questions about how ecological communities are assembled, the interactions that occur between species in communities, and the conservation of communities and species that are under threat. We work in a variety of ecosystems from forest to alpine grasslands, and work on a range of organisms.

Christmas Island Red Land Crab (Photo credit: Pete Green)

Biotic Filters to Community Assembly

Community ecology aims to understand the processes that separate a local community from a regional pool of species. These processes act as ecological filters that admit to a local community only those species that can persist under local conditions. These filters can be both abiotic (climate, soils etc) and biotic (predators, pathogens, competitors etc). The Group studies red land crabs, invasive yellow crazy ants and scale insects as biotic filters to the local assembly of rainforest seedling communities on Christmas Island (Indian Ocean). The rainforest ecosystem is notable for its high level of species endemism, recent species extinctions, and high-profile biological invasions. For more than three decades the Group has led research to understand the many species interactions which drive this ecosystem and the rise to dominance of yellow crazy ants. In collaboration with Christmas Island National Park we implement and monitor a major program of indirect biological control against the ant, targeting its key scale insect mutualist. We aim to mitigate invasive species threats and permit recovery of key species such as the Christmas Island Red Land Crab.

Maintenance of Species Diversity

Communities consist of a few common species and many rare ones. One general idea is that rare species 'avoid' going locally extinct by performing better (higher rates of recruitment, lower rates of mortality etc) than more common species. To test this we study forest dynamics on the Connell Rainforest Plot Network, Queensland. We conduct long term demographic monitoring of rainforest trees to study diversity mechanisms in tropical and subtropical rainforests.

We tag and map all rainforest trees recording size (height or girth), free-standing stems of shrub and tree species. In 1963, Prof Joseph H. Connell (University of California) initiated these plots and sampling has been done ever since. We use molecular techniques to study the microbial root rhizosphere communities, their impacts on growth and potential to mediate plant species richness.

Trait-Based Determinants of Community Assembly

Species are filtered from the regional pool according to their key functional traits, and differences in filter number, type, and strength lead to variation in local community composition. Species sharing similar key functional traits share the same ecological 'strategy' and these reveal the selective forces that shape plant evolution. Grouping plants by their strategies provides a means of predicting vegetation responses to global change. We use the C-S-R Plant Strategy Scheme to assess long-term vegetation change in the Victorian Alps under climate change and the relaxation of cattle grazing.

The ecology and conservation of Phylogenetically Distinct species

These species have no or few close relatives, and are of special significance for phylogenetic diversity conservation. Our group works on the seabird Abbotts Booby and the grassland bird Plains Wanderer to study key habitat conservation management issues.

Lab Head: Assoc Prof Pete Green.

Lab members:
Ms Christina Lipka; Mr Dan Nugent.

Fields of Study:
Conservation; Invasion Biology; Theoretical Ecology; Community Ecology; Population Ecology.

Capabilities and Techniques:
Expertise in the long-term monitoring, especially of plant communities on permanent plots; Multivariate statistics.

Translational Opportunities:
Community-level plant traits measuring to monitor environmental change rather than species monitoring; Natural area biological control for conservation; Management of phylogenetically distinct species using population conservation ecology studies.

Fire and Avian Ecology Group

Our Group investigates how threatening processes like fire, drought and over-abundant native species affect the ecology and conservation of native fauna. We conduct research at multiple scales, from single species, to communities of organisms and whole landscapes. Our goal is to conduct research that informs better management of our wildlife and landscapes. The research is collaborative and involves local, national and international partners. The Group's work combines a deep understanding of the ecosystems we work in, solid empirical data collected in the field and the latest remote sensing data to identify patterns and processes driving changes in ecological communities. Our goal is to conduct research that informs improved management and conservation of the world's wildlife and ecosystems.

Bushfire ravaged land in Australia. (Photo credit: Mike Clarke)

Fire Ecology

Our Group has a strong track record of studying the impact of fire on fauna. Until early this century, fire managers assumed catering for the needs of plants would also meet the needs of fauna. Our research has challenged this assumption and demonstrated the significant risks associated with some management practices. Our research been influential in changing the way fire is managed. In collaboration with Prof Andrew Bennett and Assoc Prof Jim Radford, we are studying the effects of fire on the conservation of flora and fauna in a range of several ecosystems including Mallee woodlands and heathlands, Foothills forests, Box-Ironbark Woodlands and the diverse plant communities of Wilsons Promontory National Park.

Threatened species

A range of past and present projects by our Group have investigated the conservation biology of threatened species. These include work on the endangered Black-eared Miner, the Helmeted Honeyeater, and the Regent Honeyeater. Current projects include work on the Mallee Emu-wren and the Shy Heathwren. All of these projects have focused on understanding the basic biology of the species and identifying the key threatening processes that continue to endanger them and what management actions are most likely to enhance the species' survival.

Native Pests

Some of our research has focused on a particular genus of native honeyeaters – the Miners (*Manorina* spp). Two of the four species in the genus (Noisy Miners and Yellow-throated Miners) form extensive permanent colonies and are notoriously territorial. Our research was the first to experimentally demonstrate their extraordinary capacity through indiscriminate aggression to exclude a wide range of other woodland species from their colony's territory. Human alteration and fragmentation of woodland habitats has profoundly advantaged these species of Miner, to the significant detriment of other woodland birds, many of which are now endangered. Our research explores which factors exacerbate or ameliorate the impact of these now over-abundant and expanding native miners.

Conservation Biology

Our Group's research is driven by a deep curiosity to discover how the natural world works. Whether we are studying a single species' nesting behaviour, a bird community's recovery after fire or factors that determine how a whole ecosystem will respond to Climate Change, our goal is to increase understanding of natural systems so that they can be conserved, valued and enjoyed by future generations.

Lab Head: Prof Mike Clarke.

Lab members: Dr Angie Haslem;
Dr Kate Callister; Mr Simon Verdon;
Mr Rhys Makdissi; Mr Shannon Braun.

Fields of Study:
Ecology; Conservation Biology; Behaviour; Evolution.

Capabilities and Techniques:
Field-based ecological assessment in remote localities; Conceptual modelling of complex systems; GIS and mathematical analysis of complex data sets.

Translational Opportunities:
Fire management; Threatened species conservation; Park management; Pest species management.

Fish Ecology and Fisheries Group

Our group in the Centre of Freshwater Ecosystems has extensive expertise in fish ecology and fisheries science, and works closely with industry and research partners across Australia and internationally. We study the behaviour, biology and ecology of freshwater, estuarine and marine fishes, and focus on understanding how human disturbances - including climate change, water resource use and fisheries – affect the viability and sustainability of fish populations. Our research supports the sustainable management of fisheries and associated natural resources.

Tagged Barramundi ready for release (Photo: David Crook)

Movement and migration
Understanding how fish and other aquatic organisms are distributed in the environment over time allows for the identification of critical movement pathways and the impacts of human activities. We have expertise in a range of methods for studying fish movement and migration. We use radio- and acoustic telemetry to directly track the movements of fish and turtles in riverine landscapes, estuaries and the sea. We are also leaders in the use of otolith (fish earstone) chemistry analysis, which allows us to hindcast the migration histories of individual fish over their entire lives. The data we generate are integrated with environmental information (e.g. river discharge) to understand the responses of fish to environmental drivers and used to devise strategies to protect fish populations.

Population structure
Fish populations are often comprised of distinct spatial units that are demographically isolated. Management of structured populations requires location-specific approaches that account for variable population dynamics across regions. We use a suite of natural tags, (otolith chemistry, parasites assemblage composition and population genetics - SNP, microsatellites) to examine population structure in freshwater, estuarine and marine fisheries. Our research is used by management agencies to define boundaries for spatial management of commercially and socially important fisheries.

Biochronological analysis
Calcified structures, such as fish otoliths, provide the key to understanding many aspects of fish ecology and fish population dynamics. Otoliths provide a chronological record of a fish's age, migration history and growth rate across the entire life history. We use this information to build statistical models linking fish recruitment (year class strength) and growth rates to environmental variables such as river flow and large-scale climatic variation. These models are used to examine the outcomes of future climatic and hydrologic scenarios, and inform water resource allocation and fisheries regulation.

Traits and life history
We use ecological species traits (e.g., morphological attributes) and life history attributes (e.g. reproductive groups) to explain and predict species abundance patterns, the likelihood of species extinction and invasion, and changes in species distributions caused by environmental change. Along with collaborators in Australia and overseas we apply trait-based ecology and life history theory to study how fish drive ecological function.

We study trait correlations and links between 'trait-scapes' and the environment to predict fish community assembly and responses to future hydrologic regimes and climate.

Theme Head: Assoc Prof David Crook.

Theme members:
Assoc Prof Alison King; Prof Nick Bond; Dr Luke McPhan; Dr Michael Shackleton; Dr Andre Siebers; Dr Nicole Thurgate.

Fields of Study:
Ecology; Fisheries Sciences; Conservation Biology; Ecosystem Science; Genetics; Behaviour; Comparative Physiology.

Capabilities and Techniques:
Otolith chemistry & biochronology; Radio & acoustic telemetry; Split beam sonar; Laboratory experiments; Static & flow-through respirometry; Fish surveys; electrofishing; eDNA; Stable isotope analysis; GIS; Quantitative modelling.

Translational Opportunities:
Fisheries management; Threatened species conservation; Climate change impact & mitigation; Water resource policy & management; Biodiversity assessment.

Insect Ecology Group

Our research focus is on the ecology and conservation of insects and other terrestrial arthropods, which are vital contributors to biodiversity and ecosystem function. Our emphasis is on biotic and abiotic drivers of community structure. We work in various ecosystems (including deserts, temperate woodlands and boreal forests) and use field and laboratory experiments, mensurative surveys and databases.

Understanding ecological communities using species traits

An ecological community is a group of organisms that coexist in an environment. We use functional trait-based approaches to study the structure of ecological communities. Functional traits of organisms (e.g. morphology, physiology, behaviour) affect survival and reproductive success and are critical for identifying general rules in ecology. We study traits and environmental relationships of communities and examine how these vary in response to anthropogenic disturbances and climate. We co-developed a new model-based fourth- corner statistical analysis that allows ecologists to better predict how species traits might change in response to environmental change. We lead the Ant Traits International Collaboration, a worldwide collaboration of over fifty researchers studying trait-environment relationships and the impacts of global change. Our research shows very large ants, very small ants and predatory ants do worse following human disturbances, leaving a “mediocre” ant fauna.

Using experiments to understand species interactions in the field

Species interact with both the environment and one-another. We use experiments to understand how species interactions regulate community structure. The importance of a process depends on scale, so we work at multiple scales. We study competitive interactions in ant assemblages and their regulation by environmental factors (e.g. forestry). Our research has shown that the impacts of Swedish red wood ants on other ant species ranged from facilitative in recently clear-cut sites to negative in established forests.

Calomyrmex purpureus (beauty ants) prior to social carrying. (Photo credit: Ajay Narendra)

Cascading effects of mammal extinctions on Australian ecosystems

European colonisation led to the loss of thirty Australian mammal species and declines in many others. We use reintroductions of threatened mammals as models for pre-European Australian ecosystems. We test the impacts of returning long-lost species on biodiversity and ecosystem functioning, looking at soils, microbes, plants and invertebrates. By using sanctuaries distributed across Australia, we test the impact of ecosystem productivity (rainfall) on ecosystem functions performed by threatened mammals. Our research has shown that native mammals have large cascading impacts on plant assemblages and invertebrate prey and improve soil functioning, especially in arid climates.

Conservation interventions in managed landscapes

We develop new methods to improve the success of terrestrial arthropods after anthropogenic disturbances, (e.g. agriculture, forestry) or natural disturbances (e.g. fire). Our work focusses on factors that enable dispersal-limited and habitat-specific species to recolonise. Examples of these conservation interventions, include adding dead wood and reintroducing entire litter invertebrate assemblages (‘rewilding with minibeasts’).

Lab Head: Prof Heloise Gibb.

Lab members: Ms Lucy Johansson; Dr Orsi Decker; Mr James Buxton; Ms Melissa Van de Wetering; Mr Peter Contos; Mr Zac Kayll.

Fields of Study:
Community Ecology; Restoration Ecology; Functional Ecology; Macroecology; Entomology.

Capabilities and Techniques:
Field invertebrate sampling and experimentation; Invertebrate identification; Statistical modelling,; Ecophysiology.

Translational Opportunities:
Restoration ecology: using invertebrates to improve damaged land restoration; Sustainable management of natural areas.

Landscape Ecology Group

Our group investigates how landscape structure, function and change influence the ecology and conservation of native fauna. We work in a range of landscapes and focus on how changes associated with human land-use (e.g. agriculture, forest management, fire management, urbanization, restoration) influence Australian wildlife. An innovative theme in our research is a 'whole of landscape' approach in which we compare the biota of 'whole' landscapes that differ in the extent, configuration and composition of native vegetation, or pattern of land-uses. Our work, often in collaboration with land management agencies, aims to provide knowledge and solutions for more effective conservation of flora and fauna in Australia and globally.


Rural landscape in north-central Victoria (Photo credit: Andrew Bennett)

Conservation in rural environments

Worldwide, agriculture is a dominant and expanding land use. The future of many species depends on their ability to persist in rural landscapes. A global challenge is to find solutions to balance human production of food and fibre with conservation of ecosystems and wildlife. We focus on identifying characteristics of rural landscapes that enhance the persistence of wildlife, particularly woodland birds. This includes 'whole landscape' characteristics (e.g. amount and pattern of native vegetation) and the role of key features (e.g. streamside vegetation, roadside networks, scattered trees). We also investigate the benefits of restoration through revegetation in farmland to identify effective actions that landholders can undertake. Several long-term projects (>10 years) give key insights into changes through time (e.g. impacts of the Millennium Drought).

Fire in the landscape

Fire, both wildfire and prescribed burning, generate long-term changes that affect native flora and fauna. In collaboration with Professor Mike Clarke, we study the effects of fire regimes on conservation in a range of ecosystems – semi-arid mallee,dry box-ironbark forests, foothill forests of the ranges. We aim to understand the long-term responses of native flora and fauna to fire, identify how spatial patterns of different post-fire age-classes of vegetation influence species and communities; and synthesise this knowledge for more effective fire management planning and practice.

Conservation biology of wildlife

We study the conservation biology of individual species and communities in relation to changing land use. This includes threatened species such as Squirrel Glider and Brush-tailed Phascogale; more widespread species such as Yellow-footed Antechinus and Superb Lyrebird (as an ecosystem engineer); and faunal communities (e.g. woodland birds and insectivorous bats).

Ecology of woodland ecosystems

Over the last 200 years, Australia's temperate woodland ecosystems have been greatly affected by human land-use, leaving highly fragmented systems. We undertake a range of projects, such as the long-term dynamics of bird communities, the effects of habitat fragmentation, the flowering ecology of eucalypts and effects of prescribed burning.

Lab Head: Professor Andrew Bennett.

Lab members:
Dr Angie Haslem; Dr Jim Radford (RCFL); Mr Alex Maisey; Ms Jess Lawton; Mr Fred Rainsford; Ms Jacinta Humphrey; Ms Rachel McIntosh; Ms Emmi van Harten.

Fields of Study:
Landscape Ecology; Conservation Biology; Wildlife Conservation.

Capabilities and Techniques:
Field-based ecological studies; Study design; Wildlife surveys; Ecological data analysis and synthesis; Restoration ecology.

Translational Opportunities:
Wildlife ecology; Conservation on farms; Revegetation and restoration; Fire management; Landscape change.

La Trobe University Herbarium

The Department of Environment and Genetics houses an internationally registered herbarium with over 25,000 vascular plant specimens, c. 10,000 of which are fully curated (pressed, mounted, labelled). The herbarium is available for use by all members of the La Trobe community and the public by arrangement. The herbarium was first registered with Index Herbariorum under the code LTB in 1973. LTB is a member herbarium of the Council of Heads of Australian Herbaria (CHAH https://chah.gov.au/). The herbarium is actively used for teaching and by researchers and students in the Department of Environment and Genetics who examine specimens, lodge their own collections, are able to access collections at other herbaria nationally and internationally though LTB's CHAH membership.

Microscope and one of LTB's early specimens (Photo credit: Alison Kellow)

History

The La Trobe University Herbarium (LTB) was established in 1967 in the School of Biological Sciences (later to become the Department of Botany). It was started by plant geneticist Noel Thurling, who is responsible for many of the early collections. Trevor Whiffin, lecturer in plant systematics, took over running the herbarium in 1973. He kept this role until his retirement in 2008, and most of the collection was developed under his watch. The diversity of the collection mostly reflects the interests of staff and students in the Botany Department (now DEEE) over the last four decades, and are mostly from southern and eastern Australia, with an emphasis on *Eucalyptus, Angophora, Acacia, Correa* and rainforest plants, including Melastomataceae, Monimiaceae, and Rutaceae. There are also collections from Papua New Guinea and Thailand.

Database

LTB's collection has been databased with support from the Royal Botanic Gardens Victoria, the School of Life Sciences, Eucalyptus Australia, and through the efforts of many student and ex-student volunteers. Data have been uploaded to the Atlas of Living Australia (ALA) and can be searched in depth on The Australasian Virtual Herbarium (http://avh.ala.org.au) Herbarium records are not just for taxonomists. They provide invaluable information regarding changes in species' distribution and flowering over time, underpinned by verifiable identification. This can be used for many types of research. In the last 3 months alone, over 200,000 records from LTB's database were downloaded in almost 1000 separate download events. There have been over 1.6 million record downloads in total. These records were documented as contributing to biosecurity management and planning, collection management, education, environmental impact and site assessment, and nearly half the downloads to ecological research.

Current operations

LTB's collection is currently expanding as it incorporates specimens collected by current staff, research associates, and students in DEEE. Links have also been established with other parts of the university and affiliates. For example LTB recently accessioned a collection of Thai Enthobotany vouchers from a past Linguistics PhD student, and collections of aquatic plants from staff at AgriBio (DJPR). On a regular basis, the herbarium provides advice and equipment for researchers undertaking collecting, and it can arrange direct access to collections from other herbaria around the world. There is a regular program for undergraduate student volunteers who provide most of the labour involved in specimen databasing and curation.

Curator: Dr Alison Kellow.

Fields of Study:
Systematics and Taxonomy; Plant Ecology; Conservation Biology.

Capabilities and Techniques:
Collections management; Field-based ecological studies; Plant identification.

Translational Opportunities:
National and international botanical exchange; Research collaboration; Preservation of holotypes and rare plants; Citizen Science; Botanical biosecurity.

Molecular Ecology Group

We a use range of genetic and genomic tools to study terrestrial and aquatic species. Our research ranges from addressing important population-level process such as genetic diversity, dispersal, kinship and population structure to deeper level evolutionary processes responsible for shaping present day biodiversity. We also use genomic methods to investigate elusive and hard to identify species from environmental DNA and to study species diets. Our research addresses a range of critical management questions including the conservation of threatened species, invasive species management and biodiversity monitoring. Our research is highly collaborative, with many industry and academic partners across Australia.

Blanche Cup Spring, South Australia (Photo credit: Nick Murphy)

Freshwater Fish
Australian freshwater systems are under pressure from a multitude of stressors, including changes to flow regimes. To promote the genetic health of vulnerable Victorian fish species, we use highly resolving single nucleotide polymorphism markers (SNPs) and genome sequencing, to investigate the relationship between critical demographic factors (breeding dynamics and dispersal) with environmental watering and fish stocking programs. Our research across diverse species over multiple years is informing water management strategies to develop the best methods for promoting genetic diversity within the Murray Darling Basin.

Invasive Deer
Our research is undertaken in collaboration with ongoing government partnerships aimed at improving deer management, mainly through detection of deer species and assessment of deer connectivity and density across Australia. We use genetic tools to identify deer hybridisation, population size, identify distinct management units, track dispersal and assess deer control methods. We study deer diets to identify effects on native flora and the potential to spread invasive weeds.

Conservation Genetics
Many Australian species are threatened with extinction, and rapid declines can negatively impact the genetic diversity and fitness within the remaining populations. We directly inform endangered and threatened species managers on conservation strategies. We focus on genetic diversity patterns to define species management units and assist with genetic management plans. We have shown there are fitness costs associated with inbreeding in threatened species which can be addressed by incorporating genetics into species management plans (e.g. the helmeted honeyeater - *Lichenostomus melanops cassidix*).

Trace DNA
We study trace DNA for conservation and management of species and ecosystems. We use eDNA techniques to detect single species of conservation importance or species of management interest. We also use DNA metabarcoding to characterize entire communities from both unique aquatic environments for biomonitoring, and from dung samples to characterize diet and food webs to better understand species interactions.

Short Range Endemics
Vulnerable short range endemic species act as bioindicators for the overall health of their ecosystems. We study groundwater dependent and forest litter ecosystems to identify the biodiversity present and understand the ecological and evolutionary impacts of long-term environmental changes and short-term events on dispersal limited species.

Lab Head: Dr Nick Murphy.
ARC DECRA Fellow: Dr Katherine Harrisson.
Lab Members: Ms Erin Hil; Mr Jude Hatley; Mr James O'Dwyer; Mr Zac Billingham; Mr Matt Quin; Ms Jess Taylor.

Fields of Study:
Population genetics; Conservation Genetics; Phylogenetics; Trace DNA; Evolution.

Capabilities and Techniques:
Amplicon sequencing; eDNA; qPCR; Species specific detection; Diet analysis; Metabarcoding genotyping; Next Gen Genotyping (ddRAD, SNP panels); Microsatellites; Bioinformatics; Species delimitation; Phylogenetics; Field sampling.

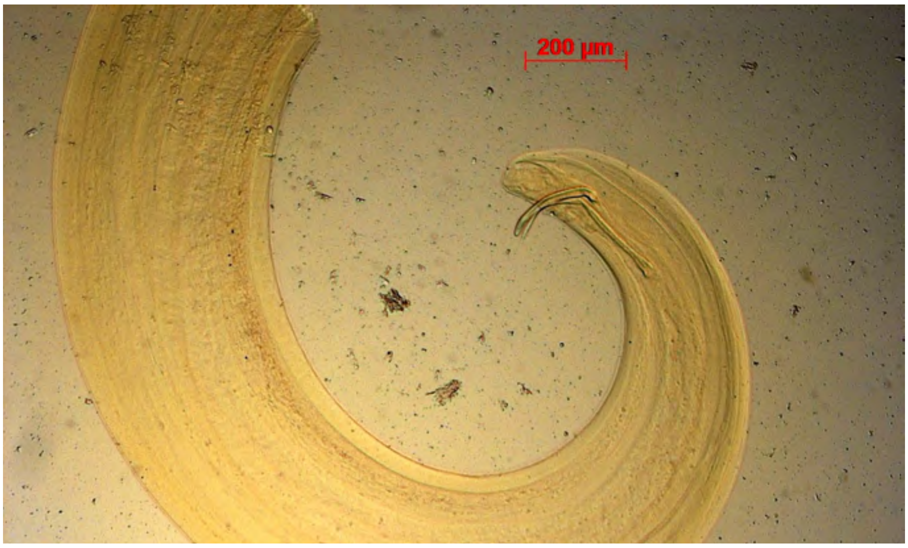
Translational Opportunities:
Threatened species conservation; Invasive species management; Cost effective biomonitoring; Water management.

Nematode Genomics Laboratory

Our research, which involves national and international collaborators, aims to improve our ability to understand and eliminate parasitic nematodes, particularly those that occur in resource-poor settings. We use genetics, genomics, bioinformatics, and mathematical modelling to assess solutions to challenges faced by people at risk of parasite infection.

Population genetics and parasite transmission
Filarial nematodes, which cause onchocerciasis or lymphatic filariasis, are controlled using mass drug administration to as many people in a community as possible. Parasite elimination requires interrupting parasites transmission permanently and requires that drugs are given until transmission stops across the whole transmission zone. We use population genomics of the parasites and their vectors to identify transmission zone boundaries (a transmission zone is the region through which parasites are transmitted, but between which parasite transmission is rare) then combine these genetic analyses with spatially explicit epidemiological models to assess re-invasion risk between zones and inform surveillance once treatment is stopped. Our models aid control programs to decide when and where to safely stop drug distribution.

Ecological genetics of drug resistance in parasites
Anthelmintics are drugs that kill nematode parasites. The evolution of anthelmintic resistance threatens effective control of these parasites in humans and livestock. We investigate anthelmintic resistance mechanisms in a range of laboratory and field systems by identifying genes that are under selection then testing their functions, and have developed sensitive molecular diagnostic tests for changes in these genes in treated populations.



Dog heartworm tail (Photo credit: Haylo Roberts)

Nematodes with unusual life histories: models for the evolution of parasitism
Some nematode genera are unusual as they have both free-living and parasitic life cycles. In *Parastrongyloides* the choice of life cycle is determined by environment at the start of each generation and can be manipulated by cultural conditions. This enables identification of the genetic components of the switch and investigation of the genetic steps that may occur in the evolution of a nematode parasite from a free-living ancestor. We also study the impact of free-living development in the related human parasite, *Strongyloides stercoralis,* on its epidemiology and the evolution of drug resistance.

Host switching, endosymbionts and the evolution of pathogenesis in filarial parasites
Onchocerca volvulus, the cause of river blindness, is the product of a recent host-switch from cattle into humans. *Cercopithifilaria johnstoni,* a native rat/bandicoot parasite, also has a history of recent host switching and similar pathology in its new hosts.

We are using comparative genomics amongst species of to study host- switching and pathogenesis in nematodes, including the potential roles of endosybiont bacteria in filarial worms.

Lab Head: Prof Warwick Grant.

Lab members: Dr Shannon Hedtke; Dr Karen McCulloch; Dr Gowtam Chalasani; Dr Katie Crawford; Ms Mary Awobifa; Mr Ernest Gyan; Ms Kirsty McCann; Ms Ellyse Noy; Mr Haylo Roberts; Mr Himal Shrestha; Ms Neha Sirwani; Mr Jordan Baldacchino.

Fields of Study:
Evolution; genomics; epidemiology; parasites; bioinformatics.

Capabilities and Techniques:
Genomics; bioinformatics; DNA-based diagnostic assay development (qPCR/HRM, LAMP); experimental evolution; nematode transgenesis.

Translational Opportunities:
Improved parasite & pathogen detection diagnostic tools; zoonotic human health risk identification; effects of environmental changes on vector transmission potential.

Plant Reproduction and Conservation Genetics Group

Our research is diverse and includes aspects of plant conservation, demography, ecology, reproduction and genetics. Our group has a strong research interest in the conservation genetics of native flora but also undertakes foundational research involving other native plants, and applied studies in relation to weeds and crops. We are collaborative and work with colleagues from other local, national and, at times, international institutions. A variety of techniques are used by the group including traditional field-based ecological approaches and morphological investigations, as well as single gene studies associated with mate choice and massively parallel, next-generation genomic approaches.

Grevillea alpina. (Photo credit: Susan Hoebee)

Unravelling the evolutionary history of an iconic Australian plant genus

Using genetic studies coupled with pollination studies, we aim to identify processes involved in speciation in a group of Australian plants belonging to the genus *Grevillea*. The project is multi-pronged with a phylogenetic component, a narrower population genomics approach and an aspect that combines floral cues and pollination biology. Owing to habitat fragmentation and declining pollinators, identification of the processes underpinning population structure and species evolution will aid conservation management for several taxa. *Collaborators:* Gareth Holmes (La Trobe University (LTU); Royal Botanical Gardens Victoria)

Diversity within the bush food Sweet Quandong

Preliminary studies have shown that in northern Victorian and southern NSW population, Sweet Quandong harbours low genetic diversity, with many stands consisting of single multilocus genotypes. Multiple stems of single genotypes were widely spaced suggesting vegetative growth via root suckers is extensive. Furthermore, there was no geographic structure to the diversity identified.Interestingly some individuals were putatively polyploid (i.e. having more than two sets of chromosomes) – a finding that is consistent with some studies but equivocal with others. Using an array of approaches, we plan to determine if variation in ploidy level of this widely distributed bush food species is more common than is currently recognised. The results will have implications for the bush foods industry, seed production areas and other revegetation programs. *Collaborators:* Linda Broadhurst (CSIRO), Jim Begley (Goulburn-Broken CMA)

New ways to find old mates – rapid identification of sex genes in plants

Approximately 60% of plant species use a self-incompatibility (SI) system to prevent inbreeding caused by self-fertilisation. Although there are many SI systems, only three have been characterised at the molecular level, with the remaining systems very poorly described. Understanding these systems has implications for conservation and restoration programs, as well as weed control and crop and horticultural breeding programs. In this proof-of-concept project, we will identify markers of sexual compatibility by an extension of differential gene expression analysis based on an RNA sequencing approach. This will have broad applications across many plant species with both conservation and agronomic value. *Collaborators:* Anthony Gendall (LTU); Roger Cousens (University of Melbourne)

Other SI related research has been contracted by the Australian Nurserymen's Fruit Improvement Company Ltd.

Lab Head: Dr Susan Hoebee.
Lab Members:
Ms Tamandra (Mandi) O'Dombrain;
Ms Simone Currie; Mr Graham Jury;
Mr Stanislaw Wawrzyczek;
Mr Surendra Bam.

Fields of Study:
Ecology; Evolution; Genetics;
Plant Reproduction; Conservation Biology.

Capabilities and Techniques:
Field skills; Refractometry and Reflectance (with application to floral traits); Standard and High-throughput genomic techniques; Scanning electron microscopy.

Translational Opportunities:
Species conservation, utilisation and/or management; Plant breeding; Genetics for future climates.

Plants and Pollinators Group

We have a broad interest in the ecological and evolutionary consequences of the interactions between plants and pollinators. This topic is critical for understanding the incredible morphological and taxonomic diversity of both flowering plants and nectar feeding animals. Further, in Australia there are many cases of relatively specialised pollination systems, meaning that numerous plants are vulnerable to the loss of pollinators following the extensive modification that the Australian landscape has experienced. Studies of plant-pollinator interactions encompass a range of approaches including field experiments, analysis of plant and pollinator communities, studies of animal behaviour, and molecular approaches. At present, we undertake field research in both south-eastern Australia, and the south-west Australian biodiversity hotspot.

A honeyeater feeding on kangaroo paw, *Anigozanthos flavidus.* (Photo credit: Myles Menz)

Pollination biology in conservation and restoration

Despite widespread concerns about declining pollinator populations, pollinators are rarely considered when attempting to improve the conservation of threatened plant species. In a partnership with the Royal Botanic Gardens Victoria, we have developed a project aiming to optimise the establishment of new populations of threatened orchids based on knowledge of pollination biology. We are also interested in how incorporating pollinators into ecological restoration could lead to greater animal biodiversity and improved plant recruitment in restored landscapes.

The evolution of deceptive pollination strategies in Australian orchids

Australia is home to some of the world's most remarkable orchids, many of which use deceptive pollination strategies. This includes orchids that mimic rewarding flowers, but also species that attract male insect pollinators through mimicry of females. We aim to understand how deceptive strategies evolve, which floral traits attract pollinators, and how the evolution of deceptive pollination strategies has affected diversification of orchids. Through collaboration with Australian and overseas scientists, our research has already led to the discovery of new sexually deceptive systems and the chemicals involved in pollinator attraction.

Understandingtheecologicalandgenetic consequencesofpollinationbyvertebrates

The Australian flora is characterised by numerous plants pollinated by vertebrates, including many of our most iconic plants. Our research has focused on testing the hypothesis that, for floriferous shrubs and trees, pollination by birds rather may lead to greater pollen dispersal and more fit seed. However, many Australian plants that appear to be pollinated by birds or mammals are morphologically specialised understory species. Until now, the consequences of vertebrate pollination for this intriguing group of plants remains essentially untested, inspiring this to become a new research focus for our group.

Floral adaptations to pollination niches

As a requirement for plant reproduction, pollination is a critical component of a plant's ecological niche. We are interested in using plant-pollinator networks as an objective way of recognising groups of ecologically similar pollinators that could represent pollination niches. Having recognised such niches, we aim to test the role of visual and chemical cues in attracting these pollinators. This represents a potentially powerful new approach for understanding floral adaptation and how this might affect co-existence in plant communities.

Lab Head: Dr Ryan Phillips.

Lab Members:
Mr Stan Wawrzyczek; Mr Tobias Hayashi.

Fields of Study:
Ecology; Evolution; Conservation Biology; Behaviour; Restoration Ecology.

Capabilities and Techniques:
Field experiments; Behavioural observations; Plant-pollinator networks; Spectral reflectance analysis; Camera trapping,; DNA barcoding.

Translational Opportunities:
Species conservation; Ecological restoration; Threatened species recovery; Invasive species management.

Riverine Landscapes Research Group

Our group, located in the Centre for Freshwater Ecosystems, has expertise in spanning hydrology, spatial modelling, GIS, ecology, ecosystem science, molecular and genetic techniques and has strong links to industry and research partners in Australia and worldwide. We study interactions between the physical environment, (climate, hydrology, fire and land-use), and how these affect ecological patterns and processes across the landscape, including species distributions, population dynamics, connectivity and food-webs.

The effects of climate-variability and change on species distributions

Australia has extreme patterns of interannual climate variability and frequent drought. We use field and modelling approaches to relate aquatic ecosystems species distribution to water stress, hydrology, fire, climate change and other physiographic variables. Our predictions of potential future shifts in species range, abundance and occupancy are combined with conservation planning models to prioritise areas for protection and targeted management interventions. We work with Melbourne Water and the University of Melbourne to develop the Habitat Suitability Models for stream and wetland fauna around Melbourne, and we are monitoring the 2020 bushfires impacts on the nationally endangered Alpine Stonefly (*Thaumatoperla alpina*).

Ecohydrology of intermittent stream networks

Up to 80% of river networks worldwide experience regular periods without surface flow. Dry period water habitats can contract to isolated waterholes along river channels which become critical refuges for aquatic biota. In human modified landscapes, sedimentation, groundwater extraction and runoff catchment interception cause declines in refuge quality and quantity. We study surface-groundwater interactions and food-web structure within individual waterholes, as well as, catchment hydrology roles roles determining waterhole persistence and metapopulation structure and dynamics

Aquatic biodiversity conservation and management

Freshwater ecosystems account for around 10% of global biodiversity, but are declining at a rate far exceeding terrestrial or marine ecosystems. We study the ecology and fundamental biology of aquatic biota, including threatened species and other significant species of management interest (e.g. fishing target species); with the goal of improving management decisions and actions for these species. Our research includes evaluating and improving conservation strategies for threatened species, threatened species detection and distribution, and assessment of population viability through modelling. We are currently compiling genetic databases of freshwater invertebrates to map species distribution and use DNA metabarcoding to assess biodiversity and inform conservation measures.

Aquatic ecosystem processes and food-web ecology

Our research explores how ecosystem processes (such as nutrient cycling, decomposition) and food-webs (ecosystem energy and matter flows) are influenced by human induced threats. We study how environmental change (such as altered river flows) affects connectivity, ecological processes and the trophic structure of aquatic food-webs. Our research, under field and laboratory conditions, often includes experimental manipulation in many aquatic ecosystem types.

Theme Head: Prof Nick Bond.
Theme Members: Assoc Prof David Crook; Assoc Prof Alison King; Dr Luke McPhan; Dr Nicole Thurgate; Dr Michael Shackleton; Dr Andre Siebers; Dr Julia Mynott.

Fields of Study:
Ecology; Hydrology; Landscape Ecology; Ecosystem Science.

Capabilities and Techniques:
Quantitative modelling: spatial, GIS, population models; Species-distribution; Environmental hydrology; Food-web ecology (stable isotopes use; Molecular techniques (population genetics, eDNA).

Translational Opportunities:
Water resources management and policy; Catchment management; Climate change impact and mitigation; Environmental impact assessment; Habitat restoration; Spatial prioritisation and conservation planning.

Water Geochemistry and Landscape Evolution Group

The Water Geochemistry and Landscape Evolution Group studies processes that affect groundwater composition, including acidic drainage at mines, and the landscape evolution of eastern Australia.

Acid lagoon, Murray River near Mildura. (Photo credit: John Webb)

Groundwater composition

Groundwater composition is determined by the interaction between rainwater and the soil and rock through which the groundwater moves. In Southeast Australia, we used major element and isotopic analyses to show that plants alter infiltrating rainwater composition before it reaches the groundwater, by transpiration and the extraction of particular species, e.g. potassium. To understand flood impact, we used high resolution bore water level data in Murray River native red-gum forests to determine the influence of trees and river leakage on the amount and composition of groundwater.

Dryland salinity occurs when groundwater comes close enough to the ground surface to be affected by evaporation, which concentrates salt in groundwater. Salinity impacts large areas in western Victoria, reducing agricultural productivity. Our studies identified climate as the primary factor determining the extent of dryland salinity; during droughts, dryland salinity recedes as groundwater levels drop.

Future northern Victoria rainfall is predicted to decrease and become episodic due to climate change (more rainfall in high intensity storms). The impact of 2010-2011 northern Victorian floods was studied and showed that groundwater recharge during short-lived flooding was high enough to almost negate the preceding years of below-average rainfall. So climate change impact on groundwater resources in this region may not be as negative as first thought.

Acid mine drainage

Acid mine drainage (AMD) is generated when exposed mined sulphide minerals are oxidised, releasing acidity and dissolved heavy metals. AMD must be neutralised before disposal, generating sludge. We studied AMD neutralisation using limestone, particularly anoxic and open limestone drains. We are studying ways to increase the chemical stability (resistance to leaching) of neutralisation sludges to enable safe disposal, and ways of reducing AMD generation from waste rock dumps using cement. AMD often contains large concentrations of copper and zinc. We are developing AMD neutralisation procedures to extract these metals to help offset costs.

Landscape evolution

We study the old and young landscapes of Southeastern Australia: alpine high plains (~200 M years old), beach dunes deposited by an inland sea ~10 M years ago, highlands (uplifted ~5 M years ago) and volcanoes (~2 M years old). Current projects include characterising ancient river systems that flowed north from the highlands and deposited gravels during catastrophic floods. We also study karst landscapes that form on limestone and contain caves with sediments and stalagmites; these record climate impact and surface landscape change, providing landscape development insights.

Geoarchaeology

Our group provides expertise for worldwide archaeological projects to help understand landscape evolution and human settlement interactions, e.g. ~5 K years ago, an earthquake near the Dead Sea in Jordan made a previously fertile area uninhabitable by removing access to water. Our expertise has aided projects on hornfels artefacts and ochre in Tasmania and explained the location of aboriginal silcrete quarries in Queensland.

Lab Head: Assoc Prof John Webb.
Lab member: Dr Susan White.

Fields of Study:

Water Geochemistry; Acid Mine Drainage; Landscape Evolution; Geoarchaeology.

Capabilities and Techniques:

- Water analysis (major elements);
- Mineralogical & chemical rock analysis;
- Grain size analysis.

Translational Opportunities:

- Better remediation of acid mine drainage.

About La Trobe University

Our Mission

Advancing knowledge and learning to shape the future of our students and communities.

Our Vision

To promote positive change and address the major issues of our time through being connected, inclusive and excellent.

Our Values

Our early reputation as a radical and challenging institution continues to influence the way we enrich the experience of our students and engage with our partners and communities.

We were founded half a century ago to broaden participation in higher education in Melbourne's north and, later, in regional Victoria. We have succeeded for many thousands of students who would otherwise have been excluded from the opportunities provided by a university education.

We continue to support access, diversity and inclusivity while undertaking world-class research that aims to address the global forces shaping our world and make a difference to some of the world's most pressing problems, including climate change, securing food, water and the environment, building healthy communities, and creating a more just and sustainable future.This approach is based on our values of:

- inclusiveness, diversity, equity and social justice
- pursuing excellence and sustainability in everything we do
- championing our local communities in Melbourne's north and regional Victoria
- being willing to innovate and disrupt the traditional way of doing things.

Of all Australian universities, we are the most successful at combining accessibility and excellence, and have become a place where social inclusion and globally-recognised excellence come together for the benefit of our students, our staff and our communities.

Our academics and researchers achieve national and international recognition, our public intellectuals demonstrate an enduring social conscience and influence, and our alumni achieve extraordinary success and impact in government, industry and not for profit organisations.

We strive to be exemplars for the sector in our commitment to gender equity and to inclusivity for marginalised groups; and we work with indigenous peoples and organisations to support their social, cultural and economic aspirations.

We embrace sustainable practices across all our campuses because we are committed to improving environmental, social and economic outcomes for our communities.

We contribute to economic development for our local communities, and our future activity will increasingly be international as we become a globally connected university in everything we do.

Our Culture

La Trobe Cultural Qualities

Our cultural qualities underpin everything we do. As we work towards realising the strategic goals of the University we strive to work in a way which is aligned to our four cultural qualities:

Connected

- We are Connected: Connecting the students and communities we serve to the world outside

Innovative

- We are Innovative: Tackling the big issues of our time to transform the lives of our students and society

Accountable

- We are Accountable: Striving for excellence in everything we do. Holding each other to account, and working the highest standards

Care

- We Care: We care about what we do and why we do it, because we believe in the power of education and research to transform lives and global society.

About Victoria and Melbourne

Experience Melbourne

Melbourne is the capital of the state of Victoria, and Australia's second largest city. It's a multicultural hub with 4.5 million people from over 153 countries. It's one of the world's best sporting cities, and is Australia's art and culture capital. Melbourne is a safe, well-serviced city in which to live. The main campus of the University at Bundoora is close to many world class hospitals, schools, research centres, shopping centres, bike paths and parklands. Melbournians enjoy, affordable healthcare, world-class education, reliable infrastructure, business opportunities and a healthy environment. In Melbourne you'll find just about every cuisine: French, Italian, Spanish, Greek, Chinese, Malaysian, Indian, Thai, Japanese, Moroccan and lots more. Melbourne has over 100 art galleries as well as theatres, international and local opera, ballet, comedy and live music.

Each year Melbourne hosts major international sporting events like the Australian Open Grand Slam tennis tournament, the Formula One Grand Prix, the Rip Curl Pro surfing championship, the Australian Masters golf tournament, the Melbourne Cup and the Grand Final of Australian Rules Football. As well as over 2500 festivals and events including the Melbourne International Arts Festival, Melbourne International Film Festival, Melbourne International Comedy Festival and the Melbourne Spring Racing Carnival.

Find out more: https://liveinmelbourne.vic.gov.au/discover

La Trobe University Campuses in Australia

Each of our seven campuses (Melbourne, Albury-Wodonga, City, Bendigo, Shepparton, Midura and Sydney) is a unique expression of place, people and history that play an important role in social, cultural and economic life. We are located in Victoria's major regional cities, creating a unique network of research, industry and innovation expertise that can be accessed across the state.

Victoria: The Garden State

Victoria has many notable gardens and 36 national parks covering two and a half million hectares. Victoria's many attractions include the Great Ocean Road, (stunning coastal views and the world-famous Twelve Apostles), the Grampians and the High Country.

Find outmore: visitvictoria.com

Melbourne Campus

La Trobe's Melbourne Campus has 27,000+ students and is surrounded by bushland. Students from across the world take advantage of state-of-the-art facilities, including our AgriBio Research Centre, the La Trobe Institute for Molecular Science and our very own Wildlife Sanctuary.

Albury-Wodonga Campus

La Trobe's Albury-Wodonga Campus has 800+ students and is home to our leading regional research centre, the Centre for Freshwater Ecosystems which focuses on water science and policy of the Murray-Darling basin. Here, undergraduate students work alongside Honours and research students on local issues.

School of Agriculture,
Biomedicine and Environment,
La Trobe University