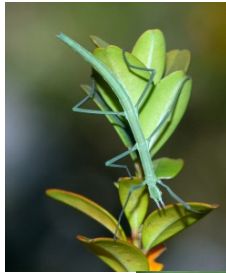


The Joint Graduate School in Biodiversity and Biosecurity Student Seminar Day

Tāmaki Campus Function centre 730 220
(Population Health Building)

Tuesday, 22 October 2013



Entertaining and informative talks, whilst networking

WELCOME

Tēnā koutou,

Welcome to the fourth student seminar day for the Joint Graduate School in Biodiversity and Biosecurity. Combining academic excellence and an industry perspective, the Graduate School is jointly hosted by The University of Auckland's Faculty of Science and Landcare Research as part of the Centre for Biodiversity and Biosecurity. We offer postgraduate students the opportunity to undertake MSc or PhD research to help maintain New Zealand's terrestrial ecosystems and to enable our natural flora, fauna and fungi to flourish. Working alongside key stakeholders will ensure we equip students with the critical skills and knowledge they will need for a successful career in biodiversity and biosecurity.

This seminar day aims to showcase a diverse range of excellent student research from the Joint Graduate School

Hei konā mai



Jacqueline Beggs

Director, Joint Graduate School in Biodiversity and Biosecurity

<http://www.biodiversity-biosecurity.auckland.ac.nz/uoa/>

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PROGRAMME

		Session 1
11:05	Jacqueline Beggs	Welcome
11:15	Shelley Myers	Hybridisation between two species of New Zealand Phasmatodea
11:30	Rachael Sagar	Preparing for translocation: growth, provisioning, meal size and a trial translocation of mottled petrel <i>Pterodroma inexpectata</i>
11:45	Megan Friesen	Sensory ecology of New Zealand petrels: A model for sensory-based conservation
12:00	Twyla MacDonald	A spatially explicit model of the annual movements of the black petrel in relation to commercial fishing operations
12:15	James Brock	Investigating the role of tree ferns in forest succession
12:30-1.15 - Lunch		Session 2
1:00	Craig Simpkins	Population viability of whio (<i>Hymenolaimus malacorhynchus</i>) within the Te Urewera Mainland Island: a spatially explicit individual-based modelling approach
1:15	Emma Feenstra	Four and twenty blackbirds: three methods to control blackbird damage in a semi-enclosed glasshouse
1:30	Emma Bodley	Ecology and pollination of deception New Zealand greenhood and spider orchids
1:45	Erin Kennedy	A spatially explicit approach to assessing and resolving kea-human conflicts
2:00	Paul Battersby	Reproductive ecology of mānuka (<i>Leptospermum scoparium</i>) under various fire regimes
2:15	Corin Gardiner	Trap morphology in the carnivorous plant genus <i>Utricularia</i>
2:30	Jingjing Zhang	A fine-scale time budget of little blue penguins provides insights into the foraging strategies of land-breeding coastal seabirds in New Zealand
2:45-3:15 – Afternoon Tea		Session 3
3:15	Ellery McNaughton	Supplementary feeding practice and patterns of Indian myna (<i>Acridotheres tristis</i>) visitation to feeders on the North Shore, Auckland
3:30	Lena Weissert	Investigating the potential of urban vegetation to mitigate local carbon dioxide concentrations in the Auckland Region, New Zealand
3:45	Justine Atkins	Intrinsic influences on dispersal success in fragmented landscapes: a spatially-explicit individual-based approach
4:00	Patrick Garvey	Foraging Ermine Avoid Risk: Stoats feeding and behavioural responses to the presence of a larger sympatric predator
4:15	Helen Nathan	Ship rat interactions with detection devices
4:30 Onwards		Networking Drinks and nibbles Joined by Auckland Conservation Biologists Network

ABSTRACTS



Deep introgression across two Northland hybrid zones. Has isolation due to geographic distance allowed for *Clitarchus* speciation in Cape Reinga but not on the Karikari Peninsula?

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Supervisors: Thomas R. Buckley, Gregory I. Holwell

The New Zealand Phasmatodea genus *Clitarchus* consists of three species; *Clitarchus hookeri* and two undescribed species. These recently discovered species were found in the northern range of New Zealand, one restricted to Cape Reinga, the other Poor Knights Island. The species are differentiated on the basis of male and female genitalia, egg morphology and mtDNA. Interestingly the populations living on the tip of the Karikari Peninsula are phenotypically the same as the Cape Reinga species; however mtDNA analysis results in a closer shared ancestry to *C.hookeri*. Here we have employed a 14 microsatellite markers to assess the level of admixture across the Cape Reinga- *C.hookeri* hybrid zone, and to work out the origin of the Karikari Peninsula populations which phenotypically look as though they are from Cape Reinga. Our research uses a multi-disciplinary approach involving morphology, behaviour MtDNA and microsatellites to examine the history of gene flow between *Clitarchus* populations.



Preparing for translocation: growth, provisioning, meal size and a trial translocation of mottled petrel *Pterodroma inexpectata*

Rachael Sagar

Supervisors: Brendon Dunphy, Matt Rayner

Petrel colonies play a major role in shaping the ecology of terrestrial communities through the importation of marine derived nutrients and the modification of habitat through burrowing activity. Due to the effects of human-driven habitat modification and introduced exotic predators, many petrel colonies have been extirpated from historical breeding sites. Consequently, re-establishment of seabird populations through translocation is increasingly recognized as a tool to restore lost ecological linkages. In order to develop sound management and provide effective conservation actions, knowledge of a species biology and ecology is required.

Chick growth and development, meal size, and provisioning frequency of mottled petrel, *Pterodroma inexpectata*, on Codfish Island (Whenua Hou) were studied at the end of the 2012, and for the entire 2013 breeding seasons. A trial translocation was performed at the end of 2012 breeding season, to determine the viability of fledging chicks fed the currently accepted artificial diet in the weeks leading up to fledging. Additionally, foraging range in relation to sex was studied using archival light-recording devices throughout the chick rearing period in 2013.

Chick development was slower in 2013 than in 2012, and the 2013 chicks fledged at significantly lower weights than the 2012 chicks (mean weight 290g \pm 25g vs. 348g \pm 30g; $P < 0.001$). Possible reasons for the differences in chick condition between the two seasons will be discussed. Provisioning frequency in mottled petrel is significantly lower than in other *Pterodroma* spp., and most likely related to a novel long-distance niche that has implications for the provisioning frequency of chicks during translocation. Adults ventured below 70° south, to waters as cold as -1.7°C (indicating that they were among the pack-ice) during foraging trips made in the 2013 chick rearing period. This suggests they could play a role as readily accessible sentinel species for Antarctic ecosystems.



Sensory ecology of New Zealand petrels: A model for sensory-based conservation

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Supervisors: Jacqueline Beggs, Anne Gaskett

Seabirds are thought to have evolved unique sensory adaptations as a result of their extreme environments. Tube-nosed seabirds (Procellariiformes) have been at the centre of many of these studies. Their distinct behaviours, such as foraging at great distances from land and returning to their burrows in colonies at night, mean that Procellariiformes rely greatly on chemical and auditory cues. This project has used the Grey-faced Petrel (*Pterodroma macroptera gouldi*) as a model organism to study the sensory adaptations of petrels. Using solid phase microextraction coupled with gas chromatography mass spectrometry analysis, we have been able to form a picture of the composition of the species' odour. Our preliminary results show feather odours exhibiting plant-based compounds specific to nesting material (including terpenes, aldehydes, aromatic hydrocarbons, and others), likely important in mating behaviour. This project ultimately aims to investigate other aspects of this and other petrel species sensory adaptations, and advise management practices for seabirds with an emphasis on the importance of understanding the unique sensory adaptations of the Procellariiform order in conservation.



A spatially explicit simulation model of the annual movements of the black petrel, *Procellaria parkinsonii*, in relation to commercial fishing operations

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Supervisor: Todd Dennis

The black petrel, *Procellaria parkinsonii* is a medium-sized endemic seabird. They breed annually in colonies on Great Barrier Island and Little Barrier Island in the Hauraki Gulf. With a current IUCN status of 'nationally vulnerable', knowledge of the movements and at-sea behaviour of this pelagic seabird is crucial to successfully addressing the major conservation challenge to which it is subjected. Geo-locator data from 32 birds collected over the years 2007 and 2008 (sampling interval – 1-2 fixes per day) were used to develop a spatially-explicit model of the annual movements of the black petrel. Once this was complete, the key aim, the interactions of the black petrel with fisheries was then added into the model.

Statistical analysis using the likes of sensitivity analyses and BehaviourSpace will be carried out in order to identify the extent of interactions between the annual migratory cycle of the black petrels and the: location of fishing efforts; what time during the year fishing occurs; and how intensive fishing operations are, as the main aim is to begin to form an idea of how variations in the placement of commercial fishing areas; and both the intensity i.e. the number of ships and therefore the rate of incidental mortality, and timing of the commercial fishing operations in relation to the annual migratory cycle.

My primary objective is to estimate the greatest at-sea mortality risk as a result of commercial fishing operations. The results of this study will be used to inform the Department of Conservation about the magnitude of petrel-fisheries interactions, and, hopefully, to inform future management strategies for this endangered, iconic member of New Zealand's avifauna.



The role of tree ferns within the native forest of New Zealand as potential keystone species

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Supervisors: Bruce Burns, Bill Lee, George Perry

New Zealand's forests are fragmented, and losses to indigenous vegetation cover are ongoing. These fragments are experiencing plant diversity loss, in part due to the failure of species to successfully establish, and the long-term viability of these ecological islands is decreasing. Effective stewardship and positive management of degraded habitat, along with biodiversity restoration, mitigation and habitat creation projects, requires an understanding of the process of succession and the ecosystem engineers that influence this process. Therefore, identifying ecosystem engineers and understanding their mechanisms of action are critical steps in our ability to restore biodiversity and recreate natural communities. In New Zealand natural forests, tree ferns are a common component of the understory and early successional habitats yet little is known of their roles in influencing overstorey composition, density, basal area, productivity and overall species diversity. In particular the role of tree ferns in succession and regeneration has not been examined as a function of the forest communities. Given the age and ubiquitousness of this group of species, it is considered likely that they will function as keystone species within forest communities. The proposed research will consider the environmental drivers for distribution, establishment requirements of gametophytes, successional communities developing from habitat dominated by *Cyathea medullaris* and interspecific competition between tree ferns, shrubs and tree species. The aim of the research is to provide data to inform the management of forest fragments, to enhance habitat creation proposals and design, as well as to increase the understanding of the influence of tree ferns on the forest ecosystem.



Population viability of whio (*Hymenolaimus malacorhynchos*) within the Te Urewera Mainland Island: a spatially explicit individual-based modelling approach

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Supervisors: Todd Dennis, George Perry

The blue duck or *whio* (*Hymenolaimus malacorhynchos*) is a threatened anseriform endemic to New Zealand that is the focus of an intensive management programme aimed at increasing population numbers and viability. While attempts have been made to quantify the effectiveness of management schemes, little is known about how chance events such as floods and behaviour of individuals affect these schemes. Spatially explicit individual-based models (SEIBMs) provide a means of investigating dynamics of populations while accounting for variation in behaviour of individuals within heterogeneous environments. We constructed a SEIBM to assess population dynamics, and identify key threats to *whio* inhabiting two catchments (Te Waiiti Stream and the Tauranga River) within the Te Urewera Mainland Island, New Zealand. Our SEIBM was parameterised using a 13-year monitoring study and a satellite-tracking investigation of natal dispersal within the area. The model was used to investigate the effects of predation and flood frequencies on the viability of the population. Population size was significantly larger under current predator-management compared to the population under no management. However, the population's mean growth rate was negative, indicating that current management may not be sufficient to ensure long-term viability. Both populations were especially at risk when there was a marked increase in flooding frequency. The Te Waitii population alternated between being a source and sink of individuals from surrounding areas. Under current management schemes the Tauranga River acted as a permanent sink. We recommend that management be expanded to include the Tauranga River, thereby maximising the viability of the populations.



Four and twenty blackbirds: three methods to control blackbird (*Turdus merula*) damage in a semi-enclosed glasshouse

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Supervisor: Todd Dennis

Blackbirds (*Turdus merula*) are a species known globally for their significant impacts on agriculture. Consumption of human food resources by blackbirds is a massive problem worldwide and responsible for considerable economic loss. In New Zealand, blackbirds are invasive pests that ingest a variety of agricultural produce, including grapes, stone fruit, flowers, tomatoes and capsicums. Various control methods have been tried, both nationally and internationally, to reduce bird-damage to human food sources, however, none have been widely accepted or provided long-term success. My research contributes to the search for an effective blackbird control method, by trialling three different methods simultaneously in a 10-ha semi-enclosed glasshouse subject to extensive damage to tomatoes by blackbirds. The glasshouse has been separated into comparable areas that are being used to trial: 1) polarized light 2) curb animal repellent, and 3) a simulated predator-effect. The extent of bird-related damage and the number of birds in the study areas over time will be used to quantify the effectiveness of the three control methods. A successful means of reducing agricultural damage by blackbirds is widely sought and becomes increasingly important as the human population expands, requiring more efficient food production.



Ecology and pollination of deceptive New Zealand greenhood and spider orchids

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Supervisors: Anne Gaskett, Jacqueline Beggs

The Orchidaceae is a highly diverse family of plants that have various mechanisms to attract pollinators and create a pollinator-plant specific interaction. Sexually deceptive species produce scents that mimic those produced by female insects in order to attract male pollinators. In contrast, broodsite deceptive species mimic oviposition odours produced by males to encourage female insects to lay their eggs on flowers. Greenhood orchids are thought to use sexual deceit as they have a trigger mechanism to trap potential pollinators and are thought to only attract male pollinators. *Nematoceras* species are widely believed to be broodsite deceptive. Greenhoods and *Nematoceras* are diverse in New Zealand, but the form and extent to which deception is used is largely untested as orchid pollination rates are typically low and pollinator observations are often very rare. We aim to better understand the pollination of a greenhood orchid, *Diplodium brumale*, and several species of *Nematoceras* by investigating olfactory and tactile pollinator cues via scanning electron microscopy (SEM). For *D. brumale*, we also investigate the phenology, mating system, pollination success, pollen movement patterns and potential pollinators in the field. This will contribute to the understanding of the evolution of deceptive plant-insect interactions, and hopefully resolve whether greenhood orchids are indeed sexually deceptive.



A spatially explicit approach to assessing and resolving kea-human conflicts

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Supervisors: Todd Dennis, George Perry

The kea (*Nestor notabilis*), New Zealand's iconic mountain parrot, is under continual threat of significant population decline due to increasing conflicts with humans. However, little is known about how the kea's patterns of movement, space-use, and activity vary in relation to human influence, and how interactions with humans directly expose kea to conflicts. To assess the extent of kea-human interactions, I will use state-of-the-art animal-telemetry technologies to track the movements of adult and post-fledging juvenile kea. Data provided by GPS and ARGOS satellite devices will enable me to: a) describe the movement patterns of individual kea, especially in relation to anthropogenic threats; b) quantify patterns of behaviour, micro-habitat use, and the extent to which individual kea visit human settlements where conflicts occur; and c) follow the fate of fledglings as they disperse from natal areas. The movement patterns and survivorship of kea will be used to parameterise a spatially explicit individual-based model (SEIBMs) of dispersal, human conflict, and population dynamics. SEIBMs will allow me to ask questions (e.g., how different would kea movement patterns be in the absence of human 'attractors') that are impossible to answer using empirical (field) data alone. SEIBMs also will allow me to conduct 'virtual experiments' and thereby evaluate how conflicts may vary in response to different exogenic factors (e.g., population increase, human development etc.) and inform strategies of proactive and cost-effective management.



Reproductive ecology of mānuka (*Leptospermum scoparium*) under various fire regimes

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Supervisors: George Perry & Janet Wilmhurst

Before human arrival in New Zealand *c.* 750 ybp fire was rare and as a result NZ's flora is not strongly fire-adapted. One exception is mānuka (*Leptospermum scoparium*; Myrtaceae), which likely arrived from Australia 3-5 million years ago and, similar to conspecifics in Australia, possesses serotinous capsules. Serotiny enables plants to store seeds in capsules in seed banks for release post-fire when conditions are favourable for recruitment. I investigated: (i) whether the level of serotiny in mānuka populations is predictable from site-level environment conditions and (ii) the extent to which levels of serotiny might provide a reliable indicator of past fire regimes.

I found a north-south gradient of stronger serotiny in the north compared to southern regions. Serotiny is most prevalent at drier sites where mean annual temperatures are higher and summer rainfall as a proportion of total annual rainfall is lower. These sites are generally located in northern regions, especially on the restiad bogs known to have burned frequently over the Holocene. However, serotiny in mānuka does not appear to provide a reliable indicator of past fire regimes, probably due to inherent inconstancies in the palaeocharcoal record. Flammability was not correlated with serotiny and was minimally correlated with environmental parameters.

Serotiny, as a fire-adaptation, is a strongly conserved trait and NZ's fire regime has probably been enough to maintain it over the Pleistocene/Holocene. The anthropogenic intensification of fire regimes over the last 750 years has probably caused serotiny to become more common in populations of mānuka.



Trap Morphology in the carnivorous plant genus *Utricularia*

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Supervisors: Anne Gaskett, Lubomir Adamec, Judy Sutherland

The bladderworts (genus: *Utricularia*) are carnivorous plants occupying water-logged terrestrial, epiphytic and aquatic habitats. Current phylogenies show the aquatic habit has arisen independently multiple times within the genus. Regardless of lifestyle, bladderworts catch prey with complex suction traps adorned with glandular trichomes, bristles and more developed protuberances called 'appendages'. These aspects of trap morphology are highly variable across the genus as a whole and may evolve in response to a variety of habitat-based physiological demands or foraging strategies. While the role of appendages remains largely untested, those among one speciose, wholly aquatic section of the bladderwort genus, section *Utricularia*, appear to be highly conserved suggesting strong stabilizing selection on their form. Appendage removal from one species in this section results in reduced rates of prey capture. Coupled with observations of prey taxa behaviour, this indicates the structures enhance the probability of a prey encounter by either exploiting the innate feeding preferences of substrate dwelling prey or by providing refuges. Aquatic *Utricularia* spp. are known to vary their investment in carnivory by changing both their trap to leaf biomass ratios and the size distribution of their traps. What environmental factors trigger such changes? If antennae and bristles also represent an investment in carnivory, to what extent is their expression also variable? How persistent are clonal differences in appendage expression in the face of environmental variation?



A fine-scale time budget of little blue penguins provides insights into the foraging strategies of land-breeding coastal seabirds in New Zealand

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Supervisors: Todd E. Dennis, Kathleen M. O'Reilly, George W. Perry

Little blue penguins (*Eudyptula minor*) are well distributed around the coasts of New Zealand and Australia, however, little is known about how their behaviour varies during foraging trips. With the continued improvement of GPS (global positioning system) technologies, animal-borne tracking devices are now small enough to fit on this smallest of penguin species. We used GPS telemetry to track the movements of little blue penguins during the breeding season from Matiu/Somes Island (174°E 41°S) located within the heavily urbanised Wellington Harbour. GPS devices were configured to record locations at a sampling interval of one fix per minute, and thus provided detailed depictions of the movements of individuals over single foraging trips. We then applied 'Behavioural Change Point Analysis' (BCPA) to the observed movement trajectories. This technique identifies 'break points' between bouts of different behavioural states that were classified by unique combinations of inter-fix speeds and turning angles by K-means Clustering model. Results of the BCPA and K-means clustering models suggest that there were three distinct modes of movement behaviour within foraging trips, and that the timing of changes in behaviour was associated with variation in ambient light. Our study presents new information about fundamental biological patterns of little blue penguins, and further demonstrates the value of high-resolution GPS telemetry for study of the behaviour and ecology of marine birds.



Supplementary feeding practice and patterns of Indian myna (*Acridotheres tristis*) visitation to feeders on the North Shore, Auckland

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Supervisors: Margaret Stanley, Jacqueline Beggs, Cheryl Krull

Provision of supplementary food for wild birds by members of the public is a common global practice. In urban New Zealand supplementary feeding practice could be benefiting introduced and invasive bird species such as the Indian myna (*Acridotheres tristis*) at the expense of native species. Questionnaires regarding feeding practice were sent to houses within a 100 m radius of focal properties ($n = 23$) to determine localised patterns of feeding. Footage from wildlife cameras set up at previously established experimental feeders ($n = 11$) was analysed to determine seasonal and daily rates of myna visitation. Fifty-eight percent of respondents ($n=276$) engaged in the practice of supplementary feeding and factors that may influence feeding decision such as property size and social deprivation rank will be discussed. Wildlife camera footage confirmed that mynas are utilising supplementary food and their patterns of visitation will also be discussed. Current supplementary feeding practice may be advantaging Indian mynas over native species and this needs to be recognised when considering guidelines of food provision for urban avifauna in New Zealand.



Investigating the potential of urban vegetation to mitigate local carbon dioxide concentrations in the Auckland Region, New Zealand

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Supervisors: Luitgard Schwendenmann, Jennifer Salmond

Urbanization is taking place at a rapidly increasing rate in New Zealand and worldwide. Urban areas are generally large sources of anthropogenic carbon dioxide (CO_2) emissions. However, attempts to quantify atmospheric CO_2 concentrations and fluxes have suggested that densely vegetated urban areas may absorb sufficient quantities of anthropogenic CO_2 to act as a local sink. Consequently, urban greening programs now form an important part of many urban climate change mitigation policies globally as well as in New Zealand. However, knowledge about the direct contribution of urban vegetation on atmospheric CO_2 concentrations is still limited and measurements scarce with a strong focus on cities in the northern hemisphere. Using a combination of micrometeorological (eddy covariance) and isotopic tracer measurements in an urban and rural Auckland area, local CO_2 fluxes and concentrations and their sources will be quantified. Field campaigns in Auckland urban parks and residential gardens are additionally used to quantify carbon storage and CO_2 efflux from urban soils across a range of urban lawns and forests and to assess the photosynthetic CO_2 uptake of commonly planted tree species in Auckland. This research will provide new insight into, 1) the spatial and temporal distribution of local CO_2 fluxes and concentrations in a city from the southern hemisphere, 2) the CO_2 sources and, 3) the potential of urban vegetation in mitigating local CO_2 concentrations. Such knowledge will be essential to accommodate for the rapid urban growth coupled with increasing greenhouse gas emissions.



Intrinsic influences on dispersal success in fragmented landscapes: a spatially-explicit individual-based approach

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Supervisors: Todd Dennis, George Perry

Dispersal, the ability of animals to move between isolated patches, is a process that is fundamental to our understanding of the dynamics and persistence of meta-populations. Successful dispersal depends on the interactions between the animal and the landscape. Simulation models of terrestrial landscape structure, particularly those considering the extent of habitat fragmentation, suggest that dispersal ability is strongly related to environmental composition and the degree of actual or perceived connectivity among habitat patches. However, much less is known about how the biological characteristics of animals affect dispersal success. Here, I investigate how intrinsic traits of animals, particularly those correlated with body size, influence dispersal success in fragmented landscapes, using spatially-explicit individual-based models. The dispersal success of virtual populations of individuals that exhibit different intrinsic traits is analysed in simulation experiments across a range of fragmentation scenarios. I use *in silico* experimentation methods to assess variation in dispersal success among ‘treatment’ groups defined by different body size related traits. Preliminary results support the well-established notion that habitat fragmentation is a fundamental driver of dispersal ability. Nevertheless, specific analysis of intrinsic traits suggests that the scale at which animals perceive the environment and their speed of movement also have an important influence on dispersal success rate.



Foraging Ermine Avoid Risk: Stoats feeding and behavioural responses to the presence of a larger dominant predator

Patrick Garvey
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Supervisors: Roger Pech, Al Glen, Mick Clout

Interference competition between predators strongly influences the structure and composition of ecological communities. These interactions are usually asymmetrical as larger predators dominate in aggressive encounters. Smaller predators are therefore forced to balance the conflicting demands of obtaining food while reducing the risk of a confrontation.

We tested the behavioural responses of 16 wild captured stoats (*Mustela erminea*) to the presence of two larger predators, the feral cat (*Felis catus*) and the ferret (*Mustela furo*). Stoats were individually released into an outdoor arena and nocturnal activities were recorded on infra-red video cameras. On treatment nights, one of the larger predators was placed inside a segregated holding cage within the arena, while a control cage was placed in the other peripheral pen. A stoats' daily food allocation was divided into two equal portions, one placed in front of each holding cage to form a food "patch". A stoats' perception of risk was assessed by comparing behaviour at the high-risk versus the low-risk areas.

We found that stoats harvested significantly less food, increased levels of vigilance and avoided the area containing the larger predators both spatially and temporally. The results show that stoats alter their foraging behaviour due to interference competition when they encounter larger predators. Understanding trophic interactions is essential when making conservation decisions where mustelids are invasive species. Pest control directed specifically at feral cats and/or ferrets is likely to alter the behaviour of stoats, potentially leading to increased predation on prey species particularly susceptible to stoats.



Ship rat interactions with detection devices

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Supervisors: James Russell, Rachel Fewster, Bruce Warburton

The ability to detect pest animals is fundamental to conservation practice. Detection methodologies are used to monitor changes in population indices, estimate occupancy, determine probability of eradication success and detect incursions on pest-free areas. The results may influence important decisions, such as whether to modify existing pest control strategies or whether deployment of contingency responses to a new invasion is necessary. Yet, factors affecting the probability of successful detection are poorly understood. Effective detection requires animals not only to encounter detection devices, but also to interact with them. Factors influencing encounter rates may include pest density and device spacing, whereas rates of interaction may be more influenced by the attractiveness of baits and lures or an animal's previous experiences. Our research investigates the partitioning of P_d (probability of detection) into its constituent components of P_e (encounter) and P_i (interaction) using the ship rat (*Rattus rattus*) as a model species. We aim to determine factors influencing these probabilities and methods of manipulating these to maximise rat detection. Models predicting optimum choice and landscape distribution of devices will be generated using a simulation study. The models will be informed by data from a field study using marked rats, motion detector cameras and radio-frequency identification (RFID) loggers to determine rates of interaction with devices given an encounter. An optimum control model will be chosen and tested for validity at an alternative field site to determine the general utility of the model for informing rat control programmes across New Zealand.

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