

# Department of Environmental Management and Ecology and Murray-Darling Freshwater Research Centre 2009 potential research projects

## *Food Web Research*

### **Experimental dietary manipulations for determining the importance of different food resources to shrimp & other freshwater consumers. (Mid year intake Project)**

The understanding of the relative importance of the potentially numerous organic matter sources and the nature of linkages within riverine-floodplain food webs is poorly understood. This deficiency prevents a thorough understanding of ecosystem functioning and hampers attempts to manage the freshwater component communities. Shrimp are a dominant component of riverine-floodplain food webs and play an important role in many aquatic ecosystems, influencing food web structure and function through alterations in sediment cover, the processing of leaf litter and detritus, grazing and predation, and as prey for fish and waterbirds. However, despite their abundance and ecological significance, research on shrimp has mainly been limited to studies of the distribution or aspects of biology and ecology of adult shrimp whereas studies on shrimp productivity are limited. This study plans to investigate the effect of food type on shrimp productivity. Our chosen species will be *Paratya australiensis* a common species of lowland rivers and standing freshwater bodies. This study will focus on laboratory feeding trials. Laboratory trials will examine feeding shrimp & possibly other freshwater consumers in the laboratory on different food types such as macrophytes, chironomids, algae, leaf litter (*Eucalyptus* and/or willow) to compare how growth rates (i.e. productivity) differ on different food resources. In addition we will examine shrimp & possibly other freshwater consumers food preferences by giving a choice of different food items to the consumer. By understanding the role of shrimp within riverine-floodplain food webs we can better understand the dynamics of food web processes. This will therefore allow us to improve the management of our important freshwater resources. In addition, this study will contribute greatly to our understanding of shrimp diet which is largely missing in the Australian riverine-floodplain literature.

Supervisors: Dr Sally Hladyz, Dr Amina Price & Dr Daryl Nielsen MDFRC (02 60582300)  
[info@mdfrc.org.au](mailto:info@mdfrc.org.au)

### **The influence of landuse on food resources for aquatic biota in the Mitta Mitta catchment.**

Basal food resources (algae, biofilm and terrestrial litter) in stream food webs vary widely in their quality and quantity in response to the surrounding catchment characteristics. These resources are a major determinant of the higher order biotic communities and may structure the species diversity, abundance and function. Landuse within the catchment can have major implications on the quality and quantity of these basal resources. Landuse can impact on the basal resources through altered vegetation and riparian zone composition and cover, altered inputs of particulate and dissolved organic matter, increased sediment loads, altered nutrient status and direct physical disturbance due to direct access to streams by stock. Therefore, these altered resources may impede growth, reproduction, and maintenance of the biotic communities. This project proposes to assess the quality and quantity of these primary food resources and examine food web linkages to macroinvertebrates in un-impacted forested streams and heavily impacted agricultural streams in the Mitta Mitta catchment. This will help determine how land management practices may impact on the riverine environment.

Supervisors: Dr Sally Hladyz MDFRC, Dr Rob Cook MDFRC & Dr Ben Gawne MDFRC (02 60582300) [info@mdfrc.org.au](mailto:info@mdfrc.org.au)

### ***Crayfish & Fish Ecology***

#### **The physiological requirements of spiny crayfish.**

Crayfish species' distributions are often determined by altitude and these boundaries may be changing due to climate change. Using state of the art equipment recently purchased by the MDFRC, we will measure the oxygen and temperature requirements of several crayfish species, which should allow us to make predictions about the potential impact of climate change on their future distributions.

Supervisors Dr Susan Lawler, Senior Lecturer LTU (02 60249874) [s.lawler@latrobe.edu.au](mailto:s.lawler@latrobe.edu.au) and Dr Rick Stoffels, MDFRC (02 60582300) [info@mdfrc.org.au](mailto:info@mdfrc.org.au)

#### **The impact of land use on spiny crayfish and their symbiotic flatworms.**

The Buffalo River, south of Myrtleford, flows through pristine habitat, cattle yards and pine plantations. The river contains several different species of crayfish all of which have several species of symbiotic worms called Temnocephalans. We will attempt to quantify the impacts of different land uses on these endemic fauna.

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#### **Wetland preferences of a threatened freshwater fish, the southern pygmy perch, *Nannoperca australis*.**

The southern pygmy perch is becoming increasingly rare in wetlands throughout SE Australia, but no-one really know why. In fact, we do not even know which floodplain wetlands pygmy perch prefer. Preliminary observations on the Ovens floodplain imply that pygmy perch prefer wetlands with specific characteristics, but inferences are anecdotal and these systems await scientific investigation. This Honours project will determine wetland preferences of pygmy perch on the Ovens floodplain, an area where these fish are still reasonably abundant.

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#### **Diet overlap between brown trout and blackfish in small montane streams.**

There is much speculation about the impact introduced trout have on native fishes. Some have suggested that introduced trout compete with two-spined blackfish for food, but there is little scientific evidence for this. This Honours project will utilise a range of techniques to compare the prey preferences of these two species in small montane streams.

Supervisors Dr Rick Stoffels, MDFRC (02 60582300) [info@mdfrc.org.au](mailto:info@mdfrc.org.au), Dr Susan Lawler, LTU (02 60249874) [s.lawler@latrobe.edu.au](mailto:s.lawler@latrobe.edu.au) or Dr Phil Suter, LTU (02 60249889) [p.suter@latrobe.edu.au](mailto:p.suter@latrobe.edu.au) or Dr Peter Pridmore, LTU (02 60249887) [p.pridmore@latrobe.edu.au](mailto:p.pridmore@latrobe.edu.au)

## ***Seabird Ecology***

Impact of fire management and invasive weeds on breeding success in Short-tailed Shearwaters (Great Dog Island, Tasmania) – examination of fire histories used by indigenous muttonbirders, GPS work

Population biology of Short-tailed Shearwaters on Phillip Island – population size, breeding success, etc.

Pair-bond duration and divorce in Short-tailed Shearwaters (Fisher Island, Tasmania) – using the 63 years of data (extensive computing)

Role of successional vegetation on the breeding success of Pacific Gulls (Goose Island, Tasmania) – monitoring changes in nest-side vegetation from September to Christmas on a very remote island (NO TRIPS OFF FOR FOUR MONTHS)

Breeding success of roof nesting Silver Gulls (Melbourne) – need to be very fit and willing to undergo tons of OH&S training with the port authorities

Stress hormones, carotenoids, immunocompetence and chick survival in Silver Gulls (Hobart and Flinders Island) – collection of fresh eggs from colonies and monitoring growth

Population biology of invasive Kelp Gulls – population estimates, diet and pathogen transfer through major urban tips (Hobart)

Supervisor: Dr Catherine Meathrel, LTU (02 60249875) [c.meathrel@latrobe.edu.au](mailto:c.meathrel@latrobe.edu.au)

## ***Population Ecology***

### **Role of waterbirds on nutrient movements in wetlands**

My honours students have been involved in one of two major areas, seabird ecology and population ecology (everything from heavy metals and soil bacteria to pest birds and kangaroos). Both areas involve extensive field work; the seabird work at remote locations requires first aid training and a boat license.

Supervisor: Dr Catherine Meathrel, LTU (02 60249875) [c.meathrel@latrobe.edu.au](mailto:c.meathrel@latrobe.edu.au)

### **Habitat requirements of a rare burrowing lizard.**

*Aprasia parapulchella* is a rare (?) worm-lizard (family Pygopodidae) which is occasionally found in rocky areas on the nearby hills. It shelters under rocks and in ant tunnels in the soil beneath them. Its food is most likely primarily ants and termites. Little is known of the species' ecology, and the primary objective of this study will be to document the physical and biotic parameters of its habitat and its population ecology. This will entail monitoring of the temperature and humidity at sites of known occurrence, characterising the nature of the surface cover and soil substrates at these sites, documenting what other species are present, and marking the *Aprasia* for individual recognition. An integral part of the study will be construction of a much more complete map of the local distribution of the species. All of this will constitute essential base line information for possible future management of threatened populations of the lizard.

Supervisor: Dr Dennis Black, LTU (02 60249873) [d.black@latrobe.edu.au](mailto:d.black@latrobe.edu.au)

## ***Systematics***

Morphological and molecular investigations on the still water (wetland and pool) inhabiting mayflies in *Cloeon* or *Centroptilum* (Ephemeroptera : Baetidae). Current state of knowledge recognises 5 species of *Cloeon* and 2 species of *Centroptilum* but this is clearly an under-estimation of these widespread genera. In addition both genera are cosmopolitan but it is hypothesised that the Australian animals are worthy of separate generic status. This project would enable identification of local and interstate species using both morphological and molecular techniques, and by comparison with overseas data determine the placement of the Australian species.

Morphological and molecular investigations on the mayfly genus *Tasmanophlebia* (Ephemeroptera : Oniscigastridae). Current state of knowledge recognises 3 species from mountain streams, but at least 8 different morphological taxa have been recognised based on the nymphs only. This project would enable identification of local and interstate species using both morphological and molecular techniques.

Alpine Stoneflies – How do you get 13 species of adults from 5 species of nymph? Within the Family Gripopterygidae there are recognised 13 species of adult stoneflies in the Falls Creek area. However, there are only five different nymphs recognised from streams in the same region. Why? Using molecular and morphological techniques on both adult and nymphal material these questions may be answered, along with potential conservation status of the species present and not to mention climate change!

Any other aquatic insect group (eg. caddisflies, dipterans) where there is a good knowledge of the adult life stage but poor knowledge of the larval forms.

Supervisors: Dr Phil Suter, LTU (02 60249889) [p.suter@latrobe.edu.au](mailto:p.suter@latrobe.edu.au) and Dr Jeff Webb.

## ***Alpine Ecology***

### **Water inputs – groundwater, rain and snow**

Groundwater physical and chemical composition – variations between sites, over full year timescales and over longer time scales (fire recovery effects).

Isotopic composition: e.g.  $^3\text{H}$  for determining water origin (obvious), age and aquifer volume – climate change susceptibility.

Rain and snow composition and variability – variations between snow events, changes in snow pack with age, variability in rain composition with season (?), during rain events, during electrical storms.

Runoff composition and variability.

Supervisors: Dr Ewen Silvester, LTU (0260249878) [e.silvester@latrobe.edu.au](mailto:e.silvester@latrobe.edu.au), Mr Martin Fussell, LTU (02 60249876) [m.fussell@latrobe.edu.au](mailto:m.fussell@latrobe.edu.au), Dr John Webb LTU Bundoora, Dr John Pengelly MDFRC and David Dunkerley Monash.

### **Wetland (peatland) chemical processes**

Nutrient regulation – variation in nutrient removal efficiency between different wetlands (type, vegetation, condition).

Organic carbon export (gauged systems) – amount, type, discrete molecules (e.g. uronic acids), buffering (charging) properties.

Peat characteristics – Temperature (full year) / chemical / mineralogical / hydrological.

Microbial and algal communities associated with peatlands and different bryophyte communities.

Quickflow – baseflow separation (urgent).

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### **Acquisition and transformations of aquatic carbon - longitudinal**

Peatland vs. runoff carbon (storm response) – characteristics.

Fungal / bacterial transformations in water bodies associated with peatlands: role of internal (autochthonous) and external (allochthonous) sources.

Identification of vegetation biomarkers (stable molecules) – water origin.

DOC buffering characteristics – seasonal, catchment position, flow.

Bryophytes and associated biotic assemblages (fungi, protozoans, algae and macroinvertebrates) in alpine to sub-alpine streams.

Role of Bryophytes and external leaf inputs in nutrient dynamics (acquisition and retention) of alpine streams.

Supervisors: Dr Ewen Silvester, LTU (0260249878) [e.silvester@latrobe.edu.au](mailto:e.silvester@latrobe.edu.au) and Dr Phil Suter, LTU (02 60249889) [p.suter@latrobe.edu.au](mailto:p.suter@latrobe.edu.au), Dr John Pengelly, MDFRC (0260582300) [info@mdfrc.org.au](mailto:info@mdfrc.org.au) and Dr Gavin Rees, MDFRC (0260582300) [info@mdfrc.org.au](mailto:info@mdfrc.org.au)

### **Wetland (peatland) ecology**

Macroinvertebrate – physico-chemical associations (who lives where, and why).

Macroinvertebrate food sources above the treeline compared with below the tree line.

Unique habitat associations: – Snowpatch vegetation and macroinvertebrates;  
Macroinvertebrate emergence (life cycle / natural history).

Relationship between the aquatic biota (macroinvertebrate communities mainly, but not exclusively) in Alpine bogs and alpine streams with spatial chemical and physical changes.

Supervisors: Dr Ewen Silvester, LTU (0260249878) [e.silvester@latrobe.edu.au](mailto:e.silvester@latrobe.edu.au) and Dr Phil Suter, LTU (02 60249889) [p.suter@latrobe.edu.au](mailto:p.suter@latrobe.edu.au), Dr Rob Cooke, MDFRC (0260582300) [info@mdfrc.org.au](mailto:info@mdfrc.org.au) and Mr John Hawking, MDFRC (0260582300) [info@mdfrc.org.au](mailto:info@mdfrc.org.au)

### **Stream ecology - longitudinal**

Stream macroinvertebrate community changes associated with changes in altitude, chemical, physical and food supply. *Raison d'etre* etc.

Catchment condition assessment.

“Pristine” reference data – Big river catchment.

Microbial changes along stream length associated with nutrient sources.

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### **Long term fire effects on alpine invertebrates in grassland and heathland.**

Major fires in the Falls Creek alpine region in January 2003 had in some areas devastating, but usually patchy effects on grassland and heathland habitats. Some monitoring of the effects of the fires on the terrestrial invertebrate fauna has been carried out, and there is some evidence that while diversity in the burnt grassland sites has recovered fairly well, the heathland sites will take much longer to recover. This project will involve invertebrate pitfall trapping in already identified burnt and unburnt grassland and heathland sites. Particular invertebrate taxa (e.g. spiders, bugs, beetles & ants) will then be selected for analysis of diversity to identify the effects of the fires after six years. Much of the work will involve sorting and identification of the 'catch' in the lab. A mid-year start is necessary for this project.

Supervisor: Dr Dennis Black, LTU (02 60249873) [d.black@latrobe.edu.au](mailto:d.black@latrobe.edu.au)

### ***Lowland Stream Ecology***

#### **Active or passive drift – What makes microfauna move in lowland rivers**

Microfauna (rotifers and microcrustaceans) are important biotic components of lowland rivers. Recent research by Nielsen, Ning and others have indicated that microfaunal communities within slackwaters are diverse and abundant and that communities within the main channel have similar diversity but with lower abundance

The aim of this project is to determine if zooplankton actively move out of slackwaters into the main river channel or whether dispersal is passive with animals being washed out by changing flows.

Supervisor: Dr Daryl Nielsen, MDFRC (02 60582300) [info@mdfrc.org.au](mailto:info@mdfrc.org.au)

#### **Macroinvertebrates in Slackwaters**

Recent work on the micro-invertebrates has shown the importance of the backwaters (slackwaters) in lowland streams, and their contribution to the supply of food to larval fish. It is hypothesised that the backwaters are also important for juvenile macroinvertebrates which may also provide a food supply to the larval fish. The project will investigate the habitat use of selected insects from lowland streams and investigate if they change the habitat throughout their life cycle with early instars in the slackwaters and later instars in flowing/main channel habitats.

Supervisor: Dr Phil Suter, LTU (02 60249889) [p.suter@latrobe.edu.au](mailto:p.suter@latrobe.edu.au) and Dr Daryl Nielsen, MDFRC (02 60582300) [info@mdfrc.org.au](mailto:info@mdfrc.org.au)

## ***Floodplain/Wetland Ecology***

### **The Good, the Bad and the Ugly – germination of aquatic plants and microfauna from dormant propagules from wetlands within different watering histories.**

Yanga National Park, on the lower Murrumbidgee floodplain, has a range of wetlands that have known flood histories. These flooding histories have produced wetlands where the biota are in good, poor and extremely stressed states. By studying wetlands with different (and extreme) flood histories we can determine how long a wetland can remain dry before depletion of the dormant seeds and eggs occurs.

Dormant seeds and eggs bank are capable of persisting for 10 years without flooding. After 10 years there will be a loss of both diversity and abundance of plants and microfauna emerging once sediment is re-wetted



Supervisors: Dr Daryl Nielsen , Dr Gavin Rees and Dr Darren Baldwin, MDFRC (02 60582300) [info@mdfrc.org.au](mailto:info@mdfrc.org.au)

### **Leaf litter breakdown in seasonally inundated floodplain wetlands**

Industry demand for water in the Murray-Darling Basin and subsequent river regulation has resulted in changes to the timing of flows and floodplain wetland inundation. This seasonal reversal of inundation (from spring prior to regulation, to summer) has led to changes in wetland ecosystem functioning, including the transfer of energy from resources such as leaf litter to the food web.

This project will address the question of how organic matter processing in floodplain wetlands is altered by seasonal changes in the timing of wetland inundation. It will involve assessing rates of decomposition in spring- and summer-inundated wetlands, and relating this to ecosystem functioning such as the presence of macroinvertebrate consumers.

Supervisors: Dr Sally Hladyz, Dr Susanne Watkins & Dr Daryl Nielsen, MDFRC (02 60582300) [info@mdfrc.org.au](mailto:info@mdfrc.org.au)

### **Dispersal of dormant propagules (eggs and seeds) by birds (and other things)**

Recent overseas studies have quantified the transport of invertebrates by birds (and other vectors) however there is limited knowledge of the importance of these dispersal methods to the maintaining populations within wetlands.

This project aims to test the hypothesis that birds contribute to the dispersal of dormant seeds and eggs between wetlands thus maintaining diversity across the wetland landscape

Supervisor: Dr Daryl Nielsen, MDFRC (02 60582300) [info@mdfrc.org.au](mailto:info@mdfrc.org.au)

### **Measuring Fish Abundance in Wetlands and Relating Fish Abundance to Zooplankton Density**

This project is linked to the project titled “Optimising environmental watering protocols to maximise benefits to native fish populations” that is being carried out by the Murray Darling

Freshwater Research Centre (MDFRC). One of the most important issues in the study of freshwater fish is our inability to accurately estimate exactly how many fish there are in a system. Despite this being a critically important piece of information for scientists and managers alike, to date there exists no comprehensive study to evaluate the relationship between the number of fish collected in a variety of net types and the actual number of fish within a wetland system. As such, the aims of the Honours project are to:

1. Evaluate a range of fish capture techniques as a means of estimating fish abundance in wetlands.
  - The aim of this part of the project is to measure the efficiency of a range of fish nets at different depths and in different areas of the wetland using capture-recapture methods to estimate the probability of capture of a range of fish species.
  - The project will involve field sampling with MDFRC scientists. Nets will be placed in shallow and deeper sections of at least one Murray River wetland. Fish are initially caught and marked (perhaps with a fluorescent dye), and then the number of marked fish caught on subsequent occasions is recorded.
2. Determine whether there is a correlation between fish abundance and zooplankton density.
  - The MDFRC is investigating the relationship between wetting regime and the production of zooplankton and fish in Murray River wetlands.
  - The aim of this part of the project is to determine whether there is a positive correlation between zooplankton density and fish abundance within wetlands.
  - The project will be carried out over one season (spring-summer), and it will involve placing a number of nets within the shallow and deep sections of at least one wetland and recording the number of fish caught and the zooplankton density at each net.

Supervisors: Dr Warren Paul - LTU (02 60249871) [w.paul@latrobe.edu.au](mailto:w.paul@latrobe.edu.au), Dr Peter Pridmore - LTU (02 60249887) [p.pridmore@latrobe.edu.au](mailto:p.pridmore@latrobe.edu.au) and Dr Shaun Meredith – MDFRC

### **Phytoplankton ecology, lakes and wetlands, microbial nutrient cycling.**

Supervisor: Dr Roger Croome, LTU (02 60249872) [r.croome@latrobe.edu.au](mailto:r.croome@latrobe.edu.au)

### ***Community Ecology***

#### **Decompositional ecology of large woody debris.**

A major habitat resource in forests and woodlands is large woody debris, and the quality of this resource determines diversity levels that can be supported. Invertebrate communities associated with woody debris undergo various successional stages during the decompositional processes, which impacts on the small vertebrates that share the habitat. The rates of decomposition and associated succession are dependant on many different environmental factors. There has been very little investigation of the relative importance of woody debris in the context of overall animal diversity levels in forests and woodlands, and even less on the effects of clearing of debris through activities such as firewood collection. Related to this there are various projects possible, such as: comparing diversity levels of key taxa in cleared and uncleared patches; determining what factors influence the "quality" of individual logs as habitat resources; assessing and comparing the habitat value of the debris from different tree species; the effects of dominant species (such as ants or termites) on diversity levels.

Supervisor: Dr Dennis Black, LTU (02 60249873) [d.black@latrobe.edu.au](mailto:d.black@latrobe.edu.au)