Centre for Freshwater Ecosystems

Masters and PhD Information

2023/2024

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Introduction

The Centre for Freshwater Ecosystems (CFE) brings together a wealth of expertise to understand and solve significant challenges to support the sustainable management of freshwater ecosystems.

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

Our mission is to lead the way for healthy and sustainable freshwater ecosystems through innovation and excellence in research and education. Research themes pursued by the centre include:

- Ecosystem monitoring and assessment
- Environmental biogeochemistry and contaminants
- Environmental and social policy
- Fish ecology and management
- Genetics and conservation
- Invertebrate community ecology
- Quantitative modelling and forecasting
- Spatial modelling and GIS analysis
- Water management
- Wetland and floodplain ecology
- Impacts of climate change on aquatic systems

Further information available at https://www.latrobe.edu.au/freshwater-ecosystems

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Masters and Doctor of Philosophy (PhD) Research Programs

A Masters or Doctor of Philosophy (PhD) allows you to pursue an independent and sustained investigation into a research problem (of your own design) that makes a significant and original contribution to knowledge in the context of professional practice.

Before you apply for graduate research candidature you must identify a potential supervisor and receive in-principle approval for your research project. You can search for a suitable supervisor by browsing the research and training scholars at La Trobe.

Once you have in-principle approval from your supervisor you should then submit an application. Information on the application process

Graduate Research Scholarships

Find out information on the types of scholarships you can apply for as a graduate researcher at La Trobe

Further information on Scholarships

Potential Research Topics

Please note: Each topic listed below can be scaled and adapted for masters or PhD studies.

Quantifying productivity and fish growth rates across different habitats.

Many fish species have a short critical period after hatching when appropriate food densities must be available to allow survival. With increasing pressure on water-managers to use limited volumes of water wisely for the environment, environmental water is increasingly being used to manipulate water levels in channels and in wetlands to support fish recruitment. This project will investigate what habitats need to be inundated to maximise zooplankton production and associated productivity to support of fish-recruitment. This will quantify the relationship between flow and zooplankton emergence from channels, perennial wetlands and intermittent wetlands sediments. Without this information, river managers will be unable to ensure there is sufficient larval fish-food to support recruitment following spawning under differing environmental flows.

Contact: Professor Nick Bond

Fish use of floodplain habitats?

A critical question in Australian river management—and indeed river management around the world—is: how does allocating water to floodplains affect the mean fitness of aquatic animal populations? Dominant theoretical frameworks of freshwater science contend that many fishes of river-floodplain ecosystems have evolved dependencies on floodplain access, but anecdotal evidence indicates that there is much uncertainty concerning the role floodplain habitats play in the population dynamics of freshwater fishes. The PhD project will focus on deciphering the significance of floodplain habitats to fish populations of the Murray-Darling Basin. This project will involve melding field and laboratory studies to compare and contrast the relative effects of floodplain and channel habitats on individual- and population-level fitness.

Contact: Professor Nick Bond

Altered flow regimes, indicators and the restoration of socioecological systems.

Water is the world's most important resource. Climate change and other perturbations threaten the biodiversity, ecological integrity and societal interactions with all water bodies including rivers, wetlands, and smaller water bodies such as springs and farm dams.

Macroinvertebrates play a key role in aquatic foodwebs and often show early signs of impact or response to management actions where longer-lived indicators may be less affected. Both structural and functional changes to macroinvertebrate communities can help identify impacts on ecological integrity and responses to restoration activities.

Government agencies across the world have a long history of utilising macroinvertebrates in their monitoring programs due to their convenience of capture and response to changes in water quality, yet often use little of the information they can provide.

There is a need to further assess and synthesise the structural and functional changes that occur as a result of altered flow regimes. Elucidating the functional traits that are affected, liking to survival strategies, such as resistance and resilience, will help to identify appropriate management techniques.

This project will use both data held in public repositories as well as the design of experiments relating to management actions either in the laboratory or field.

Contact: Dr Sally Maxwell

Effects, importance, and management of farm dams in socioecological systems

Farm dams are ubiquitous across agricultural systems, particularly in areas with small streams. They have multiple social values including amenity, irrigation and stock and domestic supply. They also provide lotic (non- flowing) habitat for aquatic species including plants, invertebrates and fish. However, the provision of lotic habitat often comes at the expense of lentic(flowing) habitats within the small streams they are fed from. The socioecological trade offs being made, particularly under a changing climate, are poorly understood.

This project aims to assess the social and biodiversity values provided and impacted by farm dams and develop recommendations for management of these systems under a changing climate.

Contact: Dr Sally Maxwell

How is eDNA transported through river systems?

Environmental DNA (eDNA) is rapidly being adopted as a non-invasive and relatively cheap methods for detecting species in auatic ecosystems. However, there are multiple potential factors that can influence the reliability and interpretability of eDNA data. Among these is the distance over which eDNA travels through different environments. This project will investigate the relationships between eDNA concentration, river structure and eDNA transport. It will link into a larger ARC funded program investigating the distributions and meta-population structures of coastal fish.

Contact: Professor Nick Bond or Dr Michael Shackleton

Quantifying distribution and effect of invasive trout in alpine headwater streams.

Field sightings confirm that introduced trout are now located beyond natural barriers in headwater streams of the Victorian alpine region. Areas upstream of these barriers are likely to have become refuges from trout predation for many aquatic organisms and the recent invasion of trout may pose a risk to local populations of macroinvertebrates and galaxiid fish. This project will determine the extent of any potential trout incursions into alpine refuge streams using a mix of environmental DNA detection and traditional sampling techniques. The project also aims to assess the effect of trout density on native fauna by characterising the community composition of macroinvertebrates and the density of galaxiids in water variably impacted by trout.

Contact: Dr Michael Shackleton

Environmental DNA can be a useful tool for conducting freshwater bio-assessments.

Conventionally, universal probes, designed to capture genetic material from many taxa, have been used for eDNA -based community analyses. However, many of the organisms traditionally targeted in freshwater bio-assessments are often missed when using universal probes on eDNA. This is primarily due to the abundance of, and bias towards detecting, non-target organisms. What is required is a suite of probes that target selected groups of freshwater organisms.

This project would investigate, develop and test taxa-specific probes for use on Australian freshwater fauna.

Contact: Dr Michael Shackleton

Flow alteration and the ecotone between aquatic and terrestrial environments

Climate change impacts on aquatic systems are becoming systemically apparent. Cease to flow periods are increasing and the timing of peak and low flows, as well as ambient temperatures, are being altered. As the timing of flow in rivers changes, the nature and timing of interactions with the terrestrial environment are also changing.

Both plants and invertebrates are recognised as essential components of foodwebs and the importance of associations between invertebrates and plants has long been recognised. However, there is a paucity of information about the interaction between aquatic and riparian communities and how they respond to changes in temperature and the timing and duration of flow.

This project aims to look at the effects of altered flow regimes on the interactions between aquatic and terrestrial environments including the integration of emerging aquatic invertebrates. This project will examine changes in invertebrate communities and their consequences for biodiversity and ecosystem services.

Contact: Dr Sally Maxwell

Enhancing landscape scale outcomes for threatened small-bodied wetland fishes.

The status of small-bodied, wetland fishes has undergone rapid decline in the thirty years, with many species now listed as Threatened under both State and National legislation. Restoration and recovery activities to protect existing and breed and release fish into new locations have both seen varied results, with little consolidation of success or factoris limiting their success. Reintroductions have also focussed on localised sites (e.g. one wetland), whereas recovery goals need to be at much larger scales. This PhD project will elucidate the driving factors controlling the success or failure of previous reintroductions, and will undertake meta-population modelling to explore fish outcomes of various reintroduction scenarios.

Contact: Professor Nick Bond

Disentangling taxonomically cryptic species.

Archaeophylax are Australias largest caddisfly. Two species are currently recognised, with one of these, A. ochreus, occurring across mountain ranges in Tasmania, Victoria and New South Wales. Preliminary DNA evidence suggests that, rather than two species, there are likely more than eight species with many existing as short-range endemics on Australian mountain peaks.

This project would update the taxonomy of Archaeophylax using molecular and morphological techniques, and where appropriate establish new species in this family.

Contact: Dr Michael Shackleton

Thermal niches of aquatic invertebrates.

As small-bodied ectotherms, invertebrates are highly susceptible to changes in temperature and the distributions of invertebrate species are largely driven by their thermal tolerances. Understanding how invertebrates are likely to respond to warming climates is critical for appropriate management of invertebrate populations. This project will investigate the fundamental and realised niches of aquatic macroinvertebrates. The project will involve collecting field data, undertaking respirometry experiments, and mining and utilising data held in public repositories. It will help to develop a better understanding of how thermal niches and climate determines macroinvertebrate distributions and how these distributions are likely to change under projected climate change scenarios.

Contact: Dr Michael Shackleton

Flow response of floodplain vegetation in the southern Murray Darling Basin.

Globally, floodplain vegetation communities have been heavily impacted by altered flow regimes due to river regulation and water extraction for off-stream use. These impacts are likely to be exacerbated under an increasingly variable climate. Recently developed models of floodplain vegetation condition by researchers at the Centre for Freshwater Ecosystems (CFE Albury-Wodonga, La Trobe) use state-and-transition models to model the dynamic ecological response of vegetation communities to variable hydrologic conditions we have refined. This model would then be used to simulate alternative future scenarios of floodplain vegetation under a changing climate with higher flow variability.

Contact: Dr Luke McPhan and Professor Nick Bond

Freshwater turtle conservation and ecology.

Freshwater turtles have declined in the Murray-Darling catchment by 70-90% since the 1970s. Invasive red foxes appear to be the major threat, because they destroy turtle nests before they can hatch. The project aims to test the effectiveness of novel conservation approaches for protecting turtle nests from foxes. At the same time, it will provide the opportunity to design new projects aimed at furthering understanding of turtle and freshwater ecology. Hatchling and juvenile turtle ecology is a particularly understudied area, with many opportunities for critical research. The project extends across the southern Murray-Darling basin, and so provides a number of opportunities for natural experiments to test hypotheses about factors that impact on freshwater turtle recruitment. The project also provides a number of opportunities for working with on-ground partners, including land managers, water and agricultural industries, Traditional Owners, and citizen scientists.

Contact: Dr James Van Dyke