Centre for Biodiversity & Restoration Ecology Graduate Symposium

Thursday 27 April

LBLT118, Laby Building, Kelburn Campus
Victoria University

Schedule

8.30	**Morning refreshments**	
9.00	**Welcome and acknowledgements**	
9.10	**Introducing guest/plenary speaker**	
9.15	***Plenary speaker*** **A/Prof Yolanda van Heezik, University of Otago**	
10.15	**Morning tea**	
People, cities & nature		
10.45	Julie Whitburn	**Meta-analysis of connection to nature and pro-environmental behaviour**
11.00	Christopher Woolley	**Quantifying and restoring lizard faunas in New Zealand cities**
11.15	Sean Rudman	**Experimental games to understand the poaching of wildlife for valuable commodities: Can rhino be saved through horn devaluation?**
11.30	**Poster session & lunch**	
Pest species		
1.10	Justyna Giejsztowt	**Interactive effects of climate change and plant species composition on alpine biodiversity and ecosystem dynamics**
1.25	Michael Jackson	**New long-life semiochemical lures for rats**
1.40	Antoine Felden	**Molecular determinants of risk-taking in the Argentine ant and behavioural variation along an introduction pathway**
1.55	John Haywood	**Long-term wasp population dynamics: spring weather is key in native and invaded ranges, with remarkably similar density-dependent effects**
2.15	**Afternoon tea**	
Biodiversity		
2.45	Charlie Clark	**Climate niche shifts do no predict plant trait change through time**
3.00	Laura Kelly	**Factors affecting toxin production in *Phormidium***
3.15	Nyree Fea	**How do New Zealand bird populations fare when rat abundance is high?**
3.30	Olivia Vergara	**Effect of mammal exclusion on ground-dwelling invertebrates. A study at ZEALANDIA, a fenced reserve in New Zealand.**
3.45	Zoe Lennon	**Computer modelling of complex interstitial spaces to protect endemic lizards from mice**
4.00	**Drinks mixer**	

PLENARY

Some Kind of Nature

A/Prof Yolanda van Heezik
Department of Zoology
University of Otago

Urban nature is increasingly recognised as vital for human well-being, in the provision of ecosystem services, but also a wide range of physical and mental health benefits. At the same time, it is increasingly under threat as cities grow. While modelling of different development strategies can provide insights into how ecological values can be best retained, social factors in the form of people's values and preferences are very important in driving the kind of nature that is found in our cities. Is this kind of nature ecologically authentic? And is the current emphasis on public health benefits, together with increasing alienation of urban dwellers from truly natural environments, likely to shift the focus away from biodiversity conservation? ? I summarise research in New Zealand on the kinds of nature people value and use, and discuss implications for urban biodiversity conservation.

Speakers

Meta-analysis of connection to nature and pro-environmental behaviour

Julie Whitburn

Understanding what drives environmentally protective or destructive behaviour is important to improve the design and implementation of interventions aimed to encourage people's pro-environmental behaviour. A strong bond or connection to nature has been consistently associated with greater engagement in self-reported pro-environmental behaviour. However a variety of instruments have been used to measure both connection to nature and pro-environmental behaviour. In addition, studies include different study methods with sample sizes ranging from N = 46 – 1186. This poses a major barrier for comparing results across studies.
Therefore, a meta-analysis was carried out to provide a synthesis of the available data. A systematic review of the literature was undertaken to identify studies. Comprehensive Meta-analysis software was used to analyse the results of 26 studies with N = 7067.

A random-effects model demonstrated a moderate association between connection to nature and pro-environmental behaviour, r = 0.48 (95% CI = 0.42 – 0.53, p = 0.00). Significant heterogeneity was observed in the sample; Q (25) = 201.463, p < 0.0000 and I^2 = 87.59. A meta-regression demonstrated that the measures used to determine both connection to nature (Q (11) = 11.34, p = 0.415) and pro-environmental behaviour are significant moderators (Q (2) = 0.01, p =0.994). This meta-analysis demonstrated that differences in people's connection to nature are positively associated with their engagement in pro-environmental behaviour. A connection to nature may help explain why some people behave more environmentally than others and may be a more consistent predictor of pro-environmental behaviour than environmental attitude.

Quantifying and restoring lizard faunas in New Zealand cities

Christopher Woolley

New Zealand is home to one of the most diverse lizard faunas of any cool temperate region on earth, with recent taxonomic work now recognising over 100 species. Skink and gecko species have experienced both range restrictions and extinctions due to predation by introduced mammals and as a result many species are now threatened or restricted to island strongholds. As it has with birds, conservation of lizards on islands following pest eradication has been successful in allowing the restoration of lizard populations, sometimes to very high densities. However, islands comprise only a small fraction of the potential habitat for lizards and conservation on the mainland is imperative if we are to ensure the longevity of the full diversity of species. The recent rise in urban ecological restoration projects along with national, city-wide and community predator-free initiatives have made conservation of lizards within urban centres more viable. My project aims to answer the following questions: what lizard diversity could potentially live in urban centres under different predator control regimes?; what benefits could habitat modification and increases in predator control have for lizard population viability?; and how might the presence of a more visible lizard fauna in cities affect public attitudes towards restoration and conservation?

Experimental games to understand the poaching of wildlife for valuable commodities: Can rhino be saved through horn devaluation?

Sean Rudman

Escalating poaching and trade in rhinoceros horn threatens the species' with extinction. Population managers have therefore implemented commodity devaluation strategies, such as horn removal or poisoning to discourage poachers. Whether these strategies work is debated, and resolving these debates is made difficult by the challenges of researching criminal behaviour. To overcome these constraints and test the outcomes of commodity devaluation strategies we applied game theory and games. We conducted a series of four hunter-guard games on campus where differing ratios of valuable to de-valued stakes were hidden in campus gardens. For each game, we recruited 20 Victoria University students to 'hunt' for 20 stakes, and 3 volunteer 'guards' to protect those stakes for a monetary reward. Compared to the control game when all 20 stakes were worth $5 each, there was no significant difference in hunter activity or the number of stakes taken when half the stakes were devalued, although the remainder doubled in value to $10. However, there was a significant drop in hunter participation and effort, and stakes taken, when 90% of stakes were devalued and the remaining two stakes were worth $50 each. This indicates that devaluation strategies may only be effective when a high proportion of a population is treated. Devaluation may be an effective strategy for small populations where most rhino can be treated, but may not be the *silver bullet* solution required for larger populations where most poaching occurs. I discuss the usefulness and limitations of games as tests of theory and 'real-world' strategies.

Interactive effects of climate change and plant species composition on alpine biodiversity and ecosystem dynamics

Justyna Giejsztowt

Ecosystems worldwide are undergoing dramatic transformations as a result of multiple interacting drivers of environmental change. Climatic variables such as temperature and precipitation are crucial determinants of alpine plant diversity and distribution and affect community function and provision of ecosystem services.

Higher than global mean rates of anthropogenic climate change have been recorded in New Zealand; Ontario National Park is currently 1.5°C warmer and drier (-5 mm of rain/year) than it was 50 years ago. Concurrently, weed invasions (notably European heather, or *Callum vulgaris*) place additional pressure on native plant communities.

While warming and biotic global change agents are likely to directly alter the structure and function of alpine plant communities, indirect effects of warming that are mediated through species interactions are predicted to have greater effects on ecosystems globally. Over the summer, I have been setting up experimental plots along elevational gradients in Ontario National Park. These investigate how heather invasion and climate change will work in tandem to affect native species richness at a variety of scales. In addition to highlighting community trajectories under future climates and invasion scenarios, I use field collected data to inform species distribution models to predict the fate of *taonga tipu*- plant species of particular importance to local iwi.

New long-life semiochemical lures for rats

Michael D. Jackson, Robert A. Keyzers, Wayne L. Linklater

Olfactory lures are important tools in species management, being widely used to monitor, trap and increase bait consumption, especially for pest species. For invertebrates, the use of semiochemical-based lures predominates and has done for decades. These *de facto* lures overcome the inherent limitations of food-based lures, such as perishability and inconsistent odour properties, and provide a suite of other benefits like low cost, ease of handling and storage, efficient large-scale manufacture, consistent odour properties and in-field longevity. But the identification of attractive semiochemicals and the development of effective lures for vertebrate pest species remains an underexploited opportunity. The identification of attractive semiochemicals, be they in urine, faeces, secretions or foods, has historically been considered a task too complex for reductive science, because it is widely assumed that mammalian olfaction is primed to identify complex multi-component blends at specific ratios. Our research group has cut a swathe through the apparent biological complexity of pest-mammal olfactory signals to identify simple, high-performing semiochemical rat lures. We have provisionally protected the intellectual property (IP) of two simple multi-component long-life lures for rats. The techniques we employed for this rapid advance are applicable to other pest-mammal species and the new long-life lures are compatible with all current and emerging trapping and bio-detection devices and strategies and so improve control operation efficiencies and scale. Moreover, these semiochemical lures will help realise the potential of multi-kill, remotely networked self-resetting traps and monitoring devices. Semiochemical lures show considerable potential to provide an early, low-risk win for the Predator-free 2050 aspiration.

Molecular determinants of risk-taking in the Argentine ant and behavioural variation along an introduction pathway

Antoine Felden, Philip Lester, Monica Gruber

Are we driving the evolution of invasive species to our own detriment? Humans routinely transport invasive species around the globe. It has been suggested that this process leads to selection for traits that promote invasiveness. We tested this hypothesis by investigating a risk-taking behavioural syndrome in the Argentine ant, which has successively colonised most temperate regions around the world, including New Zealand.

We studied variation in foraging behaviour and aggression in native as well as introduced Argentine ant populations from California, Australia and New Zealand in order to determine if data was consistent with selection of risk-taking along the introduction pathway. We combined behavioural assays, neurochemical and transcriptomic analysis to investigate the risk-taking behavioural syndrome as well as its molecular basis.

Our first results show that octopamine – a major biogenic amine – mediates foraging behaviour in the Argentine ant. Behavioural variation within regions was high, but we found no phenotypic evidence for increased risk-taking along the studied introduction pathway.

The next step of this study is to perform a global comparative analysis of the Argentine ant transcriptome in the different regions along its introduction pathway. This will help to investigate underlying mechanisms of how evolution and invasion processes may interact, as well as to understand better the molecular basis of variation in a key behavioural trait in the invasive Argentine ant.

Long-term wasp population dynamics: spring weather is key in native and invaded ranges, with remarkably similar density-dependent effects

John Haywood, Phil Lester

Introduced species often experience different population dynamics in their introduced and native ranges. We examined the long-term population dynamics of the invasive common wasp, Vespula vulgaris, in its native (English) range and its (New Zealand) invaded range. Wasp population time series were examined using partial rate correlation functions. Gompertz population regression models and multivariate autoregressive state-space (MARSS) models were fitted, both incorporating climatic variation.

Density dependence in wasp populations was similar in both countries, with previous-year wasp abundance the most important variable in predicting intrinsic rate of increase. No evidence of cyclic population dynamics was observed. Both Gompertz and MARSS models highlighted the role of weather conditions in each country as significant predictors of annual wasp numbers. The temporal evolution of wasp populations at all sites was best modelled jointly using a single latent dynamic factor for local trends, with the inclusion of a latent spring weather covariate. That same parsimonious multivariate model structure was optimal in both the native and invaded ranges.

Spring weather in both countries has a major influence on wasp numbers, probably through impact on wasp colony initiation and early development. Invasive species may not exhibit different population dynamics, despite considerable variation in abundance throughout their distribution.

Do climate niche shifts predict trait change through time in introduced plants?

Charlie Clark, Stephen Hartley

Non-native species often show evidence for a shift in trait values when introduced to a new range. Records of herbarium specimens that document a species since colonization provide a unique opportunity to examine how plant traits may change through time when introduced to a new range. This study set out to test if the direction and magnitude climate niche shifts for 35 plant species recently introduced to Australia and New Zealand could predict the rate of morphological trait change through time observed in herbarium specimens collected from the introduced range. I re-analysed the change through time in key plant morphological traits (height, leaf area, and leaf shape) for ~4000 herbarium specimens, and compared observed changes with the results of correlative species distribution models used to predict the magnitude of their niche shift from the native to the introduced range.

Species' climate niche shifts did not effectively predict herbarium plant trait change through time. This suggests that climate may not be the predominant driver of trait change in introduced plants in Australia and New Zealand. Alternatively, the combined noise and the mismatch in scales that may arise when combining these two methods could mask any underlying patterns in plant trait responses to the new environment. While the use of herbarium specimens and species distribution models may individually provide useful tools to explore species' responses to shifts in geographic range and climate, the two approaches did not combine to provide a consistent perspective on how these processes affect species that have expanded into introduced ranges where they experience novel biotic and abiotic conditions.

Factors affecting toxin production in *Phormidium*

Laura T. Kelly, Susanna A. Wood, Ken G. Ryan

Benthic blooms of the cyanobacterium *Phormidium* pose a significant risk to the ecological health of freshwater ecosystems. *Phormidium* spp. can produce powerful neuromuscular blocking compounds collectively known as anatoxins which can impact aquatic and terrestrial organisms. Like other toxic cyanobacteria, *Phormidium* comprise both toxic and non-toxic strains, which are morphologically identical. Our understanding of toxin production by *Phormidium*. has been limited by an inability to determine the proportion of toxic genotypes in a sample. Gene sequences of *anaC,* one of the genes in the anatoxin biosynthesis cluster, were used to design primers for a Taqman probe qPCR assay for differentiating toxic from non-toxic cells. *Phormidium*-dominated mat samples were collected and corresponding environmental variables including dissolved inorganic nitrogen, dissolved reactive phosphorus, pH and turbidity, were measured. The mat samples were analysed using the *anaC* qPCR and a qPCR assay targeting a cyanobacterial specific region of the 16s rRNA. Results were modelled with the environmental data, identifying several factors that warrant further investigation. These methods yield a more accurate determination of anatoxin quota in *Phormidium* by relating toxin production to toxigenic cells. On-going management of toxic *Phormidium* blooms will benefit from the ability to test how environmental factors influence toxin quota and genotype ratios to identify conditions leading to toxic blooms.

How do New Zealand bird populations fare when rat abundance is high?

Nyree Fea, Stephen Hartley

In New Zealand, predation by invasive mammals has been implicated in the historical decline of many forest bird species with ship rats identified as one of the worst culprits. Effective and sustained control of rats in remote forests is, however, extremely difficult and control operations often report a rapid recovery of rat populations within 1.5 years. We investigated the responses of native bird populations to changes in rat abundance to identify bird species that may be able to take advantage of a temporary release from predation, or conversely, those that are particularly vulnerable when rat populations re-establish. We compiled a database of monitoring results from four large biodiversity restoration projects in central New Zealand and used five-minute bird counts to estimate bird populations. Using linear models, we calculated the relationship between rat abundance (tracking rate) in one year to the percent change in bird counts from that year to the next. We plan to also include seedfall, elevation and weather in these models. Preliminary analyses from a meta-analysis approach show single occurrences for four different native bird species where a significant negative relationship to rat abundance was observed. When effect sizes for these bird species were combined across all projects the combined relationship with rat abundance was also significantly negative. Short-term positive responses by these bird species have, at times, been observed across these invasive mammal control projects however it appears long-term recovery of these bird species may be, directly or indirectly, prevented by the rapid population recovery of rats.

Effect of mammal exclusion on ground-dwelling invertebrates. A study at ZEALANDIA, a fenced reserve in New Zealand

Olivia Vergara, Nicola Nelson, Stephen Hartley

The introduction of non-native mammals has altered food web interactions and has become a serious threat to invertebrates over the past two-hundred years in New Zealand. ZEALANDIA is a fenced mainland reserve where introduced mammals (rats, possums and stoats) are excluded, and the mouse population is controlled annually. Outside the fence, there is some pest control, but mammals are still present. We sampled invertebrate communities inside ZEALANDIA and in the adjacent non-fenced area to look at the effects of mammal exclusion on the diversity and composition of invertebrates during summer 2014 and 2015. In addition, a field manipulation was performed to investigate the effects of predator pressure on invertebrates (using mealworms as baits) inside and outside the reserve. No significant differences were found in the average number of invertebrates due to mammal exclusion and/or year of sampling except for Araneae (year $p<0.05$) and Collembola (year × exclusion $p<0.001$). Our predator-pressure experiment showed 100% of mealworm predation for all treatments placed inside the reserve while a range of 13% to 100% predation was recorded in treatments outside it. Robins were the main predator of mealworms inside the fence and blackbirds outside, for all treatments. We conclude that abundances of epigeous invertebrates at order level were similar on both sides of the fence probably due to a similarity in vertebrate predation pressures primarily from birds. Fenced places are crucial areas to protect endangered vertebrates and large invertebrates but their role in protecting smaller invertebrates and in generating a safe environment for enhancing their reproduction and population is still uncertain.

Computer modelling of complex interstitial spaces to protect endemic lizards from mice

Zoe Lennon

New Zealand is home to a large diversity of endemic lizards, with 42 gecko (Diplodactylidae) and 55 skink (Scincidae) taxa, ~ 84% of which are classified as Threatened or At Risk. Habitat destruction and invasive mammalian predators are responsible for much of this decline. Endemic lizard species are afforded legal protection in New Zealand, meaning that when populations are threatened by human activity such as road construction, individual animals must be salvaged and moved to a safe location (mitigation translocation). Mitigation translocations of lizards in New Zealand often involve habitat enhancement, for instance building new rock pile habitat. However, there is little research to show if habitat enhancement actually has the intended effect of providing better habitat for lizards, or if there might be undesirable side effects such as creating habitat for invasive predators like mice (*Mus musculus*). I describe a novel technique using a computer game physics engine (Unity, PhysX) to investigate the best rock pile design to protect translocated skinks while hindering the movement of mice. I achieve this by measuring the interstitial spaces in virtual rock piles to determine which compositions (sizes, shapes of constituent rocks) will maximise skink-sized gaps and minimise
mouse-sized gaps, enabling skinks to avoid predation. My virtual approach allows me to model complex spaces which were unable to be measured using previous, physical techniques. Resulting designs will be tested in a real mitigation translocation. This research will inform understanding of predator/prey interactions and conservation of species threated by invasive mammals.

Posters

An analysis of the benthic diversity around offshore installations in the South Taranaki Bight

Elemental group

This poster will present some of the early work being conducted as part of the Sustainable Seas Science Challenge project exploring the potential re-use of offshore oil and gas infrastructure. The work described in this poster is a desktop analysis and comparison of environmental data available from a number of offshore installations and control sites that have been in place for an extended period.

The work considers a range of benthic biota that utilise these structures over time, and compares the benthic diversity of these structures to control sites that haven't been influenced by oil and gas activities to ascertain whether the presence of these structures influence the underling biodiversity in the area.
In the study we analyse long-term environmental monitoring data obtained through benthic sampling surveys undertaken in the vicinity of active production platforms and pipelines off the coast of Taranaki. This data is being used to understand any potential benefits of the structures for marine life, and will feed into a study on the larger question relating to the net environmental benefit of in-situ structures following productive field life.

Collaborative urban ecology research opportunities

Heidy Kikillus, Myfanwy Emeny (Wellington City Council)

Wellington City Council (WCC) and Victoria University of Wellington (VUW) have a long-standing Memorandum of Understanding (MOU) to cooperate in applied research, education, and other mutually-agreed activities for the purposes of supporting the ecological sustainability and resilience of Wellington's urban environment. A key component of this MOU is the Summer Scholar Scheme, in which high-calibre university students partner with local organisations to undertake a 10-week research project. Previous research Topics have ranged from: the evaluation of the Great Kereru Count Citizen Science programme and providing suggestions for improvement, investigating pet cats' secret lives via collar-mounted cameras, and the analysis of mobile phone use in the Wellington Botanic Gardens and the design of a Smartphone App which could provide information to visitors.

Research projects that WCC are interested in supporting include further investigation of Wellingtonians' connection to nature, pest control / ecological restoration, and engagement with community groups for conservation benefits. Summer scholarships can also open the door to postgraduate study. There is scope for larger projects to form the basis of a Masters or PhD thesis.

For more information, please see:
http://www.victoria.ac.nz/students/money/scholarships/summer- scholarships and / or contact Myfanwy.Emeny@wcc.govt.nz

Human dimensions of wildlife ecology in Wellington City: Residential feeding of kaka as a catalyst for property damage and nutritional deficiencies

Beckie Calder-Flynn

Human-wildlife conflict is an intensifying contemporary issue for global conservation efforts. As habitat is lost to deforestation, agriculture and urbanisation, interactions between humans and wildlife are growing, particularly in urban areas. After reintroduction to the Wellington region in 2002, the North Island Kaka (*Nestor meridionalis septentrionalis)* population has thrived, resulting in mixed public perception and tolerance.

An emerging concern surrounding their reintroduction is circumstantial evidence of metabolic bone disease in juvenile birds, suggested to be the result of kaka consuming inappropriate food items supplied by residents. There are also increasing reports of property damage by kaka, but whether these consequences are related is not been extensively studied.

This study aimed to investigated the nature of household kaka feeding around the Wellington region and any consequent relationship between feeding and reported property damage. Surveys were delivered to 560 residents in suburbs surrounded the Karori Wildlife Sanctuary (Zealandia) with a freepost return envelope and online participation link, with a 53% return rate. While evidence for metabolic bone disease resulting from anthropogenic food sources is inconclusive, a strong, positive relationship exists between feeding and property damage, with increased incidences of damage reported in suburbs with higher feeding rates.

This study has highlighted the impact of feeding on property damage, increasing potential for human-wildlife, and human-human, conflict. While educational campaigns discouraging kaka feeding in Wellington City have focused on the health consequences of feeding, future strategies may incorporate the link between feeding and damage in order to provide an economic motivation for discontinuing feeding.

Can juvenile toutouwai learn from their parents?

Chris Woolley

While social learning has been well studied in a wide range of species in the laboratory, few studies attempt to identify what specific social learning mechanisms are used by animals in the wild. Our study investigated social learning for the first time in North Island toutouwai (*Petroica longipes*) using experiments designed to allow the discrimination of imitation (the copying of a behaviour) from stimulus enhancement (association of a stimulus with a reward). Both experiments found only weak evidence for social learning but together are informative regarding how best to investigate social learning in this species.

Benthic mat forming cyanobacteria harvest their own phosphate. An alkaline phosphatase assay

Zohrab I, Kelly L, Sherratt M, Phillips H, Ryan KG

Efforts to restore freshwater bodies in New Zealand have largely focused on riparian planting as a means to reduce nutrient inputs from land use. But in doing so, are we unwittingly driving our freshwater bodies toward a more toxic state? *Phormidium autumnale* is a filamentous cyanobacterium with both toxic and non-toxic strains that is common in riverbeds NZ and worldwide. Toxic strains produce anatoxins that are fatal if ingested. Indeed, in summertime in the Hutt River the dense mats that form on the substrate have caused numerous dog deaths since the 1990's. *Phormidium* is dominant in freshwater systems with low bioavailable phosphates and elevated nitrates. Riparian planting reduces sediment input and thus phosphate levels, but cannot address the highly soluble nitrates entering our rivers. *Phormidium* is able to harvest organic phosphorus and convert it to a bioavailable form for use, thus resulting in extensive and sometimes toxic blooms. This study determined the alkaline phosphatase activities of both toxic and non-toxic strains, providing a better understanding of the likely response of this deadly cyanobacteria to our efforts to restore our freshwater environment.

Don't judge a rat by its cover

Kate Irving, Stephen Hartley

Rats are one of the biggest threats to New Zealand's unique flora and fauna so understanding their behaviour is beneficial for monitoring and eradication projects. The aim of this research was to investigate whether vegetation cover had any effect on the tracking rates of rats at monitoring stations. Tracking tunnels were employed at eight different sites in the Aorangi and Rimutaka ranges. Each site consisted of three transects each with 10 tunnels set up at 50m intervals. Vegetation cover in the $1m^2$ surrounding tracking tunnels was estimated visually in November 2016 and rat tracking rates (presence/absence of footprints) were collated over six field seasons (February 2015 to November 2016). The amount of vegetation cover around tracking tunnels had no significant effect on the rat tracking rates regardless of whether vegetation cover class was treated as a categorical variable (GLMER ANOVA, $P = 0.91$) or as a transformed continuous measure (GLMER covariate, $P = 0.23$). Information on how the habitat surrounding monitoring devices affects a rat's interaction with that device offers guidance on more effective trap placement for pest control and whether microsite variables should be taken into account during monitoring. In this case, variation in vegetation cover is unlikely to be influencing results of monitoring via tracking tunnels.

The effect of elevation on tracking rates of rats in the Aorangi Forest Park

Cherie Balls, Stephen Hartley

Rats are a detrimental pest species to the native wildlife, therefore understanding how elevation plays a role in their persistence, before and after 1080 drops, is fundamental to applying the most significant pest eradication methods and how best to utilise 1080. Tracking tunnel data was collected from 8 sites over a four-and-a-half year study period using tracking cards with ink and bait (peanut butter or rabbit meat). Three seasons worth of data was collected each year from 3 lines at each site. The ink prints on the cards were later analysed to detect rat presence and were assessed against elevation. Overall, the probability of detecting rats in the two years after a 1080 drop significantly decreases with increasing elevation, particularly at elevations greater than 500m. The results indicate that after 1080 application, rats repopulate lower elevations more quickly. It is probable that rats outside the 1080-treated zone migrate into these lower elevations boosting population recovery and only later migrate to higher elevation due to potential overpopulation or resource limitation. Populations at higher elevations may also have a lower intrinsic growth rate due to cooler temperatures and fewer resources.

Is the recovery of rat populations fuelled from outside or inside the 1080 drop zone?

Annemieke Hendriks, Stephen Hartley

Having evolved in isolation from the rest of the world New Zealand's flora and fauna is vulnerable to mammalian predation, particularly from rats. Large-scale control of mammalian pests in back-country forest habitats is often achieved via the aerial application of 1080 poison once every 3-6 years. This project aimed to understand how distance from the boundary of a 1080 treatment area may influence recovery of rat populations.

Three months after a 1080 drop in August 2014, rats were virtually undetectable across the Aorangi Forest. Six months after the drop rat numbers had recovered within 500m of the boundary but remained low 2km into the drop zone. After 18 months rat populations had recovered throughout the whole forest. This suggests that re-invasion from outside the treatment zone has a significant influence on the recovery of local rat populations. In order to maximise the effectiveness of rat control to provide a window of opportunity for recovery of bird populations, the strategic timing of drops (3 months prior to the bird breeding season), and the treatment of areas with a large internal core (>2km from the edge) seems like the best strategy. It is also clear that managing pests is an on-going consideration.