UNIVERSITY of OTAGO

Te Whare Wānanga o Otāgo

Department of Zoology
suggested thesis topics for 2018

This booklet contains a list of suggested thesis topics for 2018. If you are interested in doing a project in an area or on a topic that does not appear in this list, please discuss your interests with a member of staff whose research interests are in a similar field. Remember, it is often appropriate to have two supervisors within the department, or one in Zoology and one in another department or government agency.

Zoology – the natural selection

Dr Caroline Beck

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As a developmental biologist, I am interested in how a single cell, the fertilized egg, develops into a complex multicellular organism that progressively acquires the form and function of its parents. It has become apparent that a handful of genetic pathways not only pattern the development of the basic embryo body plan, but that co-option of these pathways in later life can drive appendage formation, tissue repair and regeneration, and even diseases such as cancer. My lab uses mainly amphibian models (Xenopus laevis, the African clawed frog, and Ambystoma mexicanum, the axolotl, to study development and regeneration.

Research in my lab would suit students with a strong interest in molecular biology, embryonic development and genetic engineering. These include, but are not limited to:

- Are limb development and regeneration dependent on activation of transcription factors by retinoic acid?
- Exploring novel strategies for spinal cord regeneration.
- The effect of manipulating extracellular sulfation on limb development patterning.

Professor Phil Bishop

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My main interests centre around amphibian conservation, breeding behaviour and communication and these present good opportunities for MSc and PhD studies. Currently we have 2 species of native frogs (Leiopelma spp.) in captivity at Otago and my frog research group studies their breeding and social behaviour, aspects of amphibian diseases, captive husbandry and conservation management in the field. Others amphibian projects involving citizen science, population monitoring, translocations, predation, behaviour and ecology in New Zealand, Australia, Fiji and Borneo may also be offered.

Emeritus Professor Carolyn Burns

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Carolyn's research interests centre around biological processes in lakes, particularly trophic interactions, microbial food webs and plankton ecology. Her current research focuses on:

(i) the effects of land development and climate change on Otago lakes of recreational and conservation value,
(ii) the trophic transfer of fatty acids in freshwater plankton and their use as tracers,
(iii) water bloom formation and management,
(iv) behaviour and life history strategies of freshwater crustaceans, related to invasive species.

Professor Gerry Closs

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My research covers a range of topics in the area of freshwater and estuarine ecology, with a more specialist interest in ecology and biology of freshwater fish. Currently, I am particularly interested in the factors influencing the life histories of fish and invertebrates, particularly in relation to migration and dispersal, and early life history.

Current and recent projects include:

- Life history and population dynamics of amphidromous fishes.
- Early life history and larval ecology of amphidromous fishes.
- Life history and population dynamics of salmonids, particularly brown trout.
- Ecology of mysid shrimps.
- How do fish recognise each other?

Visit my webpage for an overview of my research interests (http://www.otago.ac.nz/zoology/staff/otago008918.html). I am interested to receive expressions of interest and research proposals from students at any level of postgraduate study.

Professor Alison Cree

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My primary interests lie in the effects of temperature on reproduction of terrestrial ectotherms, especially reptiles. Current and recent projects that I have supervised or co-supervised include studies on the thermal suitability of Orokonui Ecosanctuary for reintroduction of tuatara, variation in life-history with altitude in common geckos, reproductive cycles in skinks and the use of endocrine tools for assessing sex and reproductive condition in frogs. I would be interested in discussing potential BSc (Hons), MSc and PhD topics for 2018 relating to the effects of temperature and climate on reptiles of the Otago region.

Dr Stephanie Godfrey

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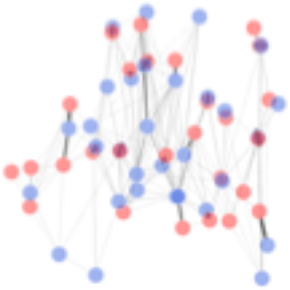
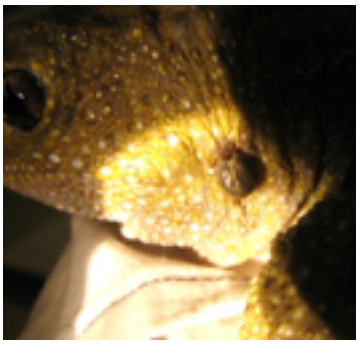
My research focuses on the ecology of host-parasite interactions in wildlife, and specifically, the role of animal behaviour in the transmission of parasites. I am interested in how individual behaviour can shape the transmission of infections through wildlife populations, and I use network models to understand what factors that shape these transmission pathways. I mainly work with field-based systems involving both reptilian and marsupial hosts, but I am open to discussing opportunities with other systems. Currently, I am interested in exploring three key areas around this research theme:

- **Infectious personalities**. Personality is a major source of behavioural variation in wildlife populations, yet we have little understanding about how it shapes the transmission of parasites. Do 'bolder' personality types have a more important role in parasite spread (e.g. superspreaders) than 'shyer' individuals? How does the composition of personality types in a population shape transmsision networks? Are there feedbacks between personality type and parasite infection?



- **Perturbing networks**. Most of our understanding of how networks influence parasite transmission is based on static representations of hosts and parasites, yet these networks are frequently used to predict dynamic responses to management manipulations. I'm interested in developing projects that empirically test the resilience of networks to perturbations (both 'natural' perturbations or experimental manipulations), and their consequences for parasite transmission.

- **Parasites in conservation.** I am interested in developing projects that examine how conservation management activities (e.g. translocation, supplementary feeding, etc) impact the transmission of parasites (through changes to host behaviour). In particular, I am interested in how we might manipulate transmission pathways during conservation activities to conserve parasites (where they are of conservation value themselves), and whether this conveys any benefits to conservation programs.



Dr Travis Ingram

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My research addresses questions related to individual specialisation, food web ecology, and evolutionary ecology. My research group works mainly with freshwater species, and uses a combination of field studies, mesocosm experiments and ecological and evolutionary theory. More information about our work can be found at http://www.otago.ac.nz/ecoevotago/

1. **Causes and consequences of individual niche specialisation** (MSc/PhD) Individuals within a population often differ in their diet, habitat use, and behaviour. My research group is investigating how niche specialisation in multiple ecological dimensions related to species interactions and food web structure.

2. **Local adaptation of freshwater fishes** (MSc/PhD) Native New Zealand fishes such as galaxias and bullies are affected by environmental factors including trout introductions, environmental gradients and catchment structure. I am interested in whether these factors drive evolutionary change, and whether there are consequences for species' ecological function.

3. **Macroevolution of New Zealand's biota** (MSc/PhD) I have developed methods for using phylogenies (evolutionary trees) to ask questions about evolutionary radiations, such as the extent to which traits are affected by either convergent evolution or divergence during speciation. These and related methods could be applied to diverse groups of species in New Zealand and around the world.

Dr Jennifer Jandt

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I am interested in the behavioral ecology of social insects and the evolution of social behavior – particularly in wasps, bees, and ants. Most behavioral research is conducted in the field, but there are many opportunities to engage in lab work to study how behavior, development, and social environment correlate with physiological and genomic factors.

Environmental influences on bee behavior

Bumble bees play an important role in New Zealand pasture pollination. They nest in the ground, but are also sold commercially for use in greenhouse pollination. How does the development of the individual and the colony differ between bees that nest in the ground outside, and those that can be purchased? Are there differences in how well these colonies care for brood or collect food?

Personalities of individuals and colonies of social insects

Animals, not just people, can have different personalities. Using paper wasps (colony sizes are relatively small, and they do not construct a nest envelope so individuals are easy to see), I ask: (a) Do individuals within a colony have different personality types? If so, how do they develop those differences? (b) Do colonies within a population have different personality types? And (c) How does the mixture of individual personalities within a colony or colony personality type affect colony fitness?

Evolution of Sociality and the Invasive Yellowjacket

The German yellowjacket, while obnoxious and invasive, can provide insight into the evolution of social behavior. Like honey bees, yellowjackets nest in large colonies with a single queen. Also like honeybees, brood can develop into small, non-reproductive workers or large, reproductive new queens. However, unlike honey bees, yellowjackets do not use a sophisticated method to recruit nestmates. Instead, they use cues (e.g., the scent of a rich food source) that they experience inside the nest. Given what we know about the similarities and differences in the social structure of yellowjacket wasps, papers wasps, and honeybees, we can ask (a) How do interactions between brood and adults differ as the colony season progresses or as workers begin rearing new queens? Which aspects of these adult behaviors actually influence larval development? (b) How do interactions among adults change as the colony season progresses? How does this vary with food availability or the amount of brood in the nest?

Dr Sheri Johnson

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My primary interests lie in behavioural and reproductive ecology, with a particular focus on sexual selection, parental effects, mating system evolution, and the effects of environmental challenges on behaviour.

Transgenerational epigenetic inheritance (MSc/PhD)

Parents influence their offspring in multiple ways, but recent studies have highlighted the role of non-genetic (epigenetic) pathways. The life-history challenges experienced by parents, particularly fathers, may be transmitted via epigenetic marks that may play an important role in the fitness of subsequent generations. Using zebrafish as a model, we are investigating how three environmental challenges (toxins, hypoxia and predator-induced alarm cues) affect fitness parameters over multiple generations. Other environmental challenges/aspects can also be explored in zebrafish or other species.

How early life experience affects behaviour later in life (Hons/MSc/PhD)

Numerous studies have investigated how different experiences affect animal personality, but few have explored how early life experience can affect behavioural traits later in life. Triplefin fishes are an ideal model for this as females lay clutches that can be separated for different exposures. Also, males provide parental care for ~10 days – how does the level of parental care affect offspring behaviour later in life? Other species/ environmental challenges could also be explored.

Effects of environmental challenges on weta behaviour (Hons/MSc/PhD)

Our native invertebrates come in contact with various insecticides, pesticides and herbicides and while it is common to explore how these affect invertebrate survival, very few studies have explored the subtler effects on behavioural traits. For example, how do rodent baits, that weta eat, affect activity, exploration, aggression?

Associate Professor Mark Lokman

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My research focus is centered around (the endocrine control of) reproduction in teleost fish and the evolution of endocrine systems related to steroid hormone synthesis in echinoderms and osmoregulation in basal tetrapods. I also have a vested interest in aquaculture (including integrated systems). Where relevant, molecular tools are (can be) used to address research questions.

Main themes:

Growth vs reproduction (MSc / PhD)
Previtellogenic oocyte growth, a growth phase that has been overlooked in teleost fish, notably contributes to the formation of a fertilizable gamete. For example, lipid uptake starts well before puberty commences and lipids are well-known as important determinants of egg quality. My group has been pioneering the use of ovarian cultures to understand how lipids may make their way into the growing egg. We have complemented this by application of ~omics technologies: large-scale sequencing of protein or RNA to understand how and when genetic cascades may be (in)activated in relation to oocyte development.

Metamorphosis (Hons / Postgrad Dip / MSc)
The eel life cycle is characterized by a stunning migration from freshwater feeding grounds to a distant oceanic spawning area. The migratory journey is a physiological challenge and requires that the eels undergo numerous physiological adaptations, for example, to becoming endurance 'athletes'. In my group, a suite of projects over the years have implicated the steroid hormone 11-ketotestosterone in driving these physiological adaptations – but despite notable research efforts, the origins (tissue) of this steroid hormone, and the endocrines that stimulate its synthesis remain unknown. A fascinating challenge….

Echinoderm reproduction (Hons / MSc / PhD)
Deuterostomes are subdivided between two key taxa: the chordates and the echinoderms. Much less is known about the biology of echinoderms than that of vertebrates. We recently isolated two vitellogenins (yolk protein precursor molecules) in echinoderms – a major stepping stone to help us understand where these vitellogenins are produced, and opening avenues towards understanding what controls their synthesis. Can this sister taxon to the vertebrates be valuable as an indicator species for ecotoxicology, perhaps through measuring vitellogenin gene expression?

Aquaculture (Hons / MSc / PhD)
Aquaculture has been amongst the fastest growing primary industries in the world – and expansion of the industry in NZ is more topical than ever. For the industry to grow, a variety of issues requires attention: full control of reproduction and larval rearing, species diversification and new systems that focus on sustainability and responsible use of resources (both in terms of ecology and use of animal feeds). Possible topics are endless – it's a matter of sitting down and taking one's pick.

Dr Christoph Matthaei

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I am an Aquatic Ecologist with a long-standing passion for experimental design and statistical data analysis. My research interests include the following areas:

1. Disturbance ecology in streams and rivers
2. Effects of human land use activities on running water ecosystems, especially impacts of agriculture and multiple stressors, also water abstraction and other flow regime changes (environmental flow ecology)
3. Invasive species in aquatic ecosystems
4. Estuary ecology
5. Pond ecology and life history strategies of aquatic insects
6. Ecology of shallow lakeshores

I will be happy to discuss potential research projects in any of these areas.

For an overview of my publications, please see my Google Scholar Profile at http://tinyurl.com/cd-matthaei-scholar

For photos and information about recent or ongoing collaborative research in New Zealand and overseas, please see:
https://picasaweb.google.com/otagostreamteam
http://genestream.de/english/

Associate Professor Mike Paulin

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How do animals move so smoothly and efficiently? In contrast, why are robot movements so … robotic? We know that the cerebellum plays a key role in animal agility, but it is not clear exactly what its role is. It is also clear that the mechanical design of organisms has a lot to do with their agility. In my lab we build computer models – virtual animals – to combine data at different levels, from neurons to mechanics and behaviour. These models are used to test theories about animal agility and cerebellar function, to develop design principles for agile robots, and virtual creatures for applications in computer gaming and animation.

Currently we have a virtual shark, a virtual spider and a virtual dog.

Some student projects are entirely computational, but others involve experiments and observations on neurophysiology, mechanics and behaviour of animals. We have access to high quality motion capture and high speed video for kinematic analysis. Recently we've looked at sharks, spiders, bees and dogs, but just about any animal – agile or not – could be a useful subject for this research. We collaborate with neurophysiologists, physicists, mathematicians and engineers in NZ, USA and Japan. Generally I am willing to consider (co-)supervising any project that applies computational models in biology.

Professor Robert Poulin

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My interests include all ecological, behavioural and evolutionary aspects of host-parasite interactions, in all animal taxa. In particular, I'm currently interested in the role of parasitism in the maintenance of biodiversity and community structure in intertidal ecosystems. Most intertidal molluscs and crustaceans harbour parasites that either directly increase their mortality or reduce their growth, or indirectly modify their phenotype. These present ideal opportunities for field and lab studies appropriate for BSc Hons, MSc or PhD degrees.

Other areas of current interest include: the evolution of alternative transmission routes in trematode parasitic in NZ freshwater animals; the evolution of parasitism and host exploitation strategies; biogeography and diversity of parasitic lineages; the evolution of host specificity; the population genetics of parasites.

Dr Nic Rawlence

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Several projects on birds, marine mammals, fish, and plants are available in these research programmes, integrating next-generation molecular techniques (ancient DNA and environmental DNA), with palaeontological methods (morphological analysis and radiocarbon-dating of fossil remains), and have funding from Marsden (2017-2020).

Testing for fisheries-induced evolution using DNA from ancient and modern snapper.
(BSc Hons/MSc/PhD)

Industrial-scale fishing has become such a powerful anthropogenic evolutionary force that it could be causing fish to mature earlier and at a smaller size. This research programme will test for directional selection on the New Zealand snapper genome using a comparison of ancient DNA retrieved from preindustrial bone samples, excavated from prehistoric NZ middens, and samples from heavily-fished modern stocks. This approach will enable us to determine whether there has been a genetic component to shrinking fisheries stocks. The research will address a fundamental question about humans as an emerging evolutionary force, and could help preserve the long-term future of fisheries stocks.

Do glaciers drive diversity: using ancient DNA to retrace the history of New Zealand's biodiversity.
(BSc Hons/MSc/PhD)

Glaciers are traditionally seen as destructive forces for biology. By contrast, intriguing new evidence emerging from temperate glaciated mountains, including New Zealand's Southern Alps, implies that glaciation may have been a key evolutionary force driving diversification. Using ancient-DNA of animals and plants from multiple time-series of bones and sediment cores covering the past 50,000 years, including the Last Glacial Maximum, this research programme will test the hypothesis that glaciers generate biodiversity along our Southern Alps. This research will answer fundamental questions about speciation and the underlying mechanics in real time, as well as the role of glaciers in shaping current biodiversity patterns.

Extinction and colonisation: The fauna of prehistoric New Zealand (in collaboration with Professor Jon Waters)
(BSc Hons/MSc/PhD)

The New Zealand region is home to a unique and highly endemic array of animal species. However, much of our prehistoric biodiversity was rapidly lost as a result of human arrival. Many species went extinct, and others now have highly fragmented ranges. This research program seeks to reconstruct the biology of prehistoric New Zealand, and to better understand the biological impacts associated with human colonisation.

Palaeoecology of the endemic New Zealand King Shag and Kohatu Shag.
(MSc)

New Zealand's endemic King Shag (Leucocarbo carunculatus) has occupied only a narrow portion of the northeastern South Island for at least the past 240 years. However, pre-human Holocene fossil and archaeological remains have suggested a far more widespread distribution of the three Leucocarbo species (King, Otago, Foveaux) on mainland New

Zealand at the time of Polynesian settlement in the late 13th Century CE. The King Shag was formerly widespread around southern coasts of the North Island and the northern parts of the South Island but experienced population and lineage extinctions, and range contraction, probably after Polynesian arrival. This history parallels range contractions of other New Zealand seabirds. Moreover, combined genetic, morphometric and osteological analyses of prehistoric material from mainland New Zealand suggest that the now extinct northern New Zealand Leucocarbo populations comprised a unique lineage. Although these distinctive populations were previously assigned to the King Shag (based on morphological similarities and geographic proximity to modern Leucocarbo populations), they represent a new species, the Kohatu Shag (Leucocarbo septentrionalis). The extinction of this species further highlights the dramatic impacts Polynesians and introduced predators had on New Zealand's coastal and marine biodiversity. The prehistoric presence of at least four species of Leucocarbo shag on mainland NZ further highlights its status as a biodiversity hotspot for Phalacrocoracidae.

However, there is still much that is not known about the pre-human distribution, genetic diversity and palaeoecology of the King and Kohatu Shags. This research programme will involve new palaeontological excavations of Northland sand dune fossil deposits (in collaboration with Auckland Museum and local iwi) and re-analysis of North Island palaeontological/archaeological collections, as well as ancient DNA, isotopic and morphological analysis of King and Kohatu Shag bones.

Associate Professor Bruce Robertson

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My research takes an integrative approach to investigating behavioural ecological, evolutionary, wildlife management and conservation biology and genomics questions using New Zealand native species, including the kakapo Strigops habroptilus and the NZ sea lion *Phocarctos hookeri*. I also have research interests in invasive species management. My research group employs various molecular genetic and genomic techniques, laboratory and field based experiments, observations and analyses to examine issues such as sex allocation, mate choice, heterozygosity-fitness correlates, parentage, mating systems, bioacoustics, immunocompetence, identification of management units, genetic population structure, phylogeography, and phylogenetic affinities.

Current projects in my research group include:

- Mate choice, reproductive behaviour, ageing, and conservation genomics of the kakapo *S. habroptilus*.
- Role of animal personality in silvereye speciation.
- The genetic basis of exploratory behaviour of kea *N. notabilis*.
- Genetic basis of disease susceptibility in the NZ sea lion.
- NZ parrot *Mhc* genes and immunocompetence.
- Conservation genetics of the kea, rock wren, white-chinned petrels, black billed gulls, black fronted terns and kokako.
- Reproductive behaviour, paternity and genetic population structure of the New Zealand sea lion *P. hookeri*.
- Phylogenetic affinities of diving-petrels.

These projects (or aspects of them) are appropriate for BSc Hons, MSc or PhD degrees. Please also contact me if you have a project idea aligned with my other research interests.

Dr Marc Schallenberg

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Marc is a Research Fellow who studies freshwater and brackish systems - mainly lakes and coastal lagoons. He has studied over 80 lakes and lagoons in New Zealand, from Northland to Campbell Island. His main research interests are in: 1. freshwater ecology especially in relation to pollution, climate change and invasive species 2. reconstructing environmental histories from lake sediment cores (Environmental CSI) and 3. understanding important but often overlooked ecosystem services provided by lakes and lagoons. Marc often co-supervises students interested in lake projects with Prof. Carolyn Burns. To find out more about Marc's research, check out his Zoology Department webpage http://www.otago.ac.nz/zoology/staff/otago008970.html

Potential postgraduate research topics include:

Freshwater ecology
• How can we measure the ecological resistance of lake ecosystems? Which organisms and processes confer ecological resistance against anthropogenic perturbations such as eutrophication, climate change and invasive species?
• Can we clearly define and identify ecological feedbacks that are beneficial or detrimental to maintaining lake health? How can we act to strengthen the beneficial feedbacks and break the detrimental feedbacks?
• How does invasive, nuisance "lake snot" (mucilaginous macroaggregates) affect the food webs of some of our most pristine lakes?

Environmental CSI by looking at lake sediments
• Prior to human arrival in New Zealand, did the higher densities of marine mammals and birds add substantial marine nutrient subsidies to coastal lakes?
• What can micro- and macro-fossils of organisms preserved in lake sediments tell us about the prehistorical conditions of lake ecosystems?

Lake ecosystem services
• Can the manipulation of fish biomass in lakes create a trophic cascade leading to higher zooplankton densities, resulting in fewer algal blooms?
• To what extent do water fleas (Daphnia sp.) and native freshwater mussels (*Echyridella* sp.) increase the assimilation capacity of lakes for nutrient pollution from agricultural sources? What are the pollution thresholds which threaten these beneficial organisms in shallow lakes?

Professor Philip Seddon

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Phil is Director of the Postgraduate Diploma in Wildlife Management, and his research interests therefore relate to the management and restoration of threatened species and habitats.

My primary research interests and current collaborations relate to species translocations, including reintroductions and conservation introductions.

There is potential for student projects at MSc and PhD levels that would be run in collaboration with colleagues in the Department of Conservation and Crown Research Institutes relating to seabird ecology, especially penguins, to the spatial ecology of mammalian pests, and to the restoration of native species.

Professor Liz Slooten

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Liz's research interests include population biology and population models for estimating the risk imposed by human impacts on animal populations. Her research focusses on the environmental impacts of fishing, in particular the effects of fisheries bycatch on marine mammal populations. Liz may be able to supervise one more student providing there is a strong overlap between their research interests and hers.

Professor Hamish Spencer

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Hamish's research involves the application of mathematics and computing in population biology, especially population genetics. He is also interested in the molecular phylogenetics of several animal groups, including molluscs and birds, and the use of phylogenetic trees in the interpretation of patterns of biodiversity. He is happy to discuss any ideas you might have for research projects in these areas. Recent research projects include the population genetics of genomic imprinting and the phylogeography of kauri snails and intertidal molluscs.

Models for the Evolution of Plasticity (BSc Hons, MSc, PhD)
Phenotypic plasticity is the ability of a single genotype to give rise to different, appropriate phenotypes in different environmental conditions. Mathematical models for the evolution of plasticity have recently been developed that reveal the sorts of conditions that favour the evolution of plasticity. This project would involve expanding some of these models, especially to situations in which the plastic response occurs a long time after the environmental cue.

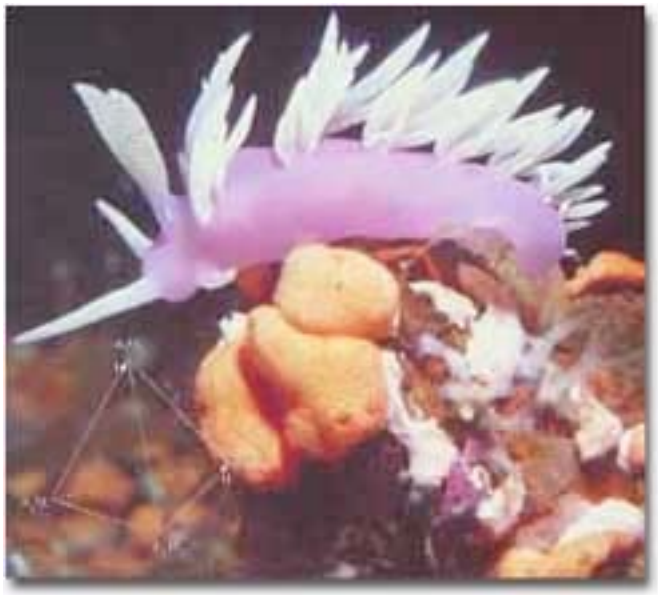
Mathematical Models that Maintain Genetic Variability (BSc Hons, MSc, PhD)
One of the central questions in population genetics is "Why do we observe so much genetic variation in populations?" This project involves constructing computer simulation models of various forms of natural selection and assessing their ability to maintain variation.

Phylogeny of Australian and New Zealand Molluscs (BSc Hons/MSc)
Several groups of Australian and New Zealand molluscs display interesting biogeographic patterns. Some examples are the small limpets of the genus *Notoacmea* and the sponge-eating tiger shells, *Calliostoma*. This project would involve sequencing a portion of the mitochondrial DNA and using these results to estimate genetic differentiation within species and the phylogeny of the chosen group. It could be expanded into a PhD thesis with the inclusion of related overseas taxa. This topic requires no maths background.



Population-level consequences of genomic imprinting (BSc Hons/MSc/PhD)
Genomic imprinting describes the non-Mendelian phenomenon in which the sex of the parent passing on the genes affects that gene's expression. Imprinting has been implicated in a number of human genetic diseases, e.g. Huntington's chorea and fragile-X syndrome. Although there is a large body of work on genomic imprinting, there is less published concerning its population genetics. This project would involve constructing novel (yet simple) models to describe the effects of various kinds of imprinting on populations. Prospective students should enjoy working with equations. Alternatively, more complicated models could be simulated on computer.

Models of Population Epigenetics (BSc Hons/MSc/PhD)
There is much more to inheritance than just genes. It is becoming very clear that various modifications to genetic materail - so called "epigenetic marks" can sometimes also be inherited. This project involves constructing mathematical models analogous to those in population genetics. Students should enjoy working with equations.



Associate Professor Yolanda van Heezik

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My interests fall into two main research strands, urban ecology and penguin ecology, although I am involved in a wide variety of projects concerning terrestrial ecology. In the urban environment I am interested in spatial ecology and resource selection of wildlife, biodiversity of private spaces, and factors determining distributions and abundance of different species across cities. More recently my urban research has included social dimensions, investigating attitudes and values of the public towards biodiversity and mapping children's independent encounters with biodiversity in relation to its availability using spatial tools. I'm also interested in bird feeding and its impacts on wild populations.

My interest in penguins is long-term. Current projects involve collaboration with the Department of Conservation, examining factors influencing lifetime reproductive success and foraging ecology in yellow-eyed penguins, and tourism impacts on blue penguins and yellow-eyed penguins. I'd like to gain a better understanding of yellow-eyed penguin foraging ecology in relation to parent quality, reproductive success and diet.

Professor Graham Wallis

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My research interests include molecular evolution, molecular systematics, genetics of hybrid zones and phylogeography, particularly using endemic fish and insects. In the evolutionary genetics lab, we ask questions about gene flow, population subdivision and species relatedness. We test geological hypotheses and infer evolutionary process using molecular genetic patterns to understand better the evolutionary history of the NZ biota. Molecular approaches that we use include: PCR of mitochondrial and nuclear DNA sequences, DNA sequencing, microsatellite DNA analysis and AFLP analysis, usually in conjunction with morphological and behavioural data and field observations.

I suggest some project titles below, but they can be modified to suit your interests. Joint supervision is welcomed. See my departmental web page for publications in these areas.

Darwinian evolution of a new zona-pellucida domain gene in galaxiid fishes
Contact zones and hybridisation in common river galaxiids
Hybrid zones in alpine weta- the evolution of melanism in relation to ecology
Hybrid zones in cicadas- gene flow in relation to song type
Mixed modes of reproduction in the brittle star *Ophiomyxa brevirima*

If you have an interest in evolution, and would like to combine it with questions in systematics or ecology, come and talk to me!

Professor Jonathan Waters

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Extinction and colonisation: The fauna of prehistoric New Zealand
(BSc Hons/MSc/PhD)

The New Zealand region is home to a unique and highly endemic array of animal species. However, much of our prehistoric biodiversity was rapidly lost as a result of human arrival. Many species went extinct, and others now have highly fragmented ranges. This research program seeks to reconstruct the biology of prehistoric NZ, and to better understand the biological impacts associated with human colonisation.

Several projects are available, integrating next-generation molecular techniques (ancient-DNA) with palaeontological methods (morphological analysis and carbon-dating of fossil remains). This research has funding from Marsden and from the Allan Wilson Centre.

References:
Boessenkool S et al (2009) Relict or coloniser? Extinction and range expansion of penguins in southern New Zealand. Proceedings of the Royal Society B 276:815.

Collins C et al (2013) Prehuman New Zealand sea lion (Phocarctos hookeri) rookeries in coastal New Zealand. Journal of the Royal Society of New Zealand (in press)

Wing-reduction and flight loss in alpine insects - evolution and ecology
(BSc Hons/MSc/PhD)

NZ has a large number of flightless alpine insect lineages. Some widespread stonefly species have populations that have progressivelysmaller wings as altitude increases.
We have several project possibilities looking into the evolutionary and ecological causes and consequences of flight loss in stoneflies. There is scope to include detailed morphological and physiological studies.
This topic has Marsden funding from 2015-2018.

Starting Reference: McCulloch GA, Wallis GP, Waters JM (2009) Do insects lose flight before they lose their wings? Population genetic structure in subalpine stoneflies. Molecular Ecology 18:4073-4087 [doi: 10.1111/j.1365-294X.2009.04337.x]