ORAL PRESENTATIONS

Organ-Altering Microbes: The role of the microbiome in the regeneration of *Xenopus laevis* tadpole tails

Mr Thomas Devine[1]
[1]*Department of Microbiology University of Otago, Dunedin, New Zealand*

Biography:
I am a 4th year honours student completing my degree at the end of this year. My project focuses on a combination of microbial ecology and regenerative genetics, looking at the microbiome as a trigger of regeneration. Born and raised in Whanganui i have a strong connection with the Whanganui Maori community, and am very passionate about Maori issues in science. I have completed my Bachelors at Otago and plan to work as a Research assistant next year.

The interactions between microbes and host play a vital role in health and development. The microbiome of amphibians and other *ika* (aquatic animals) have widespread effects on their biology. We hypothesize the microbiome has a role in the regenerative potential of amphibians. In the amphibian model *Xenopus laevis*, tadpoles are capable of regenerating their tails after partial amputation. The tail comprises multiple tissues including the spinal cord, notochord and somites, as well as blood vessels, nerves and pigment cells. The triggers of the regenerative response are not well understood. Previous experiments showed that culturing tadpoles in gentamicin had a negative effect on regeneration whereas inoculation with heat shocked *E.coli* or lipopolysaccharide stimulated regeneration. This finding prompted characterisation of the skin and gut microbiome of *X laevis* to better understand this regenerative response. In this study, bacterial DNA from the gut, tail and skin, were collected and shotgun Illumina sequencing was performed on 500 samples. The identified microbial communities were shown to be important to tail regeneration, as treatment with gentamicin, penicillin and vancomycin caused decreased regeneration of tail buds in treated *X. laevis.* This study characterizes the *X. laevis* microbiome. A comprehensive coverage of amphibian microbiomes will be critical in preventing the present decline of New Zealand and worldwide amphibian populations. Characterization of amphibian microbiomes will also contribute to the conservation of native *ika* and *taonga* species such as *tuna* (eel) as these populations share similar biology, evolution and environment.

Shoot flammability is decoupled from leaf flammability, but leaf traits control shoot flammability

Mr Md Azharul Alam[1], Dr Sarah Wyse[2], Professor George Perry[3], Dr Jon Sullivan[1], Researcher Norman Mason[4], Researcher Sarah Richardson[5], Research Technician Rowan Buxton[5], Associate Professor Hannah Buckley[6], Dr Timothy Curran[1]

[1]Department of Pest Management and Conservation, New Zealand, [2]Bio-Protection Research Centre, New Zealand, [3]School of Environment, New Zealand, [4]Landcare Research, New Zealand, [5]Landcare Research, New Zealand, [6]School of Science, New Zealand

Biography:

Md Azharul Alam, from Bangladesh, is currently enrolled as a PhD candidate in Department of Pest Management and Conservation, Lincoln University, New Zealand. He is in the final year of his PhD research and his research mainly focuses on plant flammability and fire ecology. Specifically, he is trying to quantify the relationships between plant flammability and plant functional traits to identify suits of traits that can determine the flammability of plants.

Flammability is an important plant trait, relevant to plant function, wildfire behaviour, and plant evolution. However, appropriate measurement of plant flammability has proved difficult because of varying methodologies and assessment at different fuel scales. We compared the flammability of plants at the leaf-scale (the most commonly measured scale) and the shoot-scale (which retains aspects of plant architecture). Furthermore, we examined relationships between leaf functional traits and flammability to identify key leaf traits determining plant flammability. Existing leaf- and shoot-scale flammability data from 43 species, along with existing data on leaf morphological and chemical traits, were collated and analysed. We found shoot-scale flammability to be decoupled from leaf-scale flammability. Moreover, shoot-scale rankings were highly correlated with rankings derived by expert opinion, but leaf-scale rankings were not. Leaf dry matter content (LDMC), leaf thickness, and phenolic and lignin concentrations were found to be strongly related to shoot flammability. Our study suggests that shoot-scale measurements of flammability are a useful way of characterising the flammability of species. Additionally, we identified some key leaf traits, particularly those widely measured like LDMC, that may be good surrogates for plant flammability in global dynamic vegetation models.

Community level indirect impacts of an invasive plant favour exotic over native species

Dr Warwick Allen[1], Ralph Wainer[2], Dr Jason Tylianakis[1,2], Dr Barbara Barratt[1,3], Marcus Shadbolt[2], Dr Lauren Waller[1], Dr Ian Dickie[1,2]

[1]Bio-Protection Research Centre, Lincoln University, Lincoln, New Zealand, [2]University of Canterbury, Christchurch, New Zealand, [3]AgResearch, Invermay, New Zealand

Biography:

Warwick Allen is a postdoc in the Bio-Protection Research Centre at Lincoln University. He is interested in species interactions and their role in structuring communities. His postdoctoral research investigates how direct and indirect species interactions structure communities by using network theory to predict community resistance and response to plant and insect invasions.

Indirect interactions mediated by shared natural enemies or mutualists (i.e., apparent competition/facilitation) can strongly influence whether invasive plants impair or facilitate co-occurring species. However, studies to date have largely examined single pairwise interactions, leaving it unclear whether indirect effects systematically favour native or exotic species at the community level. We conducted a field experiment to measure the indirect effects of invasive Scotch broom (*Cytisus scoparius*) on the survival and performance of 21 native and exotic legume species, via soil fungi, foliar pathogens, and herbivores. Potted plants were buried adjacent to or 50 m away from an extensive broom invasion to compare interactions between invaded and uninvaded communities. External soil fungi and arthropod herbivores were prevented or allowed to colonise plants using nylon mesh pot windows of differing porosity (1 or 38 µm) and two spray treatments (pyrethrum pesticide or water control). Despite increasing arthropod herbivory and pathogen damage, broom had a positive net impact on survival and growth of other legume species, mediated by soil fungi and release from browsing by European hares (*Lepus europaeus*). Moreover, soil fungi associated with broom increased arthropod herbivory and promoted the growth of exotic over native legumes. Exotic legumes were favoured by hares. Our study is the first to integrate multiple above and belowground indirect impacts of invasive species, suggesting that invaders indirectly affect competitors through multiple pathways, and that their impacts (positive and negative) may be strongest for fellow exotic species. Our results support broom as a potential nursery plant for native restoration.

The devil is in the demography: Population persistence in the native gloxinia *Rhabdothamnus solandri*

Ms Sandra Anderson[1], Prof George Perry[1]

[1]*University of Auckland, Auckland, New Zealand*

Biography:
I am an ecologist at the University of Auckland. I am interested in mutualistic interactions between birds and plants, and their role in maintaining native ecosystems. My research looks at the importance of birds as pollinators and seed dispersers, and whether native bird declines - and the concomitant introduction of a range of bird and insect species, as well as flowering and fruiting plants - have impacted native forest regeneration. The objective of my work is to better understand how these systems function, and be able to predict vulnerability in mutualisms, so that management of native biodiversity can be optimised.

Pollen limitation, leading to reduced seed-set and fewer seedlings, would be expected to result in plant population decline. However, the relationship is not always so straightforward.
Rhabdothamnus solandri is a widespread endemic flowering shrub that suffers severe pollen limitation in the absence of native bird pollinators, and subsequent seedling recruitment failure. Yet even at sites with few bird pollinators *R. solandri* populations persist, suggesting that other factors may also influence population trajectories in this species.
To investigate the population dynamics of *R. solandri*, we set up plots of tagged individuals at sites with and without bird pollinators and monitored plants bi-annually. We obtained measures of plant density, size and flower number to compare population structure at each site. We also measured survival, growth and fecundity, to model the viability of each population and enable long-term predictions of their fitness under different pollinator regimes.
The situation here can be applied to other bird-pollinated flowering shrubs in NZ, and highlights the need for detailed information in order to fully understand the demography of a species and effectively target conservation management.

Habitat quality, interspecific interactions and anthropogenic activities influence the distribution of urban invasive mammals

Victor Anton[1], Dr. Stephen Hartley[1], Dr. Heiko U Wittmer[1]
[1]*Victoria University of Wellington, Wellington, New Zealand*

Biography:
I am a PhD student at Victoria University of Wellington. I am interested in the use of novel technologies to better understand how urban ecosystems function. I have been involved in citizen science and community-driven conservation activities for almost ten years. Currently, I am working with remote cameras to research introduced mammals and native fauna in New Zealand urban areas.

Understanding the distribution and abundances of invasive mammals is crucial to address the ethical, ecological, and practical concerns associated with their management. Studies aimed at understanding the ecology of invasive species in urban New Zealand, however, are limited. To address this gap, we used remote cameras to investigate the influence of habitat quality, management efforts, interspecific interactions and seasonality on the occupancy and relative abundance of nine invasive mammalian species across 47 forest patches within Wellington, New Zealand. The abundance of cats (*Felis catus*) and European hedgehogs (*Erinaceus europaeus*) was greater close to forest edges; the abundance of house mice (*Mus musculus*), however, tended to increase towards the forest interior. These results provide rare evidence that interspecific interactions may shape distribution and abundance patterns of ecological communities of invasive mammals. Furthermore, cats, hedgehogs and mice, often overlooked in current predator control initiatives, were the most widespread mammalian species we recorded. We also found a positive influence of nearby buildings on the occupancy of cats, a positive interaction between the occupancy of ship rats (*Rattus rattus*) and the abundance of Norway rats (*Rattus norvegicus*), and how management control reduces the occupancy of target species, particularly during spring. Overall, our results highlight the importance of using season- and species-specific approaches to identify the most important factors influencing the distribution of invasive species in urban environments.

The role of perching lilies (epiphytic *Astelia* spp.*)* as habitat-formers in northern New Zealand forests

Mr. André Bellvé[1], Assoc. Prof. Bruce Burns[1], Prof. George Perry[1], Dr. James Brock[1]
[1]*University Of Auckland, Auckland, New Zealand*

Biography:
Andre Bellve is a MSc candidate in at the University of Auckland. His research interests involve factors determining plant community assembly using epiphyte communities as model systems. In particular Andre has been researching the role of nest epiphytes (Astelia spp.) in these systems, and how such communities can be explored using drone technology and statistical models. Andre also works at Plant and Food Research on quarantine research developing R packages and data science.

The stress-gradient hypothesis (SGH) predicts that as abiotic stress increases, biotic interactions will shift from competitive to facilitative. Epiphytes are subject to stressful abiotic conditions, with light, water and nutrient-limitations across multiple scales; this makes epiphyte communities ideal taxa for testing the SGH. Moreover, epiphytes are important components of ecosystems as they create / modify habitats for a variety of other flora and fauna. Epiphyte assemblages in New Zealand are nested, which has been attributed to the high proportion of obligate, rather than facultative, epiphytes, and the presence of epiphytic *Astelia* spp. that trap litter, which may facilitate other vascular epiphytes. We assessed the associations of epiphytic *Astelia* spp. and other vascular epiphytes along gradients of abiotic stress (water and light availability) among forest sites, within forest sites, and across host trees. We carried out ground-based surveys at three forest sites in northern New Zealand (Great Barrier Island, Hūnua Ranges and Pirongia Forest Park), and drone surveys of individual host trees. Species-specific correlations with epiphytic *Astelia* spp. were assessed. We found evidence that vascular epiphyte associations with *Astelia* spp. were species-specific and varied non-randomly along gradients of light and water availability. Moreover, these associations were largely constant across the scale of observations. Associations were primarily negative for 'pioneering' species of the epiphyte community (e.g. *Pyrrosia eleagnifolia*) and positive for later successional species (i.e. shrub epiphytes). Our results suggest that *Astelia* spp. form habitat critical for the success of vascular epiphytes particularly at high abiotic stress, consistent with the SGH.

Using climate data to model establishment of myrtle rust in New Zealand

Dr Robert Beresford[1], Dr Richard Turner[2], Dr Andrew Tait[2], Dr Rebecca Martin[3]
[1]Plant & Food Research, Auckland, New Zealand, [2]National Institute of Water and Atmospheric Research Limited, Wellington, New Zealand, [3]Ministry for Primary Industries, Wellington, New Zealand

Biography:
Dr Robert Beresford, Principal Scientist, Plant & Food Research, Auckland, has 39 years research experience. Career specialisation is plant disease epidemiology and modelling. Has pioneered development of weather data networks and decision support tools for disease risk management. Has led numerous teams developing advanced risk prediction and disease management systems for crop production industries. Has developed disease forecasting models, including the Myrtle Rust Process Model used by MPI and DOC for surveillance planning. Work extends to effects of climate on establishment of biosecurity threats from unwanted fungal and bacterial pathogens and effects of climate change on future plant disease prevalence.

Plant disease outbreaks can often be accurately modelled using weather and climate data at various scales of time and space. Large scale models are used to predict biosecurity risks and climate change impacts and fine scale models make site-specific disease forecasts for crop management. When myrtle rust (*Austropuccinia psidii*) was first detected on mainland New Zealand in May 2017, the Ministry for Primary Industries and Department of Conservation needed to know how climate would affect establishment to assist their surveillance and management response. The myrtle rust process model (MRPM) was developed by Plant & Food Research using published information on *A. psidii* biology. It was implemented by the National Institute of Water and Atmospheric Research Limited using data generated by their New Zealand Convective Scale Model (NZCSM). This produced weekly 1.5 km resolution maps of potential risk. Model output shows risk is greatest in northern North Island and decreases further south, but is still substantial in coastal areas of Tasman, Marlborough and the West Coast during summer and autumn. Lowest risk occurs in the southern South Island and in mountainous areas. Predicted risk showed good agreement with the distribution of myrtle rust detections from surveillance data. Myrtaceae hosts are only susceptible to attack during flushes of new growth and further research is using climatic data to model the seasonality of host growth. Use of the MRPM, the myrtle growth model and species distribution data is allowing regional and seasonal risk of myrtle rust throughout New Zealand to be accurately characterised.

Genetic structure across the natural range of *Eucalyptus caesia*, an endemic tree on granite outcrops

Ms Nicole Bezemer[1], Professor Stephen Hopper[1], Dr Siegfried Krauss[2], Dr David Roberts[2]
[1]*University Of Western Australia, Albany, Australia,* [2]*Kings Park Science, Perth, Australia*

Biography:
Nicole Bezemer is in the final year of her PhD on the evolutionary biology of Eucalyptus caesia, a tree endemic on granite outcrops

Terrestrial island-like habitats harbour unique assemblages of endemic plants and animals. Old, relatively stable island-like habitats such as granite outcrops are hotpots of plant evolution yet are understudied. In contrast to predictions based on mainstream population genetic theory, some granite outcrop plants appear to have persisted as very small populations, despite prolonged isolation. To investigate patterns of genetic structure and connectivity, we employed microsatellite genotyping at 14 loci of all plants in 17 populations of *Eucalyptus caesia* Benth., a long-lived lignotuberous tree with a naturally fragmented distribution on granite outcrops in south-western Australia. Sampled populations had low levels of genetic diversity (mean H_O = 0.36 ± 0.02) and small effective population sizes. At the regional scale, high levels of population genetic differentiation were most pronounced among representatives of the two subspecies in *E. caesia* (mean G''_{ST} = 0.63 ± 0.07). Past genetic interconnection was evident between some geographical neighbours separated up to 20 kilometres. Paradoxically, other pairs of neighbouring populations as little as 7 kilometres apart were genetically distinct. Dispersal both within and among outcrop populations appears limited. Little gene flow, a long history of isolation, and lack of relationship between heterozygosity and population size suggest that purging of genetic load has occurred in *E. caesia*. Restoration of gene flow to combat inbreeding depression should be restricted to recently fragmented populations of diploid sexual organisms. For endemic plants on inselbergs, the implementation of conservation management strategies developed specifically for biota occurring on old landscapes may be the way forward.

The island syndrome in plants

Matt Biddick[1]
[1]*Victoria University of Wellington, New Zealand*

Biography:
Matt is a passionate ecologist, botanist, and polyglot. His PhD work attempts to illuminate general trends in the evolution of plant life on islands; though he has also published works on plant-animal interactions, physical dormancy in seeds, and alternative water transport systems.

Abstract
Continental animals undergo rapid and predictable evolutionary changes on isolated islands that are collectively known as the *'island syndrome'*. Though the island syndrome has gained considerable empirical support, to date, no large-scale study has demonstrated whether it applies to the evolution of island plants. Here, we provide the first large-scale empirical test of the island syndrome in plants. We made phylogenetically informed morphometric comparisons of island plants and their closest living mainland relatives using a dataset comprised of field measurements, flora descriptions, and herbarium specimens. Results are remarkably consistent with those seen in insular faunas. Large-statured plants tend to become dwarfed on islands, while smaller-statured plants become gigantic. Contrastingly, leaf size was overwhelmingly larger in island taxa, irrespective of changes in stature. Overall results demonstrate that the theoretical predictions applied to insular animals are equally applicable to insular plants. Future work will attempt to disentangle differences in the evolution of island taxa that result from cladogenisis versus those that result from anagenisis.

Wellington central city green spaces: Is there enough and do they deliver optimum ecosystem services?

Dr Paul Blaschke[1], Dr Maibritt Pedersen Zari[1]
[1]*Victoria University of Wellington, New Zealand*

Biography:
Paul is an applied ecologist and environmental consultant based in Wellington. He's also a part-time lecturer in the School of Geography, Environment, and Earth Sciences at VUW. He's interested in many aspects of applied urban ecology and conservation, but especially in documenting and promoting the multiple values of urban green spaces.

Green spaces are a critical part of the green infrastructure of cities, delivering a wide range of vital ecosystem services to humans. We report on a recent study of the current and future provision of green spaces in central Wellington.

Taking a very broad approach to what constitutes green space, the Central Wellington area has a total of 41.25 ha of public green space, 9.3%% of its total area. A significant proportion of this total (43%) is located not in city parks and reserves but in road reserves (24%) or in non-council-owned public areas (33%). There is also a significant area of private green space within residential lots in the central city, but this was not quantified in our study.

A significant amount of the total public green space area (26%) consists of impervious and largely non-green surfaces such as paved areas and single trees within paved areas. This significantly reduces the ability of green spaces to deliver multiple ecosystem services.

We concluded there was a shortage of high-quality green space in parts of central Wellington. This shortage will significantly grow as the predicted population increases. Environmental constraints such as sea-level rise, and more intense storms, floods and dry periods, could further limit green space availability.
Our recommendations focus on planning for increased availability, accessibility and quality of green space in the central city in order to provide for human health, wellbeing and amenity benefits, and to maximise the range, suitability, quantity and quality of all ecosystem service benefits.

Our study found that there is a shortage of high-quality urban green space in inner-city Wellington. In some areas a significant portion of public green space is in road reserve, in otherwise impermeable areas, or in non-council-owned public lots.
difficult to increase provision of larger parks and reserves in the city centre, but there are important smaller-scale opportunities such as increasing permeable planting areas, providing more street trees, utilising and developing green space 'pockets', and engaging in creative green space planning such as planter boxes, green roofs, and green 'walls'.

Urban planning in Wellington requires planning for urban green spaces that work with a number of demands. These pressures include increasing urban density and its concomitant land-use pressures; the wellbeing of a diverse population with multi-faceted needs including people with disabilities, and needs of older and younger people; the need to consider the equity of green space in different socio-economic areas;
Our recommendations focus on building on the high-quality green spaces that Wellington already has, and making the most of new development opportunities, to increase urban green spaces across Wellington city.

Bioacoustic monitoring of native New Zealand *avifauna* before and after three aerial 1080 operations

Mr. Roald Bomans[1], Mr. Asher Cook[1], Dr. Stephen Hartley[1]
[1]*Victoria University of Wellington, Wellington, New Zealand*

Biography:
Roald Bomans recently completed his Master's thesis at Victoria University of Wellington, studying bioacoustics and their use in monitoring native bird species across aerial 1080 operations. Roald has a background in Ecology and Biodiversity and Environmental Science and is currently working in Ecological Restoration in the Wellington region.

The control of invasive species plays a major role in conservation world-wide. In New Zealand, predator-control of possums, stoats and rats is necessary for the protection of native avifauna. An important component of this control across large areas with challenging terrain occurs via the aerial distribution of sodium monofluoroaceteate (1080). The use of this toxin, however, is subject to significant public debate. There are concerns regarding 1080's impacts on non-target species, including claims that forests 'fall silent' after aerial operations - indicative of detrimental impacts. Autonomous recording units (ARUs) provide a novel way to directly assess the validity of this concern using bioacoustics. We utilised ARUs to monitor the prevalence of bird song from multiple species, recorded before and after three aerial 1080 operations in the lower North Island of New Zealand, employing a BACI design with non-treatment controls. The prevalence of silence (recorded in thirty ten-second blocks per recording) did not increase in treatment areas post-treatment in any of the three operations monitored. Across three operations, there was a significant site-by-time interaction consistent with the 'silent forest' claim in two out of 27 species-level tests (tomtit and chaffinch), 4 instances of an interaction where call rates increased post-1080 (tomtit, bellbird, bellbird/tui and whitehead), and the majority (21) of cases with no significant interaction effect. These results are in line with what would be expected due to chance fluctuations and do not imply consistent negative population-level effects on non-target bird species. The implications and caveats of these results are discussed.

The nectar-microbial loop in Mānuka plants: microbial composition and its effect on DHA production

MSc. Jorge Bresciano[1], Dr. Dragana Gagic[3], Dr. David Pattemore[2], Dr. Alastair Robertson[1], Dr. Andrea Clavijo McCormick[1]

[1]Massey University, School of Agriculture and Environment, Wildlife and Ecology group, Palmerston North, New Zealand, [2]Plant and Food Research, Hamilton, New Zealand, [3]Massey University Institute of Fundamental Science, Palmerston North, New Zealand

Biography:

My background is in microbial ecology, for my bachellor I studied biochemistry with focus in microbiology and microbial ecology at the University of Uruguay, Afterwards I did research in ecogenomic and aquatic microbiology. I moved to Spain and Ecuador for my Master in Biodiversity and Conservation where I studied amphibian bacteria and the chytrid fungus. At the moment I am doing my PhD in plant nectar bacteria and their effect on metabolites and pollinators

Microorganisms are key metabolite producers in numerous biological systems. In plants, they engage in symbiotic or antagonistic interactions, where multiple species coexist and cooperate or compete for substrates. The endemic New Zealand plant *Leptospermum scoparium* (Mānuka) contains dihydroxycetone (DHA) in its nectar, which chemically converts in the honey into methylglyoxal, associated with the antimicrobial and antioxidant properties of Mānuka honey. The origin of this compound is still unclear. Interestingly, bacteria and yeast that are often present in floral nectar have the capability to produce DHA from several types of carbohydrates and other photosynthesis intermediates, suggesting that this compound could have a microbial origin. Pollinators add complexity to this interaction by influencing the microbial composition of nectar and its physicochemical environment. This study aims to determine the diversity and abundance of bacteria and fungi in Mānuka nectar, identify the mechanisms of DHA production, and gain a better understanding of the nectar-microbial interaction and the effect on pollinators on microbial communities. To achieve these aims we cultured bacteria from Mānuka flowers and began their functional characterisation including metabolic capabilities and microbe-microbe interactions. Culturing showed a high abundance of the metabolically versatile bacterium *Pseudomonas fluorescens* in the nectar of Mānuka plants. As Mānuka plants produce minuscule amounts of nectar, we optimized the methods for isolation of metagenomic DNA to determine its microbial community composition using high throughput sequencing. This project will contribute to our knowledge on the ecology of tri-trophic interactions between plants, microorganisms, and pollinators and their effect on secondary metabolites.

Skirting the issue: Epiphytes and chilly tree ferns

Dr James Brock[1]

[1]*University of Auckland, Auckland, New Zealand*

Biography:

James Brock recently completed his PhD at the University of Auckland (NZ) researching the influence of tree fern ecology on forest structure and composition. With a post-doctorate position soon to start at Auckland he has dedicated the interim to sailing and counting epiphytes on tree fern trunks.

Epiphytic establishment on tree ferns of tree seedlings can contribute significantly to the composition and structure of New Zealand indigenous forest. For example, hemi-epiphytism (establishing epiphytically with subsequent development of a terrestrial connection) of *Weinmannia racemosa* has been recorded as contributing up to 60% of canopy stems in south Westland forests. The impact of successful epiphytes on tree fern health and persistence is unknown, but likely deleterious. The presence of skirts of dead fronds on many tree fern species has therefore been posited as a potential defence against epiphytes.
Tree fern skirts are surprisingly varied in structure and density; in examining tree fern skirts across New Zealand, a skirt-cover index has been developed. To examine relationships between epiphyte density and skirt cover, tree ferns across New Zealand are being surveyed to consider 1) a possible relationship between skirt cover / type and epiphyte density; 2) how often tree fern crowns are at risk of damage from epiphytes; and 3) whether patterns of skirt cover and type co-vary with other potential factors other than epiphyte development.

Preliminary results from several hundred tree ferns examined across Rakiura, Ulva, the Catlins and Waitākere Ranges suggest that 1) epiphyte density does not relate to skirt cover, 2) crown establishment / invasion by climbing or hemi-epiphytes is not prevented by skirt presence, and 3) skirt presence, length and density increases with latitude and is therefore potentially a means of crown insulation. Intriguing vertical distributions of anemochorous vs endozoochorous epiphytes will also be presented and discussed.

Using host plant removal and habitat fragmentation for eradication of invading insect herbivores

Dr Eckehard Brockerhoff[1], Dr Mandy Barron[2], Dr Andrew Liebhold[3], Dr John Kean[4], Dr Brian Richardson[1]
[1]Scion (NZ Forest Research Institute), Christchurch, New Zealand, [2]Manaaki Whenua - Landcare Research, Lincoln, New Zealand, [3]US Forest Service, Morgantown, USA, [4]AgResearch, Hamilton, New Zealand

Biography:
"Ecki" Brockerhoff is a principal scientist with Scion (New Zealand Forest Research Institute) working mainly on invasive species, biosecurity, and biodiversity. Before coming to New Zealand, he worked and studied in Canada, Switzerland and Germany. He has a PhD from the University of Toronto.

Invasions by non-native species pose serious threats to biodiversity and primary production. Given the level of international trade, not all invasions can be prevented, so early detection and eradication (forced extinction) are important strategies for preventing establishment and long-term impacts. Removal of host plants has historically been a common tool used alone or with other tools for plant pest eradication, but there is little scientific theory specific to the management of invasive species to guide the application of this eradication strategy. We drew upon extensive conservation biology literature documenting the effect of habitat destruction or fragmentation driving extinction. We applied a previously developed spatially explicit model of gypsy moth (*Lymantria dispar*) spatial dynamics to explore how fragmentation affects population persistence. The model accounts for a component Allee effect driven by mate-finding failure that interacts with dispersal. We found a nonlinear dependency of population persistence on the fraction of habitat cover and the level of habitat fragmentation. Simulation of active habitat fragmentation via removal of habitat in swaths of varying widths showed that host removal in narrow swaths caused the greatest probabilities of extinction. We demonstrate that host removal and habitat fragmentation can be an effective insect eradication method.

Reviving the Cockayne plots: 130 years of post-fire succession records in Arthurs Pass, NZ

Olivia Burge[1], Larry Burrows[1], Sarah Richardson[1], Peter Bellingham[1], Susan Wiser[1], Elise Arnst[1], Chris Morse[1], Janet Wilmshurst[1], Kerry Ford[1], Margaret Robinson[1], Hamish Maule[1], Rowan Buxton[1], Karen Boot[1]
[1]*Manaaki Whenua - Landcare Research, Lincoln, New Zealand*

Biography:
Olivia Burge is a terrestrial ecologist at Manaaki Whenua-Landcare Research where she works on plant community succession, restoration ecology, and invasion ecology, particularly in forest and wetland ecosystems.

In 1890 the Midlands Railway Company was responsible for a fire that burnt through the majority of Arthurs Pass; small pockets of vegetation were spared. Leonard Cockayne visited in 1898 and published a report on the pre- and post-fire vegetation. Thereafter permanent transects were set up and measured in the 1930s, 1960s, and 2001 on which all plants were mapped and hand-drawn to scale on paper maps (the 'chart quadrat' method). We describe the process used to modernise these data and make them more amenable to quantitative analysis, and the methods by which we selected a 2018 re-survey method that did not require hand-drawing all plants. Charcoal cores were taken to give an indication of pre-European fire rates; increment cores on transects were taken to provide greater temporal resolution as to woody species establishment. We used the resulting data, the longest-known records of post-fire succession in New Zealand, combined with pre-existing trait data, to describe the trajectories of the vegetation and recovery rates in this subalpine ecosystem. We found compositional change but no change in beta diversity over time; woody species recolonization (range expansion) was slow but once established, growth rates were relatively high. Of nine transects established and retained, one now has a public walking track through it, indicating the importance of preserving both data and public knowledge of New Zealand's long-term monitoring sites.

Are kauri thirsty at night? Exploring nocturnal sap flow in *Agathis australis*

Mr Tynan Burkhardt[1]
[1]*University of Auckland, Auckland, New Zealand*

Biography:
Tynan is a Masters student in the Ecology Ngatahi Lab at the University of Auckland, where he also completed his bachelors degree (Ecology and Statistics) and postgraduate diploma (Biosecurity and Conservation). He is studying water loss in kauri, with specific focus on its nocturnal component and how this differs under drought conditions. Tynan is set to complete his Masters by the end of 2018.

An increasingly recognised yet understudied component of whole-tree water use, is nocturnal transpiration (NT). Nocturnal transpiration is the loss of water through open stomata at night, when there may be significant atmospheric demand. Traditionally, stomata have been assumed to close at night. However, recent sap flow and stomatal conductance measurements have shown that in most species during summer, transpiration rarely reduces to zero overnight. This raises questions of nocturnal water loss for New Zealand's native flora, which may be under water stress in future. I quantified the percent contribution of NT to daily water loss in different seasons or drought scenarios and determined the temporal patterns of stem water storage fluctuations in seral kauri forest. To estimate transpiration, I used a Penman-Monteith evapotranspiration equation, allowing for partitioning of nocturnal sap flow into NT or refilling and determining water storage refilling/withdrawal. In summer, I found both transpiration and refilling decreased throughout the night, but with a steeper gradient for refilling. As well, NT contributed a greater percentage to daily water loss in winter (27.5 ± 1.5 %) than in summer (11.4 ± 1.5%), due to differences in day/night length. Significantly more water was lost from the canopy at night during a drought summer (0.21 ± 0.01 mm) than a non-drought summer (0.11 ± 0.01 mm). This research exemplifies the need to account for NT when quantifying tree water budgets, as it may contribute substantially to daily water loss, especially in winter and during periods of drought

Time to abandon the loss of dispersal ability hypothesis?

Dr K.C. Burns[1]
[1]*Victoria University of Wellington*

Biography:

K.C. Burns is Associate Professor in Ecology & Evolution at Victoria University

The loss of dispersal ability hypothesis predicts that selection favours the evolution of reduced dispersal potential in spatially isolated populations. Here I review previous tests of the loss of dispersal ability hypothesis in island plant populations. Despite its widespread appeal for over 150 years, relatively few studies have tested the hypothesis' predictions quantitatively. Results from this relatively small body of work indicate that many island plant species don't actually exhibit a loss of dispersal ability. When a loss of dispersal ability is observed, it's usually associated with increased seed sizes, rather than the loss of functionality of dispersal aides. This raises the possibility that the loss of dispersal ability, when it is observed, may evolve as a passive by-product of selection for large seeds, for reasons that may be wholly unrelated to their dispersal. These issues advocate a fresh approach to the study of how selection shapes the evolution of dispersal potential in island plant populations.

Initial response of old-growth forest at Maungatautari to pest mammal exclusion

Bruce Burns[1], Neil Fitzgerald[2], Mark Smale[3], John Innes[2]
[1]University of Auckland, Auckland, New Zealand, [2]Manaaki Whenua - Landcare Research, Hamilton, New Zealand, [3]Independent ecologist, Hamilton, New Zealand

Biography:
Dr Bruce Burns is an Associate Professor in Plant Ecology at the University of Auckland, His research interests focus on the abiotic and biotic factors driving plant community composition and change in the context of restoration ecology and conservation.

The eradication and maintenance at zero density of pest mammals inside pest-proof fences is carried out to restore forest ecosystems, but assessments of effectiveness are few. Here we report on the initial vegetation response of a 3300 ha old-growth forest to exclusion of all mammalian pests (except mice) over ten years at Maungatautari. A network of 31 x 400 m^2 plots was established at the time of pest-fence emplacement there (2004/2006), and then remeasured a decade later. Hierarchical classification on plot composition revealed three general forest types, reflecting variation in elevation and slope stability; tall lowland forest, short lowland forest on steeper slopes, and upland forest. Vascular plant species richness in plots increased significantly, particularly of epiphytes. Cover abundance of nine species (including four major canopy tree species) also increased significantly, but not stand basal area or density. Relative proportions of herbivore-preferred species increased in saplings in plots with treefalls and in seedlings in all plots in tall lowland forest. Our results are consistent with other studies of vegetation response to pest removal but not more so than for alternative management approaches. The relatively small magnitudes of changes observed likely indicate that the forest on Maungatautari was not strongly degraded by pest mammals at the time of fence emplacement, and a lag time for vegetation response. Greater vegetation responses may have been observed on specific sites such as treefall sites and landslide scars, and specifically monitoring these sites in addition to the existing plots in the future is recommended.

Monitoring biodiversity with acoustic indices: what time of day, seasons, and frequency to monitor?

Ivan Campos[1], Dr. William Lee[1,2], Dr. Anne Gaskett[1]
[1]*University Of Auckland,* [2]*Landcare Research,*

Biography:
Master in Primatology at the University of Barcelona (UB), Spain (2007-2009). Graduated in Biological Sciences in the Minas Gerais Federal University (UFMG), Brazil (2006). Since 2007 holds the position of Environmental Analyst in the Chico Mendes Institute for Biodiversity Conservation (ICMBio), a Brazilian federal agency for endangered species and protected areas. From 2011 to 2014 was the research coordinator in the Serra do Cipó National Park, working on the integration among park management and researchers. Currently PhD candidate at University of Auckland, New Zealand, conducts studies on the effectiveness of passive acoustic techniques for biodiversity monitoring in protected areas.

Acoustic indices that extract specific information from sound recordings makes passive acoustic monitoring (PAM) a good candidate for surveying biodiversity in protected areas. These acoustic indices are mathematical filters that provide a representation of how acoustic energy is distributed across time and frequencies in a sound file. These acoustic features vary across time and space, so they can provide information about the acoustic activity of ecological communities in protected areas and surrounding unprotected areas. Indices such as Acoustic Complexity (Pieretti et al. 2011) and Acoustic Entropy (Sueur et al. 2014) are sensitive to biophony, including sounds produced by animals (e.g. birds, insects, amphibians, mammals). We calculated these and other acoustic indices for recordings from *Serra do Cipó* National Park (Brazil) and the Waitakere Ranges (New Zealand). The indices measurements were then divided into 20 panels defined by specific time and frequency ranges. There were significant differences in the acoustic indices values inside and outside the protected areas, reflecting the differences in the environmental condition. The different ratios among panels allowed us to identify the acoustic region in which the soundscape differs most between inside and outside the PAs – which can now be targeted for future monitoring. These results support the use of acoustic indices for monitoring biodiversity, as well as giving important insights about "where" (frequency range) and "when" (time and season) to consider when using soundscape for monitoring.

Assessing the ecological consequences of extinction: are flightless birds important seed dispersers in New Zealand?

Jo Carpenter[1], Dr Colin O'Donnell[2], Professor Dave Kelly[1]
[1]*University Of Canterbury,* [2]*Department of Conservation*

Biography:
Jo Carpenter is currently in the last year of a PhD in Ecology at the University of Canterbury. Her research interests include plant-animal interactions, conservation biology, and palaeoecology. She has also worked on several research projects for the New Zealand Department of Conservation, ranging from developing monitoring methods for cave weta, to understanding alpine ecosystem dynamics.

Understanding the ecosystem functions provided by species is essential when assessing the consequences of their loss. New Zealand historically harboured ~27 species of flightless land birds, of which 67% are now extinct, but the mutualist services these taxa provided are still unclear. While moa (Dinornithiformes) are now known to have destroyed large seeds with their grinding gizzards, recent research shows that a flightless rail, the weka (*Gallirallus australis*) may be a significant disperser for some plants. We investigated seed retention times (SRTs) in weka using microchipped hinau (*Elaeocarpus dentatus*) and miro (*Prumnopitys ferruginea*) seeds. Weka have the longest avian SRTs ever recorded worldwide (mean >73 hours). These long SRTs mean that weka are likely to provide important long-distance seed dispersal. We combined the SRTs with high resolution weka movement data (from GPS tracking 39 birds over three sites) in a mechanistic model to estimate dispersal distances for miro and hinau seeds. Weka moved seeds similar dispersal distances to kereru (*Hemiphaga novaeseelandiae*), yet the potential contribution of weka to forest regeneration is frequently overlooked by conservationists. Our research demonstrates the importance of critically examining assumptions about which species conduct important ecosystem functions. The Pacific has lost >450 rail species in the last 3000 years, which may represent one of the most widespread, yet least appreciated losses of dispersal function ever recorded.

Is the One Billion Trees programme fancy or folly? Results and implications from a GIS-based scoping analysis

Dr Bradley Case[1], Associate Professor Hannah Buckley[1], Professor David Norton[2]
[1]Auckland University of Technology, Auckland, New Zealand, [2]University of Canterbury, Christchurch, New Zealand

Biography:
Brad is Senior Lecturer in Geographic Information Systems and Remote Sensing at Auckland University of Technology. His research focuses on quantifying and understanding ecological patterns and processes across multiple spatial and temporal scales. Recent areas of research are in forest ecology and agroecology. A major interest is in the development and application of spatial tools and technologies to achieve this aim. He is currently a research aim leader in the "Farming and Nature Conservation" project (Project 3.3) within the NZ's Biological Heritage National Science challenge.

The “One Billion Trees” (1BT) government initiative aims to plant a billion trees over the next 10 years to enhance and diversify regional economies and, ostensibly, to provide a range of ecosystem services such as erosion control and carbon sequestration. Nonetheless, an unaddressed and critical first question is whether this initiative will be spatially-feasible, particularly within the current context of our production landscapes. Accepting many uncertainties and assumptions, a back-of-the-envelope calculation suggests that from 0.5 to 1M hectares of land will be required to support this initiative, of which half might be planted in natives with obvious biodiversity conservation benefits. Where will all of this space come from? Does it exist, or will some hard decisions need to be made to achieve the outcome? Results of a spatial analysis using nationally-available GIS datasets are presented. Assuming that the majority of the trees will be planted in areas currently lacking significant woody vegetation cover and that are less productive agriculturally, and hence likely to be hill country sheep and beef farmland, we map likely planting scenarios that aim to maintain highly productive land in agriculture, while accounting for the distributions and types of already-existing vegetation in the landscape. We conclude with some more detailed spatial scenarios for a typical farm landscape, illustrating the possible positive and negative consequences of 1BT scenarios for a range of ecosystem values such as biodiversity, habitat connectivity, and carbon sequestration.

Smelly ferns: Investigating responses to herbivory in ancient plants

Dr. Andrea Clavijo Mccormick[1], M.Sc. Keylee Soriano[1]
[1]*Massey University, Tennent Drive, New Zealand*

Biography:
Andrea Clavijo-McCormick is an Ecology Lecturer at Massey University, where she leads the Chemical Ecology group. She obtained her bachelor's degree in biology from the Universidad Javeriana in Colombia and did her M.Sc. research at the Swedish University of Agricultural Sciences, Ph.D. studies at the Max Planck Institute of Chemical Ecology in Germany, and a post-doc at the Swiss Federal Institute of Technology in Zurich. Her research explores how different species communicate using chemical signals and how human activities modify these interactions.

Ferns are a very ancient group of plants, and there is ample fossil evidence proving that the relationship between ferns and insects started long before the appearance of angiosperms. Interestingly, ferns are less attacked by herbivores than their angiosperm counterparts, suggesting they are well defended. New Zealand has a high diversity of ferns including unique endemic species, and although their taxonomy and phylogeny have been well described, their biochemistry and ecology remain a mystery. With the growing need to replace chemical pesticides for more sustainable pest-control methods, understanding the natural mechanisms of plant defence may be essential to potentiate the plant's ability to resist attackers, but agricultural species have been selected for other non-defence related traits, rendering them highly susceptible to herbivory. In this sense, exploring non-domesticated plant species that have survived the long-standing battle against insects may provide new insights on how to protect our crops. This presentation explores the responses of six native NZ fern species to herbivory through the emission of volatile organic compounds (smells). Plant volatiles are known to mediate multiple plant-insect interactions in angiosperms, being powerful tools in plant defence. Volatile emission was investigated under herbivory, phytohormone, and mechanical wounding treatments. A total of 15 volatile compounds were identified with links to fern physiology. Further work into fern volatiles could give insight into the evolution of anti-herbivore defence mechanisms in plants, inform conservation decisions on native ecosystems, be applied to plant-protection, and identify compounds of pharmaceutical interest.

Application of museum data for insect conservation

Mr Simon Connolly[1], Dr Darren Ward[1]
[1]*University of Auckland, Auckland, New Zealand*

Biography:
Simon recently gained a Postgraduate Diploma in Science, with Distinction, in Biosecurity and Conservation from the University of Auckland, following on from his Bachelor of Science with majors in Biology and Statistics. His Masters project sees him combining his passions for insects, conservation and statistics, into an analysis of the state of New Zealand's insect conservation.

Insect conservation is often impeded by lack of species-specific data on population size and geographical range, utilising natural history museums, study key information locality, date, habitat, and morphological measurements. Locality data for insect species classified as 'Threatened' and 'At Risk' were cross-referenced with the New Zealand Land Cover Database and used to assess the Protected Area Network. Threatened non-threatened, to examine if functional traits can act as predictors of the current classification system. Results could show that there is little difference between threatened species and their congeners or could show predictable differences. Both would have significant implications: the former would indicate that the current classification of insects may be insufficient to reflect actual vulnerability, whilst the latter could lead to a traits-based analysis for the assessment of insect conservation.

Rivers as geographical barriers to Possum movement: A scalable strategy for defending predator free landscapes from possum reinvasion

Miss Briar Cook[1]
[1]*Zero Invasive Predators Ltd, Karori, New Zealand*

Biography:
Briar Cook has worked for Zero Invasive Predators Ltd since 2015, beginning as a field ranger in the Marlborough Sounds after a three-year stint with the Department of Conservation. In early 2017, she took up a more technical role for the organisation, developing ZIP's research and development trial concepts and implementing them in the field. Her current focus is around the use of geographic features as barriers to predator reinvasion, urban barrier design and the use of biomarkers to measure predator behaviour.

As the Predator Free 2050 movement gains momentum, proven, feasible methods of defending large tracts of mainland New Zealand from predator reinvasion are needed. To this end, Zero Invasive Predators Ltd (ZIP) has begun to investigate the potential of natural features such as rivers and alpine ranges to act as large-scale barriers. Here, we report on a field study aimed at building confidence that rivers can be used to support barriers to reinvasion by possums, at large scale implementation. Our study was carried out in the Orongorongo Valley, where one side of the river was treated with 1080 and a 4km stretch on the opposite side was excluded from treatment to provide a possum reservoir. Non-toxic cereal bait containing Pyranine biomarker was sown over a period of nine weeks in the 1080-excluded area. Possums were trapped on the opposite side of the river and then examined for the presence of the biomarker. Thus, any trapped individuals found stained with biomarker must have crossed the river. No marked possums were caught on the 1080-treated side of the river, giving a strong indication that the small, braided river was a significant barrier to movement of possums in the landscape. This suggests that wider, faster, stronger rivers will also be a significant barrier to possum movement, meaning rivers could become a reliable tool used successfully to defend large tracts of predator free mainland.

Mature kauri (*Agathis australis*) throughfall exclusion experiment to assess water and nutrient storage and use during drought

Ben Cranston[1], Dr. Cate Macinnis-Ng[1]
[1]*University of Auckland*

Biography:
Ben is in the second year of his PhD in the School of Biological Sciences at University of Auckland. He completed his B.Sc. in chemistry and some postgraduate work in radioanalytical/material sciences before transitioning into ecology and completing a Certificate of Proficiency at University of Auckland. He has been climbing, biking, running, and exploring all over Te Ika a Maui since arriving in 2015.

Aotearoa enjoys a predominantly maritime climate yet droughts represent a danger as extreme events are projected to occur more frequently in the future. Drought-induced forest mortality is a growing global concern including for New Zealand forests and it is unknown how resilient native flora are to protracted periods of water stress. Owing to their size, kauri (*Agathis australis*) act as significant media in water and carbon cycling. They exhibit certain traits which signify avoidance of and tolerance to droughts; however, other traits, shifting rain patterns and overall drier atmospheric conditions anticipated for the northern regions could pose a considerable threat to this iconic species.

An Aotearoa-first throughfall exclusion (TFE) experiment is underway on mature kauri trees at Huapai Scientific Reserve in western Auckland. Tarps have been fitted to the base of study trees in order to intercept rainfall thus reducing total soil water uptake. The experiment will gauge water and carbon flux patterns throughout successive temporal cycles. Continuous sap-flow (as a proxy for tree water-use), biomass fluxes (carbon) and soil moisture monitoring data will be coupled with meteorological data to examine relationships between plant water stress and climatic factors.

How good are green firebreaks at suppressing fire? A global review.

Dr Tim Curran[1], Prof George Perry[2], Dr Sarah Wyse[1], Prof David Bowman[3], Mr Azhar Alam[1], Mr Xinglei Cui[1]
[1]Lincoln University, , New Zealand, [2]University of Auckland, , New Zealand, [3]University of Tasmania, , Australia

Biography:
Tim is a Senior Lecturer in Ecology at Lincoln University and is interested in using plant functional traits to understand how plants survive disturbances. Recently the research focus of Tim, his students, and colleagues has been on comparative plant flammability, to tackle a range of applied and basic topics. These include: methods to measure flammability, traits associated with flammability, evolution of plant flammability, and identifying low flammable species to plant as green firebreaks across the landscape to reduce fire spread. The main device used in this research is a 'plant BBQ', which is a lot of fun to operate.

Severe wildfires have occurred in many parts of the world recently, prompting renewed consideration of how best to manage them. One option to help suppress wildfires is green firebreaks: strips of low-flammability vegetation planted at strategic locations across the landscape. While green firebreaks have been established on every vegetated continent, there has been little empirical testing of their effectiveness at halting fire. Here we review existing evidence, focussing on two extensive green firebreak schemes: the western USA 'greenstrips' programme, and China's 'biological fuelbreaks' initiative. The greenstrips programme saw 10,700 ha grown under perennial, low-flammability grasses, forbs and shrubs. The effectiveness of this programme has not been formally tested, although reports exist of large fires being successfully stopped, and of fire intensity being reduced, by greenstrips. China leads the world at green firebreak implementation, having established 364,000 km of them, with another 167,000 km planned by 2025. China is also the research leader, conducting the only comprehensive experimental tests of green firebreaks, though these studies are rare. For example, three separate green firebreaks (10 m wide and 8-9 m tall) of the tree *Schima superba* stopped seven discrete experimental fires, including some of very high intensity (e.g. flame height = 15 m; intensity = 34,438 kW m^{-1}; fire spread rate = 0.378 m s^{-1}). While research from China suggests that green firebreaks can stop even high intensity forest fires, further experiments are required to examine their effectiveness in a wider range of fire scenarios and ecosystems, including those in New Zealand.

Diversification of NZ woody lineages: Are biome shifts important?

Ms Esther Dale[1,2], Dr Matthew J Larcombe[1], Professor William Lee[2,3]
[1]Department of Botany, University of Otago, Dunedin, New Zealand, [2]Manaaki Whenua - Landcare Research, Dunedin, New Zealand, [3]School of Biological Sciences, University of Auckland, Auckland, New Zealand

Biography:
Esther Dale is a PhD Candidate with the Botany Department at the University of Otago and Manaaki Whenua - Landcare Research. Her research focuses on the role of biome shifts in lineage diversification. She combines various modelling approaches with trait data to understand plant evolution. She is interested in evolutionary ecology, plant ecology, plant biogeography, and plant conservation.

Biome boundaries are often presented as difficult barriers for lineages to overcome. This niche conservatism may limit lineage diversification by confining them to a particular biome. Alternatively, biome shifts could promote diversification by facilitating speciation into a greater range of environments. We hypothesised that biome shifts do promote diversification, would be infrequent, linked to new ecological opportunities when biomes first appear, and dependant on the evolution of key traits to enable niche expansion. Using three woody lineages (*Melicytus, Myrsine*, and *Pseudopanax*) we constructed phylogenies and estimated colonisation times for New Zealand. At the species level we determined occupancy of either Forest, Open (non-forest below treeline), and Alpine biomes. We modelled biome occupancy through time using BioGeoBEARS to estimate biome shifts and modes of speciation. We compiled a suite of traits, including measured traits and modelled niche traits, and compared predicted biome shifts to trait changes across all taxa. Biome shifts were surprisingly common, especially from Forest into Forest and Open. Biome shift rates spiked when the Open biome emerged 4-3.5 Ma for *Melicytus* but not the other two genera. Interestingly, functional trait changes significantly associated with biome shifts were uncommon and occurred when shifts were into the Alpine. The relative importance of different biomes for hosting speciation shifted from the Forest to Open and Alpine through time. Our findings indicate that lineages are not constrained by biome niche conservatism. Biome shifts did not directly promote speciation but fostered diversification and niche adaptation through provision of novel habitats and ecological opportunity.

Seedling Regeneration Dynamics within Planted Urban Forests

Miss Katherine de Silva[1]
[1]*Victoria University of Wellington, Wilton, Wellington, New Zealand*

Biography:
Kat is a master's student at Victoria University of Wellington and an Environmental Monitoring Officer at Greater Wellington Regional Council. Her research will help bring science into the practice of ecological restoration, by assessing the regeneration dynamics of native seedling communities and obtaining a better understanding of how we can build self-regenerating urban forests.
Before studying at VUW, Kat worked as an ecologist for an ecological consultancy for two years, and prior to then contracted to the Department of Conservation, regional councils and other consultancies as a field technician.

Urban forest restoration programmes are a key tool used to initiate, re-create or accelerate the succession of forest species; improving ecosystem services, function, resilience and biodiversity. Succession is a temporal shift in species dominance driven by abiotic and biotic influences, but over decadal timescales the trajectory and success of restoration plantings in degraded urban environments can be hindered. To implement successful restoration programmes, we must understand the regeneration patterns of native seedlings from dominant drivers and inherent traits. Research at the local scale has reported micro-climate, canopy cover and competition as key determinants of natural regeneration. Using a chronosequence approach, whereby space is substituted for time, I established permanent plots at 45 urban planting sites across five cities, aged 5 to 58 years since planting from bare ground. This presentation includes preliminary results on 1) the temporal dynamics of native seedling regeneration and their associated traits, and 2) the relative influence of dominant drivers of self-regenerating forest ecosystems at the local and regional scale. We show that 1) native seedlings become dominant once the canopy reaches 10 years of age, 2) pioneer and early successional seedlings are consistently twice as abundant than mid-successional species, and 3) seedling species richness increases with canopy richness. This information will provide scientists, practitioners, managers and policy makers with an advanced capacity to close the gap between the science of restoration ecology and the practice of ecological restoration, creating new opportunities for improved urban forest restoration guidelines and strategies in New Zealand.

Functional roles and specialization, and species' contribution to functional diversity in plant-bird interactions on the local and continental scale, and across the Pacific

Matthias Dehling[1]
[1]*University Of Canterbury, Christchurch, New Zealand*

Biography:
Matthias Dehling is a postdoc at the University of Canterbury.

I tested whether differences in local species composition lead to differences in the richness and composition of functional roles in bird-plant interactions across eight sites along the Andes, and eight sites in New Zealand. On the network level, I analysed whether differences in species' functional roles (niche position and niche overlap) corresponded to differences in species' morphology and phylogenetic relatedness. I also quantified species' contributions to the diversity of functional roles and tested whether it was related to species' functional specialization. On the regional and continental scale, I compared alpha and beta diversities of local bird and plant communities and of their functional traits combinations. I also compared the diversity of functional roles of birds between the communities via the similarity in species' niche position and niche overlap.

Differences in functional roles were more strongly related to differences in morphology than to phylogenetic relatedness. A species' contribution to the diversity of functional roles was only weakly correlated with functional specialization or even tended to decrease with functional originality. All communities showed similar distributions of species' contributions to FD. Local communities differed more strongly in their species composition than in their functional traits and functional roles. The similarity in niche positions was higher than similarity in niche overlap.

The characterization of functional roles in ecological processes and the assessment of their similarity and comparability between communities is a prerequisite for modelling the outcome of ecological processes in both current and future species communities.

Managing biodiversity in the Waikato District through the Significant Natural Areas (SNA) programme

Daniel Tait[1], Dr Yanbin Deng[1], Gerrry Kessels[2], Dr Catherine Beard[3], Wiea van der Zwan[2]
[1]Waikato Regional Council, Hamilton, New Zealand, [2]Tonkin and Taylor, Hamilton, New Zealand, [3]Department of Conservation, Hamilton, New Zealand

Biography:
Terrestrial Ecologist at Waikato Regional Council

As part of a long-term commitment to understanding, maintaining and enhancing regional biodiversity, the Waikato Regional Council has worked towards completing an inventory of Significant Natural Areas (SNA) across its 11 governance districts. The recently completed Waikato District SNA inventory completes the regional dataset and provides a solid foundation upon which decisions on biodiversity management needs and priorities can be set.

As is typical of the wider Waikato Region, the Waikato District hosts a wide array of prominent and ecologically significant ecosystems, despite being dominated by agriculture and rapid urban and rural-residential expansion. The Waikato District has 2 internationally significant, 20 nationally significant, 87 regionally significant, and 589 locally significant SNA sites. These occupy about 16.4% of the District's land area; approximately 47% of which is legally protected.

Encouraging restoration and legal protection of SNA refuge occupied by threatened and at-risk species; creating incentives and opportunities for targeted restoration and legal protection of SNA within all rural areas through conservation lot provisions in the District Plan; creating, improving and protecting key habitat connections such as highly degraded gully systems dominated by non-native species; discouraging vegetation clearance and protecting SNA from grazing livestock and animal pests; controlling plant pests; providing guidance on replanting and maintenance techniques to all SNA landowners; and helping facilitate improvement of gully systems by providing advice and guidance to rural-urban landowners and community groups restoring and enhancing habitats.

Independently of plant-fungal guild, mycorrhizal networks are nested

Dr Julie Deslippe[1], Dr Phillip Staniczenko[2], Professor Jason Tylianakis[3]
[1]Victoria University of Wellington, Kelburn, New Zealand, [2]National Socio-Environmental Synthesis Center (SESYNC), Annapolis, USA, [3]University of Canterbury, Christchurch, New Zealand

Biography:
I am a community ecologist with research interests in plant-microbial interactions and ecosystem ecology. I study how plants and their associated communities of microbes respond to land use and climate change, and how these changes feedback to affect ecosystem structure and function. Ultimately, I seek to understand how species interactions determine the trajectories of ecosystems to different stable states. My research programme enables better conservation, restoration and management of terrestrial and wetland ecosystems. Current projects include elucidating the role of plant-fungal networks in ecosystem carbon exchange, the restoration of a Kahikatea swamp forests, and the fate of alpine ecosystems globally.

Mycorrhizas are symbiotic trophic associations between plant roots and soil fungi. The mutualism is diffuse, so that single fungi may associate with multiple plants and vice versa. The complex networks of plant roots and fungal hyphae that result can have profound effects on ecosystem function. However, knowledge of the topology of mycorrhizal networks (MN) is in its infancy, which limits understanding of their effects on larger-scale processes. The application of ecological network analysis to mycorrhizas involves their depiction as bipartite networks of interacting plants and fungi. This has revealed that MN share features with better-studied mutualistic networks. One property of mutualistic network topology that has received much attention is nestedness. In a nested network, specialist species with few interactions interact with a subset of the species that interact with more generalist species (those with many interaction partners). Nestedness confers resistance to disturbance and species losses, so there is interest in whether nestedness is a general phenomenon of MN, however, studies have shown conflicting support for the nestedness of MN. Here we collated 46 MN from 21 studies and applied a spectral method to assess their topologies. We tested whether MN are generally nested, and whether this depends on the plant-fungal guild. We show that MN are nested independently of plant-fungal guild and that variation in binary (presence/absence) and weighted (including interaction frequency) nestedness was driven primarily by differences in network size. We discuss these results in light of the co-evolution of the plant and fungal partners in this pervasive symbiosis.

Biogenic volatile organic compound emissions are affected by competition in natural environments

Mr Evans Effah[1], Mr Paul Barrett[1], Mr Paul Peterson[3], Professor Murray Potter[1], Professor Jarmo Holopainen[2], Dr Andrea Clavijo-McCormick[1]

[1]Wildlife and Ecology Group, Massey University, Palmerston North, New Zealand, [2]Environmental Ecology Group, University of Eastern Finland, Kuopio, Finland, [3]Manaaki Whenua - Landcare Research, Palmerston North, New Zealand

Biography:

My name is Evans Effah. Born in the late 1980's, I have seen and also read about how significant our environment has changed. These changes, which are mostly human induced pose varying threats to biodiversity. This led to my interest in behaviour ecology and conservation. I completed my bachelor's degree in University of Education Winneba, Ghana and master's degree in University of Eastern Finland. I am currently a PhD candidate at Massey University and looking at interactions between invasive and native plants. "We inherited a beautiful planet from our ancestors and should not deprive subsequent generations of this".

Biological invasions are major cause of biodiversity loss, second only to habitat destruction. Successful invasive plants outcompete natives for space and resources. Our knowledge of plant competition has generally focused on investigating the direct impacts of one plant on its competitor. However, little is understood about indirect impacts, which may strongly influence the outcome of competition. Volatile organic compounds (VOCs) emitted by plants mediate several above and belowground interactions within and across trophic levels. VOCs could thus influence competitive outcomes between plants directly through allelopathy and/or indirectly by modifying the behaviour of pollinators, herbivores and predators. This potential role of VOCs in competitive interactions is so poorly represented in the literature and experimental evidence under natural conditions is scarce. The aim of this study was to investigate VOC emissions in natural competitive scenarios between all possible pairwise combinations of two New Zealand native plants (Monoao and Manuka) and two European introduced invasive plants (Heather and Broom). VOCs from the headspace of the four plant species were analysed during competition. In addition, arthropods from each combination of plant species were collected and identified to their respective taxonomic rank (order). Our results show that volatile profiles differ between plants interacting with conspecifics compared to heterospecifics. In addition, arthropod communities varied in different competitive scenarios, which could account for corresponding differences in the amount of herbivory recorded. Establishing the ecological roles of the identified VOCs could be useful to help design and implement management programmes to control the spread of invasive species.

The capacity of restored urban forests to support native birds: Ecological or social restoration?

Ms Elizabeth E. Elliot[1], Professor Bruce D. Clarkson[1], Dr Ottilie Stolte[1], Mr John Innes[2], Dr Chaitanya Joshi[1]
[1]The University Of Waikato, Hamilton, New Zealand, [2]Manaaki Whenua-Landcare Research, Hamilton, New Zealand

Biography:
I am a PhD candidate at the University of Waikato. My areas of research interest include urban restoration ecology, human-wildlife interactions in cities and urban wildlife ecology. My Masters of International Nature Conservation was jointly awarded by the University of Göttingen and Lincoln University for my research on city residents' perceptions of and behaviour affecting urban coyotes in Chicago and Los Angeles.

Urban restoration has been championed for performing the dual role of creating refugia for native plant and animal communities, as well as greenspaces where city residents can connect on a personal level with the natural world. My ongoing PhD research combines ecological and social science to evaluate the contribution that restored native forests in two New Zealand cities can make to native bird conservation and reconnecting urban residents with nature.

Using qualitative, semi-structured interviews, we explored Hamilton residents' perceptions and experiences of urban nature in frequently visited parks as well as in their own gardens. Results reveal that parks dominated by native vegetation are valued for the opportunity they provide for observing nature and escaping the stresses of city life. Interviewees' appreciation of native nature was ambiguous and complex, however, and reported preferences for native vegetation and birds did not result in increased plantings of native species in respondents' gardens.

Our findings suggest that we cannot rely on urban gardens to support native biodiversity in the short term and stress the need for local authorities to invest more time and resources in urban restoration. As the number of people living in cities continues to rise, our research offers renewed evidence for the importance of reserving a space for nature in cities. Far from being a dispensable luxury, native bush parks are crucial for the health and wellbeing of both people and our native flora and fauna.

Phylogeny of Inocatops *(Coleoptera: Leiodidae)* and implications for mycophagy

Ms Lizzy Farrington[1], Dr Rich Leschen[2], Dr Thomas Buckley[2]
[1]University of Auckland, Auckland, New Zealand, [2]Manaaki Whenua Landcare Research, Auckland, New Zealand

Biography:
Lizzy is currently studying her MSc in Biodiversity and Conservation at the University of Auckland and is based at Manaaki Whenua in East Tamaki. She has an interest in entomology and botany, and attends meetings with the Entomological Society of New Zealand. In her spare time, she tries to go for bush walks in the small parts of Auckland that are still open.

Leiodids (Coleoptera: Leiodidae) are small, ovoid beetles with a worldwide distribution that feed on fungus. They are taxonomically diverse with 21 described New Zealand genera (73 species); are typically smaller than 3 mm and easily recognisable by having a reduced 8th antennomere segment. Leiodids are found nation-wide, but are poorly known with most groups requiring taxonomic revision. The endemic genus *Inocatops* has cryptic habits, and is largely found in leaf litter and not in large fungal fruiting bodies. *Inocatops* has nine described species: two in the North Island and seven in the South Island. They are wingless, are characterised by having large foveae on the scutellum and have an enlarged fourth segment of the maxillary palpi. Little is known of their biogeographic history. Here I use molecular phylogenetics to reconstruct the biogeographic history of the family in New Zealand and the evolution of fungus feeding. Two mitochondrial genes (COI and 28s) were used to reconstruct the relationships of the species. Preliminary trees confirm the monophyly of *Inocatops* and its placement within the tribe Camiarini, and that clades correspond to biogeographic area and habitat type. The generic phylogeny shows that feeding on macrofungi may be derived from lineages that were ancestrally living in leaf litter.

Management of introduced mammals preferentially benefits large, endemic forest birds: A New Zealand meta-analysis

Dr Nyree Fea[1], Dr Wayne Linklater[1], Dr Stephen Hartley[1]
[1]*Victoria University of Wellington, Wellington, New Zealand*

Biography:
Nyree Fea recently completed her PhD in Conservation Biology and Restoration Ecology at Victoria University of Wellington and was supervised by Dr. Stephen Hartley. For the last twenty years she worked in research and management of introduced mammals for Landcare Research, regional councils and DOC and so this new foray into the population biology and conservation of native birds was a welcomed change.

The management history of New Zealand's forests over the past fifty years presents a unique ecological opportunity in which a varied and sustained control programme of introduced mammalian predators has created a broad-scale replicated "management experiment". This has potential to provide insight into the ecological forces structuring forest bird communities. We present here the first comprehensive review of population-level responses of forest birds to different levels of mammal control recorded across the breadth of New Zealand. We collected data from 71 uniquely treated sites and 20 extant bird species representing a total of 459 population responses to high-intensity, low-intensity and no control of invasive mammals. We modelled population-level responses of native birds according to key life history attributes in order to understand the biological processes that influence species' responses to management. Larger endemic species consistently showed positive population-level responses to an increase in control intensity and populations of smaller, deeply endemic species responded positively only within sites receiving high intensity management. We also identified three small, native bird species of shallow or zero endemism and three introduced species that routinely decline in detections after mammal control. Our study suggests that large or deeply endemic forest birds would decline in places where management of mammals were to cease, but conversely, also reveals three species that apparently tolerate the presence of invasive mammals and whose populations may be sensitive to competition from other, larger birds.

Assessing the impact of avian predation on New Zealand lizard fauna

Brittany Florence-Bennett[1]
[1]*Victoria University of Wellington*

Biography:
Brittany is a MSc Candidate studying at Victoria University of Wellington, supervised by Nicola Nelson

Insular island ecosystems are highly susceptible to the effects of invasive species.
Species extinctions, and changes to patterns of abundance and distribution, resulting from predation or competition, break down the complex co-evolved linkages between endemic species. This makes managing species and restoring ecosystems challenging and can lead to unexpected management outcomes.

In New Zealand, there has been a recent swell of interest in controlling and eliminating pest mammal species, using both top-down policy and bottom-up community. However, with some species there is a risk of meso-predator or competitive release, leading to predation by species not currently targeted by new initiatives.

The effect of avian predation on New Zealand's native lizards, has rarely been studied. Through largely anecdotal evidence we are aware of at least 23 bird species, both native and introduced, that prey on lizards.

This project will record and assess avian predation on New Zealand lizards through the use of 3D-printed skink replicas. Attacks on replicas will be used as a proxy for avian predation pressure, allowing the identification of high-impact predators and an indication of their effect on lizard populations.

Using balanced acceptance sampling as a master sample for biodiversity monitoring in New Zealand

Mr Ollie Gansell[1], Mr Blair Robertson[2], Mr Paul van Dam-Bates[3]
[1]Department of Conservation, Hamilton, New Zealand, [2]University of Canterbury, Christchurch, New Zealand, [3]University of St Andrews, St Andrews, Scotland

Biography:
Ollie Gansell is a terrestrial ecologist with the Department of Conservation. His work focusses on development of consistent, standardised approaches to biodiversity monitoring and reporting.

Well-designed biodiversity monitoring programmes are important for evidence-based decision making. However, many problems are not single agency issues that require intervention or monitoring at one spatial scale. A master sample can be used to coordinate and scale monitoring designs to ensure consistency in information gathered and robust inference at different spatial scales.

We used balanced acceptance sampling (BAS) to generate a master sample. In this context, practical applications and justification of BAS as a master sample are addressed. We then address some practical aspects of designing a study using a Master Sample (e.g., incorporating legacy monitoring). Management agencies can benefit from increased coordination of monitoring programmes. A master sample is an excellent way to incorporate coordination directly into the sample design. BAS improves on methods previously described and provides an effective method to monitor populations at multiple spatial scales.

Using BAS as a master sample is conceptually simple, gives good spatial balance over different spatial scales, and is computationally efficient to generate. Examples for terrestrial biodiversity monitoring in New Zealand will be demonstrated.

Orchid distributions and diversity: spatial and climatic patterns from herbarium records

Dr Anne Gaskett[1], Dr Rachael Gallagher[2]
[1]*School of Biological Sciences, The University of Auckland/Te Kura Mātauranga Koiora, Te Whare Wānanga o Tāmaki Makaurau, Auckland/Tāmaki Makaurau, New Zealand/Aotearoa,* [2]*Dept. of Biological Sciences, Macquarie University, North Ryde, Australia*

Biography:
Kia Ora - I'm a lecturer in Behavioural Ecology, specialising in animal behaviour, sensory ecology and the evolution of orchid-pollinator relationships. At work, my priorities are equity, researching iconic native species, developing evolutionary hypotheses, and teaching that celebrates diverse species, approaches and people. At home, my priorities are my family and cooking. I've developed an excellent 3-minute scone recipe - feel free to ask me about it. Postgrad enquiries welcome!

Orchids are super-diverse - there are more orchid species worldwide than mammals, birds and reptiles combined. Orchid diversity could be driven by their unusual and often deceptive relationships with pollinators, but abiotic factors such as climate are also a possible driver, especially since they dictate the distribution of mycorrhizal fungi, with which orchids have obligate symbioses.

How do diversity, biotic and abiotic factors operate at a landscape scale? We analysed spatial and climatic distributions of Australian orchids using digitised herbarium records.

Collecting effort generally reflected orchid species diversity, range sizes, and niche breadths. Australia's 1583 orchid species are restricted to 13% of the landmass, with 211 species absent from any protected areas. Orchids have narrower range sizes than non-orchid species. Surprisingly, highly diverse orchid genera have narrower rainfall breadths than less diverse genera - speciation probably doesn't occur via invasion and local adaptation to new habitats. Instead, diversification may rely on access to extensive obligate symbioses with both pollinators and mycorrhizae fungi.

Climate change, plant invasion and their interactive effects on species' distributions

Justyna Giejsztowt[1], Aimée Classen[2], Julie Deslippe[1]
[1]*Victoria University of Wellington, Wellington, New Zealand,* [2]*University of Vermont, Burlington, United States of America*

Biography:
I am interested in the interactive effects of climate change and invasive species on alpine plant communities. My PhD, supervised by Julie Deslippe (Victoria University of Wellington) and Aimee Classen (University of Vermont), focuses on Tongariro National Park. I investigate how interacting drivers of change affect species' distributions on the landscape, richness patterns across spatial scales, and pollination services. *After completing a Bachelors at the University of Canterbury, I moved to Europe to complete an Erasmus Mundus Masters in Applied Ecology. My thesis, supervised by Andreas Tribsch (University in Salzburg), investigated links between population genetics, phylogeography and niche.*

Drivers of environmental change, such as climate change and species invasions, can alter the distributions of taonga plant species. Furthermore, synergistic interactions among drivers can lead to unexpected and non-linear changes. Species distribution models (SDMs) are valuable tools for predicting future potential distributions of plant species, but they typically omit the effects of species interactions and rarely incorporate social interests. Tongariro National Park is subject to a changing climate and the invasion of European heather (*Calluna vulgaris* L.). We collaborated with Ngāti Rangi, who are kaitiaki over the park. Access to mātauranga Māori via interviews idnetified five ecologically important indigenous plant species that are taonga. We surveyed the distribution and density of these species and *C. vulgaris* in the park along elevational and invasion gradients. Survey data, bolstered with public repository data was used to model the climatic niche of *C. vulgaris.* We parameterized SDMs for each taonga species using their climatic tolerances and estimates of pairwise competition with *C. vulgaris* derived from co-occurrence along the invasion gradient. We predicted future distributions of taonga species based on climate scenarios and predicted *C. vulgaris* distribution in those climates. SDMs indicate that future climates will facilitate an expansion of *C. vulgaris* distribution. These changes are associated with reductions in the distribution and density of taonga species, indicating a synergism between these two drivers of ecosystem change. Importantly, although indigenous species responded idiosyncratically, SDMs which incorporated both drivers yielded more negative forecasts for taonga species than models incorporating climatic variables alone.

Revisiting remnant populations: Surveys of tuatara on Northern and Cook Strait islands

Dr. Kristine Grayson[1], Susan Keall[2], Caitlin Greene[1], Dr. Lindsay Anderson[3], Dr. Alison Cree[4], Dr. Charles Daugherty[2], Dr. Nicola Nelson[2]

[1]University of Richmond, Richmond, USA, [2]Victoria University of Wellington, Wellington, NZ, [3]Government of British Columbia, Canada, [4]University of Otago, Dunedin, NZ

Biography:

Kristine L. Grayson received her Ph.D. in 2010 from the University of Virginia. Her graduate research used mark-recapture methods to examine migration behavior in a pond-breeding amphibian. She received an NSF International Fellowship for postdoctoral research at Victoria University of Wellington in New Zealand to conduct research with Nicky Nelson on sex-ratio bias in tuatara. Upon returning to Virginia, she worked with Dr. Derek Johnson at Virginia Commonwealth University on the invasion of gypsy moth. Dr Grayson currently is an Assistant Professor in the Biology Department at University of Richmond.

Population viability of tuatara is a conservation priority due to the unique evolutionary and ecological characteristics of this species and the isolation of remnant populations on offshore islands. The Department of Conservation recovery plan focuses on the protection of island populations and using translocations to restore tuatara to locations throughout their relict range. While detailed data are available for a small number of islands, monitoring has been limited for most relict populations due to challenges in access, costs, and fragility of the habitat. We compared tuatara survey data collected in 1988/1989 with data from 2012 from four Northern Islands (Tawhiti Rahi, Aorangi, Ruamahua-iti, and Ruamahua-nui) as well as two Cook Strait Islands (Middle Trio and North Brother) for changes in capture numbers, catch per unit effort, body condition, and sex ratio. Demographic changes in population structure can have important consequences for viability, where shifts in age class or sex ratio can impact future population growth. We find that the major shifts in body condition and sex ratio documented on North Brother Island have not occurred on the other islands in this study, with similar metrics of population composition across the 23 years between the two surveys. We also find similarities in baseline corticosterone among islands except North Brother. Together, our work demonstrates that the concerns for population viability on North Brother Island do not necessarily reflect the population status on other islands, which is good news for efforts to conserve this iconic species.

Using geospatial data for ecological modelling in R

James Griffiths[1], Clayson Howell[2], Susan Waugh[3]
[1]Department of Conservation, Nelson, New Zealand, [2]Department of Conservation, Wellington, New Zealand, [3]Te Papa, Wellington, New Zealand

Biography:
James Griffiths works as an animal and plant pest ecologist for the New Zealand Department of Conservation.

Geospatial data play an increasingly important role in ecological research. LiDAR and hyperspectral imagery are used to describe vegetation structure and composition at large spatial scales; satellite derived metrics, such as sea surface temperature, wind direction and speed, and chlorophyll can be paired with bathymetric and fisheries data to model distributions of marine organisms; and climate surfaces interpolated from weather stations can be used to predict seed-fall events for masting tree populations.

We illustrate the use of geospatial data in ecological analyses in R through three New Zealand examples. We discuss the importation and manipulation of geospatial data, linking ecological data with covariates extracted from geospatial datasets, and the creation of modelled prediction surfaces. We also examine the value of modelled prediction surfaces for natural resources management and planning.

Eradication is not the only option: Sustained control of introduced yellow crazy ants improves ecological and social outcomes in Atafu, Tokelau

Monica Gruber[1,5], Allan Burne[5], Vivienne Van Dyk[2], Paul Craddock[2], Leuta Naseri-Tamoa[3], Rafael Barbieri[5], Meghan Cooling[5], Betty Tuilotolava[3], Ray Pierce[4]

[1]Centre for Biodiversity and Restoration Ecology, School of Biological Sciences, Victoria University of Wellington, Wellington, New Zealand, [2]Flybusters Consulting Ltd., Auckland, New Zealand, [3]Ministry of Economic Development, Natural Resources and Environment, Atafu, Tokelau, Atafu, Tokelau, [4]Eco-Oceania Pty Ltd., Speewah, Australia, [5]Pacific Biosecurity, Victoria Link Ltd., Victoria University of Wellington, Wellington, New Zealand

Biography:

Monica Gruber leads the Pacific Biosecurity not-for-profit programme at Victoria University, and since then has worked in Australia, New Zealand, Tokelau, Kiribati, Samoa, French Polynesia and Fiji. Her research expertise includes aspects of ecology, evolutionary ecology, genetics, genomics, statistics and bioinformatics. Monica is also Ecology and Environment Programmes Manager at Victoria Link Limited, a role that involves extending Victoria University's research in the Pacific.

Populations of invasive species are routinely removed from environments around the Pacific. Eradication is typically seen by invasive species managers as the ideal goal for management. However, in some cases eradication may not be feasible, or even desirable. For example, cost - financial, social or environmental - might be high, and lapses in biosecurity may result in re-introductions or introductions of new populations. We report on the management of yellow crazy ants in Atafu, Tokelau, over a five-year period. In our initial work we found that yellow crazy ants had density-dependent negative effects on seabirds, local ant communities and the concern people expressed over the effects of the ant on their lives. Following a single island-wide control event we reduced the abundance of yellow crazy ants to a point where these density-dependent effects were no longer detectable. These positive ecological and social outcomes were evident three years after treatment, indicating that the initial control event had a persistent effect. We found no adverse environmental or social impacts. Populations of other ants were significantly higher after treatment and may indicate biotic resistance to the yellow crazy ants. Our study shows that control alone can be an effective solution for the management of invasive ant populations when eradication is not feasible.

Broad-scale effects of city, habitat and season on tracking rates of urban mammals

Dr Stephen Hartley[1], John Innes[2], Niel Fitzgerald[2], Deborah Wilson[3], Hayley Ricardo[3], Yolanda van Heezik[4], Kim Miller[4], Cherie Balls[1]

[1]Victoria University of Wellington, Wellington, New Zealand, [2]Manaaki Whenua / Landcare Research, Hamilton, New Zealand, [3]Manaaki Whenua / Landcare Research, Dunedin, New Zealand, [4]Otago University, Dunedin, New Zealand

Biography:

Stephen Hartley is a senior lecturer at Victoria University of Wellington and director of VUW's Centre for Biodiversity and Restoration Ecology. His research interests include spatial ecology and improving methods of monitoring for conservation and restoration ecology. He is a member of the MBIE-funded research team: People, Cities and Nature.

Introduced mammals have been the focus of a long history of ecological study in New Zealand forests and rural grasslands, but their habits and distribution in urban New Zealand have been largely unstudied. Recent initiatives for cities to become "predator-free" require a better understanding of pest behaviour and their use of urban landscapes. We present preliminary data on the detection rates of rodents, hedgehogs, possums and mustelids from 960 tracking tunnel and chew-card events deployed across three New Zealand cities in urban gardens, bush reserves and amenity grassland over two seasons. Tracking rates of rats and mice were influenced by season (more often detected in late autumn than in late spring / early summer), whereas possums were significantly associated with urban forest patches. Hedgehog tracking rates responded to the interaction of habitat and season (most often detected in spring / summer in residential and non-forested areas). Possum control was highly effective in Wellington; while hedgehogs were most commonly detected in Dunedin. Rat tracking rates were considerably lower in urban habitats compared with studies that used the same standard method in back-country forests. Recommendations to councils and community groups for how to monitor mammals in urban environments include: (1) deploy tunnels and/or chew cards for 7 nights (to increase sensitivity), (2) allow some flexibility in tunnel spacing and transect layout compared to the standard operating protocol designed for forest monitoring, and (3) consider the use of cameras to better detect hedgehogs and cats.

Using stable isotopes to show that an herbivorous beetle from alpine rock outcrops relies on ammonia-absorbing lichens

David Hawke[1], John Marris[2]
[1]*Ara Institute of Canterbury, Christchurch, New Zealand,* [2]*Lincoln University, Christchurch, New Zealand*

Biography:
David Hawke is an environmental chemist, with particular interest in landscape-scale cycling of nutrients and trace elements. As such, he works at the interface between ecology and geochemistry. Much of his work, including that presented here, involves stable isotopes of carbon and nitrogen. His PhD came from University of Otago and was followed by post-doctoral work at University of Miama and University of Canterbury.

The endemic beetle Protodendrophagus antipodes (Coleoptera: Silvanidae) is unique among 12 globally-distributed genera of the tribe Brontini in exchanging the forest for an alpine existence. Larvae from other Brontini genera consume fungi found underneath loose bark, but since P. antipodes lives well above the treeline, this tree-based fungal diet is clearly impossible. Because lichens are composite organisms comprising fungi and either algae or cyanobacteria, we proposed that lichen consumption could be the dietary link between P. antipodes and the remaining fungivorous Brontini.

Our samples came from rock outcrops at 1800 m on Mt Hutt ski field at the eastern edge of the Southern Alps. Primary producer δ15N values fell into two clusters; crustose and fruticose lichens at very low δ15N, and mosses, vascular plants and foliose lichens close to 0‰. Adult and larval P. antipodes δ15N values were 1-3‰ higher than crustose and fruticose lichens and so consistent with these lichens as their food source. Lichens depend for their N on either atmospheric deposition or atmospheric N2 fixation. The remarkably negative δ15N values of the crustose and fruticose lichens at our site best matched gaseous ammonia as their N source. Ammonia sources to New Zealand alpine environments may have changed, as ammonia from increasingly intensive agriculture has replaced that from formerly widespread surface-nesting river bird colonies. If P. antipodes is a significant prey animal for alpine lizards, birds and predatory arthropods, this unusual beetle would be an important conduit for lichens and atmospheric ammonia in supporting alpine biodiversity.

Protectionist versus indigenous peoples' approaches for management of a culturally-significant species

Mark Herse[1], Dr. Phil Lyver[2], Nigel Scott[3], Dr. Andrew Gormley[2], Dr. Jason Tylianakis[1]

[1]University of Canterbury, Christchurch, New Zealand, [2]Manaaki Whenua/Landcare Research, Lincoln, New Zealand, [3]Te Rūnanga o Ngāi Tahu, Christchurch, New Zealand

Biography:

Mark Herse received his BSc in Wildlife Ecology and Management from Montana State University in 2010, and MSc from Kansas State University in 2017, where he studied landscape ecology of threatened grassland birds. Mark has special interests in avian ecology, population processes, and using field-based research to identify practical conservation strategies.

Most recent species extinctions and range contractions have been caused by human exploitation of natural resources. Species conservation therefore often focuses on assessing how human-induced environmental pressures influence population dynamics, and typically defaults to protected areas to maximize survival and reproduction. Conservation management systems that favour the protection of species in reserves or prohibit harvesting of juveniles are common in western cultures. However, these systems can conflict with the biocultural approaches of indigenous cultures that focus on human-environment relationships and managing species for future use. Likewise, there is growing interest in establishing management systems that engage with traditional practices and provides opportunities to increase the role of indigenous peoples in environmental management. To explore these issues, I will assess how different wildlife management strategies (e.g. harvesting adults only versus individuals from multiple life stages) and larger-scale impacts of land use affect culturally-significant black swan (*Cygnus atratus*) populations. Here I will discuss outcomes from the first year of my PhD study to understand the effects that kaitiakitanga-based interventions by Māori have on black swan population viability.

Wilding conifers other than *Pinus*

Mr Clayson Howell[1]

[1]*Department of Conservation, Wellington, New Zealand*

Biography:
Clayson is an Ecologist at the Department of Conservation (DOC), based in Wellington. Wilding conifers are a major focus for DOC and Clayson contributes to research into all aspects of their identification, prioritisation and control.

Wilding conifers are a major environmental weed in New Zealand. A full checklist of 364 exotic conifers present in New Zealand has been prepared based on herbarium specimens. The checklist includes presence in New Zealand and quantification of naturalised extent. Not all cultivated conifers have become environmental weeds. There have been several investigations into the relative importance of climate matching, life-history traits and cultivation history in determining naturalisation and invasiveness of conifers and *Pinus* in particular. However, the lists used were based on out-dated naturalisation data and omitted some rarely cultivated conifers. I examine whether the substantially revised list affects previous findings and discuss weed risk of conifers other than *Pinus*.

Automated detection of kiwi (*Apteryx spp.)* from continuous field acoustic recordings – New Zealand Tier 1 data analysis

Julius Juodakis[1], Stephen Marsland[1], Nirosha Priyadarshini, Virginia Listanti[1], Isabel Castro[2], Moira Pryde[3]
[1]School of Mathematics and Statistics, Victoria University of Wellington, Wellington, New Zealand, [2]Wildlife and Ecology Group, Massey University, Palmerston North, New Zealand, [3]Science and Policy, Department of Conservation, New Zealand

There is a need for improved tools to measure changes in population distribution and abundance of endangered species to assess and improve the effectiveness of management actions. For hard-to-see avian species, call counts are the traditional method of monitoring. These surveys are spatially and temporally limited, labour intensive, weather dependent, and prone to error and bias. Modern acoustic field recorders enable simultaneous data collection at many sites with minimal disturbance. However, automating the extraction of target species sounds from recordings is still largely unsolved.

The New Zealand Department of Conservation (DOC) runs a National Biodiversity Monitoring and Reporting System that uses acoustic recordings as part of Tier 1 monitoring. We will present our approach to developing and using an automatic recogniser to identify the calls of New Zealand's national bird, kiwi (*Apteryx* spp.) in the 2011-2016 recordings, a small part of which has been annotated manually.

Kiwi is a group of endemic, nocturnal, and flightless birds in five species and 11 taxa under various conservation threats. The recordings are noisy and contain many sounds in addition to kiwi. Further, bird vocalisations are often far from the recorder, therefore having low energy. Despite this, our wavelet-based call detection approach and post-processing techniques detected >75% of kiwi vocalisations. We evaluate the success of these methods via the precision of species abundance estimates. The methods are built into our AviaNZ software, which also allows humans to easily review and confirm/reject the outputs.

Mast seeding in *Aciphylla* species: Patterns in a weird reproductive system

Dave Kelly[1]

[1]*University of Canterbury*

Acipylla species (Apiaceae) in New Zealand are endemic long lived, dioecious, insect-pollinated mast seeding plants. This is a combination of characteristics that appear to pose special problems for plant reproduction. I have been following flowering in permanent plots for three species at five sites since the 1990s and a number of interesting features are apparent. Flowering is highly variable, with a large number of zero years, and high Coefficients of Variation (CVs) around 1.4-2.1. Flowering is significantly synchronous among sites and among *Aciphylla* species, but the genus is not in step with *Chionochloa* and *Nothofagus*. Plant sex ratios take a long time to estimate from revealed flowering of marked plants. Allocation theory predicts that low-flowering years should be dominated by male inflorescences, but oddly this is not the case. Finally, for a mast seeding plant, adults suffer unusually high rates of mortality, which imposes a major cost of mast seeding. The counterbalancing economies of scale which favour masting are not entirely clear.

Macroinvertebrate Diversity in Ponds in the Auckland Region

Abigail Kuranchie[1], Professor Dianne Brunton[1], Dr. Aaron Harmer[1], Dr. Manu Bird[1], Prof Russell Death[1]
[1]*Massey University, Auckland, Albany, New Zealand*

Biography:
Abigail is a postgraduate student (PhD) of Massey University studying Conservation Biology. Her research is focused on freshwater ecology and conservation specifically on pond ecosystem and conservation. Her research is on the role of land use and environmental factors on species composition on ponds in the Auckland Region.

In New Zealand, more than 10% of freshwater invertebrates species are known to be at risk of extinction, many others have unknown conservation status due to insufficient data. Hence NZ's freshwater invertebrates are becoming a significant contributor to the world's endangered and threatened freshwater species. Within the context of freshwater ecosystems, ponds (small water bodies) are recognised as important habitats in many parts of the world; habitats that support uncommon aquatic macroinvertebrates at a regional scale. In spite of this, research on pond macroinvertebrates, and how different land-use types affect these ecosystems, has received little attention in NZ. This makes the ecological basis for pond conservation weak

An assessment of macroinvertebrates in 12 ponds in different landscapes has been done. Macroinvertebrates were sampled with a d-frame net which was swept through the range of microhabitats within the ponds for three minutes. Net contents were extracted then transported to the lab for sorting and identification. Macroinvertebrates were preserved in 70% ethanol. Identification was done under a dissecting microscope with identifications guides and keys.

A total of 3,428 individuals belonging to 54 families were sampled over winter 2018. A total of 28 families were rare occurring in only one sampling site. There was no family that occurred in all 12 sites however, 10 and 11 different families occurred in four sites each. Fewest families (5) were detected in a rural irrigation pond where the water is used for horticultural purposes and the highest family richness was recorded in a rural ornamental pond.

High multifunctionality of *steppes* under moderate grazing is associated with high plant and fungal, low bacterial, but not faunal diversity

Dr Frank Yonghong Li[1], Ms Xinyu Wang[1]

[1]*School of Ecology & Environment, Inner Mongolia University, Hohhot, China*

Biography:

Frank Yonghong Li is a professor of ecology, and dean of School of Ecology & Environment, Inner Monoglia Univeristy (China). He is interested in a wide range of topics in ecology, covering vegetation ecology, biodiverstiy conservation, and ecosystem responses to climage and land use changes. He uses both experimental and modelling approches in the research, and recent research focuses on the steppe ecosystems on the Mongolian Plateau. Frank previously worked for AgResearch and Plant & Food Research, having a good connection with the research community in New Zealand.

Current studies on the relationships between biodiversity and ecosystem functioning (BEF) have mostly focused on the aboveground communities. Less is known on the separate and combined effects of above- and belowground biodiversity on multiple ecosystem functions (multifunctionality). Based on a 6-year grassland experiment in the typical steppe region of Inner Mongolia, we aimed to evaluate the multifunctionality and separate functions linked to C, N, P cycling and productivity of grassland under three management types (grazing, mowing and enclosure), and test how aboveground (plant) and belowground (faunal, bacterial and fungal) diversity affect ecosystem multifunctionality (M-index). We found that: (1) ecosystem multifunctionality, rates of nutrient cycling and plant productivity were all greatest under moderate grazing intensity, and lowest under no grazing; (2) The changes in biodiversity, including both above- and belowground biodiversity, explained 78.6% of the variation in multifunctionality across experimental plots under three management types. (3) Plant and fungal diversity, bacterial diversity, and faunal diversity were respectively positively, negatively, or not correlated with multifunctionality; specifically, plant diversity had positive correlations with C and N cycling, fungal diversity had positive correlations with N and P cycling, whereas bacterial diversity had negative correlations with P cycling and productivity. Our results indicate that moderate grazing has the better outcomes than mowing and enclosure for conserving biodiversity and ecosystem functions. To conserve both above- and belowground biodiversity is a viable strategy in developing sustainable grassland management for increased delivery of ecosystem services.

AviaNZ Birdsong Analysis Platform

Virginia Listanti[1], Stephen Marsland[1], Nirosha Priyadarshani[1], Julius Juodakis[1], Isabel Castro[2]
[1]School of Mathematics and Statistics, Victoria University of Wellington, Wellington, New Zealand, [2]Wildlife and Ecology Group, Massey University, Palmerston North, New Zealand

The routine collection of long-term acoustic recordings of birds in the field has presented new challenges in data analysis. While many terabytes of data are collected annually across the world, effective use of this noisy, highly variable data requires skilled humans to manually identify calls. While computer programs to automatically analyse these recordings are becoming available, it is important that they are user-friendly and easy to use, so that everybody – from citizen scientists to wildlife managers to researchers – can take advantage of them, and that they keep the human in the loop so that the analysis carried out this year is comparable both to manual call counts from the past, and more accurate automated analyses performed in the future.

We present the AviaNZ program, which is designed to achieve precisely these goals: the software includes methods for simple, rapid annotation of recordings, denoising and segmentation methods, and a training procedure by which the user can prepare their own filters to recognise individual species. The software can run in batch mode, automatically processing folders of field recordings, and then present the outputs in a way that enables the user to quickly and effectively identify errors. Finally, the outputs are presented in a variety of spreadsheets to enable different statistical analyses to be performed.

AviaNZ is available at www.avianz.net. By enabling everybody involved with birdsong recording to quickly and easily analyse their own data, while future-proofing it by keeping the human in the loop, we are enabling acoustic field recordings to meet their potential.

Community structure of host-parasite associations: Native and invasive networks

Mrs. Cristina Llopis-Belenguer[1], Dr. Isabel Blasco-Costa[2], Dr. Juan Antonio Balbuena[1], Dr. Volodimir Sarabeev[3], Dr. Daniel B. Stouffer[4]

[1]University of Valencia, Spain, [2]Natural History Museum of Geneva, , Switzerland, [3]Zaporizhzhia National University, , Ukraine, [4]University of Canterbury, , New Zealand

Biography:

She is a graduate in Biology with a Master's Degree in Biodiversity: Conservation and Evolution. She is currently researching for her PhD in community ecology of fish parasites. She is supported by a predoctoral contract (ACIF/2016/374) and a visiting studentship (BEFPI/2018/012) to the University of Canterbury, both funded by the Valencian Department of Education and the European Social Fund (ESF).

One of the current stressors of ecosystems is the interactions between parasites and host translocated from their native areas. Studying the interactions of parasite and their hosts in both native and introduced areas can help us to understand the determinants of host - parasites associations. *Planiliza haematocheila* (Teleostei: Mugillidae) is a species native to the Sea of Japan that was deliberately introduced into the Sea of Azov, whereas *Mugil cephalus* s.l. is a worldwide distributed species native to both Seas. We characterize the bipartite networks of both *Mugil cephalus* s.l. and *P. haematocheila* with their respective parasite communities in the Mediterranean, Azov and Japan Seas. We compare the two networks of *P. haematocheila* in its native area (Sea of Japan) and in the introduced area (Sea of Azov). We use as a benchmark the networks of *M. cephalus* s.l. in its native distribution with the presence of *P. haematocheila* (Azov and Japan Seas) and without it (Mediterranean Sea). We conduct modularity analyses to identify characteristic associations of parasite species with individual hosts; and connectivity analyses to identify parasite species that are most important for maintaining the homogeneity of the community. At a global scale, our results suggest that the main driver of the host – parasite associations is the region (Sea) factor. However, when split by parasite phylogenetic groups, both region and host species determine the associations of monogeneans and their hosts. Monogeneans were the only group of parasites that was not able to parasitize *P*. *haematocheila* in its invasive area.

Frost and leaf size gradients in forests

Chris Lusk[1], Mike Clearwater[1], Daniel Laughlin[2]
[1]*University of Waikato, Hamilton, New Zealand,* [2]*University of Wyoming, Laramie, USA*

Biography:
Seeks to reconcile New Zealand's some of the quirks of New Zealand's flora and vegetation with ecological theory. Senior Editor of NZ J Botany.

Explanations of leaf size variation commonly focus on water availability, yet leaf size also varies with latitude and elevation in environments where water is not strongly limiting. We provide the first conclusive test of a prediction of leaf energy balance theory that may explain this pattern: large leaves are more vulnerable to night-time chilling, because their thick boundary layers impede convective exchange with the surrounding air. Seedlings of 15 New Zealand evergreens spanning 12-fold variation in leaf width were exposed to clear night skies, and leaf temperatures measured with thermocouples. We then used a global dataset to assess several climate variables as predictors of leaf size in forest assemblages. Leaf-minus-air temperature was strongly correlated with leaf width, ranging from -0.9 to -3.2 °C in the smallest- and largest-leaved species, respectively. MAT and frost-free period were good predictors of evergreen angiosperm leaf size in forest assemblages, but no climate variable predicted deciduous leaf size. Although winter deciduousness makes large leaves possible in strongly seasonal climates, large-leaved evergreens are largely confined to frost-free climates because of their susceptibility to radiative cooling. Evergreen leaf size data can therefore be used to enhance vegetation models, and to infer palaeotemperatures from fossil leaf assemblages.

Anthropogenic and climate-associated stressors combine to threaten the most biodiverse tropical forests

Dr. Filipe França[1,2], Dr. Joice Ferreira[1], Dr. Erika Berenguer[3], Dr. Alexander C. Lees[4], Dr. Gareth D. Lennox[2], Dr. Toby Gardner[5], Msc. Lais F. Maia[6], Dr. Julio Louzada[7], Dr. Nárgila G. Moura[8], Dr. Victor Hugo F. Oliveira[7], Dr. Jos Barlow[2]

[1]Brazilian Agricultural Research Corporation, Belém, Brazil, [2]Lancaster Environment Center, Lancaster, UK, [3]University of Oxford, Oxford, UK, [4]Manchester Metropolitan University, Manchester, UK, [5]Stockholm Environment Institute, Stockholm, Sweden, [6]University of Canterbury, Christchurch, New Zealand, [7]Universidade Federal de Lavras, Lavras, Brazil, [8]Cornell Lab of Ornithology, New York, USA

Biography:

Dr. Filipe França received his Ph.D in Science of Tropical Environments, and in Applied Ecology through the dual-Ph.D scheme from the Lancaster University (UK) and the Federal University of Lavras (Brazil). He then worked at the Lancaster Environment Centre as a NERC-funded Research Associate and, currently, as a postdoctoral researcher in the Brazilian Agricultural Research Corporation. His research focuses on the resilience of human-modified tropical forests, investigating how selective logging, wildfires and climate shocks impact ecosystem functioning and biodiversity. He has authored and co-authored 13 scientific publications and has produced different material for public outreach and scientific dissemination.

Given the high rates of human disturbance on remaining areas of tropical forests, it is crucial to develop a better understanding of how these interact with climatic extremes to affect biodiversity. We used a longitudinal experiment to evaluate how the 2015-16 El Niño-mediated drought and wildfires affected 579 tree, 315 bird and 103 dung beetle species sampled in 36 forest plots – half of which burned – distributed across a gradient of prior human disturbance in the Brazilian Amazon. We collected data approximately six years before and 10 months after the El Niño. Using a co-tolerance framework, we assessed species responses to the interaction between changes in landscape configuration and drought/wildfires, and evaluated changes in compositional similarity to pre-El Niño undisturbed forests over all disturbance classes. We found that up to 47% of investigated species were imperilled by both landscape- and climate-associated stressors, while only 12-18% species of trees, 18-31% of birds and 0-6% of beetles showed no or positive responses to the co-occurring stressors. Although there were significant effects from both landscape- and climate-associated stressors on species compositional changes, these varied between taxonomic groups and between forests affected by fire or drought-only. By demonstrating that distinct stressors can act together and reduce biodiversity, our study highlights that focusing on a single stressor may fail to capture the magnitude of the threat faced by tropical forests.

Remote sensing of ecosystem functions: what, why, how?

Dr Cate Macinnis-Ng[1]

[1]*University of Auckland, New Zealand*

Biography:

Cate is a plant ecophysiologist interested in climate impacts on vegetation. She uses a range of field-based and modelling approaches to explore how plant functions will respond to future climates. Cate is Senior Lecturer in Ecology and a Rutherford Discovery Fellow at the University of Auckland. She is a Principal Investigator with Te Pūnaha Matatini and the President of the New Zealand Ecological Society.

Measuring and monitoring of ecosystem change has mostly focused on structure and composition at large (landscape to global) scales. There has been less attention directed towards large-scale monitoring of ecosystem function, despite the fact that ecosystem function is central to generation of ecosystem services. This is possibly because ecosystem function is difficult to measure accurately at large scales and what defines an ecosystem function is not always clear. I will explain some current examples of satellite remote sensing of ecosystem functions in vegetated ecosystems. I will show how we can detect ecosystem responses to global change. These approaches are essential for effective biodiversity monitoring strategies.

Indirect facilitation and invasion success in annual plant communities

Michelle Marraffini[1], Trace Martyn[2], Margret Mayfield[2], Daniel Stouffer[1]
[1]*University of Canterbury, Christchurch, New Zealand,* [2]*University of Queensland, Brisbane, Australia*

Biography:
Currently a PhD student in Dr Daniel Stouffer's lab at University of Canterbury. Broadly studying species interactions and how they influence community processes such as coexistence and stability.

Non-native species (NNS) can have drastic and devastating effects on ecosystems and certain regions appear to be particularly susceptible to invasions while others remain pristine. This unequal invasion risk is often explained as the ability of more species-rich systems to better safeguard themselves. However, recent theoretical work showed that invasion probability could increase as the number of resources and species increased in a community due to what they term “native turncoats”. A “native turncoat” is a resident species that have an indirect facilitative effect on the invading species by directly altering the abundance of the invader's enemy. By extending a statistical framework for estimating neighbourhood effect in annual-plant systems, we quantify the prevalence of “native turncoats” in naturally occurring communities and examine their potential role in invasion success. We examined this on individual focal plants in annual plant communities of Western-Australia York-Gum ecosystems. Using spatially resolved data, we estimated the effects of 780 direct neighbours and over 7000 combinations of neighbour-neighbours on the fecundity of focal species. Models that included neighbour-neighbour interactions better predicted plant fecundity than those with only direct neighbour interactions, suggesting that indirect interactions are important in understanding dynamics of diverse communities. The direction and magnitude of species interactions varied with focal species and native status of the focal and neighbours. We conclude by examining the factors that influence the direction of species interactions in native turncoat scenarios. This work underscores the complexity of factors that influence invasion success in diverse systems.

Why don't orchid pollinators go extinct? The persistence of the costly coevolutionary relationship between sexually deceptive orchids and their dupes

Ms. Amy Brunton Martin[1], Dr James O'Hanlon[2], Prof. Hanna Kokko[3], Dr. Anne Gaskett[1]
[1]The University of Auckland, Auckland, New Zealand, [2] University of New England, Armidale, Australia, [3]University of Zurich, Zurich, Switzerland

Biography:
Amy Brunton Martin is currently a PhD student in Dr Anne Gaskett's lab at The University of Auckland studying co-evolutionary relationships: primarily on the evolution and consequences of sexual deception. While currently focussing on deceptive orchids and their duped pollinators, she also has a keen interest in behavioural ecology and modelling tricky evolutionary problems, as well as the natural history of all sorts of plants and animals.

Pollination is often mutualistic with fitness benefits for both plant and pollinator. But what happens when a plant imposes high costs in its pursuit of pollination? The sexually deceptive Australian and New Zealand Tongue Orchids, Cryptostylis, are extreme deceivers: they achieve outstanding pollination rates, but cause their male wasp pollinator to ejaculate and waste his limited sperm. This can have population-level impacts - if females become sperm depleted, lifetime reproductive success, and thus population survival, may be threatened. If orchids sabotage their pollinator's reproduction, why don't both plant and pollinator go extinct? Here, we propose that costs to pollinators might be buffered by a new mechanism: selection pressure on individuals is weakened by a combination of population-level counter-adaptations and species-level 'resilience' traits that allow pollinators to withstand high costs, without allowing escape from exploitation. Through field experiments, we found evidence of localised morphological and behavioural counter-adaptations to orchids: male wasps in areas with orchids have longer antennae, smaller body size, and smaller ejaculates, and are less likely to be fooled by or waste sperm on orchids than wasps in areas without orchids. Our mathematical model demonstrates that a putative resilience trait, haplodiploidy, allows pollinators to better survive orchid exploitation than a diploid pollinator, albeit with a male biased sex ratio. Natural history data from museums confirms that orchid exploitation produces a male-biased sex ratio. Our results demonstrate that while sexually deceptive orchids may harm their pollinators, some pollinators are better able to cope, and thus may make better dupes.

Can Tier 1 tell us if conservation is making a difference? A new framework linking conservation planning and power analysis

Dr. Norman Mason[1], Dr. Sarah Richardson[2], Dr. Andrew Gormley[2], Dr Peter Bellingham[2]
[1]Manaaki Whenua - Landcare Research, Hamilton, New Zealand, [2]Manaaki Whenua - Landcare Research, Lincoln, New Zealand

Biography:
Dr Norman Mason has over a decade's experience developing novel numerical approaches for addressing national-scale questions around biodiversity monitoring and ecosystem management.

Success of conservation management is often assessed merely by demonstrating the effectiveness of interventions within a managed area. Perhaps a more relevant measure of success for both conservation managers and the general public is whether or not current or planned management is sufficient to improve ecological integrity at the national scale. Conservation managers only have resources to manage a portion of public conservation land (PCL), so that trends in ecological integrity in the absence of management are just as relevant as changes caused by management. We present a novel modular analytical system for assessing the power of New Zealand's national (Tier 1) biodiversity monitoring network to detect changes in native bird and pest mammal abundance expected from differing levels of management effort (i.e. the proportion of PCL where management is applied) or management efficacy (i.e. the amount of change in abundance due to management). We show how a modular approach to power analyses permits the linking of key aspects of conservation planning with classic power analysis criteria – sample size, power to detect change, effect size and precision. We use two examples (possums and bellbirds) to demonstrate how this system could be applied in testing the ability of the Tier 1 monitoring network to detect the national-scale impact of various conservation strategies.

Using spatial distributions of Aotearoa's native Myrtaceae in the response to myrtle rust

Dr James McCarthy[1], Dr Sarah Richardson[1], Dr Susan Wiser[1]
[1]*Manaaki Whenua - Landcare Research, Lincoln, New Zealand*

Biography:
James is a terrestrial ecologist at Manaaki Whenua - Landcare Research. He is interested in patterns of species occurrence and abundance and using spatial models to project these across large scales. He likes using these models to map patterns of important ecosystem functions and make predictions for how these will be affected by events such as disease outbreak or large-scale climate change. Originally from Christchurch, James earned his MSc at the University of Canterbury before completing a PhD at the University of Queensland. He has recently returned to Christchurch to take up a position at Landcare Research.

Myrtle rust was discovered in New Zealand in April 2017, likely carried by wind across the Tasman from Australia where it has been present since 2010. Within 12 months it had spread from where it was initially detected on Raoul Island to the Nelson/Marlborough region of the South Island. The disease was primarily observed in nurseries and on planted trees, but several native populations were also affected. *Lophomyrtus bullata* initially appeared most susceptible, but the disease has also been detected on several other Myrtaceae species. While New Zealand is rich in plot-level plant community data, we lack a broad-scale overview of the spatial distributions of many species—including those susceptible to myrtle rust—especially in poorly surveyed areas and at range limits. This information is important because it can inform disease spread simulations, control attempts, design of monitoring programs, and conservation decisions. To support the response to myrtle rust, distribution maps were produced for all 26 Myrtaceae species that occur on the New Zealand mainland. These maps were produced using plant community data from the National Vegetation Survey (NVS) databank and environmental variables covering climate, soil, and topography using boosted regression trees. Here, we outline our approach, present some distributional predictions, and provide examples of how species distribution models can be used to inform the response to important diseases such as myrtle rust.

The role of plant volatiles in giant willow aphid (GWA) interactions with its host plants

Mr. Kyaw Min Tun[1], Dr. Maria Minor[1], Dr. Trevor Jones[2], Dr. Andrea McCormick[1]
[1]Massey University, Palmerston North, New Zealand, [2]Plant & Food Research, Palmerston North, New Zealand

Biography:
I got my master degree from Kyushu University, Japan specializing in insect natural enemies.I came from Myanmar to study for my Ph.D in Ecology here at Massey University. I am now a second year Ph.D student, exploring the multitropic interaction involving the giant willow aphid. It will cover volatile communication, aphid-predator interaction, the effect of aphid infestation on willow biomass production and its indirect effects on soil microbial community and honeydew feeders.

The giant willow aphid (GWA) *Tuberolachnus salignus* is an invasive species attacking willows, poplars, and other trees from the family Salicaceae. In New Zealand, it was first reported in Auckland in 2013 and has rapidly spread throughout the country with devastating consequences for planted and naturalised forests. Despite its economic importance, we have a poor understanding of its host-selection process and the plant's responses to infestation. Volatile organic compounds (VOCs) play a pivotal role in plant-insect interactions mediating insect host selection and plant defense. In this study, we aim to characterise the volatile emissions of different willow clones and the changes in volatile emission in response to GWA attack. The headspace sampling method was used to collect VOCs from the foliage of 15 different willow clones. The chemical separation and identification were done using gas chromatography and mass spectrometry. VOCs of willow saplings infested with the GWA were compared to those emitted from aphid-free plants. Twenty VOCs were identified from each sample. Major VOCs identified were (*Z*)-3-hexen-1-ol, (*E,E*)- α -farnesene, α-copaene, α-pinene, and hexanal. Preliminary results show significant variation in VOCs emissions among different willow clones. Further analyses will be performed in summer 2018-2019. Additional studies are needed to elucidate GWA responses to plant volatiles and other physiological responses of willow clones to GWA.

Using disease ecology conceptual frameworks to understand the eco-epidemiology of *Leptospira borgpetersenii serovar Ballum* in New Zealand

Dr Marie Moinet[1], Dr Yuni Yupiana[1], Dr Shahista Nisa[1], Mr Neville Haack[1], Prof Peter Wilson[1], Dr Emilie Vallée[1], Dr David Wilkinson[1], Assoc Prof James C. Russell[2], Prof Cord Heuer[1], Dr Danielle Aberdein[1], Dr Julie Collins-Emerson[1], Assoc Prof Jackie Benschop[1]

[1]School of Veterinary Science, Massey University, Palmerston North, New Zealand, [2]School of Biological Sciences and Department of Statistics, University of Auckland, New Zealand

Biography:

I graduated as a vet in France in 2008 and worked as a project manager in the Wildlife Surveillance & Eco-Epidemiology Unit (French agency for food, occupational and environmental safety). I followed in parallel a MSc in Veterinary Epidemiology & Public Health (RVC London).
There, I managed SAGIR, a wildlife diseases surveillance network, and studied various species and zoonoses, with a focus on bats, rodents and tick-borne pathogens. My veterinary thesis was about leptospirosis in wild carnivores in France and the PhD I'm doing in the Leptospirosis Research Group at Massey University is in continuity with this past research.

In NZ, leptospirosis is an occupational zoonosis, with >66% of notified cases being farm or abattoir workers. The increasing importance of serovar Ballum in human cases suggests, despite a dearth of current information, that wildlife may be an overlooked source of infection. Livestock species independently maintain *L. borgpetersenii* serovar Hardjo and *L. interrogans* serovar Pomona, and both are included in livestock vaccines. Their role in Ballum maintenance is unclear but they could act as bridge hosts for humans.
We drew from two conceptual frameworks [(1,2)] to study the determinants of Ballum spill-over. We collated findings of published and ongoing studies pertaining to:

- the infection dynamics of Ballum in maintenance hosts,
- *Leptospira* shedding and survival in the environment,
- the competency of cattle as a potential bridge species, and
- exposure (risk) factors for cattle (bridge host) and humans (target hosts).

Known maintenance hosts, *Mus musculus*, *Rattus rattus* and *Erinaceus europaeus*, are distributed throughout NZ and present on pastureland. On a Manawatu farm sampled biannually since 2016, mice densities ranged between 9-53/Ha, PCR prevalence ranged between 31-86% and Ballum-seroprevalence 25-77%. Forty-two and 36% of hedgehogs and rats were also harbouring *Leptospira*.
Literature suggests a low pathogenicity for cattle. In the same farm, 33% [CI 23-43] of heifers were Ballum-seropositive. We found in another study 0.3% [CI 0.2-0.6]) of 4000 adult dairy cows shedding Ballum despite being seronegative.

Our approach highlights that cattle are spill-over hosts for Ballum. Further studies should focus on its survival in the environment to adapt control strategies.

Native vs. exotic species richness relationships on New Zealand offshore islands

Dr. Fabio Mologni[1], Dr. P. J. Bellingham[2], Dr. K. C. Burns[1], Dr. E. Cameron[3]
[1]Victoria University of Wellington, Wellington, New Zealand, [2]Landcare Research, Lincoln, New Zealand, [3]Auckland War Memorial Museum, Auckland, New Zealand

Biography:
Fabio Mologni is currently a PhD student at Victoria University of Wellington and his project is focused on the distribution of plants on New Zealand offshore islands, in order to understand their composition and how it changes through time. Analyzing the main factors affecting species distribution is a key step for a better understanding of the processes affecting those islands and the development of crucially important forecasting tools that can help conservation bodies in managing them and natural areas overall.

Islands are particularly susceptible to plant invasions. However, differences in the distribution of native and exotic species on islands are not fully understood. We sought to determine how several geographical variables affect the richness of native and exotic species on more than 250 islands off the northern island of New Zealand. Species lists were collected by hand or from published studies for about 1700 species, half of them exotic. Results showed that richness of native and exotic species increases with island area, and declines with both isolation and exposure to ocean-borne disturbances. However, exotic species were preferentially distributed on large islands that are less isolated from the mainland and less exposed to ocean-borne disturbances. Exotic species may occur preferentially on large, close islands because they are more likely to be intercepted by dispersing seeds during the invasion process. Exotic species may also be less able to cope with ocean-borne disturbances. Overall results indicate several reasons for why islands might be susceptible to plant invasions that could apply to other acrhipelagos.

Open data in South America: Atlantic Bats and the Atlantic collection

Renata Lara Muylaert[1,2], Richard D. Stevens[3], Carlos Eduardo Lustosa Esbérard[4], Marco Aurelio Ribeiro Mello[5], Guilherme Garbino[6], Luiz H. Varzinczak[7], Deborah Faria[8], Marcelo Weber[9], Patricia K. Rogeri[2], André Luis Regolin[2], Hernani Oliveira[10], Luciana de Moraes Costa[11], Marília A. S. Barros[12], Gilberto Sabino-Santos Jr[13], Mara Ariane Crepaldi de Morais[2], Vinicius Silva Kavagutti[14], Fernando C. Passos[7], Emma-Liina Marjakangas[15], Felipe Gonçalves Motta Maia[13,16], Milton Cezar Ribeiro[2], Mauro Galetti[2]

[1]Molecular Epidemiology And Public Health Laboratory, Hopkirk Research Institute, Massey University , [2]Universidade Estadual Paulista, Departamento de Ecologia, Instituto de Biociências, Rio Claro, Brazil, [3]Texas Tech University, Department of Natural Resources Management and Museum, Lubbock, USA, [4] Universidade Federal Rural do Rio de Janeiro, Departamento de Biologia Animal, Instituto de Biologia, Laboratório de Diversidade de Morcegos, , Seropédica, Brazil, [5]Department of Ecology, University of São Paulo, São Paulo, Brazil, [6]PPG-Zoologia, Universidade Federal de Minas Gerais, Departamento de Zoologia, Instituto de Ciências Biológicas, Belo Horizonte, Brazil, [7]Universidade Federal do Paraná (UFPR), Departamento de Zoologia, Curitiba, Brazil, [8]Laboratório de Ecologia Aplicada à Conservação, Universidade Estadual de Santa Cruz (UESC), Departamento de Ciências Biológicas,, Ilhéus, Brazil, [9]Laboratório de Vertebrados, Departamento de Ecologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro,, Rio de Janeiro, Brazil, [10]Queen Mary University of London, School of Biological and Chemistry Sciences, London, England, [11]Universidade do Estado do Rio de Janeiro, Laboratório de Ecologia de Mamíferos,, Rio de Janeiro, Brazil, [12]Universidade Federal de Pernambuco, Departamento de Zoologia, Centro de Ciências Biológicas, Recife, Brazil, [13]University of São Paulo, School of Medicine of Ribeirão Preto, Centre for Virology Research, Ribeirão Preto, Brazil, [14]Programa de Pós-Graduação em Ecologia e Recursos Naturais, Universidade Federal de São Carlos, Departamento de Hidrobiologia, São Carlos, Brazil, [15]Norwegian University of Science and Technology, Centre for Biodiversity Dynamics, Trondheim, Norway, [16]University of São Paulo, Institute of Biomedical Sciences, Department of Microbiology, São Paulo, Brazil

Biography:
I am a Brazilian biologist with experience on landscape ecology and mammal ecology. I have a great interest on disease ecology, teaching, learning, doing research and science communication. Currently, I am investigating the interplay between landscape change and interactions among mammals and hantaviruses in Brazil. My project is funded by São Paulo Research Foundation (FAPESP 2017/21816-0).
I will be visiting David Hayman's group for one year to develop a part of my PhD research on hantavirus disease ecology. You can find more about my work here http://www.bv.fapesp.br/pt/pesquisador/176171/renata-de-lara-muylaert/. Follow me on twitter: @MuyRe. My publications are available at http://www.leec.eco.br/publications

In this talk we present the ATLANTIC series of data papers published in Ecology, focusing on bats and other mammals. We also discuss about open data initiatives and their applicability in ecology and conservation. Bats are the second most diverse mammal order and they provide vital ecosystem functions (e.g., pollination, seed dispersal, and nutrient flux in caves) and services (e.g., crop pest suppression). Bats are also important hosts of pathogens, harbouring more than 100 different virus types. In the present study, we compiled information on bat communities from the Atlantic Forests of South America, which are highly threatened by habitat loss and fragmentation. ATLANTIC BATS dataset comprises 135 quantitative studies carried out in 205 sites, which cover most vegetation types of the tropical and subtropical Atlantic Forest: dense ombrophilous forest, mixed ombrophilous forest, semideciduous forest, deciduous forest, savanna, steppe, and open ombrophilous forest. The dataset includes information on more than 90,000 captures of 98 bat species of 8 families. Species richness averaged 12.1 per site, with a median value of 10 species (ranging from 1 to 53 species). Six species occurred in more than 50% of the communities: *Artibeus lituratus*, *Carollia perspicillata*, *Sturnira lilium*, *Artibeus fimbriatus*, *Glossophaga soricina*, and *Platyrrhinus lineatus*. The number of captures divided by sampling effort, varied from 0.000001 to 0.77 individuals/hour*m^2 (0.04±0.007 individuals/hour*m^2). Eight species together comprise 80% of all captures: *Platyrrhinus lineatus* (2.3%), *Molossus molossus* (2.8%), *Artibeus obscurus* (3.4%), *Artibeus planirostris* (5.2%), *Artibeus fimbriatus* (7%), *Sturnira lilium* (14.5%), *Carollia perspicillata* (15.6%), and *Artibeus lituratus* (29.2%).

Seasonality and city structure affect the risk of leptospirosis in humans within Southeastern Brazil

Renata Lara Muylaert[1,2], Thiago Salomão de Azevedo[3], Marie Moinet[1], Milton Cezar Ribeiro[2], David Hayman[1]
[1]Molecular Epidemiology and Public Health Laboratory, Hopkirk Research Institute, Massey University, Private Bag 1, Palmerston North, New Zealand, [2]Department of Ecology, Universidade Estadual Paulista (UNESP), Av. 24A, 1515, Rio Claro, 13506-900, Brazil, Rio Claro, Brazil, [3]Department of Ecology, Universidade Estadual Paulista (UNESP), Av. 24A, 1515, Rio Claro, 13506-900, Brazil, Rio Claro, Brazil

Biography:
I am a Brazilian biologist with experience on landscape ecology and mammal ecology. I have a great interest on disease ecology, teaching, learning, doing research and science communication. Currently, I am investigating the interplay between landscape change and interactions among mammals and hantaviruses in Brazil. My project is funded by São Paulo Research Foundation (FAPESP 2017/21816-0). I will be visiting David Hayman's group for one year to develop a part of my PhD research on hantavirus disease ecology. You can find more about my work here http://www.bv.fapesp.br/pt/pesquisador/176171/renata-de-lara-muylaert/. Follow me on twitter: @MuyRe. My publications are available here: http://www.leec.eco.br/publications

Leptospirosis is a bacterial disease most commonly affecting people in tropical countries. In Brazil, disease is associated with contact with water presumably contaminated by infected rodents' urine. Social, environmental and climatic factors are known to influence disease risk, and knowing the particular effect of each risk factor is crucial to understanding the disease ecology and efficiently controlling transmission. Here we modelled the spatio-temporal variation in the risk of leptospirosis in humans using a 2000-2016 time series of notified cases in the State of São Paulo, southeastern Brazil. Covariates included altitude, elevation change, distance to drainage, temperature, El Niño events, and a Social Vulnerability Index, all scaled at the municipality level (N=645). A total of 12989 cases were reported in the period. A space-time Poisson model identified three clusters of higher risk in areas with steeper slopes, higher altitudes, number of floods and average distance to drainage spots in comparison to the average outside cluster areas. Overall there is a marked seasonal variation in expected disease risk peaking in summer. There was no variation in social vulnerability levels between cluster and non-cluster areas. Moreover, no clear trend of increased risk through time was observed and there was no association of disease risk with El Niño. Higher risk in the Campinas region suggests a need for targeted surveillance in upland cities where disordered urban sprawl occurs along floodplain areas. Future steps should include the dynamics of urban rodent populations in models and refine the evaluation of high-risk areas.

A Biodiversity Planning Snapshot - how well are councils protecting biodiversity?

Shona Myers[1]
[1]*Myers Ecology Ltd*

Biography:
Shona is the Director and Principal Ecologist of Myers Ecology Ltd and has worked widely with central and regional government agencies, leading biodiversity and resource management programmes. Her experience includes Environment Court and council hearings, regional plan biodiversity policy analysis, terrestrial assessment of effects, and wetland monitoring. She has worked for Department of Conservation national office advising on priorities for resource management engagement. Shona is a past President and Life Member of NZES, and is the immediate Past President of the International Association for Ecology (INTECOL). Shona is an Independent Hearing Commissioner for Auckland Council.

Regional and district councils have responsibility for maintaining biological diversity under Sections 30 and 31 of the Resource Management Act. Regional and district plans are variable in their approaches to addressing the protection of significant indigenous vegetation and habitats for indigenous fauna, and the management and enhancement of ecosystems and habitats. A National Policy Statement on indigenous biodiversity is currently being developed. Once adopted an NPS will provide statutory requirements for councils in developing policies, rules and methods for protecting and maintaining biodiversity. An NPS should provide greater consistency in plans than is currently in place. This paper will provide an updated analysis of the strengths and weaknesses of policies, methods and rules currently in district and regional plans across New Zealand. It will provide an update on earlier analysis of regional and district undertaken in 2014 (presented at the NZES conference) and analysis undertaken on wetland policies in Myers *et al.* 2013 (Ecological Engineering 56 (2013) 107–120)

‘Gen One’ detection: A scaleable strategy for detecting invading rats in predator-free landscapes

Dr Helen Nathan[1]
[1]*Zero Invasive Predators, Wellington, New Zealand*

Biography:
Helen is a Predator Ecologist with Zero Invasive Predators (ZIP), based in Wellington. She gained her PhD at the University of Auckland in 2016 with her thesis on quantifying and identifying trends in ship rat encounters and interactions with traps and detection devices. Helen’s current research focuses on strategies for detection and removal of eradication survivors and new invaders in large-scale predator-free landscapes on the New Zealand mainland.

One of the major challenges presented by the Predator Free New Zealand goal will be developing methods to efficiently protect large-scale landscapes against predator re-establishment. In large numbers, ship rats (*Rattus rattus*) devastate many of our native bird and invertebrate species populations. However, single invading rats in an otherwise rat-free area would cause minimal ecological damage to healthy native species populations. Traditional surveillance and defence of rat-free island and mainland sanctuaries has been geared towards intercepting every invading individual; requiring a high density of detection infrastructure which would be difficult and expensive to reproduce at scale. Zero Invasive Predators (ZIP) are developing an alternative strategy for landscape-scale surveillance, which focuses on detecting and initiating a management response to the first breeding event (termed ‘Gen One’). The strategy assumes that, as a unit, a mother rat with a litter of pups will be easier to detect than a single invader, because the juveniles would be expected to disperse away from the mother’s home range as they reach maturity. However, little is currently known about juvenile dispersal in ship rats so more data is needed to evaluate the viability of this approach. Here, we report on a field study aimed at measuring the spatial ‘footprint’ of a juvenile rat dispersal event. We released a bio-marked mother and litter in a rat-free (undetectable) area and monitored the dispersal for 12 weeks. Final capture locations ranged up to 682 m from the release location, suggesting the concept of a sparse detection approach holds promise.

What's hope got to do with it? The role of learned hopefulness in community conservation sustainability

Helen Ough Dealy[1]
[1]*Department of Conservation/Auckland University of Technology, Kerikeri/Auckland, New Zealand*

Biography:
Helen is a PhD candidate in the School of Science at AUT Auckland University of Technology. She works for the Department of Conservation with community groups, environmental educators and schools in the Bay of Islands.

Conservation gains are fragile. Without ongoing pest control New Zealand's endemic birds are, not surprisingly, significantly impacted. (Innes, 2001) In 2013, New Zealand's community-led conservation volunteers provided more than $160 million worth of conservation effort (Statistics New Zealand, 2015). But what keeps them going? Does "hope, a positive expectation and desire for a particular thing to happen," (Slezackova, 2017) play a role in community conservation action, and, if it does, can inter-generational conservation activism be taught through learned hopefulness?

New Zealand's government is promoting a pest-free nation by 2050. (Russell, Innes, Brown & Byrom, 2015) Community conservationists are one means of achieving this vision. Most community conservationists currently active across New Zealand, are at or beyond pension age (Peters, Hamilton & Eames, 2015) and unlikely to be active conservationists by 2050. It is, at present, unknown how many millennial New Zealanders (born early 1980s-early 2000s) will become future community conservationists, replacing present-day activists as they get older. How can community conservation contribute to a predator-free New Zealand by 2050?
Climate change education research suggests that having a hopeful attitude is more likely to lead to climate change action. (Ojala, 2007; Ojala, 2012) According to Li and Monroe (2017), hopefulness can be taught by helping people problem-solve. The relationship between hopefulness, environmental education and community conservation activism has not been considered. Snyder's Theory of Hope (Snyder, 1994) may provide a linking framework.

Successful implementation of Predator Free 2050 is dependent on a cross-generational commitment to conservation action. What future-proofing opportunities for sustaining community-led conservation does environmental education offer?

Using spatial analysis to infer socioeconomic drivers of New Zealand conservation

Dr Jennifer Pannell[1], Mr Rueben Goh[1], Ms Kelly D'Mello[1], Assoc. Prof. Hannah Buckley[1], Dr Bradley Case[1], Prof. David Norton[2]

[1]Auckland University of Technology, Auckland, New Zealand, [2]University of Canterbury, Christchurch, New Zealand

Biography:

Jennifer is a Postdoctoral Research Fellow working with Associate Professor Hannah Buckley and Dr Bradley Case at Auckland University of Technology as part of the Biological Heritage National Science Challenge project 3.3 working on enhancing biodiversity conservation in farm landscapes. Jennifer's background is in ecological modelling, and some of her previous work includes spatial and population modelling of invasive weeds, individual based forest dynamic modelling, and using multispectral imagery to measure pasture growth. She completed her PhD on modelling invasive plant distributions in 2016 at the Bio Protection Research Centre, Lincoln University New Zealand.

If we are to achieve our biodiversity goals, conservation cannot be confined to protected areas. The value of landowner and community-driven conservation initiatives in creating multifunctional landscapes is being increasingly recognised, but our understanding of what influences conservation decisions by landowners and the public is limited. It is often assumed that the attitudes and actions of neighbours and peer groups can influence land management decision-making, but quantitative evidence to support this influence on biodiversity protection is scant. Here, I report on two projects where we used spatial analysis to infer socio-economic drivers of conservation decision making in New Zealand. Firstly, we collated a comprehensive database of community riparian restoration in the Auckland Region and modelled whether number of restoration projects per suburb is predicted by socioeconomic factors such as average income, school decile, and council, as well as proximity to other restoration projects. Our second analysis looked at farm conservation. We modelled the probability of occurrence of a QEII National Trust Open Space Covenant on any individual farm using a New Zealand-wide data set. We tested whether this probability varied according to climate, socioeconomic factors, and number of pre-existing covenants in the neighbourhood. The results from both analyses provide good evidence that having a greater number of restoration projects or covenants nearby positively influences the decision to participate in conservation. Our findings validate the community landscape approach being taken by many conservation organizations and local governments and provide information on how to maximise buy-in for such projects.

Requiem for Upokororo – New Zealand's only known historic freshwater fish extinction

Finnbar Lee[1], George Perry[1]
[1]*University of Auckland, Auckland, New Zealand*

Biography:
Finnbar Lee is a PhD student at the University of Auckland. His research focuses on metacommunity dynamics in rivers and streams.

In the 800 years since humans arrived in New Zealand there has been only one known freshwater fish extinction – upokororo (grayling; *Prototroctes oxyrhynchus)*. At the time of European arrival upokororo occurred across New Zealand. In 1860 they were abundant, by 1870 their decline noticed, by 1900 they had disappeared from many rivers, and the last confirmed catch was made in 1923. While trout are frequently blamed for the loss of upokororo, little is known about how this extinction event unfolded in time and space.

We built a database of historical upokororo observations across New Zealand based on newspaper archives. Historical records were complemented with a meta-population model to explore how vulnerable upokororo populations were to off-take (fishing and/or predation) and altered source-sink dynamics.
We found 300 newspaper articles concerning upokororo, of which 120 were primary and gave dated locations. Sightings-based models suggest upokororo went extinct between 1924 and 1972. Thus, in just 74 to 122 years the upokororo went from abundant to extinct. At realistic meta-population growth rates, off-take rates between 0 and 30% in combination with up to 30% sink populations result in upokororo extinction in 100 years.

We have created the first systematic database of historic upokororo sightings and shown that extinction could have occurred under relatively low levels of population pressure. Our results shed light on New Zealand's only freshwater fish extinction and highlight the fragility of our indigenous freshwater fish. Will upokororo remain New Zealand's only freshwater fish extinction, or are there more to come?

Is the spatial signature of disperser loss detectable in the spatial structure of plant populations?

George Perry[1], Andrew Nield[2], Neal Enright[2], Phil Ladd[2]
[1]*University of Auckland, New Zealand,* [2]*Murdoch University, Australia*

Biography:
I am interested in the dynamics of forest ecosystems at spatial scales from the population to the landscape and at temporal scales from decades to milennia. All of my research involves a strong field-based component supported by simulation and/or statistical modelling. My current research is primarily focused on understanding the effects of humans on forest ecosystems.

Ongoing habitat loss and defaunation have led to concern about the potential for dispersal mutualisms to be disrupted. Although most seeds fall near their parent tree, the small fraction that are dispersed further are crucial for plant population and community dynamics. In the absence of dispersal agents, fewer seeds may be dispersed long distances and the spatial structure of plant populations may, therefore, become more strongly clustered under parents. We tested this hypothesis using field surveys and a spatial simulation model. In the field surveys we measured the spatial pattern of two plant (*Leucopogon neutans* and *Macrozamia riedlei*) species with contrasting life-histories at three sites where the density of the key disperser (emu; *Dromaius novaehollandiae*) varied from high to low to absent. Despite these differences in disperser abundance, spatial point pattern analysis suggested that the plant species were similarly distributed at all three sites. Using a spatial simulation model we found that unless the decline in disperser abundance is high and dispersers are responsible for dispersal of a high fraction of seeds, shifts in spatial pattern will be hard to detect. Although loss of dispersers will affect plant populations, detecting these effects, especially for long-lived species, in static population structures will be difficult.

Vegetation change and biodiversity restoration in post-earthquake Christchurch

Wei Quan[1], Professor Glenn Stewart[1], Professor Colin Meurk[2], Denise Ford[3], Dr. Jon Sullivan[1]

[1]Lincoln University, Christchurch, 新西兰, [2]Landcare, Christchurch, 新西兰, [3]Travis Wetland Trust, Christchurch, 新西兰

Biography:

I am a PhD student of Lincoln University and my research background is about the urban biodiversity restoration and urban ecology. My PhD research is about the native biodiversity restoration in the Residential Area in Christchurch after earthquakes.

The devastating Christchurch earthquakes of 2010/11 irrevocably damaged buildings and infrastructure across parts of the city, especially the central business district and eastern suburbs. The subsequent clearance of buildings created a 443 hectare "residential red zone" along the Avon River without houses and cars and largely devoid of people and pets. A large selection of pre-quake trees and shrubs remain across an area now managed like a large park. We have analyzed the remaining tree data and surveyed plant responses to these changes since the earthquakes. From these remaining trees we know the changes in planting patterns across a large urban area over the last 60 years. The extent of the initial regeneration from these parent trees was dramatically curtailed after the buildings were removed, areas of regenerating vegetation cleared, and the land graded, sown with grass, and mown monthly. Surprisingly, the majority of the regenerating species indigenous to NZ, with locally indigenous species regenerating disproportionately well. That is in striking contrast to exotic dominance of the pre-quake planted gardens. This indigenous dominance was also found in a seed bank study of soil from the same sites. We also combined adult tree distribution with seedling survey data to infer seeds dispersal distance and distribution patterns in Red Zone area. These findings highlight the potential for natural native forest regeneration inside Christchurch that continues to be suppressed by land management. The city currently has a rare opportunity to bring more indigenous forest cover into the city and citizen initiatives to achieve this are being promoted.

Invasion resistance of New Zealand native forests: Role of indigenous tree diversity and surrounding land cover

Ms Laureline Rossignaud[1], Dr Dave Kelly[1], Mr Mark Kimberley[3], Dr Eckehard Brockerhoff[2]
[1]University of Canterbury, Christchurch, New Zealand, [2]Scion (NZ Forest Research Institute), Christchurch, New Zealand, [3]Scion (NZ Forest Research Institute), Rotorua, New Zealand

Biography:
I am a PhD student at the University of Canterbury in Christchurch in New Zealand, working on the effect of land use and surrounding land cover on ecosystem services. I have a MSc in behavioural ecology, evolution and biodiversity from the University of Tours in France. My MSc thesis was about the biology of a potential biological agent against the invasive spotted wing Drosophila in Switzerland.

Native forest invasion by exotic plants can have strong cascading effects on ecosystem functioning and ecosystem services. Native plant species richness has been hypothesised to provide resistance to exotic plant invasions. However, studies of the native-exotic plant richness relationship found conflicting results, depending on the spatial scale that was analysed, indicating an "invasion paradox". Here, we studied factors influencing exotic plant invasions and the native-exotic richness relationship in New Zealand's native forests, including the spatial scale and the land cover surrounding plots. We analysed data from a subset of the National Vegetation Survey 2002-2007 plots and the New Zealand Land Cover Database 2008-2009 (LCDBv3). We predicted exotic richness from indigenous tree richness (above 5 m), surrounding non-native land cover types (exotic grassland, exotic forest and disturbed land), mean annual temperature and rainfall as fixed effects. Spatial scale effects on this richness relationship were assessed at six spatial scales. We found that native tree richness showed a negative relationship with exotic richness at small scales (8 km and 16 km grid) and a positive relationship at large scales (128 km and 256 km grids). Non-native land cover surrounding plots, especially exotic grassland, had a significant positive influence on exotic richness across all scales. This is the first analysis to show the native-exotic richness relationship reverses through changing the studied scale within a single dataset. Our next objectives will be to isolate and understand processes which cause this change in relationship with increasing scale.

A new DNA sampling method to describe the diet of social wasps and evaluate their impact on native biodiversity

Dr Marie-Caroline Lefort[1], Thomas Saunders[2], Professor Jacqueline Beggs[2], Professor Travis Glare[3], Professor Stéphane Boyer[4]

[1]University of Poitiers, Poitiers, France, [2]The University Of Auckland, Auckland, New Zealand, [3]Lincoln University, Lincoln, New Zealand, [4]University of Tours, Tours, France

Biography:
Tom Saunders is currently a PhD student at the University of Auckland working towards improving the way classical biocontrol agents are screened before release. He is using the samurai wasp, and the brown marmorated stink bug as a case study to explore different methods of evaluating parasitoid host-specificty. You can read more about his research at tomsaunders.co.nz or follow him on twitter at @TomSaundersNZ.

Social wasp diet is typically studied by identifying prey items carried by adult wasps during their return to the nest to feed their larvae. We aimed to develop a new method to study wasp diet, by retrieving prey DNA from larval meconium. Unlike traditional methods, this approach provides an overview of colony diet throughout the season. We worked with two Polistine species accidentally introduced to New Zealand. While the problems posed by introduced social wasps are well known, it has recently been suggested they may also provide some ecological benefits. The second aim of our project was to describe the diet of *Polistes humilis* and *P. chisensis* in urban and suburban areas of Auckland, using this new method. Our high-throughput DNA sequencing method allowed amplification of all DNA samples collected, with on average 80,334 DNA reads (±6,435 sem) per sample. Data analysis revealed a large part of both wasps' diet was composed of lepidopteran species and Thysanoptera. Several exotic pest species were identified in the diet of these wasps (e.g. *Thysanoplusia orichalcea* and *Mythimna separata*), supporting the hypothesis that some wasps can have a beneficial effect on the control of other insect pests. However, our study also revealed a large proportion of these wasps' diet is made up of native and endemic invertebrates (e.g. the moths *Ctenopseustis obliquana*, *Declana floccose* or *Planotortrix notophaea*). Based on our results, we suggest Polistine wasps from the Auckland region may have a positive impact on agriculture despite their negative impact on native biodiversity.

What drives invasive social wasp abundances on offshore islands in New Zealand?

Julia Schmack[1], Prof Dr Jacqueline Beggs[1], Dr Darren Ward[2], Dr Mandy Barron[2], Dr Matthias Schleuning[3]
[1]University Of Auckland, Auckland, New Zealand, [2]Landcare Research, New Zealand, [3]Biodiversity and Climate Research Centre Frankfurt, Frankfurt, Germany

Biography:
Julia Schmack is an international PhD student at the University of Auckland. She investigates the distribution and ecological impacts of invasive social wasps on New Zealand's offshore islands with a focus on ecosystem parameters that could inhibit invasion success. She graduated (MSc) in Ecology and Evolution at Goethe University Frankfurt and has a strong background in community ecology. Julia studied the ecosystem service 'natural pest control' provided by birds and bats in coffee agro-ecosystems on Mt Kilimanjaro, Tanzania. Before she started her PhD in New Zealand, she worked in international research and conservation projects in Africa and Europe.

Social *Vespidae* wasps, *Vespula* and *Polistes*, have successfully invaded New Zealand's ecosystems, causing severe ecological and economic damage to native taxa, apiculture and tourism. In South island beech forests (*Nothofagus* spp.), high densities of *Vespul*a significantly reduce the standing crop of honeydew and prey on native invertebrate taxa. Little is known about social wasp abundances and their impacts in other habitats, but anecdotal evidence suggests that some islands in the Hauraki Gulf have become wasp free after mammal pest eradication. This study is the first to investigate social wasps on New Zealand offshore islands – the last refuges for many endangered birds, lizards and invertebrates. We surveyed wasp abundance on 36 islands and measure both biotic and biogeographic factors for each island. Our results did not support the suggested link between mammal and wasp eradication. Both *Vespula* and *Polistes* wasp abundances negatively correlated with the amount of canopy cover. Furthermore, island size and distance to the mainland explained *Vespula* wasp numbers on islands: the further away and the smaller an island the lower the wasp abundances. We showed that a high percentage of vegetation cover may reduce wasp abundance on offshore islands. This information can help to develop long-term strategies to enhance ecosystem resilience. We hope our findings inform decision makers in conservation projects and help develop efficient control strategies for invasive insects.

Memory performance influences male reproductive success in wild toutouwai (*Petroica longipes*)

Dr Rachael Shaw[1], Mr Regan MacKinlay[1], Dr Nicola Clayton[2], Dr Kevin Burns[1]
[1]Victoria University of Wellington, Wellington, New Zealand, [2]University of Cambridge, Cambridge, United Kingdom

Biography:
Dr Rachael Shaw is an animal cognition researcher who uses behavioural-based experiments to explore the function and evolution of intelligence. Rachael joined the School of Biological Sciences at Victoria University of Wellington in early 2014 as the Principal Investigator on a Marsden Fast-Start Grant and a Rutherford New Zealand Postdoctoral Fellow. She is a current Rutherford Discovery Fellow.

Despite decades of comparative research, the evolutionary processes shaping cognition are largely unknown. Several lines of evidence suggest that natural selection acts on spatial memory in food-caching species. However, a link between reproductive fitness and spatial memory ability has yet to be demonstrated in any caching species. Here we show that memory influences reproductive success differentially for males and females in a caching songbird, the New Zealand robin (*Petroica longipes*). Males' memory performance in a spatial task during winter influenced their subsequent breeding success; individuals with better performance produced more fledglings and independent offspring per nesting attempt. Males with superior memory performance also provided an increased proportion of large prey items to chicks in the nest. No such effects were found for females. Previous research reveals that trade-offs may constrain selection and maintain variation in cognitive traits. The gender dimorphism in the reproductive benefits of robin memory ability suggests an additional role for sexually antagonistic selection in maintaining variation in cognitive traits.

Survival, predation and behaviour of the Mahoenui giant wētā (*Deinacrida* mahoenui)

Hannah Stilborn[1], Stephen Hartley[1], Corinne Watts[2]
[1]Victoria University Of Wellington, Wellington, New Zealand, [2]Manaaki Whenua - Landcare Research, Hamilton, New Zealand

Biography:
I am a MSc student at Victoria University of Wellington studying ecology and biodiversity.

The last remaining individuals of the original Mahoenui giant wētā (*Deinacrida mahoenui*) population are currently restricted to an 187ha mainland reserve in Mahoenui, southern King Country, New Zealand. Having sought refuge in the introduced woody shrub, gorse (*Ulex europaeus*), these wētā have survived in the presence of introduced mammalian predators for almost 6 decades. However, due to natural succession, the reserve is gradually reverting to native bush and wētā monitoring data show potential signs of population decline. Concerns for the species' survival have been raised as it is unknown how wētā will cope in an altered habitat alongside mammalian predators. We have assessed wētā survival rates, movement patterns and diurnal refuge choice in gorse and native vegetation using VHF transmitters attached to giant wētā. Survival results differed greatly between summer and autumn tracking periods. Predation events were more frequent during autumn and significantly higher for wētā translocated into unfamiliar native habitat. Assessment of diurnal refuge use revealed wētā translocated into native vegetation took refuge on average 3 meters higher than those inhabiting gorse. We will additionally determine the predation effect of 4 introduced mammalian species on wētā, by analysing stomach contents. This research will ultimately be used, in conjunction with other research, to inform the management of this unique invertebrate.

Targetting crowd sourcing of observations and identifications to improve passive biosecurity surveillance in New Zealand

Jon Sullivan[1], Steve Pawson[2], Melanie Mark-Shadbolt[3]
[1]Lincoln University, Lincoln, New Zealand, [2]Scion, Christchurch, New Zealand, [3]Te Tira Whakamātaki Māori Biosecurity Network, New Zealand

Biography:
Jon Sullivan is a senior lecturer in ecology at Lincoln University. Much of his research is on environmental weeds and the native plants they compete with and the insects that eat them. He is increasingly focused on documenting how nature is changing in NZ in response to changing land use, species invasions, and climate change. As part of this he makes thousands of observations a week and is one of the founders and site admin of iNaturalist NZ (previously NatureWatch NZ), the NZ branch of the global iNaturalist Network. https://inaturalist.nz/people/jon_sullivan

While much attention is being focused on predatory pest mammals, NZ's natural and production ecosystems remain threatened by a wide diversity of other animal, plant, and fungal pests. Many are not yet in NZ or here but still with restricted distributions. Excluding, eradicating, or containining these pests requires extensive surveillance coupled with rapid and effective responses. To improve surveillance, the Biosecurity 2025 initiative envisages a biosecurity team of 4.7 million facilitated by a tool kit of smart technologies. iNaturalist NZ (previously NatureWatch NZ) demonstrates the potential, and importance, of widely engaging New Zealanders in surveillance. In six years of operation, its crowd of >10,000 observers and >3,000 identifiers have discovered numerous new-to-NZ species and regional first records of pests. Our challenge is now to grow and focus a network of observers and identifiers with the greatest opportunities and motivations to find new pests. We have been working with primary industries, NGOs, regional and national government agencies, and the Bioheritage National Science Challenge, to create such a NZ biosecurity network. This includes a new Find-A-Pest app, incorporating iNaturalist tech, connected to a non-public identifier web tool. Both will be fully field tested over the 2019 summer in case studies before a full public launch.

Envisioning the future forest: Can the One Billion Tree programme achieve multiple wins for carbon, biodiversity, and ecosystems services?

Febyana Suryaningrum[1], Dr Rebecca Jarvis[1], Dr Bradley Case[1], Dr Hannah Buckley[1]
[1]*Auckland University of Technology, Auckland, New Zealand*

Biography:
Febyana Suryaningrum is a Ph.D. candidate in Auckland University of Technology. Her research topic is "Carbon Quantities and Dynamics in New Zealand Beef and Sheep Agroecosystems under Different Scenarios of Farm Biodiversity Management" which is part of a project within the “Resilient ecosystems” programme in the Biological Heritage National Science Challenge.

The New Zealand government has launched the One Billion Trees programme to make a significant contribution to offsetting current greenhouse gas emissions, with the goal of reducing net emissions to 30% below 2005 levels by 2030 (the Government of New Zealand, 2015) . To achieve this goal, the programme encourages tree plantings on public, private and Māori-owned land, including revegetation in production areas, such as forestry plantations and agricultural landscapes. Integrating woody vegetation in production landscapes can generate ecosystem services such as soil and nutrient management, water conservation, biodiversity conservation and carbon, while simultaneously delivering social and economic benefits for landowners. However, concerns have been raised that the programmes current focus on planting fast growing exotic species, rather than encouraging more permanent native forest, may miss an important opportunity to not only achieve our carbon targets, but also provide multiple co-benefits. In this talk, we present a SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) to highlight how the One Billion Trees programme can achieve its goals of restoring forest cover in New Zealand and the trade-offs and synergies that will need to be considered. Finally, we present a case study to illustrate how agricultural landscapes can be planted to maximise the co-benefits of the programme while achieving multiple wins for New Zealand.

Interactions between invasion and fire promote novelty in New Zealand's fire-naïve landscape

Riki Taylor[1], Dr George Perry[1], Dr Luitgard Schwendenmann[1]
[1]*The University of Auckland, Auckland, New Zealand*

Biography:
Riki Taylor is an early-career ecologist who recently completed his MSc at the University of Auckland. His thesis was concerned with ecosystem novelty, specifically the ways fire can promote novelty in New Zealand, with Great Barrier Island providing a landscape also shaped by extinction, invasion, and associated losses of ecosystem function. Additional interests include pedagogy and mātauranga Maori, both of which he is involved in through various roles at the University of Auckland.

Novel ecosystems are most often defined by community composition, yet disturbance can have an equally important role in creating and sustaining ecosystem novelty. In New Zealand, fire is an especially significant disturbance due to its negligible presence prior to human arrival c. 800 yr BP. Human activity has also resulted in the loss of indigenous flora and fauna, and the introduction of a suite of invasive species, forming novel assemblages with which fire now interacts. This study assessed changes in the community composition of a forested coastal area on Great Barrier Island following a 116 ha wildfire in 2013. In 2015, permanent vegetation plots were established across the burned area, in which species' frequency, height, and reproductive status, as well as soil chemistry and environmental variables, were recorded. The plots were remeasured in 2017. Five distinct plant communities were identified, representing a gradient of invasion, from predominantly indigenous to wholly invasive species assemblages. Tolerance of fire was a common trait among emergent tree species, with soil moisture and nutrients (C and N) the major controls on community composition. The greatest change between the pre-fire vegetation and that identified in 2015 and 2017 was an increase in the extent and density of fire-tolerant woody species such as brush wattle (*Paraserianthes lophantha*) and *Hakea sericea*, resulting in an increase in the quantity and connectivity of fuels. These results suggest succession toward mature indigenous forest has been arrested and a novel ecosystem comprised primarily of fire-tolerant non-indigenous vegetation has begun to arise.

Navigating complexity in conservation: a socioecological approach to framing, conflict and conservation in Virunga National Park

Nadine Tupp[1], Dr Rebecca Jarvis[1]
[1]*Auckland University of Technology, Auckland, New Zealand*

Biography:
Nadine Tupp is an undergraduate student at the Auckland University of Technology completing a Bachelor of Science double majoring in Applied Conservation and Geospatial Science. She specialises in socioecology and completes research supervised by Dr Rebecca Jarvis. She is interested in protected area efficiency and the incorporation of socially-just conservation action in Central Africa and using principles of socioecology to navigate conservation conflict producing ecologically-effective and socially-just outcomes for the natural environment local people. Particularly interested in finding the nexus between international news media framing and implications for conservation and people.

Socioecology is an emerging field in restoration ecology and conservation science working to integrate the human systems which conservation actions are embedded in, into the work we do. Such insights are important for navigating complexity and delivering conservation that is both ecologically-effective and socially-just. This research explores how news media frames social and conservation action, how these frames are used to communicate conservation and conflict, create negative stereotypes, and risk perpetuating socially unjust behaviours in pursuit of conservation goals. Using Virunga National Park in the Democratic Republic of Congo (DRC) as a case study, this research focuses on frames shown to Western audiences legitimising violence and green militarisation techniques that commonly come to resemble paramilitary-style counter-insurgency tactics. I discuss the need for socially-just conservation action, requiring reframing of local actors in conservation areas across the globe, a move away from traditional top-down solutions to armed conflict and macro-level drivers of conflict, to increased bottom-up analysis of drivers of micro-level processes and actors behind conservation conflict. This case study demonstrates the power of framing by news media and park authorities to determine how protected areas are ran, how conservation priorities are set, and how they are imagined in the target audiences psyche. This research also demonstrates negative impacts of framing on local people when negative stereotypes, and the conservation action/s they can initiate, are implemented in a region. Not only is this relevant for conservation in the DRC, but how we communicate conflict and navigate complexity in conservation around the world

Developing a national dune condition index

Dr Roger Uys[1], Dr Criag Bishop[2], Keiko Hashiba[3]
[1]Greater Wellington Regional Council, [2]Auckland Council, [3]Hawke's Bay Regional Council

Biography:
I am the Senior Terrestrial Ecologist in the Environmental Science Department at Greater Wellington Regional Council where I am engaged in state of the environment monitoring and monitoring the effects and outcomes of environmental management.

Sand dunes have become rare ecosystems in New Zealand and the condition of the remaining dunes is poorly understood. Regional councils are working to standardise the way in which they monitor the state of the environment, including the condition of sand dunes. This presentation outlines an initial attempt by Regional Councils to develop pressure and state condition indexes for New Zealand.

Green spaces for all ages

Dr Yolanda van Heezik[1], Dr Claire Freeman[1], Ms Yvette Buttery[1], Dr Debra Waters[1]
[1]*University of Otago, Dunedin, New Zealand*

Biography:
Yolanda's research examines distributions and abundance of birds and other wildlife in urban areas, biodiversity of gardens, human residents' attitudes, values and knowledge about biodiversity and their use of green spaces, children's connection with nature and how ageing affects nature in our lives.

Nature interaction is seen as a potentially inexpensive intervention to address many health issues, but for many urban resident's well-being benefits depend on accessibility and use of green spaces. Green spaces in many cities are planned following criteria concerning their accessibility to the human population – often based on distance. However, accessibility can be affected by many factors. Sectors of the population that can be least mobile are the young and the aged: children's independent movements can be severely curtailed, and ageing is associated with declining health and mobility. We discuss the factors limiting nature engagement in children, and older adults occupying family, down-sized and rest homes, to determine what drives the quality of available nature to these groups. While children's independent movements are limited mainly by parental decisions, older people's ability to spend time in natural spaces depends on the extent of nature connectedness, frailty status, home type and whether they live alone or not. Gardens assume an important role in enabling nature contact, but garden variability means the quality of the nature experience can also vary. Prioritising small nearby green spaces such as gardens in city planning also has consequences for urban biodiversity, which will be discussed.

A new mechanistic framework to explain past geographic changes and predict future limits to local occupancy in New Zealand forest birds

Dr Susan Walker[1], Dr Adrian Monks[1], Mr John Innes[2]
[1]Manaaki Whenua - Landcare Research, Dunedin, New Zealand, [2]Manaaki Whenua - Landcare Research, Hamilton, New Zealand

Biography:
Susan is a conservation ecologist with broad interests in large-scale ecological patterns and processes and the interface between ecological science and policy. Her interests include the ecology of highly modified eastern South Island drylands, national patterns of land use change and ecosystem protection, the systematic measurement of conservation outcomes and the differences made by management, ecological significance assessment and improving law and policy to maintain indigenous biodiversity in fragmented landscapes under the RMA, large-scale long-term patterns and drivers of changes in native bird distributions across New Zealand, rodent dynamics across New Zealand forests, and whole-ecosystem approaches to conservation management.

We develop a theoretical mechanistic framework to explain and interpret past geographic changes in local occupancy in New Zealand forest bird species, and predict future conservation outcomes, by combining life-history attributes with the geographic variables indicating habitat scarcity, predation pressure, and resource productivity. We test our framework by fitting models of species' local occupancy across New Zealand in 1969–1979 and 1999–2004. We show that cavity nesting, low mobility, and large size are sufficient to explain the relationship between endemism level and vulnerability to decline. Different combinations of these traits, and deforestation and temperature provide a coherent mechanistic explanation for progressive and ongoing filtering of more-vulnerable taxa and have produced predictable dynamic geographic patterns of local occupancy and extinction over time. Our results are consistent with predation being the primary driver of modern forest bird declines but show that species' dispersal ability and requirements for productive habitats have profoundly affected patterns of local occupancy change in addition to susceptibility to predators. We predict that (1) new methods to maintain low predator levels across large remaining tracts of warm indigenous forest habitat will make the greatest contribution to averting future declines and promoting recovery of endemic bird species; (2) large-bodied and non-mobile species will be most limited by forest scarcity if future management reduces predator pressure across human-dominated production landscapes; and (3) reduced predation pressure will lead to community reassortment as endemic bird taxa recover, to the detriment of presently more common and widespread small, mobile, non-cavity nesting species.

Spatial patterns and drivers of invasive rodent dynamics in New Zealand forests

Dr Susan Walker[1], Mr Joshua Kemp[2], Dr Graeme Elliott[2], Mr Corey Mosen[2], Mr John Innes[3]
[1]Manaaki Whenua - Landcare Research, Dunedin, New Zealand, [2]Department of Conservation, Nelson, New Zealand, [3]Manaaki Whenua – Landcare Research, Hamilton, New Zealand

Biography:
Susan is a conservation ecologist with broad interests in large scale ecological patterns and processes and the interface between ecological science and policy. Her interests include the ecology of highly modified eastern South Island dryland ecosystems, national patterns of land use change and ecosystem protection, the systematic measurement of conservation outcomes and differences made by management, ecological significance assessment and improving law and policy to maintain indigenous biodiversity in fragmented landscapes under the RMA, large-scale long-term patterns and drivers of changes in native bird distributions across New Zealand, rodent dynamics across New Zealand forests, and whole-ecosystem approaches to conservation management.

Populations of invasive ship rat (*Rattus rattus*) and house mouse (*Mus musculus*) vary greatly over both time and space in New Zealand's indigenous forests. Both species threaten endemic fauna and their spatiotemporal variation over short time scales and steep environmental gradients present substantial challenges for conservation management. We fitted models to18 years of 3-monthly records from a large-scale tracking-tunnel network to (1) predict, classify and describe forest-wide spatial patterns of temporal dynamics of unmanaged rat and mouse populations, and (2) understand the population-limiting roles of environment and biotic interactions. We distinguish six classes of forest rodent dynamics by classifying deciles of predicted rat-tracking rates. Classes form sequences across broad latitudinal and elevation gradients, and grade from 'irruptive', with low median but synchronous high maximum rat and mouse tracking rates in colder forests, to 'continuously ratty', with high median rat and low unsynchronised mouse tracking rates in warmer forests. Mice irrupt alone more frequently in colder forests, and their tracking rates are spatially reciprocal with rat tracking rate minima but not maxima. We conclude that predictable spatial patterns of rodent population dynamics arise from stronger low-temperature limitations on rats than mice, biotic limitation of mice by rats, and spatiotemporal food resource patterns affecting both species. Practical implications are that native species conservation in New Zealand forests requires spatially-differentiated predator management regimes; ship rats are likely to become increasingly prevalent at higher elevations as climate warms; and suppression of ship rats alone will release house mouse populations, especially in warmer forests.

Does restoring urban forest structure also restore ecological function? A look at decomposition and denitrification.

Dr Kiri Joy Wallace[1], Associate Professor Daniel C. Laughlin[2], Professor Bruce D. Clarkson[1], Professor Louis A. Schipper[1]

[1]University Of Waikato, Environmental Research Institute, Hamilton, New Zealand, [2]University of Wyoming, Department of Botany, Laramie, USA

Biography:

Kiri completed a BSc and MSc in wildlife ecology in the USA. In 2013 she received the University of Waikato doctoral scholarship to conduct her PhD on urban forest restoration ecology. Today she is a post-doc in the Environmental Research Institute at the University of Waikato working with the People, Cities & Nature programme. She holds the role of Secretary for the New Zealand Ecological Society, which she has been a member of since 2013. She hopes to continue developing her research career in community, urban and restoration ecology while also helping people connect with nature.

Forest restoration has potential to recover degraded ecosystem functions in urban environments. Leaf litter decomposition and denitrification are two critical steps in forest nutrient cycling often compromised in degraded ecosystems. As forest canopy structure develops following plantings, it may indirectly impact ecosystem functions by altering abiotic conditions. We aimed to determine whether forest canopy openness, topography, and soil sand content would affect litter decomposition and denitrification by regulating the microclimate, the herbaceous plant layer, soil chemistry and soil moisture. Research occurred in restored native temperate rainforest patches in New Plymouth and Hamilton. Decomposition rates were determined using mesh leaf litter bags and denitrification rates through denitrification enzyme activity assays. We used structural equation modelling to quantify the direct and indirect drivers of these two forms of nutrient cycling. Results indicated that decomposition rates were positively related to soil moisture, relative humidity, and herbaceous plant layer cover. Denitrification was negatively related to soil pH and positively related to soil moisture but functioned independently of forest structure (canopy openness). Unravelling the drivers of ecosystem functions can improve approaches to the restoration of degraded urban ecosystems. The identification of opposing effects can improve management so that restoration actions focus on specific direct drivers that can elicit desired changes. Some ecosystem processes, like denitrification, are not affected by restoration of forest structure, but are instead driven by edaphic and landscape factors. This demonstrates how abiotic properties can sometimes exert stronger control over ecosystem functions than the manipulation of vegetation structure and composition.

Biotic interactions drive ecosystem responses to invaders in plant communities

Lauren Waller[1], Warwick J. Allen[1], Leo M. Condron[2], John Hunt[3], Kate Orwin[3], Jason M. Tylianakis[4,5], Ian A. Dickie[4]

[1]Bio-Protection Research Centre, Lincoln University, Lincoln, New Zealand, [2]Department of Soil and Physical Sciences, Lincoln University, Lincoln, New Zealand, [3]Landcare Research, Lincoln, New Zealand, [4]Bio-Protection Research Centre, School of Biological Sciences, University of Cnaterbury, Christchurch, New Zealand, [5]Department of Life Sciences, Imperial College, London, United Kingdom

Biography:

Dr Lauren Waller studied ecology at the University of Montana, United States. For her PhD she combined molecular and field research to understand interactions at the root-soil interface and how they affect broader scale community-level processes in temperate grasslands. Lauren is currently a postdoctoral fellow at Lincoln University, working with Prof Ian Dickie. She is focused on how complex interaction networks among plants and soil biota affect community and ecosystem processes.

Soils store more carbon than any other terrestrial source and carbon dioxide release from soil exceeds anthropogenic emissions by orders of magnitude. Plant communities differ in their influence on carbon cycling, but our understanding of the factors that govern these differences is poor and complicated by the many different influences on soil respiration and storage. We designed a multifactor mesocosm experiment to unravel how plant traits and provenance, soil organisms and invertebrate herbivores influence indicators of C cycling. All measured indicators increased in communities dominated by exotic plants (invasive to NZ), but effects were moderated by interactions with herbivores and soil biota. Specifically, total soil respiration increased with the proportion of exotic plants, but only when herbivores were introduced, and plants were released from species-specific soil biota. Basal respiration, the microbial contribution to total respiration, also increased with exotic plant dominance, but again only when plants were released from species-specific soil biota. Microbial biomass, organic matter and available nitrogen (Navail) increased under exotics, but herbivores reduced Navail. Higher respiration rates under exotics were not explained by changes in plant richness or productivity, which were both lower in exotic-dominated communities. Instead, higher respiration rates may be explained by increased microbial activity, stimulated by higher nitrogen in exotic dominated plots, and mediated by biotic interactions. These results suggest that exotic plants may increase ecosystem process rates, but impacts are not simply a result of their typically heightened productivity or functional traits *per se*, but are mediated by interactions with microbes and herbivores.

Restoration of Raoul Island, Kermadecs: The weed eradication programme

Dr Carol West[1], David Havell[1]
[1]*Department Of Conservation, Wellington, New Zealand*

Biography:
Carol is an Honorary Research Associate of the Department of Conservation, having retired in 2017 after 25 years as a scientist and manager in DOC. Through her roles in DOC, she has been fortunate to work from the Kermadecs to Campbell Island, usually applying her training as a plant ecologist and often focusing on the impacts of invasive alien species, particularly transformer weeds.

Weed eradications can take a long time, requiring dedication and commitment to achieve the goal. The Raoul Island weed eradication programme is in its 47th year and, to date, has resulted in eradication of 14 species, the most significant of which are *Furcraea foetida* and *Cortaderia selloana*. During this time, all four species of invasive mammal (goats, cats and two species of rat) on the island have been eradicated. Since then, three tree species have been controlled to seed banks: mature individuals of two tree species (*Olea europaea* subsp. *cuspidata* and *Psidium guajava*) have not been detected since 2008; the last mature individual of *Ricinus communis* was removed in 2003, and last seedlings recorded in 2012. Several weed species responded positively to rat eradication, resulting in some changes to the eradication programme. Weather events, particularly cyclones, are beneficial for promoting germination of some transformer weed species from the seed bank, though they make the task of searching harder. The transformer weed species comprise four vines, one emergent tree and four small trees. The most challenging part of the programme continues to be maintaining the focus of staff and management on the nine transformer weed species that must be eradicated in order to achieve ecosystem integrity of the forest on Raoul Island. Effective quarantine and surveillance for detection of weed incursions also needs to be maintained. Challenges involved in, and progress on, achieving weed eradication on this remote subtropical island with a small team of on-island staff are described.

Using propensity scores for causal inference in ecology

Ian Westbrooke[1], Dave Ramsey[2]
[1]*Department of Conservation, Christchurch, New Zealand,* [2]*Arthur Rylah Institute, Melbourne, Australia*

Biography:
Ian is now enjoying semi-retirement after establishing and leading statistical work at the Department of Conservation since 2000.

Applied ecologists are often interested in understanding the effects of management on ecological systems. If treatment is applied non-randomly, as occurs in observational studies, then analysis must account for potential confounding. Methods that do not adjust for all confounding variables can only estimate associations.

Observational studies often estimate treatment effects by modelling and adjusting for confounding variables. However, this can involve extrapolation beyond the observed data.

An alternative procedure for assessing treatment effects is to use the propensity score. This approach is becoming widely used for observational studies in health and related fields, but not so far in ecology.

The propensity score is the probability of treatment assignment given potential confounding variables and can be used to reduce systematic differences in confounding variables among treatment groups, ensuring that data more closely resemble that expected under a randomized experiment. The propensity score also identifies situations where treatment inferences must rely on strong assumptions.

We examine the properties of commonly-used propensity scoring methods for estimating treatment and illustrate their application in a case study on possum impacts.

This work is about to be published in *Methods in Ecology and Evolution*.

Using classification assignment rules to assess land use change impacts on national and regional forest biodiversity: A case study using the Mokihinui dam proposal

Dr Susan Wiser[1], Dr Kathrin Affeld[2], Dr Miquel DeCaceres[3]
[1]Manaaki Whenua - Landcare Research, Lincoln, New Zealand, [2]Lincoln University, Lincoln, New Zealand, [3]Forest Science Centre of Catalonia, Solsona, Spain

Biography:
Susan Wiser has been a plant community ecologist at Manaaki Whenua – Landcare Research for 25 years. Her current research interests are wide ranging and include ecoinformatics and repurposing existing vegetation plot data to answer new questions, the ecology of naturally rare ecosystems, classification of NZ vegetation and how ecological understanding can be spatially extrapolated by integrating data collected by remote sensing with ground-based vegetation plot data.

Ecosystem representation is one key component in assessing biodiversity impacts of land-use changes that destroy natural ecosystems. Using the formerly proposed dam in the Mokihinui gorge as a case study, we show how vegetation plot data can be used to assess the potential inundation impacts on representation of natural forests. For local and regional comparisons, plant composition was recorded on 45 plots established in each of three gorges, with one being the proposed inundation area. The fuzzy classification framework of noise clustering was used to assign these plots to forest types of a pre-existing national-scale classification. Nationally, we examined the relationship between the number of forest types in a catchment, catchment size and the number of plots per catchment. Forest types in the inundation area are present in the region but limited locally. One type was narrowly distributed nationally, but is the most frequent type in the inundation area; flooding could have had consequences of national importance. That the inundation area had nearly twice as many plots that could not be assigned to forest types than either of the other two gorges and proportionally more than the national dataset emphasises the compositional distinctiveness of this area. Based on national sampling, the Mokihinui catchment has a higher diversity of forest types than predicted from catchment size and sampling intensity. Our approach provides a transparent solution to a common conservation planning problem: assessing how well ecosystems that will be destroyed by a proposed land-use change are represented at multiple scales of interest.

Legacy effects of pastoral agriculture on ecological restoration

Mr Joshua Wium[1], Dr Bruce Burns[2], Dr Craig Bishop[3]

[1]Wildlands, Auckland, Grey Lynn, New Zealand, [2]University of Auckland, Auckland, New Zealand, [3]Auckland Council, Auckland, New Zealand

Biography:

Joshua Wium is an ecologist at Wildland Consultants in Auckland. He has a post graduate diploma of science majoring in conservation and biosecurity from the University of Auckland. Joshua has recently submitted his masters thesis in conservation and biosecurity under the guidance of Bruce Burns from the University of Auckland. He carried out his masters research on the legacy effect of soil conditions on restoration success of retired pasture.

Most ecological restoration to forest occurs on land previously used for agriculture, and this land use may leave an imprint on the environmental conditions under which restoration is executed. To assess these possible legacy effects on ecological restoration sites near Auckland, I asked whether pasture soils used for ecological restoration were dissimilar from soils of reference old-growth forests, whether these soil characteristics correlated with growth of planted seedlings, and whether competition from residual exotic grasses might reduce seedling growth. I studied 2-6-year-old restoration plantings and their soils, occurring at Long Bay, Shakespear, and Tawharanui Regional Parks in northeast Auckland, and compared these to natural reference forests and areas still in pasture. Pasture and restoration sites had soils of higher fertility, and were lower in carbon, than reference soils. Soil conditions at restoration sites progressed significantly faster than expected towards those of reference soils. Growth of seedlings planted on the restoration sites was negatively correlated with slope, soil bulk density, kikuyu cover, and total nitrogen. Of the two most abundant species planted, kānuka grew almost twice as fast as mānuka, but manuka was more successful in low fertility and harsh sites. An agricultural legacy does occur in the soils of these restoration sites and does probably influence the success of restoration plantings in the critical early years. I recommend the investigation of management techniques to reduce this agricultural legacy, and that restoration methods and targets should consider original soil conditions.

Biogeography of New Zealand place names: using maps to trace the changing distribution of native species

Jamie Wood[1]
[1]*Manaaki Whenua Landcare Research, Lincoln, New Zealand*

Biography:
Jamie works as a palaeoecologist in the Ecosystems and Global Change team at Manaaki Whenua. His research interests are in palaeofaunal and palaeovegetation reconstruction, molecular ecology, eDNA and ancient DNA research.

The names of landmarks and localities that include reference to flora and fauna usually have some link with an observation of that particular species at the site. Place names persist for generations, and so can reveal insights into the past distribution of species. In 2002 a study of >35,000 faunal place names in the USA demonstrated their potential for revealing biogeographic patterns, and in particular historic changes in the distribution of native species. By querying the New Zealand Gazetteer of place names for some iconic New Zealand fauna and flora species names and comparing the geographic spread of these with current species distributions from iNaturalist I explore whether this is also the case in New Zealand.

A DNA-based wetland assessment and monitoring tool

Jamie Wood[1], Janet Wilmshurst[1], Sarah Richardson[1], Olivia Burge[1], Bev Clarkson[1], Hugh Robertson[2]
[1]*Manaaki Whenua,* [2]*Department of Conservation*

Biography:
Jamie works as a palaeoecologist in the Ecosystems and Global Change team at Manaaki Whenua. His research interests are in palaeofaunal and palaeovegetation reconstruction, molecular ecology, eDNA and ancient DNA research.

Wetlands hold significant cultural, biodiversity, and ecosystem service values, yet are highly sensitive to change within their catchments (e.g. via erosion or nutrient run-off). Efforts to prioritise, manage, and report on wetlands are constrained by current monitoring methods in which only a narrow range of biodiversity is considered. Moreover, historical wetland context is based only on an estimate of the 1840 AD condition. Here, we present initial efforts to develop a method that uses the latest eDNA, ancient DNA and geochemical techniques to analyse peat cores, characterise present biodiversity, quantify the natural (pre-human) variability in a wide range of wetland biota, and examine how these have been affected by different land management strategies. The project aims to use the long-term perspective (several thousand years of variability) to identify critical tipping-points (beyond which biodiversity and function are rapidly lost) for wetland monitoring and provide a tool for defining baselines to guide restoration of wetland ecosystems.

Restoring the lizard faunae of New Zealand cities

Stephen Hartley, Mr Christopher Woolley[1]
[1]*Victoria University of Wellington, Wellington, New Zealand*

Biography:
Chris is a PhD student at Victoria University of Wellington. His research focuses on where and how native lizards live in New Zealand cities, and what can be done to support populations

Cities and urban processes typically have a negative impact on biodiversity via land cover change, high rates of disturbance and high densities of pest species. Increasingly, however, people are being encouraged and empowered to reduce these impacts through urban restoration and backyard conservation initiatives. Lizards could be a good target for restoration in cities as they have small habitat requirements and could be a significant motivator for some urbanites to participate in pro-conservation behaviours. Furthermore, urban lizard restoration could lift the profile of a sometimes-forgotten fauna and offer real conservation benefits for urban-dwelling species.

As a first step, we reviewed knowledge of what lizards are present in six New Zealand cities and carried out skink surveys in four of these as a case study to determine the characteristics of urban populations.

We found that, although each of the cities has at least one currently urban-dwelling species, the diversity varies from city to city for both biogeographic and anthropogenic reasons. Skinks were found in a wide range of habitats including council-managed reserves, suburban backyards and public amenity areas such as around transport infrastructure and cemeteries. The variety of habitats found to support lizards in urban environments suggests that habitat enhancement and predator control could benefit populations although further research is required to understand how restoration should best be undertaken.

Habitat loss, weeds or seeds? Factors limiting regeneration of an endangered shrub

Debra Wotton[1,2], Danny Kimber[3]
[1]Moa's Ark Research, Wellington, New Zealand, [2]School of Biological Sciences, University of Canterbury, , , [3]Department of Conservation, Rangiora, New Zealand

Biography:
Debra established Moa's Ark Research in 2013 to provide evidence-based ecological research and advice to protect and restore native biodiversity. She is also a Research Associate at University of Canterbury. Her research interests include plant-animal mutualisms, limits to plant recruitment, pest mammal herbivory and seed predation, and threatened plants.

Hebe armstrongii is a nationally endangered shrub with just two populations left. The only protected population, at Enys Scientific Reserve, was on the brink of extinction when it was discovered in 1974. The site was trampled and browsed by stock and only six *H. armstrongii* plants and small remnants of bog pine shrubland remained. Despite restoration plantings of *H. armstrongii* and fencing to exclude stock and hares, *H. armstrongii* has failed to regenerate. We investigated whether *H. armstrongii* recruitment failure is due to loss of native shrubland, competition with weeds (browntop, *Agrostis capillaris*, and hawkweed, *Pilosella* spp.) or a lack of seeds.

We compared seedling abundance in experimental field plots using four treatments: 1) seeds added beneath shadecloth shelter (a proxy for native shrub cover); 2) sprayed with herbicide and seeds added; 3) untreated and seeds added; and 4) untreated and no seeds added. We sowed seeds in May 2016 and monitored plots in spring and autumn for two years.

Hebe armstrongii seedlings established only in plots with seeds added. There were more *H. armstrongii* seedlings beneath shadecloth shelters, and soil moisture was generally higher, than in the open. Spraying herbicide did not affect seedling establishment, but reduced soil moisture compared to untreated plots.

The historic destruction of native shrubland at Enys Scientific Reserve appears to be limiting present-day *H. armstrongii* seedling establishment, possibly due to reduced soil moisture in this dryland ecosystem. Seed availability is also constraining regeneration, but invasive plants are not.

Quantifying inter- and intraspecific variation in seed dispersal potential of introduced wind-dispersed conifers

Dr Sarah Wyse[1], Dr E. Penelope Holland[2], Professor Phillip Hulme[1]
[1]Lincoln University, Lincoln, New Zealand, [2]University of York, York, United Kingdom

Biography:
Sarah is a post-doctoral plant ecologist in the Bio-Protection Research Centre at Lincoln University, where her research focusses on the dispersal ecology of introduced conifers and its contribution to invasion risk. Her broader research interests encompass forest, seed, and fire ecology. Sarah obtained her PhD from the University of Auckland, before spending two years in the United Kingdom working at the Royal Botanic Gardens, Kew. Sarah returned to New Zealand to take up her current position at Lincoln University earlier this year.

Seed dispersal potential is an important plant trait, particularly in the context of plant invasions. High dispersal distances can maintain gene flow among populations and allow species to spread into new areas. For wind-dispersed species, seed terminal velocity is the key species-specific parameter required in statistical or predictive models but is usually represented by a mean value estimated using seeds from only a handful of plants. However, terminal velocity might vary significantly within- and between- individuals if this trait were under natural selection, while it is possible that the invasion process filters out genotypes that have lower dispersal potential. Although numerous studies have estimated seed terminal velocity, methods vary in their robustness and reliability. We present a novel method to measure seed terminal velocity using an automated system incorporating a Raspberry Pi single-board computer. The method is low-cost, reproducible, and allows high sample throughput, thereby facilitating the capture of variation within individuals, populations, and species. We demonstrate the utility of this method for measuring the seed terminal velocity of introduced wind-dispersed conifers, with a focus on the genus *Pinus*. We present data illustrating the terminal velocity variation among ten introduced conifer species. We then use *Pinus radiata* as a case study to investigate variation at the scales of individual cones, trees, and populations along an altitudinal gradient. Our results highlight the importance of capturing within-plant and within-species variation when modelling seed dispersal and predicting spread-risk of introduced species.

The fight for coexistence: niche partitioning between Chatham Island kiore (*Rattus exulans*) and ship rats (*R. rattus*)

Miss Grace Yee[1], Dr Travis Ingram[1], Dr Priscilla Wehi[2]
[1]*University Of Otago, Dunedin, New Zealand,* [2]*Manaaki Whenua - Landcare Research, Dunedin, New Zealand*

Biography:
A MSc student that has finished a BSc, major in Zoology, and a PGDipSci in Wildlife Management at the University of Otago. My academic interests include reintroduction biology, island ecology and conservation biology.

The objective of my study was to identify the mechanisms behind the coexistence of kiore (*Rattus exulans*) and ship rats (*R. rattus*) on Chatham Island and to determine the threat they pose to native species there. Specifically, I investigated the diet of kiore and ship rats in Tuku Nature Reserve on Chatham Island, New Zealand to determine whether dietary niche partitioning may be occurring between these species. With the use of $\delta^{13}C$ and $\delta^{15}N$, stable isotope analysis of kiore and ship rat tissues showed that segregation in isotopic space was occurring. This diet partitioning was indicated by the low isotopic niche overlap between species, by seasonal variation in the level of overlap between species, and in differences between kiore and ship rat niche breadths. However, Bayesian mixing models did not reveal major differences in diet composition between kiore and ship rats, with invertebrates, plants and the Chatham Island taiko (*Pterodroma magentae*) being the most important food sources for both species. The occurrence of taiko in the diet of both rats may either be due to direct predation or scavenging. Therefore, further studies are needed to determine whether these rats are directly impacting taiko populations in order to prioritise eradications. Diet partitioning was likely to be important in explaining the coexistence of kiore and ship rats in Tuku Nature Reserve. However, further mechanisms such as temporal or vertical-space partitioning may facilitate the coexistence of kiore and ship rats in Tuku Nature Reserve.

Interplay between social networks and local social-ecological feedbacks drive conservation outcomes

Dr. Johanna Yletyinen[1], Prof. George Perry[2], Dr. Pike Brown[3], Dr. Roger Pech[4], Prof. Jason Tylianakis[1]
[1]University of Canterbury, Christchurch, New Zealand, [2]University of Auckland, Auckland, New Zealand, [3]Manaaki Whenua Landcare Research, Wellington, New Zealand, [4]Manaaki Whenua Landcare Research, Lincoln, New Zealand

Biography:
Johanna's research investigates resilience and tipping points in ecosystems and social-ecological systems mainly from the perspective of complex adaptive systems theory. She is especially interested in maintaining and building social-ecological resilience in natural resource systems.

Most biodiversity is in human-dominated landscapes, where its conservation is determined by the individual decisions of land users. Survival of species on their habitat depends on the amount and spatial patterning of conservation areas, which on a landscape-level arise through collective action. Collective action, however, does not always succeed in delivering desired outcomes. Recent hypotheses propose that this may be explained by an interplay between several influences, including personal characteristics, social networks and institutional or environmental context. We examined the role of social networks in landscape change, using a social-ecological model of land user conservation decisions and their consequences for landscape structure. This model was generated with data from a survey of >3000 rural decision makers. We show how both positive and negative environmental attitudes can simultaneously spread across the network, and the tendency of individuals to connect with like-minded peers regularly hinder the spread of sustainable behaviour. Importantly, local social-ecological feedbacks involving environmental conditions and social norms in land users' immediate surroundings tend to create spatially clustered conservation areas, reach poorly connected people, and modify the influence of social network structure. In synergy with social network influence, these feedbacks can cause large oscillations through time in the protection of habitat, and lead to extreme conservation outcomes, i.e., failure or high efficiency in collective action. Hence, to generate long-term sustainable behaviour, conservation initiatives must account for an *interplay* between social and ecological influences, including both antagonistic and additive effects, that generate the extend and pattern of conservation areas in human landscapes.

POSTER PRESENTATIONS

A new search tool to aid discovery of data from the National Vegetation Survey Databank

Elise Arnst[1], Susan Wiser[1], Mohamed Abozeid[1], Margaret Watts[1]
[1]*Manaaki Whenua - Landcare Research, Lincoln, New Zealand*

Biography:
Elise Arnst is an ecologist at Manaaki Whenua - Landcare Research. She is the database manager for NVS. Other research interests include plant community ecology; field ecology; weed invasions and spatial modelling.

The National Vegetation Survey Databank (NVS) is a physical archive and electronic databank containing records of over 104,000 vegetation survey plots. NVS provides a unique record, spanning more than 60 years, of indigenous and exotic plants in New Zealand's terrestrial ecosystems, from Northland to Stewart Island and the Kermadec, Chatham and Sub-Antarctic islands. A broad range of habitats are covered, with special emphasis on indigenous forests and grasslands.

NVS datasets can be explored online as well as requested for download. We have redeveloped the online search tool to make it easier for data users to discover data to meet their needs. The tool allows both text-based and map-based searching. Text-based searching uses intelligent syntax that is more user-friendly than previously. Users can search with any relevant word or phrase and users can narrow down search results by applying multiple filters, including species names. Map-based searching allows a user to browse plot locations across the entire map display or to focus on a specific area that they delineate. As with text searching, results from the map search can be refined by applying multiple filters. Search results identify what datasets are available, and how many plots within them meet the user's criteria.
These improvements in the capacity for all users to more readily identify data that meets their needs will allow more people to take advantage of the wealth of information held in the NVS databank. This in turn will enhance our understanding of indigenous plant communities and how they are changing.

Habitat preferences of landhoppers (Crustacea: Talitridae): Perspectives from Te Paki

Dr Olivier Ball[1], Mr Patrick Whaley[2]
[1]*NorthTec, Whangarei, New Zealand,* [2]*Waikato Regional Council, Hamilton, New Zealand*

Biography:
Olivier Ball is a senior tutor at NorthTec in sunny Whangarei, Northland, New Zealand, where he teaches ecology and conservation, and studies invertebrate ecology and landhopper taxonomy.

Landhopper communities in Te Paki Ecological District were sampled seasonally by pitfall trapping at three sites in each of three habitats: native forest, exotic pine plantation forest and manuka/kanuka-dominant shrubland. Seven species, all New Zealand endemics, were detected. All seven species were trapped in native forest, whereas only three species were trapped in pine and shrubland habitats. Two species were present in all three habitats. For species present in at least two habitats, abundances were always higher in native forest compared with pine plantation and shrubland. Multivariate analysis based on the landhopper fauna indicated that the communities in native forest sites were similar to each other. Conversely, there was considerable within-habitat variation at pine and shrubland sites. Factors such as differences in disturbance history, canopy height, temperature variation, leaf litter depth and soil ion concentrations could be responsible for this variability. Our study has shown that of the three habitats, native forest provides the conditions that support the most diverse and dense communities of landhoppers. Native forest supports 'rare' species of landhopper not found in other habitats, as well as common species in the highest numbers. However, this study also found that exotic pine forests can provide a suitable habitat for some species of landhopper, enhancing their value as a refuge for native invertebrates. It is also apparent that some landhoppers are generalists whereas others are more sensitive to changes in habitat and land use, suggesting some species could be effective ecological indicators.

Do orchids use visual tricks to lure pollinators?

Miss Leah Barnfather[1]
[1]*University Of Auckland, Auckland, New Zealand*

Biography:
Leah Barnfather is a current MSc student in Dr. Anne Gaskett's lab at The University of Auckland, studying deception in pollination systems: primarily focused on the potential signal deception of fungus gnats by Corybas orchids, due to the flowers bright UV patches. Outside of pollination systems Leah is also keenly interested in insect behavioral ecology, and the evolutionary history between the relationship of plants and insects.

One third of orchids don't reward pollinators, but instead lure insects with deceptive signals. These signals are traditionally assumed to mimic resources, e.g. mates, but recent evidence suggests orchids use other forms of deception, including sensory traps, that exploit insects' innate sensory biases. The endemic New Zealand orchid, *Corybas cheesemanii*, is thought to exhibit brood-site deception, mimicking oviposition sites of female fungus gnats, (Mycetophilidae), its proposed pollinator. However recent studies show no evidence of mimicry, instead flowers have bright UV patches, which may function as a sensory trap. To test this, I have manipulated flowers' spectral reflectance with UV blocking plastic hoods in the field and monitored pollination rates through fruit set.

In the lab I am performing a choice assays to test for fungus gnat responses to UV. Additionally, I am conducting field surveys of environmental factors that may be associated with fruit set including the density of flowers within patches, canopy cover above patches, and patch distance from water. I am also surveying for fungus gnat density at each of the patches by using sticky traps. This study will help elucidate how native orchids attract pollinators and more broadly, how sensory traps function in deceptive pollination systems.

Plant-mediated behavioural responses of the Argentine stem weevil *(Listronotus bonariensis* (Kuschel)*)* when exposed to a parasitoid *(Microctonus hyperodae* (Loan)*)*

Miss Jacquelyn Bennett[2], Mr Morgan Shields[1], Miss Kate Scanlan[2], Miss Malvika Bana[1], Professor Steve Wratten[1], Professor Stephen Goldson[1]

[1]Bio-Protection Research Centre, Lincoln University, Lincoln 7647, New Zealand, [2]Faculty of Agriculture and Life Sciences, Lincoln University, Lincoln, New Zealand

Biography:

Jacque Bennett is a third-year undergraduate student in a Bachelor of Science majoring in Conservation and Ecology. She is fascinated by mycology, plant pathology and insect ecology. She has worked as a research assistant for the Bio-protection Research Centre and the BHU Future Farming Centre. She has been awarded two scholarships and is already a part of one publication in the New Zealand Journal of Crop and Horticultural Science and another one is forthcoming in Annals of Applied Biology.
Jacque is aiming towards being selected for a Masters in Science but for now is focusing on finishing her up degree.

A recent decline in biological control of the Argentine stem weevil (*Listronotus bonariensis*) by the parasitoid wasp *Microctonus hyperodae* has led to new investigations of the weevil-parasitoid interactions. Recent data have shown weevil parasitism rates to be around 52 % on the diploid hybrid *L. perenne* x *L. multiflorum*, 75 % on tetraploid *L. multiflorum* and 46 % on diploid *Lolium perenne* compared to parasitism rates of c. 75 % for all plant types in the 1990s. This could be attributed to plant-mediated behavioural adaptations in the weevil. Here, we investigated weevil behavioural responses to the parasitoid on the above plant types using microcosms in controlled environment rooms with Lincoln weevils and parasitoids. Weevils on the hybrid had a strong avoidance response with fewer of them on the plants when the parasitoid was present. In contrast, the proportion of weevils moving on *L. multiflorum* increased. The moving behaviour on plants appears to make the weevils more vulnerable to parasitoid detection. This, in conjunction with an increased proportion showing stationary behaviour, makes the weevils vulnerable to attack and may lead to high parasitism rates on *L. multiflorum*. Furthermore, the proportion of weevils feeding decreased in the presence of *M. hyperodae* on all plant types. These laboratory-derived results may explain the weevil parasitism rates previously observed for the hybrid and *L. multiflorum*. The observed tri-trophic behavioural responses could have extensive implications for biological control of the weevil in light of the parasitism decline in New Zealand.

Automated bioacoustic monitoring of morepork *(Ninox novaeseelandiae)* across three aerial 1080 operations

Mr. Roald Bomans[1], Dr. Stephen Hartley[1]
[1]*Victoria University of Wellington, Wellington, New Zealand*

Biography:
Roald Bomans recently completed his Master's thesis at Victoria University of Wellington, studying bioacoustics and their use in monitoring native bird species across aerial 1080 operations. Roald has a background in Ecology and Biodiversity and Environmental Science and is currently working in Ecological Restoration in the Wellington region.

The aerial distribution of sodium monofluoroacetate (1080) plays a major role in pest control for conservation in New Zealand. There are concerns, however, regarding the impact of this toxin on non-target native avifauna, with claims that forests will 'fall silent' shortly following operations. The recent growth in development of autonomous recording units (ARUs) provides a novel way to monitor avian species using bioacoustics. We utilised ARUs to monitor the calling prevalence of the relatively understudied morepork (*Ninox novaeseelandiae*) across three aerial 1080 operations in the lower North Island of New Zealand. Recordings were made (a) short-term: 5-6 weeks before and after, in treatment and non-treatment areas, and (b) longer-term: over a 4-year period in one area not receiving treatment, and one area receiving two 1080 treatments. These recordings were analysed using an automated detector developed for morepork calls to assess the short- and longer-term responses of morepork to aerial 1080 operations. Morepork showed no significant difference in trends of calling prevalence across the three independent operations monitored. Longer-term, a significant quadratic effect of time since 1080 treatment was found, with calling prevalence predicted to increase for 3.5 years following treatment before falling. Collectively, these results suggest a positive effect of aerial 1080 treatment on morepork populations in the lower North Island and build on the small amount of existing literature regarding the short- and long-term response of this species to aerial 1080 operations.

A functional classification of woody vegetation in agroecosystems

Bradley Case[2], David Norton[1], Hannah Buckley[2], Jennifer Pannell[2]
[1]*University Of Canterbury,* [2]*Auckland University of Technology*

Biography:
Professor at the University of Canterbury with teaching and research expertise in forest ecology, restoration ecology, sustainable land management and threatened plant conservation. Current research is focused on finding win-win outcomes for native biodiversity and farming in sheep and beef farms.

Protected areas are absent or of limited extent in agroecosystems and retention and restoration of native forest is a critical tool for sustaining native biodiversity in these areas. While amounts and spatial distribution of remaining native vegetation can be quantified using GIS data, it is equally important to understand the function of different types of native vegetation. Within NZ agroecosystems, some native vegetation occurs as remnants of the original forests, some has regenerated following earlier clearance and subsequent abandonment of agriculture, while restoration is establishing new areas of native vegetation. Agroecosystems can also contain significant areas of non-native woody species, that can be important for biodiversity conservation. In addition, the degree of intactness of woody vegetation is also important. In many agroecosystems, the presence of grazing and other agricultural practices mean that native woody species might occur as diffuse individuals (scattered trees) within a predominantly pasture dominated matrix. Here we present a functional classification framework for NZ woody agroecosystem vegetation that is independent from species composition, enabling comparative assessments of woody vegetation patches across the country. We illustrate the framework's application in the context of describing native (and exotic) woody vegetation in NZ sheep and beef agroecosystems at farm scales. Such a functional framework is important for planning how to implement new restoration initiatives, as well as for deciding what vegetation to retain in the landscape.

Pyranine as a Possum biomarker: Identifying limiting factors and quantifying pyranine expression in possums

Briar Cook[1]
[1]*Zero Invasive Predators Ltd, Karori, New Zealand*

Biography:
Briar has worked for Zero Invasive Predators Ltd since 2015, beginning as a field ranger in the Marlborough Sounds after a three-year stint with the Department of Conservation. In early 2017, she took up a more technical role for the organisation, developing our research and development trial concepts and implementing them in the field. Her current focus is around the use of geographic features as barriers to predator reinvasion, urban barrier design and the use of biomarkers to measure predator behaviour.

Biomarkers can be a useful tool for measuring bait uptake and animal movement from one area to another, if the limitations of the marker and how it affects the target species are known. Pyranine is a non-toxic, short lived, fluorescent green biomarker that stains the intestinal tract of an animal. Literature around the use of pyranine to mark brushtail possums (*Trichosurus vulpecula*) is limited, and its use during a recent field trial by Zero Invasive Predators Ltd (ZIP) highlighted the need to investigate i) how exactly the biomarker is expressed in possums and ii) the most robust method for examining possums for traces of pyranine. Here, we report on how we subsequently quantified the limits of pyranine as a possum biomarker using field data, laboratory feeding trials and external vs internal examinations. External examination was found to be unreliable due to natural green fluorescence of possum urine, whiskers and guard hairs around the paws. Internal staining appears to reliably last no longer than four days in a live possum.

Is tree-fern based recruitment demographically significant for tree species in New Zealand's temperate rainforest?

Mr. Thomas N. Dawes[1], Dr. Kevin C. Burns[1]
[1]*Victoria University of Wellington, Wellington, New Zealand*

Biography:
Tom Dawes is a 1st year PhD student at Victoria University of Wellington studying under K. C. Burns. Having previously completed an MSc in the biodiversity and taxonomy of Plants at the Royal Botanic Garden Edinburgh, his current research focuses on the ecology of epiphytes.

Tree ferns are a major constituent of New Zealand's temperate rainforest with a 'trunk' that is ideal substrate for epiphytes, including epiphytic seedlings. Although some epiphytic individuals can persist and grow into hemiepiphytic adults, it is not clear if and to what extent populations actually rely on this life history strategy. Here, we tackle the question of which species rely on this process by looking at how a tree's epiphytic prevalence changes across size classes. Tree species show significant differences in demographic structure between the forest floor and tree fern-based subpopulations, with only a few species showing reliance on tree ferns in the adult populations. Species' overall arboreality score has a negative correlation with seed size, with only smaller seeded species able to germinate on tree ferns. We also hypothesise that rooting plasticity explains the additional variation in arboreality between species, given that some species are present only as epiphytic seedlings and not adults. Overall, we demonstrate the importance of tree fern-based recruitment in New Zealand's forests, with seed size and rooting morphology being key predictors of which species utilise this strategy.

Partitioning above and below ground interactions and their effects on juvenile *Dacrycarpus dacrydioides* (kahikatea) and *Podocarpus totara* (totara)

Garth Fabbro[1], Dr Julie Deslippe[1]
[1]*Victoria University of Wellington, Kelburn Campus, New Zealand*

Biography:
Garth recently completed his MSc in Ecology and Biodiversity in the School of Biological Sciences at the University of Wellington, with first class Honours. His interest in community ecology has focused on plant-plant and plant herbivore interactions. He is particularly interested in building knowledge to combat the decline of New Zealand's endemic flora. He enjoys tramping all time spent in the field.

Competitive and facilitative interactions among plants, which occur both above and belowground, play important roles in determining plant recruitment and community structure. A better understanding of the relative contributions of these interactions to the net effect of nurses species on target trees may improve outcomes of ecological restoration (ER) projects. In the winter of 2016, we planted 168 target totara (*Podocarpus totara)* and 168 target kahikatea (*Dacrycarpus dacrydioides)* saplings (~24 months old) adjacent to 'nurse trees' that had been planted in 2011 as part of an ER project to restore pasture to swamp-forest. We utilized conspecific and interspecific pairings and manipulative belowground treatments to restrict access of the target trees to mycorrhizal networks. We monitored the height and girth of the target trees for one year, and developed allometric equations to model tree biomass based on these parameters. Tree biomass estimates were used to calculate the Relative Interaction Index (RII), an index of the net strength and direction of the interactions affecting target trees. Kahikatea and totara responded differently to the treatments. Kahikatea showed net facilitation and gained biomass when it had access to the mycorrhizal network and a neighbour. In contrast, access to a mycorrhizal network allowed totara to have net neutral interactions, and these became negative when access to the mycorrhizal network was restricted. Our results suggest that to enhance recruitment, totara juveniles should be planted farther away from older woody species while closer spacing should be maintained for kahikatea.

Mountain beech regeneration across an elevation gradient

Tarn Gillman[1], Dr. Bradley Case[1], Dr. Hannah Buckley[1]
[1]*Institute for Applied Ecology, AUT, Auckland, New Zealand*

Biography:
I am an undergraduate student with experience conducting fieldwork in Australia and New Zealand. I am aiming to complete my Honours specialising in Applied Conservation and will apply a high attention to detail in my research and hope to make a positive contribution to New Zealand's environment. I hope to increase our understanding of regeneration patterns in Beech forest ecosystems and later use this knowledge to help inform their conservation.

Nothofagus solandri var. cliffortioides (Mountain Beech) forms almost homogeneous forest from treelines to the valley floor. This provides an opportunity to measure the effects of elevation, slope, soil quality, light availability and substrate composition on seedling abundance, growth and survival. 19 Permanent seedling monitoring plots were established along an elevation gradient. These plots were arranged on 5 different transects established in Craigeburn Forest Park and the Hawdon River Valley. The coordinates of each plot were used to derive elevation and slope data in ArcGISPro. Soil samples, fish–eye canopy photographs, substrate type proportions, seedling height data, and seedling counts were taken across 16 sub–plots. Random–forest regression tree analysis was performed on the effects of elevation, substrate composition, and slope on the abundance of small and large seedlings. Slope and then elevation are the most important variables in determining both small and large seedling abundances, when compared to the effects of each substrate type observed in each plot. Together, these predictor variables explain 22.52% of the variance in small seedling abundance and 27.91% of the variance in the abundance of large seedlings. With increased sampling and incorporating more measured variables into the analysis, including seedling growth data yet to be collected, this method has great potential in terms of categorising regeneration patterns across different environmental conditions.

Factors influencing beech seedling distribution and abundance across a beech-kanuka forest ecotone in the Boyle River area, Lewis Pass

Miss Karina Hadden[1], Mr Abel Campos-Melendez[1], Dr Jon Sullivan[1], Dr Tim Curran[1]
[1]*Lincoln University, Lincoln, New Zealand*

Biography:
Karina Hadden is a third-year undergraduate student at Lincoln University studying towards a Bachelor of Science majoring in Conservation and Ecology. Her interests range from restoration ecology, ecotone interactions, and more recently insect ecology and conservation. Since starting at Lincoln University, Karina has gained two scholarships; the first to determine whether the New Zealand long-tailed bat (Chalinolobus tuberculatus) had returned to Banks Peninsula, and the second on monitoring changes to native biodiversity on a recently converted dairy farm. Karina's next aim is to be selected for a Masters in Science in 2019.

Historic burning of native beech forests in New Zealand was often followed by the development of communities dominated by species readily able to establish following fire, such as kanuka (Kunzea robusta). In many areas beech and kanuka stands are found adjacent to each other. Beech forests are known to eventually out-compete kanuka stands, so this study set out to identify what factors were driving red beech (Fuscospora fusca), silver beech (Lothozonia menziesii), and mountain beech (Fuscospora cliffortioides) seedling distribution and abundance in a kanuka stand at Boyle River, Lewis Pass. We measured canopy cover, leaf litter depth, and ground cover of moss along transect lines extended from within beech forest into the kanuka forest. Most beech seedlings were found in areas with less than 40% canopy cover and were only found where there was less than 50% moss cover. No relationship was found between leaf litter depth and seedling abundance. Few beech seedlings were found beyond the drip line of the last mature beech tree, and most of the seedlings were concentrated around the forest edge. These results may be due to availability of shelter at the forests edge, or possibly the lack of suitable mycorrhizae in the soil limiting the spread of beech seedlings into the kanuka stand.

Efficient sampling of avian acoustic recordings: Intermittent subsamples improve estimates of single species prevalence and total species richness

Stephen Hartley[1], Asher Cook[1]
[1]*Victoria University of Wellington, New Zealand*

Biography:
Stephen Hartley is a senior lecturer at Victoria University of Wellington and director of VUW's Centre for Biodiversity and Restoration Ecology. His research interests include spatial ecology and improving methods of monitoring for conservation and restoration ecology.

Automated sound recording devices have become an important monitoring tool used to estimate species richness and abundance of birds. The prevalence of calls detected in a specific time period can be used as an index of relative abundance, to compare between populations. However, the statistical power to infer true differences in abundance between populations is low when detections are highly aggregated in time leading to high variance between samples from the same population. Here, we used two different sampling methods, and used the data from each to calculate species richness and acoustic prevalence of nine bird taxa from a total of 50 sound recordings. The first method used a continuous five-minute section of the recording. The second method used the first 10 seconds of each minute to create a composite recording, also of five minutes total duration. There was no difference in the mean prevalence index between methods. The intermittent samples, however, produced prevalence indices with a lower standard deviation (mean difference = 19 %), detected 26% more species per five-minute sample and required 60% less total listening time to detect as many species as the continuous method. The intermittent method holds much promise because, for a given amount of listening time, it detects species more efficiently and provides greater power to detect differences in a species' relative prevalence, which in turn should allow for better-informed management regarding population status and trends.

The Island Rule in plants: Do island endemics differ from their mainland relatives in a consistent pattern?

Miss Annemieke Hendriks[1], Dr Kevin Burns
[1]*Victoria University of Wellington, Wellington, New Zealand*

Biography:
Annemieke Hendriks grew up in Whangārei before commencing on a Bachelors in Science at Victoria University of Wellington. Now 5 years on, Annemieke is a Masters student under the guidance of Kevin Burns. Currently working with on the "Island Rule" and evolutionary changes in plants, she also has an interest in animals, conservation and the great outdoors. Annemieke will be a familiar face to many local groups, as she volunteers at Zealandia, Mana and Matiu/Somes Islands. She also is a venturer leader at Karori 1st Scouts, plays violin and paints.

The “Island Rule” predicts that large species evolve to become smaller on islands, while small species evolve to become larger. Many studies have tested for evidence of the island rule in animals, but no previous study has considered plants. To bridge this gap in our understanding of island evolution, I tested for evidence of the island rule in over 50 plant species inhabiting small islands surrounding New Zealand. Results from plant stature, leaf area and flower measurements, provide clear support for the island rule suggesting that plants obey it.

Wings over Wairio: Using UAV imagery to perform fine-scale mapping of wetland vegetation

Mr Patrick Hipgrave[1], Dr Mairead de Roiste[1], Dr Stephen Hartley[1]
[1]*Victoria University of Wellington, Wellington, New Zealand*

Biography:
Patrick Hipgrave is a postgraduate student at Victoria University of Wellington and is currently in the process of completing his Masters in Geographic Information Science degree. His research interests include the use of aerial platforms, in particular UAVs, for remote data sensing and conservation. Prior to embarking on the MGIS programme he completed a Bachelor's Degree in geography at Victoria University, with minors in philosophy and history.

Differentiating between species of plants in aerial imagery is often challenging and, in some cases, can be impossible without significant field data collection. This project investigates the use of image classification techniques to create fine scale maps of wetland areas based on aerial photographs collected using a UAV (unmanned aerial vehicle). The project will test the effects additional ancillary data, such as digital surface models or near-infrared imagery, may have on the classification process. This project trials an emerging set of image analysis techniques called 'object-based image analysis' to investigate the potential of remote identification techniques calibrated to detect selected native and invasive species.

The project consists of a year-long monitoring programme of the Wairio Wetland block, located on the eastern shore of Lake Wairarapa, in the lower North Island of New Zealand. Using a UAV, high resolution true-colour aerial imagery is being collected at seasonal intervals. This imagery is then classified using an object-based classification algorithm in combination with surface models and/or near-infrared (NIR) imagery. The project is ongoing and the findings are expected to be published in May 2019.

In addition to providing insight into the seasonal changes that occur in recovering wetland areas, the findings of this project will have implications for future research programmes that wish to employ similar method of image classifications, particularly in regard to what additional data or processing steps are required in order to produce a suitably reliable classification result.

Detection of temporal and spatial regime shifts in NZ systems – can we make better decisions?

Ellen Hume[1], Professor Troy Baisden[1], Dr Cate Macinnis-Ng[2], Dr Rachelle Binny[3], Dr Emily Harvey[4], Dr Fraser Morgan[5]

[1]University of Waikato, Hamilton, , [2]University of Auckland, Auckland, , [3]Manaaki Whenua - Landcare Research, Lincoln, , [4]Market Economics, Auckland, , [5]Manaaki Whenua - Landcare Research, Auckland,

Biography:

Ellen Hume is in the early stages of doctoral research and is passionate about transdisciplinary research and co-production approaches to improve environmental outcomes for NZ. With a range of research experiences from ecology to sustainable agricultural production, systems modelling and environmental policy, she aims to use innovative and integrated research approaches to deal with problems arising from complex systems and generate impact through enabling societal change.

The world is experiencing unprecedented rates of change, with the increasing pressure of global change drivers landing heavily on our ecosystems. While many exhibit resilience to these pressures, other ecosystems are vulnerable to regime shifts or non-linear responses to gradual increases in system pressures. These changes to the state of a system can be abrupt and unexpected for communities living in these areas and positive feedbacks can generate hysteresis making it difficult to return to the previous and usually desired system state. Given the New Zealand (NZ) economy is reliant on primary production and tourism, and therefore the provision and maintenance of ecosystem services, it is important that we understand the risk and consequences of our systems undergoing regime shifts into potentially undesirable alternative stable states.

Being able to predict the point at which a system transitions into another state is important for ecosystem management and policy, but is also challenging to realise in the real world. We often do not have a clear understanding of system complexity, thresholds can be situation- and system-dependent, and there is a lack of appropriate long-term data and tools to detect these thresholds.

My PhD research aims to detect and potentially predict temporal and spatial regime shifts in NZ systems to enable better risk-based decision making, for example in relation to climate change. More specifically I will be exploring whether algorithms such as Fisher Information are appropriate for detecting regime shifts using data collected across different types of systems in NZ.

Sexual Deception: Hallmarks of a successful strategy

Miss Alexandra Kai Fong[1], Miss Amy Martin[1], Doctor Anne Gaskett[1]
[1]*University Of Auckland, Auckland, New Zealand*

Biography:
Alexandra Kai Fong is currently a Masters student in Dr Anne Gaskett's lab at the University of Auckland. Alexandra's research explores sexual deception, a unique form of orchid pollination. Her broad focus is to characterise the global patterns between sexually deceptive orchids and their specific pollinators. Her future aims are to model simulations to predict evolutionary outcomes, based on varying traits in the pollinators and orchids.

Before her masters, Alex obtained her BSc in Biological sciences and postgraduate diploma in Biosecurity and conservation from the University of Auckland.

Sexually deceptive orchids exploit their insect pollinators, the plants benefit from pollination, but offer nothing in return to insects fooled into mating with flowers. This deception can impose potentially acute costs on pollinators like sperm wastage - how can these systems persist over evolutionary time? How have these highly exploited pollinators evaded extinction?

Here, I test a new hypothesis: deceived pollinators have resilience traits which both protect and predispose them to deception. I have three aims; 1) to identify putative resilience and counter-adaptive traits from the literature, to create a database of morphological and behavioural traits of deceived pollinators, and test for correlations between pollinator traits and orchid fitness, 2) use theoretical models to test how resilience traits from the database can buffer extinction risk, and 3) using museum specimens, compare possible counter-adaptive traits of commonly deceived pollinator species from areas with and without sexually deceptive orchids, via a geographic mosaic model that explores the strength of coevolution across the species' distributions. This will be the first application of a geographic mosaic model to presence/ absence of an orchid and its pollinator and will have important implications in the orchid and pollination fields.

I have identified records for over 600 species of sexually deceptive orchids and their pollinators. I chose pollinator traits such as body size, mating system, flagellum length of the antennae and sociality as putative resilience or counter-adaptive traits. I am now testing which orchid or pollinator traits are most common, and if they correlate with orchid fitness.

Palatability-defence trade-off hypothesis: A New Zealand case study

Mr Ganges Lim[1], Dr Kevin Burns[1]
[1]*School of Biological Sciences, Victoria University of Wellington, Wellington, New Zealand*

Biography:
Hailing from Singapore, Ganges spent 13 years as a science teacher and education manager before coming to New Zealand. A current PhD student at Victoria University of Wellington, his research focuses on community ecology of bird-plant interactions.

He is a serial naturalist who has keen interest in ecology. His past researches are on seed-dispersal corridors between primary forest fragments in Singapore. A life-long educator with a strong passion for learning and teaching, he is presently working as an education consultant for Pacific Biosecurity and also head demonstrator for Victoria's Biology 219 Course - New Zealand's Flora and Fauna.

According to the palatability-defence trade-off hypothesis, fruiting plants with a higher rate of fruit removal have lower fruit defence and thus are at higher risk of pest or pathogen attack. While this hypothesis has been tested in other parts of the world, I am testing the hypothesis for the first time in New Zealand. Biochemical analyses of fruit nutrients and secondary metabolites are being quantified to determine the biochemical basis of palatability and defence. Focusing on common native fruiting plants in Zealandia, field experiments of fruit removal rate and fungal attack rate are also currently being conducted. Results from this study will determine whether New Zealand plants conform to global patterns in fruit phenotype.

Mate choice and sexual communication in the New Zealand stick insect *Clitarchus hookeri*

Mari Nakano[1], Dr. Andrea Clavijo McCormick[1], Prof. Steve Trewick[1], Prof. Mary Morgan-Richards[1]
[1]*Massey University, Tennent Drive, New Zealand*

Biography:
Mari Nakano is originally from Japan and has recently obtained her M.Sc. in Zoology at Massey University, where she investigated sexual communication, and reproductive behaviour of New Zealand stick insect Clitarchus hookeri.

New Zealand has a unique natural heritage, including multiple native and endemic species of arthropods. Understanding their reproductive behaviour may provide valuable information for their conservation and that of their habitats. Stick insects, are particularly interesting to investigate reproductive behaviour since they can reproduce both sexually and asexually through parthenogenesis. New Zealand stick insect *Clitarchus hookeri* has both sexual and asexual (parthenogenetic - female only) populations distributed throughout the country. This work aimed to explore the unique reproductive strategy of *C. hookeri*; specifically, the morphological and chemical traits associated with male mate choice. For this purpose we compared the morphological and chemical (i.e., insect-derived odours) characteristics of sexual and parthenogenetic females from different populations across New Zealand; and tested the ability of males to discriminate between sexual and parthenogenetic females for their pre- and post-copulatory choices. We hypothesized that females from parthenogenetic populations would exhibit different morphological and chemical traits than sexual females, and predicted that *C. hookeri* males would be able to discriminate between sexual and parthenogenetic females. Contrary to our hypotheses, sexual and parthenogenetic females overlapped in their morphology and chemical traits; and phenotypic variation in females was found to be related to differences among populations rather than to their reproductive mode. Concurrently, males failed to discriminate between sexual and parthenogenetic females both in pre- and post-copulatory choices preferring females with lighter body weight irrespective of their reproductive mode. This study suggests that parthenogenetic females still retain traits linked to sexual reproduction in spite of their potential costs.

Exploring honey bees in New Zealand forest

Rachel Nepia[1]
[1]*University of Waikato, Hamilton, New Zealand*

Biography:
Rachel Nepia is a PhD student at the University of Waikato studying the role and impact of introduced honey bees in native New Zealand forest.

In New Zealand's booming apiculture industry the number of hives registered on conservation land has exceeded the national trend, increasing by 70% in the last 5 years. As this growth continues there is a need to improve sustainability by understanding the role that honey bees play in native forest, and the availability of native resources for honey bee forage. Research addressing this need is being carried out in submontane kāmahi and tāwari forest in the Kaimai-Mamaku Range. At sites of varying hive density invertebrate flower-visitor assemblages were collected by sweep netting and identified. Pollen carried by each flower visitor was collected, acetolysed, and identified to demonstrate interactions between flower visitors and native flora. Ordination and 3D network mapping were then used to visualise the pollination networks. From 1600 flower visitors over 50 different pollen species were identified. There was a pronounced overlap in pollen preference between flies, bees and beetles, but generalist strategies may reduce the potential for competitive effects. Networks showed low levels of nestedness and low linkage density. Video surveillance and pollinator exclusion experiments showed that honey bees have low pollination potential for tāwari, however, kāmahi seed set was least limited at sites with higher honeybee visitation. Nectar and pollen were collected from kāmahi and tāwari flowers during 2016 and 2017. Sugar production per flower varied between seasons, with lower production occurring during warmer, drier seasons. Phenological observations showed that flower production per tree follows cyclical patterns. These results contribute an essential part of a larger study that will guide sustainability of apicultural operations in New Zealand native forest.

Does phylogeny explain climatic niche patterns?

Ms. Miki Nomura[1], Dr. Ralf Ohlemüller[1], Mr. Benjamin Potter[2], Dr. Barbara Anderson[3]
[1]University of Otago, Dunedin, New Zealand, [2]University of Auckland, Auckland, New Zealand, [3]Manaaki Whenua Landcare Research, Dunedin, New Zealand

Biography:

Miki Nomura is currently a PhD candidate at University of Otago. The main motivation of her research is to understand the environmental drivers of the spatial distribution of plants. Her research interests are in biogeography and climate change. She has worked on projects about how plants' distributions in Japan and New Zealand are determined and will be affected by future climate change with environmental niche modelling.

Current spatial patterns in species distributions are determined by a combination of present day and historical environmental and biotic drivers. Evolutionary processes leading to diversification of lineages play out on the background of changing and/or persisting environmental conditions. Understanding the interplay of phylogenetic relationships and environmental niches of taxa can help to better understand processes driving current species ranges and ecologies. This study focuses on herbaceous (*Acaena*) and grass (*Chionochloa*) lineages that occur across open habitats in New Zealand and have experienced major climatic and geographical changes during the Quaternary. We quantify the availability of current climate conditions in the Last Glacial Maximum (LGM) in New Zealand and investigate the relationship between phylogenetic relatedness and past and current climatic niche patterns between species in these two genera. Our main finding are; (1) warm and wet climate conditions in current New Zealand were not present anywhere during the LGM; (2) There is a positive trend in the relationship between climatic niche volume and taxon age in both genera; (3) The relationship between divergence time and similarity in currently occupied climatic niches is negative for *Acaena*, but positive for *Chionochloa* sister species. We conclude that trends of phylogenetic conservatism in climate niche of taxa vary depending on the degree to which species' distributions are at equilibrium with the current climate regime.

Water use of regenerating forests on NZ farmland

Cate Ryan[1]
[1]*University of Auckland, Auckland, New Zealand*

Biography:
PhD candidate in forest ecology and the impacts of climate change. I have in depth of experience in the environment and sustainability sectors in corporate and NGO contexts - in NZ and internationally. I have a strong research and professional background, skilled in business planning, proposals and consultancy. Fan of bicycles and outdoors in general.

Forests carry out climate regulating functions through water and carbon cycling on daily and seasonal scales. This will become even more important as climate change intensifies. During photosynthesis, respiration and transpiration, gas exchange occurs via the stomata and plants face a trade-off between maximising carbon intake and minimising water loss, thus carbon storage comes at a cost to water balances which we are not properly accounting for in NZ.

Collectively, NZ agroecosystems cover 54% of NZ's terrestrial area and are where the biggest gains in provision of ecosystem services can be made through forest regeneration. However, we need to incorporate the impact on water budgets (and other ecosystem services) when deciding what types of forests to regenerate. Different species/mixes of species have different traits that determine how they respond to environmental change. This research will use sap flow sensors to measure whole plant and ecosystem water use to quantify seasonal and daily fluxes in native and exotic regenerating forests, to identify which traits and species best support climate regulating functions. This will then be modelled at the landscape scale under different climate and management scenarios to help inform decisions about which species to plant and where.

Exotic species dominate regenerating native forest post-fire

Mr Luke Sutton[1], Dr Jon Sullivan[1], Dr Timothy Curran[1]
[1]*Lincoln University, Lincoln, New Zealand*

Biography:
Luke Sutton finished a Bachelor of Science majoring in Conservation and Ecology at Lincoln University this year. His interests include restoration ecology, pest management and insect conservation. Luke is aiming to be selected for a Masters of pest management in 2019.

Fire was uncommon in New Zealand before the arrival of humans, therefore few of our native species have adaptions to fire. These native species have been disadvantaged in the post-fire landscape following the introduction of fire-tolerant exotic species. To assess the combined impact of fire and exotic species on regenerating native bush it is important to measure community diversity and species abundance post wildfire disturbance. In this study woody seedling, species diversity, abundance, and ground cover were measured in burnt and unburnt regenerating forest of Kennedys Bush Reserve on the Port Hills of Christchurch 13 months post fire. There was a significant difference in woody seedling diversity and abundance between both burnt and unburnt sites, with burnt sites having higher seedling abundance with lower diversity, while the opposite was found in the unburnt sites. The exotic weed, *Ulex europaeus*, dominated the burnt sites as its seeds are capable of surviving the temperatures associated with fire. This could be important for conservation efforts in the future with reserves that are at risk of fire, as some exotic weeds are able to take hold early in succession if left unchecked. However, if managed properly, gorse-dominated communities return to native forest, though the process takes decades.

Do epigeous beetles respond to mammal exclusion at ZEALANDIA Reserve?

Dr. Olivia Vergara[1], Dr. Nicola Nelson[1], Dr. Stephen Hartley[1]
[1]*Victoria University of Wellington, Wellington, New Zealand*

Biography:
Olivia Vergara's PhD research examined the effects of mammal control and exclusion on ground-dwelling invertebrates in New Zealand forests, to better understand the effects of introduced mammals on invertebrate populations over time. She will present an update of one of her chapters at this conference.

The introduction of mammals to New Zealand has triggered many population declines and even extinctions of large-bodied invertebrates. 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 a suite of mammals remains present. We sampled invertebrate communities inside ZEALANDIA and in the adjacent non-fenced area to investigate 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 assess levels of predator pressure on invertebrates (using mealworms as baits) inside and outside the reserve. Ground beetles: *Ctenognathus* sp1, *Holcapsis* spp, *Plocamostethus planiusculus*, *Megadromus vigil* and morphospecies 1, were found across our study sites. Mammal exclusion and year of sampling had no significant effect on the diversity or number of beetles except for *Ctenognathus* sp1 being more abundant inside the fence and Staphylinidae outside, in both years ($p<0.05$ before Holm-Bonferroni correction). We recorded similar predation pressure on invertebrates both inside and outside the reserve, with robin as the main mealworm predator inside and blackbird outside, as well as hedgehogs outside. Fenced reserves make a crucial contribution to the protection of endangered vertebrates and large invertebrates that are known to be vulnerable to mammal predation, but their role in effecting change in the wider invertebrate community remains uncertain and may require additional intervention such as the reintroduction of vulnerable species already lost from the general landscape.