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Architecture as Habitat: Enhancing urban ecosystem services using building envelopes

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Biography:
Growing up surrounded by the beautiful Acadian forests and coastlines of Atlantic Canada instilled in me a passionate interest in biodiversity. After completing my BSc in Biology, I was deeply concerned by the destruction and degradation of natural environments as a result of urbanization. This led me to switch fields and complete a MArch so I could learn about regenerative building practices. My PhD research is driven by a desire to improve how built and natural environments relate to each other so we can better protect the amazing diversity of life we share this planet with.

Urban green space is the primary source of vegetated habitat in cities, though most cities lack the quantity, quality, and connectivity of green space needed to provide essential ecosystem services for the health, well-being, and resilience of human and non-human species. In reaction to urban densification and the increasing frequency and severity of climate change impacts, this study argues for architecture to provide vegetated habitats to supplement existing urban green space and provide refuges during extreme disturbances. A spatial analysis was conducted to test the performance of the existing green space against targets for human well-being and avifauna needs in a 1.93 km² neighbourhood in Wellington, Aotearoa New Zealand, during normal and flooded conditions. The results showed an insufficient quantity and connectivity of green space during both normal and flooded conditions to meet the habitat needs of avifauna. Though the quantity and accessibility targets for human well-being are met under normal conditions, there is insufficient green space to meet those targets during flooded conditions. During normal conditions, 9% of the roofs in the neighbourhood need to be converted to vegetated habitats to achieve the targets for both human well-being and avifauna. The amount increases to 17% if the targets are to be maintained during flooded conditions. The study concludes that though ground-level open space is limited, with ecosystem-specific habitat design and supporting governance policy, the surplus of existing architectural surfaces should be used to increase urban habitat provision, thereby enhancing the health and resilience of humans and avifauna in cities.

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Be wary of the weasels: trophic level effects of the difference in diets of stoats and weasels in an alpine ecosystem.

Jamie McAulay[1]
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Biography:
Jamie McAulay is a Senior Ranger with the Department of Conservation in Fiordland National Park. He has worked with a diverse range of threatened species - from Archey's frogs and kokako, to rock wren and kea, both in New Zealand and abroad. Jamie is an isotope ecologist using biochemical tools to study diets and dietary niches of invasive species in relation to their threatened prey.

Conservation programmes in New Zealand often supress populations of a single invasive predator for the benefit of threatened avifauna. For example, trapping invasive stoats to protect kiwi, kaka or whio. However, the establishment of whole guilds of invasive species has created complex competitor and predator-prey relationships, including some well described trophic cascades. Stoat trap networks are thought to be comparatively less effective at supressing weasels. The removal of intraspecific competition and aggression, combined with lesser mortality in traps may contribute to some programmes recording periodic spikes in weasel numbers, at times exceeding those of stoats.

We use C13 and N15 stable isotopes to examine the diet and relative trophic position of 8 weasels and 20 stoats caught in an alpine ecosystem. Using Bayesian stable isotope mixing models, we explore 3 dietary models as a framework with which to examine trophic patterns in feeding behaviour, and potential impacts on native species.

We show weasels at our site likely preyed at a higher trophic position than stoats, concentrated on smaller prey such as lizards, passerines and mice. We discuss the potential for conservation-management induced trophic cascades, in which stoat trapping programmes might result in greater damage to some native species at a higher trophic position.

Limited by a small sample size and unknown values in some model parameters, we argue for further research into the effect of weasels on native species, and for the use of stable isotope analysis as a tool to study community level effects of pest control programmes.

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Censusing of animals through acoustic individual identification

Dr Carol Bedoya[1], Dr Laura Molles
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Biography:
Born in Medellín (Colombia), Carol has a background in Electronic Engineering (BSc-MSc) and Biological Sciences (PhD). His areas of expertise are Computational Intelligence (Artificial Neural Networks/Deep Learning, Clustering Algorithms, Fuzzy Logic, Evolutionary Computation) and Animal Acoustics (Bioacoustics, Ecoacoustics, and Biotremology). Carol has extensive experience in the analysis of soundscapes and acoustic communities, and his current research involves identifying animal individuals using sound.

Vocal individuality (i.e., the set of acoustic features unique to an individual) is a more time-efficient and economically advantageous way to discriminate individuals than other identification techniques (e.g., capture-mark-recapture, in situ observation); however, it is seldom used in ecological studies and conservation tasks. Here, we introduce an artificial intelligence framework that accurately characterises vocal individuality and uses it as a basis to monitor individuals, detect unknown individuals in a territory, and perform acoustic censusing (i.e., estimating the number of individuals in a set of recordings). Our framework combines fuzzy clustering with convolutional neural networks, and is a paradigm shift in the analysis of ecoacoustic data. In this talk, we discuss the dominant techniques for the acoustic estimation of abundance and other biodiversity metrics and methodologically compare them with our framework. Our approach is a robust and non-invasive way of monitoring and quantifying individuals over time, and significantly facilitates management tasks, especially in species that are cryptic or difficult to handle.

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Climate change impacts on the biodiversity of Aotearoa - a stocktake

Dr Cate Macinnis-ng[1]
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Biography:
Cate Macinnis-Ng is a plant ecophysiologist with an interest in impact of climate change on biodiversity

Detecting climate change impacts on biodiversity is challenging in a highly variable climate but there have been a growing number of climate-related studies in Aotearoa in the last decade. In this talk, I'll outline the results of our extensive review of climate change impacts in marine, freshwater and terrestrial environments. Approaches for quantifying climate change impacts include observations, experimental manipulations and models. Experiments and models help us predict likely impacts while field measurements indicate current change. The scarcity of long-term ecological monitoring studies in Aotearoa potentially contributes to the sparse literature describing real world responses. Marine systems are better studied than terrestrial and freshwater systems with ocean acidification and marine heat waves being major threats. Vulnerable systems include alpine habitats, estuaries, wetlands and other near-shore environments. Interactions between climate change factors and other stressors such as invasive species impacts and habitat fragmentation complicate the climate change story. I'll highlight some of the well-known challenges and some of the newer research with a summary explaining future research needs and priorities.

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Continuing decline in moth abundance in a New Zealand tussock grassland over 60 years

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Biography:
Currently, Elizabeth is working towards a Masters in Biological Sciences at the University of Canterbury, focusing on insect ecology and biodiversity. Originally from the States, she has previously worked in agricultural pest research and is interested in broadening her experience by getting into insect conservation. In her non-existent spare time as a student, she enjoys reading, yoga, hiking, and amateur photography.

Recent evidence has sparked increasing concern of widespread insect biodiversity loss, often quoted in media as the "insect apocalypse". Despite growing interest, evidence to ascertain how insects are faring globally is scant, and as most insect abundance studies originate from Europe or North America, the situation in the Southern Hemisphere is particularly unclear. In New Zealand, long-term insect monitoring has been sparse, making determining threats to insect biodiversity and informing on best conservation protocols difficult. One long-term insect study, by entomologist Graeme White, measured moth biodiversity in the largely unimproved native tussock grasslands of inland Canterbury. White found a 56% decline in overall moth abundance from 1961 to 1989, possibly due to the encroachment of invasive browntop grass and subsequent decrease in native plant diversity. We resampled this moth community in the same locations to determine how insect biodiversity has changed since White's study. From December 2020 to May 2021, we sampled moths using White's original light traps, simultaneously testing an incandescent light source (to replicate White's study) and an LED light source (used in modern light-trapping). Despite there being no apparent change in land management, we found a 61% decrease in total moth abundance since 1989 and an overall 86% decline from 1961 to 2021. We will discuss whether this decline is due to continued spread of browntop and which moth species might be most affected. Evidence of further declines in moth abundance have important implications for grassland management and insect conservation in New Zealand and globally.

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Detecting Invasive Koi Carp from Water Samples Using Dogs

Miss Melissa Collins[1], Dr Clare Browne[1], Dr Timothy Edwards[1], Associate Professor Nicholas Ling[1], Dr Grant Tempero[1]
[1]*University of Waikato, Hamilton, New Zealand*

Biography:
Melissa Collins is a current PhD candidate at the University of Waikato where she investigates dogs' ability to detect invasive fish in water samples. Melissa began her research with domestic dogs in 2018, where she completed a MSc in Biological Sciences, which focused on identifying a potential repellent to deter domestic dogs from consuming poison. Through this research, Melissa developed a strong interest for animal behaviour and conservation biology, and not long after in 2019, Melissa began her PhD journey. Melissa's aim is to be able to use dogs as a low-cost, yet effective method of pest fish detection.

Koi carp (*Cyprinus rubrofuscus*) are recognised as one of the most invasive freshwater fish species, causing significant damage to freshwater ecosystems. In shallow lakes of the Waikato Region, carp biomass can exceed 400 kg/ha with negative ecological impacts occurring at biomasses above 50 kg/ha. Boat electrofishing and netting are typically used to survey for carp; however, these fishing methods can be resource intensive and ineffective when fish are at low densities. We aimed to determine if dogs could detect carp at biologically relevant biomass in naturally sourced water samples. Using an automated 17 sample carousel, pet dogs (n = 3) trained to discriminate carp scent in control water samples were presented with samples collected from three carp-free lakes of varying trophic status. Seven samples were spiked with carp scent to achieve a target concentration equivalent to 310 kg/ha, the remaining (non-target) samples were free of carp scent but spiked with carp-free control water. Each experimental day the dogs assessed all randomised samples 4-6 times. Our results demonstrated that dogs could detect and discriminate carp scent in water samples from all three lakes with a high combined sensitivity (average number of correctly identified target samples) and specificity (average number of correctly rejected non-target samples) of 86.5% and 78.9%, respectively. These results demonstrate that dogs can detect the presence of koi carp in water samples from a variety of lake types at biologically realistic concentrations and may provide an inexpensive, robust method for invasive fish detection.

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Developing functional ecological connectivity strategies based on landscape modelling

Ms Kate Heaphy[1], Sandeep Gangar[1], Dr Ian Boothroyd[1], Hana Aickin[2], Ellice Protheroe[2]
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Biography:
Kate completed her Honours degree at the University of Auckland in 2018. Her research aimed to improve the efficacy of currently available predator control tools and help inform future pest management decisions in Ipipiri (Eastern Bay of Islands). For the past three years, she has worked at Boffa Miskell as an ecologist and biosecurity consultant, specialising in developing landscape-scale predator control and ecological management plans. Kate has a strong interest in utilising GIS techniques to aid conservation decisions, and improving habitat connectivity to better protect our native biodiversity and help mitigate climate change.

Maintaining ecological connectivity, especially in increasingly fragmented landscapes, is crucial to ensure the health and efficient functioning of ecosystems. Improving ecological connectivity increases ecosystem resilience, and is a key method used to help protect biodiversity and mitigate impacts from climate change and other pressures. However, connectivity modelling software is not widely used in development of conservation strategies in New Zealand.

We developed Ecological Connectivity Strategies for two local council boards in Auckland; Upper Harbour and Rodney East, in collaboration with mana whenua, local community conservation groups, Auckland Council, and each Local Board. The aim was to develop a communication and conservation planning tool to help better coordinate and support limited conservation resources across the region.

We used the ArcGIS toolbox 'Linkage Mapper' to model the connectivity for a range of native avian 'umbrella' species to identify gaps and evaluate opportunities to protect, enhance, connect, and extend existing valuable habitats. We then prioritised areas for management and recommended management actions to ultimately enable local communities, council, and other conservation agencies to work together to achieve conservation outcomes. Each strategy was presented as an online ArcGIS StoryMap to facilitate widespread engagement and allow users to explore connectivity and potential conservation actions in their area of interest.

Linkage Mapper was an effective tool to inform evidence-based, landscape-scale connectivity strategies and help prioritise conservation actions in fragmentated landscapes. Future opportunities include using connectivity software as a tool to aid climate change mitigation, and for landscape-scale planning and urban design that incorporate ecological connectivity.

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Do better hunters make better parents? Linking together the breeding and foraging ecology of Adélie penguins

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Biography:
Taylor is a PhD student at the University of Otago, where he has previously finished a Bachelor of Science with Honours. His honours work focused on the population-level response of key New Zealand pest species in response to differing control regimes and whether it constituted a "sustainable harvest". His current PhD work is focused on the foraging and breeding ecology of Adélie penguins in the Ross Sea. Particularly, trying to link these two processes together in a statistically robust but also ecologically meaningful way.

Adélie penguins (*Pygoscelis adeliae*) are one of the most widely spread and abundant penguin species in the world, with a circumpolar distribution. While clumsy on land, they are agile marine predators, with their diet primarily consisting of small fish and krill. Because of these factors, and a well-documented relationship between the condition of the Antarctic pack-ice and population viability, Adélie penguins are considered an indicator species for the health of the Antarctic marine environment Given the recent designation of the Ross Sea, off the coast of West Antarctica, as a Marine Protected Area (MPA), research on local Adélie penguin populations can provide an excellent source of information to predict the outcomes of different management decisions and provide advice to stakeholders. Unlike other MPAs, the protection status of the Ross Sea has a sunset provision of 35 years, meaning that it's status and extent will be under review. This research on an established indicator species like the Adélie penguin could, therefore, inform whether such protection should be modified or withdrawn. This presentation will discuss current work describing the at-sea movements of Adélie penguin breeding at Cape Bird in relation to relevant local environmental conditions. Additionally, focus will also be given to the application of mechanistic modelling to link this movement to reproductive outcomes such as fledging success and chick mass, which has applications for the wider movement ecology field.

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Does shoot-level plant flammability change at different times of the year? Implications for fire management

Dr Md Azharul Alam[1], Assoc. Prof. Xinglei Cui[2], Dr Sarah Wyse[1], Dr Jon Sullivan[1], Prof. George Perry[3], Assoc. Prof. Hannah Buckley[4], Assoc. Prof. Timothy Curran[1]

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Biography:

Dr Alam is a plant ecologist from Bangladesh and currently working as a Postdoctoral Fellow in the Department of Pest Management & Conservation at Lincoln University funded by Argyle Trust. His research is focused on investigating plant flammability in New Zealand hills and high country. He obtained his PhD in Ecology from Lincoln University and MSc in Ecology from Norwegian University of Life Sciences. He is also interested in mangrove ecology and lichen biology.

Plants fuel wildfires and fire regimes vary substantially depending on the composition of plant species in any region. Assessing and understanding plant flammability is essential to identify potential fire hazards. While there have been considerable efforts in recent times to measure the flammability of different species, there has been less focus on how flammability changes within species throughout the year. Therefore, we quantified the temporal variation of plant flammability by collecting and burning 70 cm shoot samples from several common indigenous and exotic NZ plant species at different times of the year at Hinewai Reserve, Banks Peninsula, and Lincoln University. All flammability variables, except total burn time, varied significantly throughout the year. Flammability of the examined species was the highest (ignited faster, higher temperatures recorded, and more fuel burnt) in spring and lowest in winter. All the flammability variables were found to be strongly related to fuel moisture-related traits i.e. leaf dry matter content and twig dry matter content. However, individual species had a different temporal variation for different variables. This study suggests that fuel hazards vary at different times of the year and emphasizes the consideration of species flammability and season for the application of specific fire management practices (i.e. prescribed burning) during a year. The findings further suggest that species with higher flammability pose fire risks throughout the year and require careful application of fuel treatments irrespective of the times of the year.

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Dynamics of plant community flammability in Cockayne's Arthur's Pass Plots over nine decades

Ms. Shanta Budha-magar[1] Nicola J. Day[2], Timothy J. Curran[3], Olivia R. Burge[4], Sarah J. Richardson[4], Ruby R. Ross[3], Hannah L. Buckley[1]

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Biography:

I am a botanist and currently PhD student at Auckland University of Technology, New Zealand from Nepal. My current research is focussed on plant traits and community level flammability. To date I have been involved in research projects where natural habitat, plant population and communities were studied. Regarding my related research activities, I have published five peer reviewed papers, two book chapters and have several presentations in conferences and workshops. I have been awarded with several funds, of them the most noted is Miss EL Hellaby Indigenous Grasslands Research Fund to pursue my PhD, in AUT, New Zealand.

Changes in plant community composition and traits can be used to infer changes in community-level flammability. In subalpine ecosystems, we expect higher community flammability in the decades after fire due to the dominance of grasses (fine fuels) and other high-flammability species like bracken and *Dracophyllum* spp. This would be followed by a decline in flammability, due to a shift to lower-flammability species. In this study, we aimed to determine the plant community flammability of different subalpine vegetation types over 86 years since fire in nine permanent vegetation monitoring transects established by Leonard Cockayne in 1932 at Arthur's Pass and remeasured four times until 2018. We explored how plant morphological and chemical traits predict community flammability in different vegetation types (grassland, shrubland, forest). Combined with existing trait and flammability data, we examined the interrelationships among community composition, shoot flammability (n = 67 species), plant morphology (n = 52) and leaf chemistry (n = 23). We show that community flammability was highly variable across the nine transects in the 86 years since fire. This contrasts with our original hypothesis. However, we show that flammability is strongly related to plant traits, such as leaf specific area and plant dead material. Therefore, we conclude that although post-fire vegetation dynamics is highly variable, changes in plant community flammability are predictable when considered in a trait framework.

Key words: flammability, plant community, plant functional traits, species composition

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Ecology of large carnivores reintroduction: habitat selection of reintroduced lions and behavioural responses of their prey

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Biography:
Sze Wing is an MSc (biosecurity and conservation) research student at the University of Auckland. Prior to her relocation to New Zealand, she had completed her PhD at the University of Hong Kong (HKU) and more than two years of postdoc at University of the Witwatersrand in South Africa, studying the spatio-behavioural interactions between predators and prey. Following her research passion in predator-prey dynamics, Sze Wing is now studying the interactions among cats, stoats, kiore and mice on D'Urville Island in Marlborough Sound, and the behaviour response of kiore to predator scents on Slipper Island in Coromandel.

Species reintroduction is frequently used as a tool for the re-establishment of species into their former range and ecosystem restoration. In South Africa, the economic benefits of wildlife-based tourism have led to an increase in establishments of small private reserves, which frequently involves a reintroduction of large carnivores for conservation and tourist attraction. Post-release monitoring of the behaviour of the reintroduced animals and their interactions with the local species are critical for reintroduction success. I investigated the post-release spatial behaviour of reintroduced lions (*Panthera leo*) in a newly established wildlife reserve, and the effects of the induced predation risks on the vigilance behaviour of naïve prey including Burchell's zebra (*Equus quagga burchelli*) and blue wildebeest (*Connochaetes taurinus*). The location of release and intra-specific interactions both have strong influences on the lions. Lion home ranges were established close to their locations of release and continued to expand for over three years. Yet, the dominant groups gained and remained access to favourable resources while the subordinate groups had shifted to suboptimal resources. Zebra and wildebeest showed scale-dependent vigilance responses, with zebra responding to predation risk at the landscape level and wildebeest to that at the foraging area scale. Herd protection played a more important role in wildebeest than zebra, with the former forming larger but less vigilant herds than zebra. The study has advanced our understanding of the ecological dynamics behind species reintroduction. This could be important in New Zealand where birds are the primary reintroduction target and are also the top predators of island ecosystems

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Effects of sample preservation on the ability of scent-dogs to detect invasive catfish

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[1]School of Science, University of Waikato, Hamilton, , [2]School of Psychology, University of Waikato and ALPSS, ,

Biography:
Renee Denby is a Master of Science (Research) student at the University of Waikato. Her masters project involves working with scent detection dogs to investigate their ability to detect invasive catfish.

Brown bullhead catfish (*Ameiurus nebulosus*) are an invasive freshwater fish widely recognised as a threat to New Zealand's aquatic ecosystems. Early detection of new incursions increases the chances of eradication or control. Current survey methods such as netting and electrofishing are expensive and time consuming, especially if fish are at low abundances. Domestic dogs (*Canis familiaris*) have demonstrated the ability to detect the presence of catfish in laboratory water samples at biomass concentrations as low as 4.6 kg/ha, while discriminating against non-target species. Operationally, this system would require users to send water samples to be assessed by scent-detection dogs, which would likely necessitate preservation of the samples. To determine whether scent-detection dogs can reliably detect catfish in preserved samples, three previously trained pet dogs were assessed using a repeated-measures reversal design. In the baseline phase, the dogs evaluated fresh, unpreserved samples. Performance in baseline phases was compared with performance in two preservation phases, in which samples were either refrigerated or frozen for 7-days. Following at least 155 trials for each dog, no difference in detection rates (correct indications on positive samples) between refrigerated (0.97), frozen (0.96) and baseline samples (0.94) were apparent. Correct rejection rates for frozen samples (0.93) were higher than those for refrigerated (0.82) and unpreserved samples (0.87). This indicates that chilling or freezing samples may be sufficient to preserve this target odour before assessment by the dogs. This method could allow regular surveys for invasive fish species to be conducted in a time- and cost-effective manner.

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Enhancing Ecological Citizen Science Projects - The Tripartite Model and The Great Kererū Count

Mr Sam Rammell[1], Dr. Rhian Salmon[1,2,3], Myfanwy Emeny[4], Dr. Stephen Hartley[1]
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Biography:
Sam Rammell is a Masters student in the Centre for Biodiversity and Restoration Ecology at Victoria University. His research focus is on techniques to analyse low-quality Citizen Science data. Of particular interest is the analysis of presence-only data commonly found in Citizen Science projects. His thesis will focus on analysis of the data collected through The Great Kereru Count over the last 8 years, a project which has gathered a significant amount of presence-only data. In his spare time he runs a garden centre and nursery which he started with his older brother.

Citizen Science has the potential to revolutionise the study of ecological systems whilst exposing citizens to nature and engaging them with science. However, Citizen Science projects involve multiple stakeholders, each with their own project objectives. Often, these objectives are discordant, leading to projects which fulfil some, but not all stakeholder objectives. In an effort to resolve this discordance we developed a tripartite model of Citizen Science that acknowledges the roles of three parties: Citizen, Scientist, and Enabler. By explicitly acknowledging these parties and the roles they play, we provide a framework within which each party can achieve their objectives without jeopardising those of others. Application of this model to three different case studies, each with their own conflicts and harmonies, illustrates its potential to increase the scope and utility of Citizen Science projects throughout ecological science. One of these studies, The Great Kererū Count, was designed before the formulation of our model. Discordance in project objectives between stakeholders led to the collection of presence-only data. Accurate analyses of these data require new techniques. I aim to derive a method to integrate data from The Great Kererū Count with more robust data, providing a novel method for inferring trends from low quality Citizen Science data.

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Evidence for mutualisms in New Zealand's brightly coloured truffle-like fungi

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Biography:
Amy Martin is a post-doc at Manaaki Whenua - Landcare research: interested in sensory and evolutionary ecology. Amy completed her PhD in the beginning of 2020, and began this post-doc in August last year.

New Zealand's truffle-like fungi are unlike any other: brightly coloured and emerging from the forest floor. However, we know very little about how these fungi are dispersed. The unusually bright colours of their sporocarps (such as blue, purple and red) suggest they may have evolved to exploit the sensory preferences of birds and reptiles - and yet observations of New Zealand birds and reptiles eating these fungi are rare. We propose that this is because the fruit-like truffle-like fungi we see today are remnants, or ghosts, of past mutualisms – targeted towards New Zealand fauna that are now rare or extinct. Here, I present some preliminary findings for our investigation of the dispersal ecology of these fungi using spatial-trait mapping to assess their biogeography and spectral analysis to examine adaptations to putative past nd present dispersers.

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Exploring social capital in community conservation initiatives

Rosie Gerolemou[1], Professor James Russell[1], Assoc. Professor Margaret Stanley[1]
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Biography:
Rosie Gerolemou is a PhD candidate at the University of Auckland. For her research, she is focusing on the outcomes of participating in community conservation, particularly the concept of social capital. Her research also looks at the effectiveness of community pest management for native bird species and the importance of urban forest fragments for nesting. At the general level, Rosie's main research interests are human-wildlife interactions and predator management.

To help manage pest mammals, community conservation groups carry out tasks, such as rodent trapping, at their properties and around local reserves. Besides the desired positive outcomes for native species, conservation groups may have significant social value. Community groups in general (e.g. sports, cultural) have proven benefits to local communities, such as social capital. Social capital encompasses the connections among individuals and the collective positive outcomes, like community resilience, these connections facilitate. However, social capital derived from community conservation has not been fully researched. We surveyed members of conservation groups in the Auckland region and compared their responses to the general Auckland public. We applied constructs from previous socio-environmental research that have been shown to be effective for measuring social capital. In comparison to people who are not members of a community group, members of all types of community groups had significantly higher mean social capital scores, with conservation group members consistently having the highest mean scores across the constructs we measured. There was a positive correlation between mean social capital score and age, education level, income level and number of community group memberships. Because of the social value that community conservation may offer people, linking the benefits of social capital to the ecological benefits for native species could increase participation in community conservation.

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Fatty acid biomarkers reveal landscape influences on linkages between aquatic and terrestrial food webs

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Biography:

Dr. Frank Burdon is an ecologist interested in biodiversity, food webs, ecosystem functioning, and the impacts of anthropogenic disturbances. Originally from Aotearoa New Zealand, Frank gained his doctorate at the University of Canterbury studying land use impacts on stream ecosystems. Frank has since completed postdoctoral research in Switzerland and Sweden. He has published in peer-reviewed journals on a variety of topics including stable isotopes, food webs, and human impacts on stream ecosystems.

Stream and riparian habitats are strongly connected via the emergence of aquatic insects, which form an important prey subsidy for a wide range of terrestrial consumers. Human perturbations that impact these habitats can disrupt aquatic-terrestrial food-web linkages, but gaps in our knowledge remain about the relative strength of different drivers contributing to altered connectivity. We investigated how stream productivity gradients, aquatic invertebrate dispersal traits, and recipient terrestrial predators influence cross-ecosystem connectivity in temperate streams across four European catchments with varying levels of human disturbance. We used fatty acid biomarkers to measure putative aquatic linkages to riparian spiders. Trophic connectivity, as measured by the proportion of eicosapentaenoic acid (EPA), was positively associated with abundances of 'aerial active' dispersing aquatic insects, although this influence was shared with changes in environmental context and spider beta diversity. Structural equation modelling helped further demonstrate the linkage between aquatic insect communities and trophic connectivity with riparian spiders after accounting for biological and environmental contingencies. Gradients in riparian vegetation structure alter aquatic-terrestrial food-web linkages by increasing subsidy quality whilst reducing primary production. Our results further suggest that inputs of stream insects are a source of essential fatty acids for adjacent terrestrial food webs. Consequently, ecosystem properties such as woody riparian buffers that enhance aquatic-terrestrial connectivity have the potential to affect a wide range of consumers in modified landscapes.

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Fighting fire with food: establishing crops, mahinga kai, rongoā and indigenous plants to reduce fire hazard in an increasingly fire-prone world

A/Prof Tim Curran[1], Azhar Alam[1], Lloyd Carpenter[1], Tanmayi Pagadala[1], Tom Maxwell[1], Norman Mason[2]
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Biography:
Tim is an associate professor of ecology at Lincoln University, New Zealand, where his research uses functional traits to understand how plants respond to disturbances. More recently, Tim, his colleagues and students have examined the comparative flammability of plant species to better understand the evolution of plant flammability, determine the traits that influence flammability, and identify low-flammability species for use in green firebreaks. The research group has also reviewed the literature on the use of green firebreaks to reduce fire spread, and has just begun a project to identify low-flammability crops and pastures.

Severe wildfires are affecting many parts of the world and we need to find ways to mitigate their impact. One option is green firebreaks, the establishment of low-flammability plants at strategic locations across the landscape to reduce fire spread. Many wildfires start in or affect agricultural landscapes. This represents both a threat and an opportunity: food-producing landscapes could be remodelled with green firebreaks comprised of low-flammability crops, species used for mahinga kai or rongoā, or indigenous plants. However, we must first identify which of these plant species are low in flammability. Here we describe a new project that aims to provide these data for farmers, landholders, iwi, and land management agencies working in landscapes where fire is an increasing threat. We discuss our preliminary findings from shoot flammability measurements of 316 species from around NZ, including some common crops from Canterbury. We found that some tree crops such as pears and apples had high flammability, while many vegetable crops had low flammability. There are many indigenous NZ plant species that are low in flammability, and are good candidates for use in green firebreaks. Some of these are also noted for their food and medicinal properties. Planting such species can help prepare agricultural landscapes for a more fire-prone future, while also providing food, enhancing biodiversity, restoring traditional plant and medicine species, and enriching the cultural values of our landscapes.

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Global change, invasive species, and thermal squeeze: ship rat (*Rattus rattus*) invasion of high-altitude Fuscospora forest over 40 years associated with warming winters

Miss Holly Harris[1]
[1]*University Of Canterbury, Christchurch, New Zealand*

Biography:
I am a student at the University of Canterbury who completed this research under the supervision of Dave Kelly for my BSc(Hons) Thesis in 2020.

Globally changing environments could alter the range, abundance and interactions of species, potentially favouring invasive species and harming endemics. Ship rats (*Rattus rattus*), a globally invasive predator, are typically absent from New Zealand's native Fuscospora cliffortioides forest above 1000 m, and this was true in Craigieburn Forest Park (inland Canterbury) between 1973 and 2004. We analyse community trapping records from 2007-2020 which document the invasion of ship rats after 2010 at Craigieburn. We tested two potential drivers of the increase in rat range and abundance (1) more frequent mountain beech high-seed years providing more food for rats; and (2) warming winter temperatures allowing rats to invade to areas that were previously too cold. We hypothesised a third possible cause: (3) increased trapping of stoats (Mustela erminea) resulted in top-down mesopredator release, but the study design meant this third hypothesis could not be tested. We also analysed the spatial distribution of ship rats and their key predator stoats at Craigieburn. Rats were more common at low altitudes near streams, and stoat catches increased the year after a large seedfall. Average winter temperature, but not seedfall, has increased significantly at Craigieburn since 1972. The best predictor of annual rat catch was higher average winter temperatures interacting with high seedfall. This suggests that warming temperatures have allowed ship rats to expand into areas where they were previously absent, an example of "thermal squeeze" which could increase predation on sensitive endemic birds currently restricted to higher-altitude sites where invasive predators were less common.

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Growth and survival of transplanted black beech (*Fuscospora solandri*) seedlings on Motuareronui (Adele) Island

Mr Simon Moore[1], Dr. Ron Moorhouse[2], Dr. Graeme Elliott[1], Helen Lindsay[2]
[1]*Department of Conservation, Nelson, New Zealand,* [2]*Project Janszoon, , New Zealand*

Biography:
I am a terrestrial ecologist with the Department of Conservation based in Nelson. I completed a MSc at Otago University on the seed ecology of indigenous Ericaceae species in the 1990s and have since worked for DOC. I am part of the Terrestrial Science Unit and I provide advice and support for biodiversity restoration, ecosystem management, RMA and policy direction.

Black beech (*Fuscospora solandri*) seedlings were planted in randomly located plots on Motuareronui (Adele) Island to assess whether survival was sufficient for 'applied nucleation' to be used as a restoration method to parts of the adjacent mainland. The long-term goal of this project is to re-establish black beech as a keystone canopy species on ridges and headlands that lost their primary forest cover as a result of fires by the middle of last century. One hundred and sixty-four of 199 beech seedlings (82%) planted in 2014 survived to 2019. Survival was higher in seedlings that had higher levels of ambient light and plots that had a low to moderate canopy density. There were no conclusive effects on growth rate from the environmental parameters tested.

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How do environmental conditions influence fruit crop characteristics in *Beilschmiedia tawa*?

Oscar Yukich Clendon[1], Dr. Jo Carpenter[2], Dr. Adrian Monks[2], Prof. Bruce Burns[1], Dr. Gretel Boswijk[1]
[1]*The University of Auckland, Auckland, New Zealand,* [2]*Manaaki Whenua Landcare Research, Dunedin, New Zealand*

Biography:
I am a student enrolled in the biosecurity and conservation masters programme at the University of Auckland, focusing on forest ecology. Other areas of interest include evolution, plant - animal interactions and ecological restoration.

Fleshy-fruited plants are important components of many ecosystems, influencing many other taxa which consume the fruit and disperse their seeds. Changes in environmental conditions may affect both the size and number of fruit produced by plant populations, which in turn causes fluctuations in resources available to frugivores. Tawa (*Beilschmiedia tawa*) is an endemic fleshy-fruited canopy species within northern indigenous forests in New Zealand, and tawa fruits are an important dietary component of the endemic keystone avian frugivore kererū. Within Tuawhenua forests in Te Urewera, where tawa is dominant, Tūhoe elders have noted a decline in the size and abundance of tawa fruit, which may be affecting resource availability for kererū. Have changes in environmental conditions (e.g. drier forests) affected tawa fruit crops?

Here, we aim to determine abiotic correlates of fruit crop characteristics in tawa, and whether changes in environmental conditions could explain the observations in Tuawhenua forests. During the 2020/21 summer we sampled fruit characteristics and crop size for 126 trees from 13 sites, selected to fully cover the environmental variation within tawa's distribution. For each site, climate and soil variables were investigated as drivers of fruit variability. A long term seed fall dataset for several of these sites was also used to assess the periodicity of seed production and determine the climatic cues for any mast seeding in tawa. Preliminary results will be presented from these analyses.

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Hunting the underlying mechanism for masting: evidence from long term experiments

Prof Dave Kelly[1], Dr S Samarth[1], Prof Paula Jameson[1], Prof Matthew Turnbull[1], Prof Richard Macknight[2]
[1]*University of Canterbury, Christchurch, NZ,* [2]*University of Otago, Dunedin, NZ*

Biography:
Dave has been at the University of Canterbury since 1985 and studied mast seeding in snow tussocks since 1988. He has also worked on bird pollination and bird fruit dispersal in native plants.

Mast seeding in New Zealand snow tussocks (*Chionochloa* spp), southern beech (*Nothofagus* spp) and other species is well predicted by the temperature difference (or ΔT) model. While this is a very convenient predictor for DOC, it can be a good predictor without being the actual underlying mechanism. Indeed, modelling by Monks et al 2016 showed that ΔT might work only because it is a proxy for absolute temperature plus resources.

Here we try to find ways to separate these two very similar hypotheses, using three lines of evidence. The most common data are long observational time series, but these have difficulty separating proxies from underlying mechanisms. Gene expression data are more helpful, but the floral integrator genes (which correlate well with observed flowering) could be driven by either of the different underlying mechanisms. Hence, molecular data at a more detailed level (inputs to the floral integrator gene) are required. Transplant data are potentially most informative, as the two mechanisms lead to very divergent predictions about the flowering response of plants moved to a new climate after they have been there more than one year. Here we track flowering data for multiple sets of plants up to seven years after transplanting them to different altitudes in Canterbury. We also re-examine two historical accounts of previous *Chionochloa* transplantation experiments in light of newer hypotheses.

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Identifying ecological drivers of sexual dimorphism in kea (*Nestor notabilis*) using stable isotopes

Ms Lydia McLean[1,4], Associate Professor Travis Horton[2], Professor Bruce Robertson[3], Professor Ximena Nelson[1], Ms Fiona Robertson[3]

[1]School of Biological Sciences, University of Canterbury, Christchurch, New Zealand, [2]School of Earth and Environment, University of Canterbury, Christchurch, New Zealand, [3]Department of Zoology, University of Otago, Dunedin, New Zealand, [4]Kea Conservation Trust, , New Zealand

Biography:
Lydia is a PhD student at the University of Canterbury and a field researcher for the Kea Conservation Trust. Her research aims to better understand various aspects of kea behaviour and foraging ecology for conservation purposes.

Sexual dimorphism, arising through sexual selection, ecological drivers or a combination of both, is common among animals. Kea (*Nestor notabilis*) are an omnivorous generalist that exhibit moderate sexual size dimorphism in linear body measurements (~5%) and a pronounced dimorphism in bill size (12-14%). We conducted stable isotope analysis of kea feathers and blood sampled from throughout their range and employed Bayesian mixing models to correlate diet with bill size to determine whether bill size dimorphism is linked to diet partitioning. As bill size increased, so too did the proportion of invertebrate food sources in the diet, along with a reduction in the proportion of plant food sources. Adult male kea consume a higher proportion of invertebrates than adult females, while sexually immature kea exhibit no diet segregation, despite possessing the same bill size dimorphism as adults. We propose that kea bill dimorphism is an ecologically selected trait that enhances male kea's ability to forage at a higher trophic level in order to provision females and offspring during nesting.

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Impacts of soil origin and fire on mycorrhizal fungi associated with hawkweeds and tall tussock

Miss Kendall Morman[1], Associate Professor Hannah. L. Buckley[1], Associate Professor Colleen. M. Higgins[1], Dr. Nicola. J. Day[2]

[1]School of Science, Auckland University of Technology, Auckland, New Zealand, [2]School of Biological Sciences, Victoria University of Wellington, Kelburn, New Zealand

Biography:

Kendall's research looks at interactions between fire, fungi and invasive hawkweeds in New Zealand's tussock grasslands. She is focused on understanding invasive plant soil interactions using molecular tools such as DNA sequencing and through a controlled glasshouse study. Her research aims to improve our understanding of the state of New Zealand's native grasslands and how they may change in response to increased fire activity as a result of climate change. Kendall is based at the Auckland University of Technology

New Zealand's tussock grasslands have faced ongoing plant invasions of the hawkweeds *Pilosella officinarum* and *Hieracium lepidulum*. Both species readily form mutualistic associations with arbuscular mycorrhizal fungi, which form mutualisms with plant roots and are known to alter the success of invasive plants. Fire activity is also predicted to increase in many areas where hawkweeds are abundant or projected to spread. In New Zealand's tussock grasslands, there is little information on the arbuscular mycorrhizal fungal communities and their interactions with native and invasive plants. The aim of this study is to assess how arbuscular mycorrhizal communities are structured and whether they differ by soil origin (plant species) or simulated fire. We used high throughput sequencing (Illumina MiSeq) to identify arbuscular mycorrhizal fungal taxa in soil under different plants in the field: *P. officinarum*, *H. lepidulum*, *Chionochloa macra*. Our results show that soil origin was the major driver of arbuscular mycorrhizal fungal community structure in terms of composition and richness. Simulated fire had differential impacts on arbuscular mycorrhizal fungal richness and, surprisingly, no impact on community composition. These results improve our understanding of arbuscular mycorrhizal fungi in tussock grasslands and support other findings on the importance of soil origin for determining structure of arbuscular mycorrhizal fungal communities.

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Increased pressure on urban bird communities: escaped parrots

Dr Margaret Stanley[1], Dr Ellery McNaughton[1], Prof. Rachel Fewster[2], Dr Joise Galbraith[3]
[1]Te Kura Mātauranga Koiora/School of Biological Sciences, Waipapa Taumata Rau/University of Auckland, Tāmaki Makaurau/Auckland, Aotearoa/New Zealand, [2]Te Kura Tatauranga/Department of Statistics, Waipapa Taumata Rau/University of Auckland, Tāmaki Makaurau/Auckland , Aotearoa/New Zealand, [3]Auckland War Memorial Museum, Tāmaki Makaurau/Auckland , Aotearoa/New Zealand

Biography:
Margaret Stanley is an Associate Professor at the University of Auckland. Her research primarily focuses on how to mitigate the impacts of invasive species and urbanisation on biodiversity in Aotearoa. She works with a variety of community partners and stakeholders to inform decision-making through her research. Margaret enjoys science communication and loves working with her awesome postgrads and wonderful collaborators.

Native birds experience multiple stressors in urban environments, particularly habitat loss and predation by rats and cats. Although less obvious, invasive birds also pose a threat to native species through disease transmission and competition for food and nest sites. Given the expense and difficulty of eradicating or managing invasive birds, preventing their establishment is the most effective way of protecting native birds from this type of threat. The pet trade plays an important role in facilitating the spread of invasive species, with pet birds either being deliberately released or accidentally escaping. Even if only a few individuals escape during any one incident, the cumulative effect of these escapes over time increases the likelihood of establishment. We analysed online listings of lost birds from two popular websites in New Zealand to evaluate the invasion risk from pet birds. A total of 1,205 birds were listed as lost over ~3.5 years, a rate of loss of 331 birds per year. Parrots made up 92% of all lost birds, with human population size and median income influencing rate of loss. While single individuals accounted for 77% (n = 931) of lost birds, the remainder were lost as a part of a group (n = 96 groups, group size range 2 – 20). Simulations of propagule pressure show that the proportion of time with at least one male-female pair at large somewhere in Auckland is very high for species such as ring-necked parakeets (*Psittacula krameria*) and Alexandrine parakeets (*Psittacula eupatria*).

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Individual differences in the food-storing behaviour of the North Island robin (*Petroica longipes*)

Tas Vamos[1], Dr. Rachael Shaw[1]
[1]*Victoria University of Wellington, , New Zealand*

Biography:
Tas Vamos is a PhD candidate at Victoria University of Wellington investigating the relationship between spatial memory, caching behaviour, and reproductive success in the North Island robin

A number of bird species engage in caching behaviour - the storage of excess food for later consumption. Although well-documented at the species level, little is known about how individuals within the same species vary in their caching behaviour, and whether different caching strategies may co-occur. The North Island robin (*Petroica longipes*), a food-storing songbird, is uniquely suited to an in-depth study of caching behaviour, thanks to its small territory size and tolerance of close human observation. In a field study, we presented free-living, wild robins with food items and measured spatiotemporal aspects of the caches they subsequently made. Our results suggest that individual birds can favour different caching strategies, with caching behaviour occurring on a spectrum between 'fast-caching' and 'slow-caching': fast-caching birds rapidly stored many food items in just a few nearby sites, while slow-caching birds spent more time scattering items across a greater number of distant caches. Differences in caching behaviour may be linked to variation in the spatial memory abilities that individual robins employ to remember and retrieve their caches. This potential relationship is the subject of ongoing field experiments examining what cues the robins prefer to use when relocating caches, and their accuracy at doing so. This study represents one of the most detailed quantifications of avian caching behaviour in the wild, and adds to a growing body of literature investigating the link between wild behaviours and the spatial cognitive abilities that underpin them.

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Influences of Non-native Brown Tree Frog, *Litoria ewingii*, on New Zealand Pond Systems.

Brittany Earl[1], Prof Angus McIntosh[1], Dr Helen Warburton[1]
[1]*Te Whare Wānanga o Waitaha, University of Canterbury,*

Biography:
Brittany is a current master's student at the University of Canterbury, with an interest in invasive species and New Zealand conservation. Her interest in these things and frogs have led to her studying Litoria ewingii, the brown tree frog, initially just for a summer scholarship. The thrill of conducting her own experiment meant that she quickly enrolled for a fully fledged master's to further investigate the presence of the tadpoles.

Australian brown tree frog, *Litoria ewingii*, introduction in 1875 has resulted in widespread acclimatised populations across New Zealand. In a country lacking native anurans with strongly aquatic tadpoles, pond ecosystem functions may be vulnerable to disruption by *L. ewingii*, especially if climate-driven increases in pond drying were to exacerbate any influences. We surveyed ponds ranging from temporary to permanent in the Cass Basin, Canterbury, to assess *L. ewingii* breeding frequency and tadpole densities. They were opportunistic colonizers, being found in high densities across the pond-permanence gradient. To determine the functional influence of *L. ewingii* tadpoles, we carried out a mesocosm experiment with tadpole presence crossed with predatory invertebrate presence. Tadpoles significantly grazed down algae and macrophytes, and reduced abundance of several invertebrates (Culicidae and Chironomidae), but predators did not significantly affect tadpoles. To further evaluate tadpole-effects, we conducted a second mesocosm experiment with four tadpole densities crossed with shade to reduce the temperature fluctuations typical of drying ponds. Phytoplankton concentration significantly increased with tadpole density in unshaded compared to shaded mesocosms, possibly because of nutrient release from tadpole excretion boosting production in high light situations. High-density tadpoles also decreased dissolved oxygen concentrations irrespective of shade; potentially an indirect effect of grazing reducing photosynthesis. Overall, tadpoles are likely having large influences on ecosystem processes, including nutrient cycling and productivity in small ponds. Therefore, frog impact in New Zealand should be more carefully considered, especially in addition to climate warming influences on pond ecosystems that may push them towards more eutrophic states.

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Introducing Wild Counts, a flexible method for high-frequency long-term ecological monitoring

Jon Sullivan[1]
[1]*Lincoln University, Lincoln, New Zealand*

Biography:
Jon Sullivan is an ecologist at Lincoln University. He is increasingly focused on using technology-facilitated, human-powered local sensing, by both citizens and experts, to document how nature is changing 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 https://www.wildcounts.org

In our lifetimes the natural world is moving into uncharted territory. Long-term ecological monitoring can chart the many changes that are happening, and is the essential first step towards understanding, anticipating, and managing these changes. Long-term monitoring is easy to do for many taxa, but it is difficult to fund because it takes so much time. Automated monitoring technologies are on the horizon, but they're only appropriate for some taxa. My approach is to monitor as much as I can as a secondary activity while I do other things (e.g., biking to work). I use a method I call Wild Counts, entering observations into a smartphone as geotagged, date-time-stamped text shorthand, or audio notes. Over 18 years, I've refined the method and made over a million observations, all of pre-determined species, mostly along a set of regularly repeated transects. It's now among NZ's biggest biodiversity datasets, which underscores how little monitoring is happening in NZ. It's taken longer than I expected to share my data, as most of the tools and standards for wrangling and formatting biodiversity survey data are still in development. Also, NZ has no infrastructure to share such data online. I'm now in the process of uploading my methods, and data, to a new website, www.wildcounts.org. I encourage all ecologists to pick one (or many) species to monitor long-term where you live and work. It's simple to do, it's satisfying, and it's important.

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Invasive birds: a new pest issue for mainland islands?

Dr Kathryn Ross[1], Nicolas Sandoval[2], Karen Denyer[3]
[1]Toi Ohomai Institute of Technology, Rotorua, New Zealand, [2]Wintec, Hamilton, New Zealand, [3]National Wetland Trust, Ōhaupō, New Zealand

Biography:
Dr Kathryn Ross is an ecologist with broad interests in environmental monitoring, animal behaviour, and ornithology. Before moving to NZ in 2017, she worked as a research ecologist on the monitoring team of the British Trust for Ornithology. Her PhD developed an individual-based model predicting the effects of sea-level rise on protected shorebirds.

Nicolas Sandoval (MEnvMgmt) has based his career on ecological and conservation research, focusing on ecosystem restoration, pest management and environmental monitoring. In 2016, he worked with Landcare Research, studying predator movements in urban ecosystems. Presently, he is a lead researcher in managing invasive birds at Rotopiko Sanctuary.

As the Predator-free 2050 initiative continues to target introduced mammalian predators across New Zealand, irruptions of secondary pests may produce unforeseen ecological consequences. One such example has been documented at Rotopiko, a 10ha fenced mainland island, 20km south of Hamilton. The site, managed by the National Wetland Trust (NWT), contains a unique peat lake ecosystem supporting endemic plants and birds. To protect this taonga, NWT initiated a community-driven programme to eliminate mammalian pests in 2014. Since then, the number of exotic roosting birds – mainly Common Starling (*Sturnus vulgaris*) and House Sparrow (*Passer domesticus*) – has increased dramatically, and NWT has documented severe ecological changes resulting from the massive amount of bird faeces, including an increase of nitrogen and pathogens in the waterbodies.

NWT, Wintec and Toi Ohomai have formed a collaborative research group to quantify the environmental effects of the roosting birds and trial bird deterrents, monitoring methods, and ecological mitigation measures, with the aim of avoiding irreversible ecological damage. Our initial focus was to develop robust methods for monitoring the large roosting population, including the use of faecal collection plates, acoustic recordings and field cameras; to document ecological effects through water quality testing and invertebrate surveys; and to assess effectiveness of control options, such as hazing with a non-toxic deterrent.

While the full extent of the non-native bird problem is yet to be determined nationally, our results have management implications for other predator-free enclosures.

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Locating whitebait (*Galaxias argenteus*) eggs via canine scent-detection

Miss Ashlee Cooper[1], Dr Clare Browne[1], Dr Tim Edwards[1], Dr Nicholas Ling[1], Dr Grant Tempero[1]
[1]*The University Of Waikato, Hamilton, New Zealand*

Biography:
Ashlee Cooper is a Master of Science student at the University of Waikato. With a keen passion for conservation and a love for dogs, her research focuses around using scent dogs to find whitebait (Galaxias argenteus) eggs, with the goal of using dogs in a field setting to find and protect whitebait nests. Ultimately, she would like to further her career into conservation and ecology, working to help protect and preserve New Zealand's native species.

The New Zealand whitebait fishery consists of five species of Galaxiiidae fish and constitutes a culturally important commercial and recreational resource for New Zealand. Adult fish spawn on riparian vegetation near river mouths during spring tides, the eggs then develop aerially until the following spring tide when they hatch, and the larvae disperse into coastal estuaries. Despite conservation efforts by the Department of Conservation and regional councils, there has been a significant decline in whitebait over the past several decades. Anthropogenic activities such as flood management, vegetation removal and reduced water quality have led to widespread loss of suitable spawning habitat. Identification of spawning habitat is a key aspect to conserving whitebait species. However, visual surveys for spawning sites are time consuming and spawning areas difficult to predict, as most species do not return to the same spawning site each year. Scent-detection dogs may provide an efficient and effective way of locating whitebait nests, allowing increased protection of spawning areas against disturbance. Four dogs were taught to reliably detect and discriminate giant kōkopu (*Galaxias argenteus*) eggs from garden snail (*Cantareus aspersus*) eggs, grass, and blank (no scent) samples within a laboratory-based line-up. At present, dogs (n=1) have begun working on scent line-ups outdoors and have successfully demonstrated that they can reliably detect giant kōkopu eggs (>90% hit rate & >90% correct rejection rate). Ultimately, it is hoped that the dogs will successfully detect whitebait spawning locations in the field, providing a new conservation tool for whitebait in New Zealand.

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Mapping knowledge of New Zealand's ecosystems and knowledge produced by New Zealand's ecologists

George Perry[1]
[1]*University of Auckland, ,*

Biography:
I am a terrestrial ecologist with broad interests in how human activities shape forest ecosystems, past present and future. My research uses a blend of field-based and quantitative approaches.

Science is an increasingly connected and global endeavour. However, institutional and funding pressures suggest that studies addressing local questions may become less common. Here, I use the Scopus database to evaluate trends in scientific publishing 1980-2020 in the broad field of biological sciences and a more focused subset of research published in ecological journals. I compared research produced about New Zealand's environments and that produced by authors affiliated with a New Zealand institution. In some ways, these bodies of research reflect widespread trends: increasing 'productivity', larger author teams, increasing international connectivity. However, published research about New Zealand's environments has slowed relative to research published by NZ scholars. There have been shifts through time in the subjects considered; there has been a strong shift to a focus on conservation and invasion biology in NZ-focused ecological publications. The 'science of science' offers a way to assess changes in how scientific knowledge is produced and ask what the implications of these changes might be.

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Modelling movement corridors for endemic and invasive species in the Greater Wellington Region

.Henry Morse[1], Stephanie Tomscha, Stephen Hartley
[1]*Victoria University Of Wellington, ,*

Biography:
Henry is an MSc student in restoration ecology at Victoria University of Wellington. In the new year he will be continuing on at VUW to complete a PhD.

Populations of endemic species have regenerated in protected areas on the mainland of Aotearoa New Zealand. As populations have recovered, they have begun to travel outside of these protected areas in directions and extent that are not well defined. However, reducing the spread of invasive mamalian species while simultaneously facilitating expansion of endemic species remains an important challenge in Aotearoa. The geospatial model, Linkage Mapper, was used to identify potential corridors and corridor overlap for movement between protected areas in the Greater Wellington Region, for multiple species with varied traits . Movement corridors were extensive throughout the study region for a highly mobile native bird (e.g. kākā) and an invasive mammal (common brushtail possum), while they were limited to forested areas for the endemic minimally dispersive bird (e.g. rifleman), and endemic gecko. The largest amount of corridor overlap was between the highly dispersive bird and the invasive predator, the second highest was between the two less dispersive endemic species. The landscape was shown to be permeable for species able to travel over many different landuse types while the species limited to native vegetation were not able to traverse the landscape. Habitat creation and predator control to facilitate dispersal should focus on improvements for poorly dispersing species. This study may provide insight on worthwhile locations to restore to connect existing protected areas for endemic species, while illuminating where to trap on the landscape scale for invasive species.

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Monitoring the success of community-initiated kiwi translocation.

Mr Carl Dowd[1]
[1]*PNLC, Pataua north, New Zealand*

Biography:
Carl Dowd is a student at university of Auckland studying ecology and environmental science. growing up in a city wasn't his idea of fun but when his parents brought a place in northland he got a bug for the environment and never looked back. he's now a kiwi practitoner who assists groups with translocation work, monitoring and pest control operations. a passionate conservationist who believes in effective pest control and bringing back biodiversity.

Kiwi are often the first species that community conservation groups focus on as kiwi are seen to be an important indicator species and healthy populations reflect good pest control. Several Northland groups have translocated kiwi to reestablish or supplement populations. However once translocated there is little investigation of the scale of translocation success with the main monitoring method being kiwi call counts. Such counts only provide relative estimates of abundance and provides no information on the structure of the population. Pataua North Landcare (PNLC) are a community lead group which has had full pest control over 800+ha since 2009 and from 2017 returned the call of the kiwi back into the area.
I am assisting the group to conduct community lead research on the immediate and long-term success of the kiwi translocations to Pataua. We are wanting to determine the true success of the translocations by monitoring survivorship, recruitment and investigate how inbred or genetically diverse the population is. Released birds were all microchipped and chicks from nests of known parentage have been microchipped. All of which have had feather genetic samples taken. PNLC currently have transmitters on several birds which gives us the best information available. We are mindful of the Recovery Group's polices and guidelines including that "it is vital that the effectiveness of management is measured and that these results inform and direct future recovery actions." We also align with the Regional CMS which seeks to "Strengthen relationships, monitor the work, effectively demonstrate results and celebrating successes."

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National-scale mapping of potential floral resources for honey bees in Aotearoa

Dr James Mccarthy[1], Sarah Richardson[1], Gary Houliston[1], Tom Etherington[1], Anne-Gaelle Ausseil[2]
[1]Manaaki Whenua – Landcare Research, Lincoln, [2]Manaaki Whenua – Landcare Research, Wellington,

Biography:
James is a plant 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 in 2017.

Honey bees require nectar and pollen from flowers for energy and growth, with excess nectar stored as honey. At the landscape-level, floral resource supply is affected by the diversity and abundance of plant species and their phenology. Furthermore, bees can only forage when temperatures are > ~10 °C. With beekeeping activities growing exponentially in Aotearoa, largely driven by the high-value mānuka honey industry, many areas are now facing resource pressure due to over-crowding of hives. To help understand and manage floral resources for honey bees, we developed a spatial model to map nectar and pollen supply from maps of landcover and environment, vegetation plot data, and species level phenology and pollination mode scores. Maps have been generated at 100 m resolution and provide a measure of resource availability available to a hive placed in that area. Since we use data from > 7,000 vegetation plots, we also provide a quantitative assessment of how species and families contribute to national floral resource supply. We also assess how a range of land tenure types (Māori land, public conservation land, indigenous vegetation, farms) contribute to national production. This quantitative model framework considers the flight patterns of bees and is the first national effort to quantify and map floral resource production across Aotearoa. It can be used to inform the placement and seasonal movement of honey bee hives, as well as stocking densities. This will aid in honey production and reducing the impact on wild pollinators, and help control the health of managed colonies.

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Northern grass skink (*Oligosoma polychroma*) utilisation of Artificial Cover Objects (ACO) over a one-year period, and the implications for monitoring and management.

Mr Tony Payne[1]
[1]*RMA Ecology Limited, Nelson, New Zealand*

Biography:
Tony is a Senior Ecologist with more than ten years' experience as a consultant and has worked on projects throughout New Zealand, Australia and Saudi Arabia. He specialises in terrestrial and freshwater ecology. After specialising his studies in restoration ecology, Tony has worked on a wide range of projects with the aim of guiding sustainable development by enhancing environmental values and providing sound ecological advice to a wide range of stakeholders.

Over the years Tony has worked alongside various ecology specialists, engineers, designers, planners, and contractors providing practical ecological solutions to achieve sustainable outcomes.

The Department of Conservation (DOC) and Councils throughout New Zealand are seeking to improve the way native lizard protection is implemented where species salvage/rescue is necessary and is approved under the Wildlife Act 1953 (Wildlife Act) and Resource Management Act 1991 (RMA). The key to this is understanding the importance of regulatory requirements around survey, salvage and relocation.
We investigated the utilisation of Artificial Cover Objects (ACO) by northern grass skink (*Oligosoma polychroma*) in grassland habitat in Nelson, New Zealand.

We recorded 78 sightings of skinks during 240 mid-morning checks of ACOs at monthly intervals over one year. Skink sightings were highest between 12-18°C, consistent with Hoare et al., 2019, and lowest at temperatures above 18°C during dry, low-humidity periods over summer. Ambient temperature and humidity were the strongest predictors of skink utilisation of ACOs.

Our research shows utilisation of ACOs by northern grass skink is most effective during cool to warm, high humidity climatic conditions between March and November for the Nelson region. This result is not consistent with current guidance documents for using ACOs relied upon by DOC and Councils, and required for use by consultant herpetologists, which limit use to between 1 October to 30 April, referred to as the 'active season'. This 'active season' period is currently included as a condition of a Wildlife Act Authority or a resource consent condition, thereby restricting the period in which survey, salvage and relocation of grassland skink can occur. This potentially has significant implications for the ability of lizard salvage operations to fulfil DOCs requirement to provide for 'protective benefit' under the Wildlife Act.

Our research indicates that a revision to current guidance documents is needed, including refinements to how 'active season' is applied to better recognise seasonal species activity and improve outcomes from survey, salvage and relocation.

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Nowhere to hide: nationally prioritising management actions for invasive species

Mr. Zachary Carter[1], Dr. Jeffrey Hanson[2], Prof George Perry[1], Prof James Russell[1]
[1]*University of Auckland, Auckland, New Zealand,* [2]*Carleton University, Ottawa, Canada*

Biography:
Zachary T. Carter is a PhD candidate at the University of Auckland. His research is focused on prioritising management actions for threatened and vulnerable island communities to maximise the likelihood of achieving desired conservation outcomes. In particular, he works to empower practitioners by giving them tools and processes to make effective management decisions on islands.

The Predator Free 2050 (PF 2050) programme seeks to eradicate the seven most biologically and economically harmful invasive vertebrates from New Zealand by 2050. To facilitate in achieving this goal, we developed a national management plan centred on strategically implementing a suite of management tools (i.e., aerially-broadcast poisons, ground-based poisons, kill-traps, and exclusion fences) throughout New Zealand. This plan envisions what a contiguous management network could look like for New Zealand within the next 10-15 years, before the availability of future transformative technologies. To generate this plan, we used boosted regression trees, a machine learning technique, to develop models that determined the suitability of implementing different management tools within the landscape. We then prioritised the application of those tools throughout New Zealand in a series of different management scenarios that individually maximised implementation probability, humaneness, and cost-effectiveness to select the single-best tool for an area. Our models demonstrated there was a complex interplay of factors associated with determining where management tools can and should be implemented; our management scenarios provide different courses of action that can be used to create a contiguous management network. However, some locations were identified to be unsuitable for existing management tools. This may indicate the need for future transformative technologies or that some locations may have not been past conservation priorities. Overall, this plan can assist decision makers in determining whether specified management actions are appropriate for a given area and in reducing uncertainty around whether a proposed management plan will succeed once enacted.

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Phytoplankton composition and water quality in ponds

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[1]*Massey University, Auckland/Albany, New Zealand,* [2]*Cawthron Institute, Nelson, New Zealand*

Biography:
Abigail Kuranchie is a PhD student with the School of Natural and Computational Sciences, Massey University. Her research interest is the conservation of freshwater ecosystems, especially marginal freshwater systems such as ponds. She uses both field and laboratory assessments to understand her study systems.

Phytoplankton are one of the most widely distributed taxa globally, and they have been widely used as an indicator of aquatic ecosystem quality. Ponds are a feature of anthropogenic landscapes and are an essential part of freshwater ecosystems. In this study, we assessed the phytoplankton community composition in ponds and explored how composition varied seasonally and related to physicochemical water quality variables. Phytoplankton was sampled from 12 ponds in the Auckland region in two different seasons (summer and winter) in 2017. Overall, 126 genera of phytoplankton (γ diversity) were recorded, and the number of taxa (α diversity) for a pond varied from 44 and 76. Phytoplankton abundance, richness and number of taxa were significantly higher in summer than winter. Chlorophyta was the dominant phylum in both seasons. Bacillariophyceae was the dominant class and showed a significant difference in abundance between the seasons. Water quality explained 13.2% and 23.3% of the variations in the phytoplankton community. Temperature and conductivity played a significant role in structuring the phytoplankton communities. Conductivity levels had a negative impact, while temperature positively influenced phytoplankton diversity. Although the ponds in the Auckland region were low to moderately organically polluted based on the abundant genera in summer and winter, they contained healthy phytoplankton communities.

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Plant community soil legacies affect future invasions of pine and other exotic species

Ms Joanna Green[1], Dr. Kate Orwin[2], Dr. Pieter Pelser[1], Dr. Simeon Smaill[3], Dr. Warwick J. Allen[1,5], Dr. Lauren P. Waller[4,5], Dr. Ian A. Dickie[1,5]

[1]University of Canterbury, Christchurch, New Zealand, [2]Manaaki Whenua–Landcare Research, Lincoln, New Zealand, [3]Scion, Christchurch, New Zealand, [4]Lincoln University, Lincoln, New Zealand, [5]Bio-protection Research Centre, Lincoln, New Zealand

Biography:

Joanna Green is a PhD student in the Ecosystem Mycology Lab at the University of Canterbury. Her work is on wilding pine invasions in New Zealand; understanding the linkage between plant communities, associated fungi, and plant invasion.

Also, Joanna enjoys science communication and education. She has been involved in numerous outreach and community events throughout her career, including creating and running different workshops ranging from undergraduate microbiology lab skills to science resources for primary school teachers, as well as being lab demonstrator and tutor.

Joanna is a microbiologist, who is happy to say she appreciates the little things in life.

Plants interact in many ways, often indirectly via the soil, where impacts from current and past vegetation leave a persistent influence; a legacy effect. These legacies have implications for restoration post-invasion. In this study, we investigated soil legacy effects and invasion of wilding pines in New Zealand.

For our research, we used 2 greenhouse experiments. To observe plant community impacts on legacy, we created 2-year legacies from various plant communities, then using that soil grew three invasive species from different functional groups. To test how pine invasion modifies the legacy and future plant community, we collected soil along a pine invasion gradient, and grew 8 species, exotic and native grasses and shrubs, either alone or together in each soil.

Soil legacies of pine and exotic-dominated communities generally had positive effects on seedling growth. Pine seedlings grew 3x larger in exotic-dominated and pine legacy soils than in soils with low exotic dominance and no pine legacy. Pine legacy soils boosted growth of all other plants, with the strongest effects on exotic grasses, followed by exotic shrubs and native grasses, and then native shrubs.

The disproportionate benefit of pine legacy soils for exotic plants was more evident when plants were grown together, compared to single species pots, potentially because of resilience to shared pathogens or benefits from shared mutualists. To address these potential mechanisms, we are currently investigating the fungal communities on roots of pine seedlings grown in different legacy soils, and roots of grasses within and near pine invasion fronts.

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Plastic puzzle! Are seabirds ingesting specific colours of plastic?

Ariel-Micaiah Heswall[1], Dr Anne Gaskett, Dr Kristal Cain, Dr. Megan Friesen
[1]*The University of Auckland, Auckland, New Zealand*

Biography:
I was born and raised in the small country of Brunei Darussalam in South East Asia. I grew up with a fascination for wildlife surrounded by the diverse tropical rainforest. I moved to NZ to complete my Bachelor's degree followed by my Honours in seabird sensory ecology and focusing on bycatch. I have now completed the first year of my PhD studying seabird sensory and visual ecology in relation to light attraction and plastic ingestion.

Seabirds are one of the most speciose groups of animals, diverse in their morphology, behaviour and sensory features. Unfortunately, seabirds are also one of the most threatened animal groups with plastic being a huge risk for them. Seabirds can become entangled among it or consume it which leads to punctures, blockages and mortality. There is a lot of research conducted on the effects of plastics on seabirds. However, little research delves into the specific colours which seabirds are ingesting. Considering NZ is a seabird hotspot, it is important to fill this knowledge gap in plastic ingestion in seabirds. Our aim is to explore if seabirds are ingesting specific colours more than others. We carried out a literature review using online databases and peer-reviewed journals to analyse the colours of plastics more frequently ingested by seabirds. We found that white plastics were the most commonly ingested colour while red plastics was least commonly ingested by seabirds. Also, using online databases we also explored the types of colours found along NZ's coastlines. The colours most frequently found in NZ's coastlines are white and red. The colours least often found in NZ's coastline are grey and multi-colored. Seabirds may be ingesting white coloured plastics more frequently because it is more abundant. However, potentially their sensory ecology may also play a role but more research is needed. This gives rise to future work, researching whether specific colours are visually attractive to seabirds, linking the ingestion of certain plastic colours with their visual ecology.

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Predicting the invasion of *Harmonia axyridis* in New Zealand using citizen science data

Dr Heshani Edirisinghe[1]
[1]*Massey University, Albany, New Zealand*

Biography:
I am a behavioural ecologist and I recently completed my PhD on the biology and behaviour of New Zealand ladybirds: Insights into the establishment success of introduced species. I have always being passionate about insects and my key research interests are in predator-prey interactions and learning and cognitive abilities.

Ladybirds are widely introduced as biocontrol agents against agricultural pests. In New Zealand, ladybirds have been introduced for the biological control of scales, mealybugs, mites and aphids from the early 1890s. Further, recent invasion of *Harmonia axyridis* (harlequin ladybird) has raised concerns regarding the impact of invasive species on native biodiversity. This research is essential and timely as, a) we have limited information on the spatial distribution of New Zealand ladybirds, b) recent field studies show that native ladybirds have restricted distributions in the Auckland region and c) the invasive *H. axyridis* is likely to affect the distribution of native and other introduced species in New Zealand. I will use observation records from the ladybird collections held at New Zealand museums and citizen science records to develop spatial distribution models of New Zealand ladybirds. My data will be used to predict current and future distributions of invasive *H. axyridis* in New Zealand, and to identify potential refuge locations for ladybirds that have restricted distributions. Findings from this research will provide foundation for programmes aiming to mitigate the invasive *H. axyridis* and provide valuable insights for future research on the impacts of global climate change on species distributions in New Zealand.

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Prevalence of skin lesions in a population of bottlenose dolphins in New Zealand

Jessica Patiño Pérez[1], Dr. Heshani Edirisinghe[1], Prof. Dianne H. Brunton[1]
[1]*Massey University, Auckland, NZ*

Biography:
I am Jessica Patiño Pérez and am a PhD at Massey University, where I study the ecology and conservation of cetaceans in New Zealand. I am originally from Colombia and came to New Zealand following my dreams of studying these fantastic animals. Currently, I am part of the Ecology, Behaviour and Conservation Group at my University, where I work under the supervision of Prof. Dianne H. Brunton.

With escalating anthropogenic pressures on marine environments around the world, there has been a renewed interest in the health of dolphins. The health of both individuals and populations of these top marine predators are strong indicators of the health of the ecosystems they inhabit. The diseases are associated with changes in the ecology of the host and/or the pathogens and are often directly attributable to ecosystem modification due to anthropogenic activities. Skin diseases are observable and trackable traits, which correlate with the animal's health. In dolphins, skin diseases can have severe effects on their populations: increasing stranding events, reducing population viability, and transmitting diseases to humans. Therefore, describing skin diseases and quantifying their prevalence is crucial for managing dolphin populations. This research focused on i) describing skin lesions and their prevalence in bottlenose dolphins, and ii) proposing a standardised protocol for skin lesion classification for dolphins in New Zealand. A total of 154 bottlenose dolphins were photo-identified at Great Barrier Island during 2016-2019. A protocol with sixteen definitions of skin lesions was created, and nine of these skin lesions were observed in adult dolphins. 90% of the dolphins showed at least one type of skin lesion, and the prevalence of the major skin lesions was higher for pale lesions, followed by black lesions, white-fringed spots, and dark-fringed spots respectively. Patterns identified in this research provides a foundation for epidemiological research in this endangered population of bottlenose dolphins. Further, these findings will provide valuable insights into conservation and monitoring programmes.

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Protecting biodiversity under the RMA / NBA

Dr John Craig[1]
[1]*Green Inc Ltd, Whangarei, New Zealand*

Biography:
Life Member of NZES
Retired academic
Expert witness to Environment Court

S6c of the RMA requires protection of areas of significant indigenous vegetation and the significant habitats of indigenous fauna. The forthcoming MBA copies this and also require the protection, restoration or improvement of ecological integrity. Both laws require use of the mitigation hierarchy that starts with avoid and where actions are not possible ends with the possibility of offsetting and then compensation. For many developments, total destruction of vegetation is common, and compensation typically reverts to pest control which preferentially favours fauna over flora. Consideration of relative threat status and time scales for change, will be used.

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Quantifying the Effects of Introduced Dung Beetles on Ecosystem Multifunctionality in Pasture Ecosystems

Ms Fevziye Hasan[1]
[1]*University of Waikato, Hamilton, New Zealand*

Biography:
My name is Fevziye and I am a functional ecologist. I am interested in collecting and analysing data to further understand the functional dynamics of terrestrial ecosystems. With a particular focus on dung beetles, termites and ants, I want to quantify how these ecosystem engineers drive essential ecosystem functions which lead to broader ecosystem services. I am currently a PhD student in the EcoDiv Lab at the University of Waikato, New Zealand. Kia ora!

Quantifying ecosystem multifunctionality is a critical step for disentangling interactions and trade-offs among multiple ecosystem functions that occur at the same time. Yet, studies rarely quantify these interactions explicitly, even though they are critical for developing predictions of multifunctional responses to biotic changes.

To address this knowledge gap, we use introduced dung beetles in a pasture field experiment to investigate the causal linkages among multiple ecosystem functions carried out by dung beetles. In doing so, we identify how ecosystem engineer species may alter overall ecosystem multifunctionality. Using experimental mesocosms, we measure the effects of dung beetle species introductions on above and below-ground processes in cattle pasture ecosystems.

Using structural equation modelling, we isolate the causal direct and indirect effects on soil microbial communities and associated processes, such as N and C cycling, that lead to economically-important grass biomass production. Our approach moves beyond commonly employed metrics of ecosystem multifunctionality by elucidating how multiple functions are causally linked to one another. Therefore, our research enhances our understanding of how to manage the provisioning of multiple ecosystem functions in pastoral ecosystems.

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Questioning the familiar: an ecological research agenda for New Zealand ferns and fern allies

Dr Bruce Burns[1], James Brock[1]
[1]*University of Auckland, Auckland, New Zealand*

Biography:
Associate Professor Bruce Burns is a plant ecologist at the University of Auckland. Though with broad interests in plant ecology, conservation and restoration, lately his focus has centered on fern ecology.

Ferns and their allies are notable components of the New Zealand flora; so much so that 'Fernland' was a colloquial name for New Zealand in the 19th century. Despite the abundance and diversity (c. 226 species) of ferns in New Zealand, research on the ecology and influence of this group has been neglected with only c. 4% of fern literature on ecological topics. We present an analysis of fern traits within the New Zealand pteridophyte flora and identify key gaps for future fern ecology research. Ferns are ecologically important in influencing forest composition and structure by acting as pioneers and as understorey filters of woody species regeneration. Some act as habitat formers and augment forest biodiversity, while others are effective stress tolerators occupying heated geothermal areas or occurring as epiphytes. Much of the population dynamics of ferns is enigmatic, however. Fern reproduction begins with spore production yet the phenology, dispersal, and germination of spores in natural ecosystems is poorly understood. As well, spores may enter a soil spore bank once dispersed, but the duration and behaviour of spores within this spore bank is unknown. Although ecological studies of ferns focus on the sporophyte, for this to be present, a fern gametophyte must have established and reproduced. Little ecological research attention has been directed at this crucial and cryptic gametophyte life stage. Though ferns are familiar to New Zealand ecologists, we have much to learn of fern ecology to better manage their persistence and influence on New Zealand ecosystems.

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Red-eared slider turtles are spreading and breeding in Aotearoa/New Zealand

Dr Nicholas Ling[1]
[1]*Waikato University, Hamilton, New Zealand*

Biography:
Nick has been with the School of Science at Waikato University since 1992 and his key research areas encompass comparative animal physiology, conservation ecology and genetics, and ecotoxicology. He has been involved with the ecology of aquatic invasive species since 2000.

Red-eared slider turtles (*Trachemys scripta elegans*) are native to the southern United States and northern Mexico, and are the most common turtle in the international aquarium pet trade. They are highly tolerant of wide-ranging environmental conditions, are included among the worst 100 invasive species worldwide, and are now banned from importation and/or sale in several countries. They are by far the most commonly traded of the very few pet turtles available in Aotearoa/New Zealand.
Red-eared sliders live for up to 50 years and, with a maximum female body weight of around 3 kg, rapidly outgrow typical home aquaria, with the unfortunate consequence often being their illegal release to the wild. Turtles are opportunistic omnivores consuming aquatic plants, invertebrates, fish and birds. A recent survey of occurrence in the wild revealed a nationwide distribution from Kaitaia to Invercargill, mostly in urban or peri-urban locations but occasionally in reasonably remote localities. These habitats include ponds, lakes, streams, rivers and estuaries. Particularly concerning is observations of several naturally breeding wild populations in the North Island. Turtles display temperature dependent sex determination (TDSD) and monitoring of nest temperatures and offspring to date reveal that all progeny are male, however projected increases in average summer temperatures show that temperatures in much of northern Aotearoa could produce females by the middle of the century. TDSD has traditionally been regarded as requiring a minimum average temperature throughout incubation, however recent research indicates that short-term spikes in temperature (heatwaves) of just five days may result in female offspring. Furthermore, temperature dependent sex determination may be variable in some populations.
Adult turtles are difficult to catch and nests are difficult to find, making control or eradication highly challenging.

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Significant Natural Areas Inventory for Ecological Restoration and Environmental Impact Assessment

Dr Yanbin Deng[1], Dr Catherine Beard[2], Dr Paul Dutton[1], Mr Craig Briggs[1], Mr Dainel Tait[1]
[1]*Waikato Regional Council, Hamilton, New Zealand,* [2]*Department of Conservation, Hamilton, New Zeland*

Biography:
Yanbin Deng, terrestrial ecologist at Waikato Regional Council. Yanbin provides the expertise, knowledge and information needed to look after our indigenous terrestrial ecosystems in the Waikato region.

One of her projects - 'Prioritisation of Significant Natural Areas (SNA) for Biodiversity Management in the Waikato Region', aims to identify and prioritise sites of high biodiversity value on the basis that they may require pro-active management to maintain and enhance their ecological value in the region.

Yanbin is also working on the Regional Biodiversity Indicator project. Her task in this project is to assess the extent of native vegetation and forest fragmentations.

Waikato Regional Council is in the process of completing an inventory of Significant Natural Areas (SNA) in the Waikato Region. The purpose of the inventory is to support decision-making for management and protection of indigenous biodiversity. SNA identification and assessment processes are based on national biodiversity goals and criteria translated in the regional policy statement. The SNA inventory was developed on the basis of ecosystem type, of which, terrestrial and wetland SNAs were processed on a district-by-district basis, and other ecosystem types at a regional level. In total, about 8,110 (633,862 ha) terrestrial and wetland SNA sites were identified which collectively account for approximately 25.7% by area of the Waikato Region, of which 57% of the total SNA area is legally protected.
The SNA inventory provides key information on biodiversity values and ecological integrity for conservation management in the Waikato including: identification of natural mosaics and linkages to inform ecological restoration; identification of remnant vegetation to inform ecosystem reference states and successional framework for vegetative communities; threatened species habitat to prioritise pest control activities; site-specific ecological values to inform environmental impact for resource consenting; key attributes of SNAs to guide district councils when prioritising resources for biodiversity management, and determine change in spatial extent of SNAs for monitoring vegetation clearance and the State of Environment.
Accordingly, the SNA project will enable boundaries to be drawn around biodiversity 'hot spots' (tenure neutrality) to allow Council to be informed about changes to biodiversity within the Waikato Region, and facilitate the long-term management and protection of such biodiverse areas.

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Simulating collapse: An agent-based model of seabird colony dynamics

Mr André Bellvé[1,2], Assoc. Prof. Janet Wilmshurst[1,2], Prof. George Perry[1]
[1]*Manaaki Whenua Landcare Research, Lincoln, New Zealand,* [2]*University of Auckland, Auckland, New Zealand*

Biography:
BSc/BA and MSc graduate in statistics and ecology, and currently a doctoral candidate. My doctoral research aims to resolve the distribution of seabirds in New Zealand and to reconstruct the nutrient fluxes they were responsible for using a combination machine learning and computational simulations.

Aotearoa host an incredible diversity of seabirds during their breeding season (~25% of all seabird species breed here, 10% are endemic breeders). However, 90% of NZ's seabird species are threatened with extinction. These threats are primarily the result of predation and habitat destruction, with many mainland breeding colonies having been extirpated during the last two centuries. Strong feedback dynamics mean that once colonies are lost, they are challenging to re-establish, and new colonies to be rarely form naturally. I will describe a novel agent-based model that represents seabird's colony selection behaviour to identify the determinants of contemporary spatial patterns of seabird colonies. By understanding the implications of seabird's decision-making criterion for breeding ground selection, we may be able to leverage their behaviour in reforming colonies, establishing new ones, or determining what pre-historic Aotearoa looked like.

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Sixteen years of monthly bird monitoring at the western end of Lake Rotoiti, Rotorua. Relevance of breeding seasons and implications for one-off surveys.

Dr Chris Bycroft, William Shaw
[1]*Wildland Consultants, Rotorua, New Zealand*

Biography:
Chris Bycroft is a Senior Ecologist with Wildland Consultants based in Rotorua. He is currently Treasurer of the New Zealand Ecological Society and is a past President of the Society. He specialises in botany and avifauna surveys and has done many of the surveys for this project. Chris studied tussock grasslands in southern Aotearoa New Zealand in 1990s for his PhD. Since moving to Rotorua in 2000 Chris has taken a particular interest in geothermal systems. He enjoys visiting wild and remote places, particularly tramping and trail running.

Many avifauna assessments are undertaken as one-off surveys, or repeat surveys at similar times of the year. Results are presented of 16 years of monthly bird counts (adults, and juveniles in three size classes) on the same part of Lake Rotoiti. In 2005 a bird monitoring programme was initiated to monitor the effects of a diversion wall structure in Lake Rotoiti. Monitoring was established prior to wall construction and was funded by Bay of Plenty Regional Council until autumn 2017 and has been continued in a private capacity since then. Lake Rotoiti is outstanding water bird habitat and the western end being monitored contains representative populations of key water bird species in the Rotorua Lakes complex. These lakes support the largest national populations of two endemic species: weiwea/New Zealand dabchick (*Poliocephalus rufopectus*) and pāpango/New Zealand scaup (*Aythya novaeseelandiae*). Some species at Rotoiti show marked seasonal patterns throughout the year. Higher numbers of adult pāpango/scaup are present between July and January, with numbers declining from late summer. There is also some evidence that population of pāpango may be slowly declining at the site, although the population does vary between years. Similar information will be presented for other water birds, and the time of year young have been recorded. Breeding season information is potentially useful for the timing of lakeshore developments.

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Soil Temperature and Moisture Modify Soil Respiration's Response to Warming Differentially Along Elevational Gradient

James Den Uyl[1,2], Dr. Julie Deslippe[1], Dr. Aimee Classen[2]
[1]*Victoria University of Wellington, Wellington, New Zealand,* [2]*Rocky Mountain Biological Laboratory, Gothic, United States of America*

Biography:
James is an international PhD student at the Victoria University of Wellington from the United States. He has conducted his research abroad for this presentation at the Rocky Mountain Biological Laboratory in Colorado, USA but hopes to be able to return to New Zealand when the border opens back up.

Soil respiration releases significant amounts of carbon into the atmosphere. Small alterations in respiration rates could represent meaningful changes to atmospheric carbon dioxide concentrations. Temperature is a significant regulator of soil respiration. Understanding the sensitivity of soil respiration to warming is key in creating accurate models to plan for our climatic future. This study explores the role of biotic and abiotic variables in regulating the response of soil respiration to warming at different elevations.

Data was collected from a long-term warming project in the Rocky Mountains where plots at high and low elevations experienced unmanipulated (n=32) and warmed conditions (n=32). Soil respiration responded negatively to warming at the low elevation site (Q10=-0.9240) but positively at high elevation (Q10=1.0216). The negative response shows a departure from the current body of literature that suggests warmer temperatures result in more respiration. Using structural equation models for each elevation, we identified soil moisture playing a significant role in regulating soil respiration at the high elevation site, but not the low elevation site where moisture was significantly less (T=5.9171, p=5.51e-09).

These results suggest soil moisture modifies the response of soil respiration to warming, and that low soil moisture may ultimately lead to a negative response under certain conditions. While complex interactions underlie these results, these trends will be useful in understanding the large-scale implications of a warming climate.

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Song discrimination by territorial male common blackbirds: Neighbour versus stranger

Mrs Mehrnaz Tavasoli[1], Professor Dianne Brunton, Dr Aaron Harmer
[1]*School of Natural and Computational Sciences, Massey University, , Auckland, New Zealand*

Biography:
I am a Ph.D. student of Ecology at Massey University. I am doing research on the behavioural variation of common blackbirds in terms of plasticity and personality.

Territorial behaviours have an important role in territory stability and social dynamics. Territorial behaviours include both long-range signalling and short-range confrontations (Stamps & Krishnan, 1997) and warn conspecifics against approaching too close. In this study, we carried out a field playback experiment to investigate how individual common blackbirds vary in response to the song (a long-range signal) of neighbours and strangers. We recorded variation in response of 10 territorial male blackbirds to different playbacks, including dawn chorus, daytime song, neighbours, strangers and a heterospecific control. We found that male blackbirds respond strongly to stranger's songs irrespective of time of day. Additionally, their response to a neighbour's daytime song is much weaker than their response to a neighbour's dawn song, which has a more territorial function. These results suggest that male blackbirds can distinguish between intruder and neighbour signals, which is comparable to results found for the dear enemy hypothesis in other passerines.

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Spatial and temporal patterns in whitebait research: a semiquantitative review

Finnbar Lee[1], Nixie Boddy[2], Matt Bloxham[3], Angus McIntosh[4], George Perry[1], Kevin Simon[1]
[1]University of Auckland , [2]Department of Conservation, , , [3]Auckland Council,, [4]University of Canterbury,

Biography:
Finn is a post-doc at the University of Auckland, his current research focuses on the population dynamics of whitebait.

Aotearoa's whitebait fishery is made up of five species of amphidromous fish, three of which are endemic. Four of the five species are declining and there is an urgent need to improve our understanding of the threats they face, along with a better understanding of their population dynamics. To this end, and more generally, there is a growing body of literature examining aspects of the ecology of whitebait here in Aotearoa and more widely across the Southern Hemisphere. While there have been reviews conducted on aspects of whitebait's ecology, these have been achieved using a narrative approach, there has not been a quantitative review of whitebait research. Here, we conducted a semiquantitative literature review of research focusing on whitebait across the Southern Hemisphere. Specifically, we analysed the spatial patterns of whitebait research, produced collaborator networks, and used topic modelling to understand how research trends have changed through time. Our research highlights major trends in whitebait research over the past 60 years, and more importantly highlights under researched areas suitable for future focus.

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Targeting the gaps – a precise system to control predators in small inaccessible sites

Dr Craig Morley[1], Philip Solaris, Greg Quinn, Bruce Peterson
[1]*Toi Ohomai Institute of Technology, ROTORUA, New Zealand*

Biography:
PhD from University of Canterbury. Associate Professor at the Toi Ohomai Institute of Technology, Rotorua. Worked for USP in Fiji, as a conservation biologist and at DOC as a Biodiversity Manager in Northland. With his students in Fiji, he won the BP Gold conservation award for his work on Fiji's endangered ground frog. Has been the President for the SCB Oceania Section and was on the SCB Board of Governors. He is a member of the IUCN ISSG and WCPA . His research career has been dedicated to understanding the impact of invasive species on islands and in agricultural systems.

Our capacity to confidently achieve zero mammalian-predator density and defend eradication zones from reinvasion is poor because we are not controlling predators across the whole landscape. In small, inaccessible sites like gullies/ravines and buffer zones, predators are seldom controlled due to safety and cost. Indeed, controlling the last 5% of predators is significantly costlier than the first 95%. To control predators in inaccessible locations requires new technologically-advanced tools. We have developed a versatile deployment system that can be fitted to a variety of UAVs to target predators quickly, efficiently and, efficaciously. In trials, we deployed 360 bait pods with 1080 over two sites, 6 ha and 30 ha. We ground-truthed the precision of a sample of Bait Pods using a differential GPS. Accuracy in open areas was, $\bar{x}$=0.86m (N=20, range: 0.05-2.0m, s.d.= 0.54m) and in native forest under dense vegetation, $\bar{x}$=2.3m (N=40, range: 0.18-6.11m, s.d.= 1.46m). Using trail cameras/tracking tunnels, we found predator numbers declined within the two sites, however, additional trials are needed. Nevertheless, these results indicate that bait(s) can be placed precisely near sensitive sites, waterways, within buffer zones/riparian margins, indeed any area, providing the possibility for complete landscape control, especially if completed in conjunction with other community and aerial operations. Bait Pod locations, flight plans and, remote sensing data will be stored on a cloud-based system in future to provide on-going reconnaissance and outcome monitoring. With this hi-tech solution, along with other pest control efforts, NZ being predator- and TB-free is another step closer.

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Temperature drives plastic and evolutionary change in a globally invasive fish

Kevin Simon[1], David Fryxell[1,5], Emma Moffett[2], Javiera Benavente[1], Michael Kinnison[4], Eric Palkovacs[3]
[1]University of Auckland, Auckland, New Zealand, [2]University of California Irvine, Irvine, USA, [3]University of California Santa Cruz, Santa Cruz, USA, [4]University of Maine, Orono, USA, [5]Dennis Conservation Land Trust, East Dennis, USA

Biography:
Kevin Simon is a freshwater ecologist in the School of Environment at the University of Auckland. His research revolves around the role of animals in ecosystem processes.

Mosquitofish (*Gambusia affinis*) are a global invader with a tangled history with humanity as agents of biocontrol and models for ecology and evolution. We have studied populations of these fish that have invaded geothermal systems in Aotearoa and California that span a wide range of temperature. Through a series of field surveys, common garden rearing, assays of ecological effect traits, and mesocosm experiments, we have revealed wide-ranging trait variation among populations with ecological consequences. Site-to-site variation in traits are a consequence of interacting plasticity and evolved differences among populations. Evolutionary declines in growth rates and observed body size distributions in the wild reveal evolutionary downsizing in response to temperature rise. These growth and size differences, in turn, interact with plastic changes in metabolic rates and nutrient excretion to alter metabolic scaling predictions and reduce population energy demand predicted from current paradigms. Ultimately, evolved shifts in body size and plastic shifts in size-linked physiology associated with warming may enable population persistence and cause a range of ecological effects on communities and ecosystem processes.

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Testing the efficacy of rapid colour change in Raukawa geckos (*Woodworthia maculata*) as a potential defence against avian predators

Mrs Florence Kelly[1], Dr Sarah Herbert[2], Dr Vanessa Cave[3], Professor Nicola Nelson[1]
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Biography:
Florence Kelly is a mature MSc student in Ecology and Biodiversity at Victoria University of Wellington and works for Jarvis McDonald Group as a project manager and consultant. Her prior experience includes working for Ecogecko consultants, two University summer research projects focussing on lizards, as well as various other areas in Ecology including pest monitoring, invertebrate monitoring, vegetation surveys, restoration and water quality. She has also worked in the Education sector with a wide range of age groups. Her previous degree is a BSc(Hons) in Botany and Ecology from the University of Otago.

In New Zealand, geckos have three main predators: mammals, birds, and reptiles. From an evolutionary standpoint, the predators they have been coexisting with the longest are birds and reptiles, with birds the more abundant threat in most environments. As such, we sought to investigate the efficacy of a potential defence mechanism we identified in our previous research, colour change, against potential predation by birds.

Our previous research identified that Raukawa geckos (*Woodworthia maculata*) rapidly changed colour in their tails when presented with model avian predators or their calls, developing increased contrast and brightness in this region. We hypothesised that this was an antipredator defence: by diverting a predator's attention to the readily autotomisable tail, the gecko may have another chance to escape.

Using model lizards set up in front of trail cameras, we sought to determine whether increased brightness and/or contrast in the tail resulted in increased probability of attacks to the tail compared with other body parts.

We found trail camera photographs to be a largely ineffective method of capturing pecking behaviour, however, we were able to deduce behaviour from peck marks. For models with brighter or more contrasted tails, the tail was the most often attacked body part, and this at nearly twice the rate of models with tails the same colour as the rest of the body. Rapid colour change appears to be an effective defence response for Raukawa geckos when approached by an avian predator.

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The consequences of experimental heat waves on mitochondrial metabolism in the Zebra Finch (*Taeniopygia guttata*)

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Biography:
In 2011-2013 I did my honours project to become a Doctor of Veterinary Medicine, studying the morphological effects of nervous-tissue modulator protein CoREST synthesis inhibition in Drosophila melanogaster wing. Then, I turned into the Ecology field, working as a Wildlife Consultant. My research interest led me to apply for a Research Assistant position at the Chilean Patagonia, where I carried baseline studies in birds, amphibians, and semi-aquatic mammals. My PhD project investigates the correlation of sub-lethal, acute, and chronic effects of high temperatures over a range of physiological and behavioural parameters in zebra (Taeniopygia guttata) and long-tailed finches (Poephilia acuticauda).

Many researchers have examined the physiological consequences of early life exposure to heat to overcome similar conditions later in life. Here we investigated the effect of heatwave temperatures on mitochondrial metabolism - an important cellular component of organismal metabolism. We exposed 64 adult zebra finches (a widespread arid-adapted Australian bird) to a three-week acclimation period at 25°C followed by a ten-day 40°C artificial heatwave in the laboratory. Using a non-destructive approach based on blood cells, we used real-time cellular respirometry to measure oxygen consumption across the different phases of mitochondrial respiration to test whether there were differences in mitochondrial performance before and after exposure to the experimental treatment. In addition, these zebra finches were subject to experimental heat treatments as nestlings (40% were heat-treated; 60% were controls), so we tested whether this early-life heat exposure determined their response as adults. Adults exhibited a significant increase in mitochondrial metabolism for each respiratory parameter measured after the heatwave treatment (i.e., endogenous mitochondrial respiration, proton-leak, oxidative phosphorylation, and maximum respiratory capacity). However, the heat treatment experienced during early life did not affect their mitochondrial metabolism either prior to or after the heatwave treatment as an adult. These results suggest that differences in mitochondrial metabolism may be a plastic response to heatwave conditions and act as a temporary buffer against the effects of high air temperatures. These findings, alongside the lack of long-term effects of heat exposure during early development, suggest that the idea of adaptive developmental programming may be over-stated.

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The development of a real-time PCR assay to detect kiwi DNA, and its application in a stoat feeding trial

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Biography:
Talia is a research technician in the Ecological Genetics laboratory at Manaaki Whenua - Landcare Research in Tāmaki Makaurau. She carries out molecular work on a variety of projects and species, including for the commercial DNA diagnostic unit EcoGene.

Predation by introduced mammals is the most significant factor influencing kiwi (Apteryx spp.) survival. However, priorities in kiwi conservation management vary depending on species and location, and versatile tools are needed to be applied broadly in management programs. Here we describe the development and laboratory testing of a real-time PCR assay designed to detect trace amounts of kiwi DNA in both predator faeces and environmental soil samples. We also detail its application in testing faecal samples collected in a captive stoat (Mustela erminea) feeding trial, with the aim of determining the length of time that kiwi DNA is detectable in stoat faeces after consumption. A TaqMan™ probe based assay was designed to specifically target a small fragment of the cytochrome oxidase c subunit I (COI) gene in kiwi species. Laboratory trials demonstrated that the assay can detect kiwi DNA down to 7x10-5 ng/µl (70 fg) when spiked in to DNA extracted from both soil and stoat faeces. For the feeding trial, three stoats were fed kiwi meat and scats produced over a 5 day period following consumption were collected. DNA samples extracted from the faecal samples were tested using the assay, and kiwi DNA was detected in all of the scats collected post-consumption. These results indicate that this method can be effectively used in monitoring of kiwi predation, and suggest that it can be used in other non-invasive monitoring applications.

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The ecological and immunological relationships between Salmonella and tuatara

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Biography:
Danielle is a molecular ecologist at Manaaki Whenua Landcare Research. She has a particular interest in eco-immunology and microbial ecology. Danielle's PhD research at Victoria University of Wellington investigated the ecological and immunological relationships between Salmonella and tuatara. During her post-doctoral research at the University of Auckland she became interested in the microbiome, investigating the role of both the gut and lung microbiome in human disease. Danielle is now the molecular ecology research area leader at Landcare Research where she is fortunate to be able to apply her skills in molecular ecology to a wide range of species.

The transmission and expression of disease in wild animal populations is a complex interaction of host, pathogen and environmental factors. Salmonellosis is an important zoonotic disease resulting in morbidity and mortality in populations of wild reptiles, birds and mammals throughout the world. Here we establish the gut microbiome of tuatara (*Sphenodon punctatus*) and investigate their immunological response to Salmonella. Our study has shown that tuatara are exposed to Salmonella in their burrows and through contact with infected prey. However, Salmonella has not been isolated from over 600 tuatara cloacal swabs. This raises the question of whether tuatara are innately resistant to Salmonella. We examined aspects of both innate and adaptive immune responses in tuatara serum. Immune measurements included in vitro antimicrobial activity of serum and antibody recognition of bacterial antigens. We developed flow cytometry assays to investigate antibody recognition of bacterial antigens by tuatara serum and have demonstrated that tuatara possess antibodies which recognise Salmonella antigens. Assays were also established to determine the anti-microbial activity of tuatara serum and we compared this activity to that of several other reptilian and mammalian species. The anti-microbial activity of tuatara serum was approximately 6-fold higher than donkey or mouse sera but showed similar activity to the other reptilian species tested. We compare these immunological findings to gut microbiome function analyses. This is the first report of both anti-Salmonella antigens and active anti- microbial activity in tuatara serum. Understanding disease-host dynamics plays a vital role in management and health of tuatara.

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The effect of agricultural fungicides on non-target soil microbial communities with different fungicide exposure histories

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[1]University of Auckland, Auckland, New Zealand, [2]University of Lincoln, Lincoln, United Kingdom

Biography:
Lucie is a PhD candidate at University of Auckland focusing on the effects of agricultural management on biodiversity in NZ vineyards.

Up to 3.5 million tonnes of agricultural pesticides are applied globally to protect crop yields from fungal diseases to meet growing food demands. Soil biology underpins crop productivity and thus food security as it governs soil nutrient cycling, but little is known about the effects of above-ground fungicide applications on below-ground non-targeted soil organisms. Further, whether inorganic fungicides, like sulphur and copper, are less harmful to soil biodiversity than their synthetic pesticide alternatives remains largely unexplored.

In New Zealand substantial amounts of fungicides are applied to vineyards to control fruit fungal diseases. The first objective of this study is to test and compare the effects of inorganic and synthetic fungicide compounds on total soil bacterial and fungal communities. The second objective is to test if there is a differential response between soil communities derived from low pesticide input and conventional vineyards as well as non-agricultural soils as these have different fungicide exposure histories. These objectives test the null hypothesis of no difference in any change in soil biodiversity between synthetic and inorganic fungicides and no differential response by soil history.

Total soil bacterial and fungal communities will be quantified using DNA metabarcoding approaches targeting the 16S and ITS2 regions respectively and be sequenced on the Illumina MiSeq platform. I will present the change in biodiversity data from a total of 120 experimental soil microcosms from samples collected prior to fungicide application and then at 3 days and 27 days after application.

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The effect of warming temperatures on the physiology, behaviour, and niche complementarity of pollinating insects.

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[1]*The University of Waikato, Te Aka Mātuatua School of Science, Hamilton,, New Zealand*

Biography:
René studied her undergraduate degree in Ecology and Biodiversity at Stellenbosch University in South Africa. She immigrated to New Zealand three years ago and is currently tackling her Masters as the University of Waikato under the supervision if Dr Andrew Barnes and Dr Chrissie Painting.

Pollination is a vital ecosystem service that is at risk of changes driven by climate change. Most research on this issue has focused on phenological shifts (resulting in temporal mismatches between pollinators and plants), while the influence of warming on insect metabolism and pollination behaviour has not received equal attention. Additionally, the effect of warming on metabolic and behavioural niche complementarity among multiple pollinator species is unknown. Identifying complementary physiological (e.g., metabolism) and behavioural traits, and their responses to warming could allow the prediction of the stability of pollination services in a warming world. Our research tests the hypothesis that changing temperatures will differentially affect pollinator metabolism and behaviour among species, thus driving physiological and behavioural niche complementarity. Here, we examine this hypothesis by experimentally studying the patterns of visitation behaviour and metabolic scaling in four different pollinator species (*Apis mellifera, Bombus terrestris, Eristalis tenax*, and *Lucilia sericata*) across a range of temperatures that represent a rise in average and maximum temperatures across New Zealand. Ultimately, our results provide insights into individual responses of pollinator behaviour and physiology to climate warming, and the resulting consequences for physiological and behavioural niche complementarity that controls pollination rates, independent of phenological shifts across mutualists.

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The fascinating history of population divergence and connectivity in the titipounamu or rifleman (*Acanthisitta chloris*): implications for conservation management

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Biography:
Dr. Sarah Withers is a part-time post-doctoral researcher at The University of Auckland. She is interested in evolutionary ecology, with a particular focus on behaviours involved in communication, such as vocalisation and colour morphology.

The titipounamu or rifleman (*Acanthisitta chloris*) is a charismatic endemic species within the avian assemblage of Aotearoa. The species is all the more special due to its status as one of only two extant species within a relict group of basal Passerines, now positioned as separate to both oscines and suboscines. Titipounamu would have been ubiquitous across Aotearoa but now exist in isolated sub-populations, concentrated around remnant habitat on high altitude mountain ranges and islands. Recent work has concentrated on evaluating genetic divergence between these populations and investigating how varied these populations are, both genetically and phenotypically. This talk will provide some background into what makes this species so unique and curious, and will present some of the key findings from this work. Our investigation using both mtDNA and microsatellites discovered a surprisingly high level of population divergence and evidence of a highly dynamic history of connectivity across titipounamu populations on Te Ika a Maui (the North Island); particularly remarkable given evidence for relatively conserved variation in both morphology and behaviour. The significance for this work in the context of ongoing conservation management priorities will be discussed, as well as some exciting recent work that is yet to be published.

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The frost tolerance of seven New Zealand plant species and the relation to their southern limits

Mr Toby Elliott[1], Associate Professor Cate Macinnis-Ng[1], Professor George Perry[1], Associate Professor Bruce Burns[1]
[1]*The University of Auckland, Auckland, New Zealand*

Biography:
Toby is a PhD student at the University of Auckland that is currently working with Kauri and Kauri Dieback. He did his undergraduate degree in 2015 at Auckland University before completing an internship in Costa Rica. After that he completed a PgDipSci at Auckland University, focussing on plant ecology. He then did his Masters from 2019 to 2020 which focussed on the Kauri Line, a floristic boundary which concides with the southern limits of Kauri and a group of other species. In this thesis he looked at the strength of this boundary and potential reasons behind its formation.

Multiple factors control species distributions, which are challenging to disentangle due to their complex nature. Biogeographic boundaries form where the range limits of multiple species intersect, which is often coincident with rapid changes in environmental factors. The Kauri Line in New Zealand at 38°S is an example of a biogeographic boundary in which the mechanisms behind its formation have not been studied rigorously. We focussed on the role of frosts at setting the southern limits of species with southern limits approximating the Kauri Line (Kauri Line species) by comparing the frost tolerances of their seedlings with seedlings from species that have more widespread distributions. Seedlings were used for their high sensitivity to climatic influences, including frost. We tested whole plant frost tolerance by subjecting the seedlings to two different frost treatments and monitoring their survival, health and growth over eight weeks following the treatment. We also examined the frost tolerances of leaf tissues using the electrolyte leakage method. In general, both testing methods indicated that the Kauri Line species were less frost tolerant than the widespread species, and the frost tolerances of Kauri Line species were similar. This research gives fundamental insight into the Kauri Line and the potential role that frost may play in limiting Kauri Line species to their current limits, providing a gateway for further research into this area.

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The lesser of two evils? How reduced flow and trout interact to influence non-migratory galaxiid populations.

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[1]Te Whare Wānanga o Waitaha – University of Canterbury, Christchurch, NZ, [2]Te Papa Atawhai – Department of Conservation, ,

Biography:
Olivia is a current MSc student at the University of Canterbury, with a particular research interest in NZ native freshwater fish, and their conservation. These interests have led Olivia to research how non-native trout and alternating flow interact to impact native non-migratory galaxiids. Upon completion of her MSc research, Olivia hopes to aid in non-migratory galaxiid conservation, and population recovery.

Biological invasions and alterations in natural flow regimes threaten native freshwater communities. Low flow conditions could interact with biological invasions to either exacerbate or offset their impacts. Mechanisms driving any interacting effects of low flow and non-native species on native freshwater fish are poorly known, hindering management efforts. In Aotearoa - New Zealand, some native non-migratory galaxiid (NMG) populations co-occur with non-native salmonids, with water abstraction possibly playing an important role in controlling these species interactions, and thus their spatial distributions. We used field surveys to evaluate whether drying stream conditions benefitted NMGs at the expense of trout in Canterbury high country streams. Three electrofishing surveys were conducted (December – March) in streams containing NMG (*Galaxias vulgaris* and *G. paucispondylus*) in both perennial and drying reaches of the same stream to assess abundance and body size patterns between streams with high abundances (n=2), low abundances (n=2) or no brown trout (n=3; Salmo trutta). Flow effects on NMG varied depending on trout treatment. NMG abundance & biomass was significantly higher with trout absent compared to present at high abundance. Streams containing high trout abundance had significantly lower abundance & biomass in perennially-flowing reaches, and moderate NMG abundances & biomass in drying reaches. By comparison, low trout streams, showed no clear differences in NMG abundance or biomass, between reaches. However in troutless streams, NMG abundance & biomass was much higher in perennially flowing reaches and NMG were rare in drying reaches. Thus, although low-flow conditions reduce non-native predator effects, populations of native fish are also suppressed. To conserve native fish, managers should aim to: (1) restore and protect natural flow regimes to maintain suitable fish habitat, (2) actively manage harmful non-native species.

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The pathway to precision pest control: using genomics data for species-specific toxin development

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Biography:
Erica Hendrikse is a post-doctoral researcher at Manaaki Whenua - Landcare Research in Auckland. She is working on novel species-specific toxicants for vertebrate pest control. This involves applying research strategies from her pharmacology and biomedical background to toxicant development.

Pest control of invasive mammalian species is a key priority for Aotearoa New Zealand to prevent further decline of our native species, and to support the Predator Free 2050 initiative. One limitation of current vertebrate toxicants for pest control is that they are relatively broad spectrum, with associated risks to non-target species. Therefore, there is a critical need to expand our toolbox by developing novel, highly pest-specific toxicants.

The genomes of important pest species (stoat, ship rat and possum) have recently been sequenced, providing diverse new research opportunities. Using these genomes and those of non-target species, we can computationally compare protein sequences, with the goal of identifying potential novel toxicant targets that are suitable for the development of pest-specific toxicants. Our initial focus is on the protein family of G protein-coupled receptors, as these receptors are commonly used as therapeutic targets for human medicine. These receptors are well characterised and often have associated molecules that could be suitable for toxicant development. Applying target identification and validation techniques from drug discovery represents an innovative strategy for the development of new vertebrate toxicants.

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Thirsty giants - water use strategies of kauri under artificial drought

Dr Cate Macinnis-ng[1], Mr Ben Cranston[1]
[1]*University of Auckland, Auckland, New Zealand*

Biography:
Cate Macinnis-Ng is a plant ecophysiologist interested in plant-climate interactions and impacts of climate change on biodiversity of Aotearoa

As the climate changes, droughts will become more frequent and severe in certain regions of Aotearoa. The impacts of severe drought on native forests remain unquantified but in other parts of the world, the growing incidence of drought-induced forest mortality is having significant consequences for forest carbon and water cycles.

In 2017, we established The Kauri Drought Experiment at the Huapai Scientific Reserve in West Auckland. This forest throughfall exclusion experiment is helping us understand the canopy and whole-tree responses of mature trees to soil moisture reduction.

We found soil moisture mediates the responses of water use to solar radiation and vapour pressure deficit. Seasonal means of daily tree water use were strongly related to seasonal mean soil moisture. Despite reduced water use under simulated drought, relative water content in the stem (but not the leaves) declined in droughted trees. Stem water withdrawal increased in drought trees compared to control trees but tree water deficits were greater in summer in control trees than droughted trees indicating some hydraulic adjustments in trees with drier soils.

Overall, we found there were good signs that kauri have physiological adaptations in water use strategies that will help them survive drought. We'll talk about future research needs for conservation of native forests under global change.

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Toward restoration genetics of maire tawake - a nationally critically endangered tree species

Mr Colan Balkwill[1], Dr David Chagne[2,3], AProf Peter Ritchie[1,3], Dr Julie Deslippe[1]
[1]Victoria University Wellington, Wellington, New Zealand, [2]Plant and Food Research, [3]Genomics Aotearoa, ,

Biography:
I am a PhD student at Victoria University of Wellington with an interest in facilitating restoration and resilience of ecosystems in the face global change. My MSc thesis, at the University of Pretoria, South Africa dealt with systems genetics of the circadian clock in Eucalyptus grandis (Myrataceae), aiming to understand resilience of systems at the molecular level. I was trained at the Forestry and Agricultural Biotechnology Institute in South Africa, a leading institution in the study of fungal pathogens and their hosts, including the South African strain of Myrtle Rust. I look forward to building my expertise in Aotearoa.

The global decline of biodiversity is among the most pressing issues facing humanity. With over 90% habitat loss, Aotearoa's swamp forests are a prime example. Wetlands are essential to ecosystem service and habitat provision, and are taonga for Māori who have been disproportionately affected by declining biological heritage. The restoration of swampland is therefore vital to the recovery of both cultural and biodiversity values. *Syzygium maire* (swamp maire, maire tawake, waiwaka), is an endemic, critically endangered canopy tree species of Aotearoa's swamp forests. Formerly widespread, extant populations are small, fragmented and under pressure from myrtle rust. Information of the geographic and environmentally structured distribution of maire tawake's adaptive genetic diversity would support conservation and restoration strategies aimed at facilitating future resilience of the species. Genomic data for tree species is lacking, however, and often neglected in conservation and restoration efforts. Given this substantial gap in understanding, I aim to explore the landscape level and environmental processes affecting S. maire's genetic structure. In order to achieve this, I use a novel long read, high accuracy sequencing technology poised to enable rapid, cost-effective assembly of reference genomes for Aotearoa's endemic species. I then explore a genotyping-by-sequencing approach to assess the genetic diversity, population structure and potential local adaptation of S. maire as a function of climate across New Zealand. Future work will aim to describe fine-scale genetic structure and interbreeding of maire tawake populations, followed by simulation-based approaches aimed at informing integrative restoration strategies for wetland habitats.

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Towards a Possum Free Taranaki

Ms Therese O'Malley[1]
[1]*University Of Auckland, Auckland, New Zealand*

Biography:
Tess is carrying out her PhD on the management of invasive mammals in New Zealand. This merges her two interests: conservation and animal behavior. Her work has focused on novel zero-density possum management in the Taranaki region, which is being carried out as part of a landscape PF2050 project. She has worked on measuring possum home ranges and device interaction probabilities, as well as the response of rats to 1080 operations in the area.

In 2019, a multi-year Predator Free 2050 (PF2050) project was hitting its stride in Taranaki. It aimed to remove possums (*Trichosurus vulpecula*) from around 8000 ha of the mainland, across forest, farmland and urban environments. It employed a range of tools to first knockdown possums to near-zero densities, then mop up the few remaining individuals. Or so was the intention. As with many aspects of conservation, there were significant unknowns and not everything went to plan. The team there has employed a great deal of ingenuity and flexibility to roll with these challenges, and in 2021 are still working towards their goals.

One of the key unknowns influencing this project is the behaviour of possums at very low density. Knowing the home range size and movement patterns of resident possums is pivotal in designing effective control. Significant research has gone into possum home ranges, but no reliable figures exist for the combination of habitat type and possum density present in the Taranaki PF2050 project. To help fill this gap, GPS collars were fitted to 24 possums within the PF2050 management zone: 10 of these in the farmland and 14 in the forest. Home ranges were found to vary widely, ranging from around 2 ha to over 200 ha. While habitat and sex were found to influence home range size, a great deal of this variation is not yet unexplained. This illustrates the complex behavioural landscape that mainland eradication projects work in.

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Understanding mustelid dispersal through landscape genomics.

Dr Andrew Veale[1], Dr Tom Etherington[1]
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Biography:
Dr Veale is a wildlife ecologist at Manaaki Whenua specialising in the applications of genetics to understand and manage invasive species. He completed his PhD in 2013 on the invasion ecology of stoats. Since then he has worked on evolutionary genomics projects on salmon at UBC in Canada, and on stoneflies at the University of Otago, and he has worked on a range of invasive species including mice, possums, plague skinks, and wallabies. A part of his work funded by PF2050 he has led the stoat genome sequencing project.

Te Korowai o Waiheke is leading a stoat eradication campaign on Waiheke Island, and Predator Free Taranaki is leading a project attempting to eradicate mustelids from the ring plain around Taranaki Mounga. In order for these ambitious projects to succeed they need to understand how mustelids move across their regions, and how many are surviving. In this study, we explore the potential for genomic analyses to determine relatedness and dispersal of mustelids. From trapping operations in Taranaki, 554 mustelid tissue samples were obtained from the ring plain and national park. These samples consisted of 357 stoats, 121 weasels, and 70 ferrets. On Waiheke Island all stoats caught so far (>150) have been sampled. We extracted DNA from all of the samples and performed Genotyping By Sequencing (GBS) to obtain genomic data for each individual. High quality DNA was able to be extracted from most samples, despite some having high degradation. This sequencing resulted in over 400,000 variable genetic markers within each species to enable fine-scale relatedness to be ascertained. We can clearly identify close kinship(parent/offspring and full-sibling pairs) and can describe the genetic diversity across these landscapes. In a preliminary data analysis of a subset of the data, we observed a mean distance between close kin of 3.86 km, and a maximum distance of 17.4 km. From these data we can better understand dispersal distances across this landscape, and identify the ways mustelids use this landscape to disperse, providing critical information for control network planning these region-wide eradication campaigns.

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Uptake of artificial roosts by an urban population of long-tailed bats (*Chalinobus tuberculatus*) in Hamilton City

Hannah Robinson[1], Nicholas Ling[1], Grant Tempero[1]
[1]*School of Science, University of Waikato, Hamilton, New Zealand*

Biography:
Hannah Robinson is a master's student at the University of Waikato with a keen interest in bat conservation. After living abroad and being inspired by her time in Indonesia with Yayasan International Animal Rescue, Hannah returned to New Zealand to complete her undergraduate degree in Biodiversity and Ecology at the University of Waikato. During this time she volunteered for Project Echo learning more about Hamilton City's resident population of long-tailed bats, and she has been a bat enthusiast ever since.

Artificial bat roosts were first installed in Hamilton city in 2011, with reported occupation by long-tailed bats (*Chalinobus tuberculatus*) in 2017. As part of a mitigation strategy for a large-scale roading project a further 80 artificial roosts were installed in the south of Hamilton City during 2019-2020. Our research aims to understand whether occupation of urban artificial roosts changes seasonally, and how factors such as predator abundance and habitat structure influence occupation. Following an initial survey of 116 artificial roosts in Hamilton City and its surrounding landscapes; 77 artificial roosts across 10 separate sites were selected for further monitoring using night vision cameras to determine occupation. Eight artificial roosts assessed as likely to be occupied were monitored every 4-weeks, with the remaining 69 roosts monitored every 3-months. Automated bat monitors, camera traps, and chew track cards were deployed seasonally at the 10 sites to determine activity levels of long-tailed bats and potential mammalian predators. Long-tailed bats were found to occupy five of the newly installed artificial roosts within 18 months of their installation and continued to occupy these roosts throughout winter. Of the 77 monitored sites, five were occupied by one bat and three were occupied by ≥3 bats. Possums and/or rats were abundant at nine of the monitoring sites, and camera traps detected cats and possums within the close vicinity of seven occupied roosts. Monitoring will continue into 2022, providing insight into how these structures can be optimised and protected for uptake by urban long-tailed bats.

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Urban forest restoration influences community composition and network structure of the soil microbiome

Grace Mitchell[1]
[1]*University of Waikato, Hamilton, New Zealand*

Biography:
Grace is a Master's student at the University of Waikato, supervised by Dr Andrew Barnes and Dr Kiri Joy Wallace. She is an early career budding research scientist interested in microbial ecology and ecosystem restoration.

Urban environments are heavily modified, degraded natural environments. Restoring forests is vital for maintaining biodiversity and ecosystem service provision in urbanised landscapes. Soil microbiota contribute essential functions that often dictate the survival of native restoration plantings, yet our understanding of microbial community responses lags far behind knowledge of above-ground processes during urban forest restoration. In this study, we sampled soils from 19 urban forest sites in eight cities throughout New Zealand, representing a chronosequence of restoration sites ranging from 10 to 60 years of age since planting, as well as urban remnant forests for baseline comparisons. We employed DNA metabarcoding on our soil samples to quantify the diversity and composition of bacteria, fungi, and archaea communities. We analyse the effects of urban forest restoration, alongside a suite of environmental co-variates, on microbial community structure and functional group composition. Finally, we implement the recently developed SPIEC-EASI method (SParse InversE Covariance Estimation for Ecological Association Inference) to model the structure of our sampled soil microbial interaction networks. This analysis provides unique insights into the influence of aboveground restoration efforts (tree planting) on the reassembly of interactions among key microbial functional groups, and on microbial network structural properties such as connectance and modularity of microbial interactions. Our findings elucidate the reassembly of soil microbial communities under urban conditions, developing our understanding of below-ground urban forest restoration management.

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Using a new monitoring framework for regional councils to assess the integrity of prioritised ecosystems in Hawke's Bay farmland

Ruby MacGillivray[1], Jon Sullivan[1], Mark Mitchell[2]
[1]Lincoln University, Christchurch, New Zealand, [2]Hawke's Bay Regional Council, Napier, New Zealand

Biography:
Originally from Hawke's Bay, I am currently undertaking my research masters in applied science at Lincoln University in Christchurch. I am interested in the integration of native biodiversity across farmland. I am currently investigating the ecological integrity and biodiversity of native forest fragments across farmland in Hawke's Bay, using a new monitoring framework designed for councils.

The long-term sustainability of biodiversity in small native forest fragments on privately-owned lowland rural land is threatened by agricultural intensification, introduced pests, inadequate fencing, and species-area effects. Biodiversity monitoring of private land plays an essential role in protecting, and enhancing, the biodiversity that remains. These private forest fragments can contain rare and critically threatened species, and are reservoirs for indigenous species that are otherwise scarce in these landscapes. The National Policy Statement for Indigenous Biodiversity is likely going to require Councils to monitor the biodiversity within these habitats to assess state and trend of native species and to inform management outcomes. However, there has been no standard framework that Councils can follow. Regional councils contracted Manaaki Whenua–Landcare Research to develop Tier 2 Monitoring Framework for standardised biodiversity monitoring in 2020. I have trialled this framework to survey vegetation, bird, and mammal biodiversity at a selection of 10 ecologically prioritised native forest sites across the Hawke's Bay. My research offers insights into the framework's ability to measure ecological change, by assessing the ecological differences between fenced and unfenced forests. Vascular plant species richness was affected by reserve fencing, with fewer natives and many more naturalised species present at unfenced sites. I will offer my reflections on the suitability of this proposed framework for more widespread regional council use. My findings document the status of lowland biodiversity at these sites and provide a valuable baseline for future monitoring of ecological change in lowland forest fragments, by Hawke's Bay Regional Council and landowners.

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Valuing Nature: Balancing biodiversity and carbon rewards in restoration.

Dr John Craig[1], Neil Mitchell
[1]*Green Inc Ltd, Whangarei, New Zealand*

Biography:
Life member of NZES
Retired academic

Understanding the carbon value of trees and shrubs as well as the utility of the plants for establishing ecosystem processes allows ecologists to plan restoration outcomes. Carbon sequestration offers financial rewards that can allow restoration plantings of native forests to become self-funding or even profitable. Understanding the utility of different plants to different animals allows plantings that offer the suite of ecosystem processes such as pollination and seed dispersal. Such processes will ultimately determine the composition and structure of the restored area. Measurements of plantings at Pataua (www.tahinz.com) are used to illustrate the methodology.

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Why does New Zealand have so many gender dimorphic trees (and so few monoecious)?

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Biography:
Matt McGlone is a Research Associate at Manaaki Whenua-Landcare Research, Lincoln. His research speciality is palaeoecology, in particular Quaternary vegetation history through pollen and charcoal analysis. He has published extensively on the ecological history of New Zealand, Quaternary climate change, the environmental impacts of the settlement of New Zealand, biogeography, and ecological adaptations of New Zealand plant species. He has been long puzzled as to why so many of our trees are gender dimorphic, but even more so why plant ecologists tend to ignore plant sexuality in their research.

Over 42 % of New Zealand trees are gender dimorphic, that is individuals are of separate sexes, usually male or female. We have compiled a global data base of 29 tree floras (12,000 species) to explore the reasons for this exceptional statistic. The global tree gender dimorphism average is 26%, and only Hawaii at 38% approaches the New Zealand level. Several broad explanations have been suggested for the anomalously high New Zealand total, including climate, oceanic island syndrome, lack of specialised pollinators, an abundance of fleshy fruited species. We show that these factors cannot explain the New Zealand anomaly and suggest historical factors have been much more important. During the massive turnover of tree taxa during the Miocene-Pliocene period, hermaphrodite or monoecious trees tended to become extinct, while gender dimorphic trees had a much greater survivorship. Replacement trees were largely sourced from floras in the tropical north where levels of gender dimorphism are high. Ease of colonisation favoured small understory trees, which have much higher levels of gender dimorphism and lower levels of monoecy than tall canopy trees. Therefore, New Zealand has an abundance of small, gender dimorphic trees and a striking lack of tall monoecious species.

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Will fenced ecosanctuaries act as 'arks' if PF2050 is a success?

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Biography:

I'm a community ecologist with a focus on plant communities in wetlands and forests. I'm currently working on classifying New Zealand's wetland vegetation, so if you have (wetland) plot data - let's talk!

Fenced ecosanctuaries are a high-cost method of creating areas of pest predator-free habitat for species or populations for whom predation is a limiting factor. Past research has focused on 'inside the fence' habitat and bird populations, overlooking the potential for ecosanctuaries to augment bird populations 'outside the fence'. We assessed the amount of habitat around both fenced and unfenced ecosanctuaries in New Zealand, how connected the ecosanctuaries were to the wider landscape, and the overall landscape connectivity around ecosanctuaries, for six bird species at 18 sites (15 fenced; 3 unfenced), assuming a predator-free landscape. We found low levels of high-quality habitat around many fenced ecosanctuaries. There was no high-quality habitat at all around some ecosanctuaries for several bird species. Ecosanctuaries on peninsulas (with reduced fencing costs) tended to have a smaller proportion of the surrounding area in habitat and lower functional connectivity than unfenced ecosanctuaries and ring-fenced sites; meaning the reduced fencing costs at peninsular sites needs to be balanced against less habitat, on average, beyond the ecosanctuary. Managers deciding where to locate ecosanctuaries need to consider both the ecosystems within and those surrounding the site, and connectivity between the two. New Zealand is a world leader in fenced ecosanctuaries; lessons learned from this study in New Zealand are likely to apply elsewhere, where the use of fenced ecosanctuaries for predation sensitive species is incipient.

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Worth a try or makes no sense? How birds deal with novel objects

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Biography:
Sahar is based in Christchurch and studies her PhD at Lincoln University. However, she should have submitted her thesis in ecology and wildlife behaviour by now. Her research interest is not limited only to birds. Pest mammal control, microbiology, genetic fungal related subjects are her favourite areas as well.
Apart from science, reading books, watching movies, cooking, biking and travelling or talking about them would make her day.

The impact of novel challenges in urban ecosystems on wildlife allows us to examine the evolutionary processes and plasticity. Variation in neophobia and exploratory behaviour among urban and non-urban individuals of two birds introduced to New Zealand, Western blackbird (*Turdus merula*), and song thrush (*Turdus philomelos*) were examined in the Wellington and Canterbury regions. We measured neophobia and approach behaviour in urban, river and rural populations for these two species. Urban birds approached the novel object in their territory more closely than the river and rural habitat individuals. Rural birds were also more neophobic than river birds approaching the novel object less frequently. The differences between blackbirds and song thrushes were in their approach responses. Rural and river song thrushes approached less often, but if approached they then reached more closely to the novel object, indicating species-related difference in the exploratory behaviour of these closely related species. Exploratory behaviour was affected by habitat type rather than biogeographical region.