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2014

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

NEW ZEALAND ECOLOGICAL SOCIETY

CONFERENCE HANDBOOK

Massey University
Palmerston North
16 – 20 November 2014

New Zealand Ecological Society

Annual Conference

Massey University
Palmerston North
16-20 November 2014

Prepared by Gillian L Rapson

The logo for this year reflects the conference theme, and was designed by June Lincoln, Design Studio, Massey University. The logo features some of the many pest animals and plants which have been so successful in New Zealand, all homing in on our natural environment, making it an invasion hotspot. *Tradescantia fluminensis*, or wandering willy, is a very aggressive forest weed, particularly in the Manawatu, its first site of introduction to New Zealand. Image: Alastair Robertson. The ferret, *Mustela fero*, is a particularly active predator, whose omnivorous diet includes native birds and insects, as well as any available introduced species. This ferret was found in the "Fernbird area" of Manawatu Estuary. Image: Jill Rapson. Boneseed, *Chrysanthemoides monilifera*, is not yet a particularly common weed in New Zealand, but it is recognised for its invasiveness, and is slowly occupying the Manawatu, particularly waste areas, via its prolific seed output. Image: Jill Rapson. Mr Snuffles, the hedgehog (*Erinaceus europaeus*) is a welcome guest in many New Zealand gardens, but he has a tendency to seek out and consume a tasty range of native invertebrates and birds' eggs. Image: Matt Krna. The background image to our banner is a tinted version of two young fertile fronds of *Blechnum discolor* or crown fern, a common understorey species of red beech (*Fuscospora fusca*) forest in the Manawatu. Image: Jill Rapson

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Welcome!

Dear delegate,

Welcome to Massey University in Palmerston North. We are proud to be hosting the 64th Annual Conference of the New Zealand Ecological Society.

The theme of the conference is "**Is new Zealand the World's invasion hotspot?"**, and it will be interesting to see what a range of ideas and exchanges this theme generates. In addition there are a wide range of other symposia on current and important topics in New Zealand ecology, and we are sure that everyone will find something of interest.

We would like to take the opportunity to thank NZES for the opportunity to host this conference and Massey University and its Institute of Agriculture and Environment for hosting it, and dedicating many resources to the task. Thanks also go to those who have helped in the organisation of the conference and its excursions (see committee list below).

We hope you make the most of your trip to Palmerston North and find your time here enjoyable as well as profitable.

Jill Rapson

Phil Battley

Paul Barrett

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IAE's conference organising committee

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National Events & Sponsorship Team, Massey University
Te Pae Roa 2040 Conference Event Manager: Shelly Deegan
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Shelly

Acknowledgement of Sponsors

The 2014 Conference Organising Committee would like to thank the following sponsors for their generous support. Without this investment a conference of this nature is not possible. We are very grateful for their financial support or support in kind of the following organisations.

The conference venue is kindly being sponsored by Massey University.

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

The Student Day pizza is kindly being sponsored by Hell Pizza.

Penguin are supplying student prizes.

The *New Zealand Journal of Zoology* is kindly sponsoring a student prize.

the ROYAL SOCIETY of NEW ZEALAND
TE APĀRANGI

The Royal Society of New Zealand has kindly sponsored in being an Exhibitor.

Boffa Miskell

Boffa Miskell Consultants has kindly sponsored through being a Themed Session Partner.

Thermo Fisher Scientific New Zealand has kindly sponsored through being an Exhibitor and Themed Session Partner.

Advanced Telemetry Systems Australia has kindly sponsored through being an Exhibitor.

Horizons Regional Council is generously sponsoring two conference symposia.

Distinction Hotel is generously supporting the conference's formal dinner.

Sirtrack has kindly sponsored in being an Exhibitor.

Ata Rangi is generously sponsoring wines for the conference's formal dinner

General Information

The following information is offered to make your attendance at the conference as pleasant and trouble-free as possible.

Registration and information desk

The registration desk is located in the foyer of the AgHort Lecture block and will be open during the following hours throughout the conference:

Monday 17 November	8 am – 5.30 pm
Tuesday 18 November	8.15 am – 5.45 pm
Wednesday 19 November	8.30 am – 5 pm

If you require help, please call at the registration desk and the Massey University staff, Adina (left) and Zavana (right), will do everything they can to assist you.

Adina 021 406 846
Zavana 021 408 933

Emergency

In case of emergency call 111. If on a University phone, dial 1 first to get out of the University system, i.e. 1-111.

Evacuation

If you hear a continuous alarm bell or siren, you need to evacuate the building. (The usual reason for evacuation is fire drill.) Emergency exits will unlock. If you are in the AgHort Building make your way through the nearest exit and meet out by the duck pond to the north of the building, away from the rest of the buildings. You will be advised when/if return is appropriate.

Earthquakes

If you are inside during an earthquake, take shelter under a desk, bed, or doorway to protect yourself from falling debris, and try to keep away from windows or other glass, which may shatter. If you are outside, keep in the open, well away from buildings, trees, powerpoles, or anything else that might fall on you. Once the earthquake has finished, move outside in case of fire, building collapse, or after-shocks. You will be advised when/if return is appropriate.

Doctors

For dire emergencies, such as the chopping off of a limb, go to the hospital. Otherwise, go to City Doctors.

Palmerston North Hospital, 50 Ruahine St, Telephone (06) 356 9169
City Doctors (open 8am-10pm, 7 days), 22 Victoria Ave, Telephone (06) 355 3300
City Health Pharmacy, 22 Victoria Ave, Telephone: (06) 355 5287

Toilets

Toilets are situated at the far end of the Foyer, down a side corridor. The disabled access toilet is located at the foyer/corridor junction.

Name badges

We ask that you wear your name badge throughout the conference and during social events. It serves as proof that you're part of the conference and prevents you from being thrown out. It's also necessary for entry into some events, such as lunch. No badge = no lunch!

Uploading your talk

There is a single computer in AH5 in the AgHort Lecture Block for loading your Powerpoint presentations onto the Lecture block's central server system. This process will be supervised by Liz Daly or Matt Krna. Please don't try to do it yourself. Make sure you do this in advance of your session, and check that all your special features are working well!

Computers, email, photocopying

If you want to print urgently, try AH5 too, where an online printer will be housed, and support staff will assist with your print job. Photocopying can be done in the Library and some of their machines are coin-operated. The cost is 10c a page.

If you want a computer to work on in peace and quiet during the conference, then go out the exit nearest the registration desk, veer right and go in the door opposite. Take the first door on the left and into the 100-level lab. The computers are set up in strange wooden box towers (for student experiments), but they work just as per usual. They should be logged on for you, so just get started! Otherwise, the login is nzespres, and the password is Nzes5623. Ask back in AgHort Lecture Block if you need a hand.

Wifi

Wireless Internet is available throughout the conference venue and the area aimmediately nearby for conference delegates whilst attending the conference each day. If you have any difficulties, please see the team at the registration desk throughout the conference. To connect to the Massey University Wireless Network

- Ensure your wireless internet is turned on, on your device
- Look for WIFI Connection "MUEvents"
- Enter the password: FLCR2014

Programme enlarged

The conference programme is included in the back of this booklet,, but if you have difficulty reading the small print (on colour!) then ask at the Registration desk for a large-print copy.

Courteous conduct during sessions

Please turn off your mobile phones or put them on silent mode while you are listening to presenters. Please use the 2 empty minutes between sessions for changing between rooms.

Delegates are not permitted to use any type of camera or recording device at any of the sessions unless written permission has been obtained from the relevant speaker.

Security

Please protect your own personal belongings. Do not leave laptops/mobiles, cameras or bags unattended. The organising committee accepts no liability for the lost property of any delegate/sponsor/exhibitor. If you find an item of lost property, please take this to the registration desk.

T-shirts
A few extra conference t-shirts are available at the Registration desk. There are limited numbers – first in, best dressed.

Smoking
Smoking is not permitted within 10m (30 feet) of University buildings except where there is a designated smoking area. Time to give up the evil weed!

Luggage storage
Limited space in AH5 will be available to store your luggage at the venue on the day of your departure. Please note that all care, but no responsibility, will be taken as this area is not be secure and may not be manned.

Transport
Taxis usually can't be flagged down from the sidewalk; instead you can call one, either by phoning one of the taxi companies or by going to a taxi stand. There is a taxi stand just outside the Palmerston North airport terminal and also a shuttle bus. There are regular **buses** that run out to the Massey campus from the centre of town as well as around parts of Palmerston North, and ther Feilding bus occasionally goes via the airport.

Palmerston North Taxis	06 355 5333 or 0800 355 5333
Manawatu Taxis	06 355 5111 or 0800 355 5111
Super Shuttle	0800 748 885

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Bus stops

The main bus stop is in the centre of the campus, with smaller bus stops around the Ring Road. There should be timetables in the shelters; wait here for your bus. Ticket cost is about NZ$2. Buses numbered 12 go directly between the Square and Massey.

Bus timetable

Palmerston North Airport bus services
Airport Trial

From Monday 3 November, the Palmerston North-Feilding and Feidling-Palmerston North bus services will be trialing a new stop at the Palmerston North Airport terminal (Girls High and Boys High services will not be affected).

Appriximate timings for the airport stop are;

Services from Palmerston North-Feilding: Mon-Fri 7.53am, 9.13am, 11.43am, 1.58pm, 3.18pm, 4.33pm, 5.05pm and 5.38pm. Sat 3.42pm

Services from Feilding-Palmerston North: Mon-Fri 7.23am, 8.38am, 9.58am, 12.28pm, 2.43pm, 4.03pm, 4.30pm and 4.55pm. Sat 10.28am

Food and functions

Morning and afternoon teas

All morning and afternoon teas will be served in the AgHort Lecture block foyer. If delegates have advised the conference secretariat of any special dietary requirements through the online registration process, these requirements have been communicated to caterers and appropriate food will be set aside and marked clearly.

Lunches

The conference lunches (held Monday, Tuesday and Wednesday) will be held at the far end of the Student Centre's Dining Hall on the Concourse and you will need your name badge to get in. Vegetarians are catered for in the main buffet line, and specialist diets are catered for separately - please ask the catering staff.

To get here from the AgHort Lecture Block, go out the main doors and turn left, walking past the Vet Pond (with all the ducks) on your left and the Science Towers on your right. Turn right around the Science Towers and walk across the concrete area between the Library and the Science Towers. This brings you to the head of the main Concourse. Go down the steps and into the large, glass-fronted building directly in front of you, which is filled with dining tables. Go to the back of the room and you will see the area where we will be sitting off to your left. Flash your name badge for entry.

Posters and drinks Session

Monday 17 November; 4.30 – 6.30pm AgHort Lecture block foyer, Massey University

Held in the late afternoon of the first day, this occasion gives an opportunity to inspect the various posters on display in the foyer of the AgHort lecture block, and at a time when the poster-presenter will be in attendance, to answer your questions or discuss your interpretations.

To encourage interaction over the posters, each participant will have two drinks tickets inside their name badge. Each has 3 blank squares on it. When you have interacted satisfactorily with a poster presenter, ask them to put a stamp on your ticket. When you have 3 stamps, you are entitled to a free drink from the bar. Otherwise there is a pay bar. Poster presenters have one pre-stamped ticket, to help them stand by their posters, and nibbles will circulate.

The event is open free of charge to all registering for the conference, but accompanying persons need to book (and pay) separately (Cost: $40). If you have purchased an extra ticket, that ticket will also be inside your name badge.

Conference dinner

Tuesday 18 November; 7 – 11pm Distinction Hotel, Cuba Street, Palmerston North

Our annual dinner will be held on Tuesday evening. It gives an opportunity to meet in more relaxed surroundings, and celebrate our plenary speakers, and society prize winners. The venue is the ballroom of the Distinction Hotel Palmerston North (Formerly Travelodge) on Cuba Street, behind the Square. Dinner music will be provided by harpist Lesley van Essen. After dinner entertainment will be provided by local band, the Ruahine Rangers, who will play country, blues and dance music during the evening.

This event is also included in the registration price for all full-conference registrants, including students, but accompanying persons or single day registrants need to book (and pay) separately (Cost: $95). If this funtion is included in your registration or you have purchased an extra ticket, these tickets (in the form of your menu choices) will be inside your name badge.

Important: You will NEED to take your tickets to the dinner! If you can no longer attend the dinner, please advise the team at the registration desk.

Out and about on the campus

Refer to the Turitea Campus map below. Numbers-letters in brackets refer to map references.

University Ave
University Avenue (known locally as the Ring Road because of its shape) is the main road on campus and from here you can get anywhere. It joins up with itself, so if you don't see what you're looking for on the first time through you can always just go around again. The speed limit is 30km/hr and the speed bumps are copious and sometimes vicious.

Parking
There is a huge carpark out the back of the campus (E12), with a charge of $2 per departure. It only takes real money, and preferably $2 coins. You have to buy a ticket in advance to get out past the barrier arms.

To enter, go round the the Ring Road to Orchard Road, and turn with the red brick building on your right. Drive slowly over the road spikes, and then, 10m further on, turn right into the carpark (going over a second set of spikes). You can also access the carpark from Albany Drive, the back route into the campus.

Other parking around University Ave is all time-restricted, and you have to pay at the nearby machine.

AgHort Lecture Block (F10)
This is where the presentations will be held. To get here from the carpark, head into towards the hub of the Ring Road. Then follow the Ring Road to your left until you see Riddet Rd. Walk down Riddet Rd to the second buildings (our main AgHort office block). Go in through the main door, across the foyer, and out into the courtyard. To your right and on the opposite side of the courtyard is the AgHort lecture block. Alternatively, you can access the back route by turning off the Ring Road just inland of the Vet Clinic and its horse-float carpark. Walk past the carpark and keep on going straightish - the lecture block is on your left.

Library (E8)
The only door to the library building is on the Concourse. You can get here by many routes, depending on where you start. Coming off Turitea Rd (E7) on foot, go under the Registry and onto the Concourse, with the library to your right. Alternatively you can come up Library Rd (G6) and go either way around the building to the door.

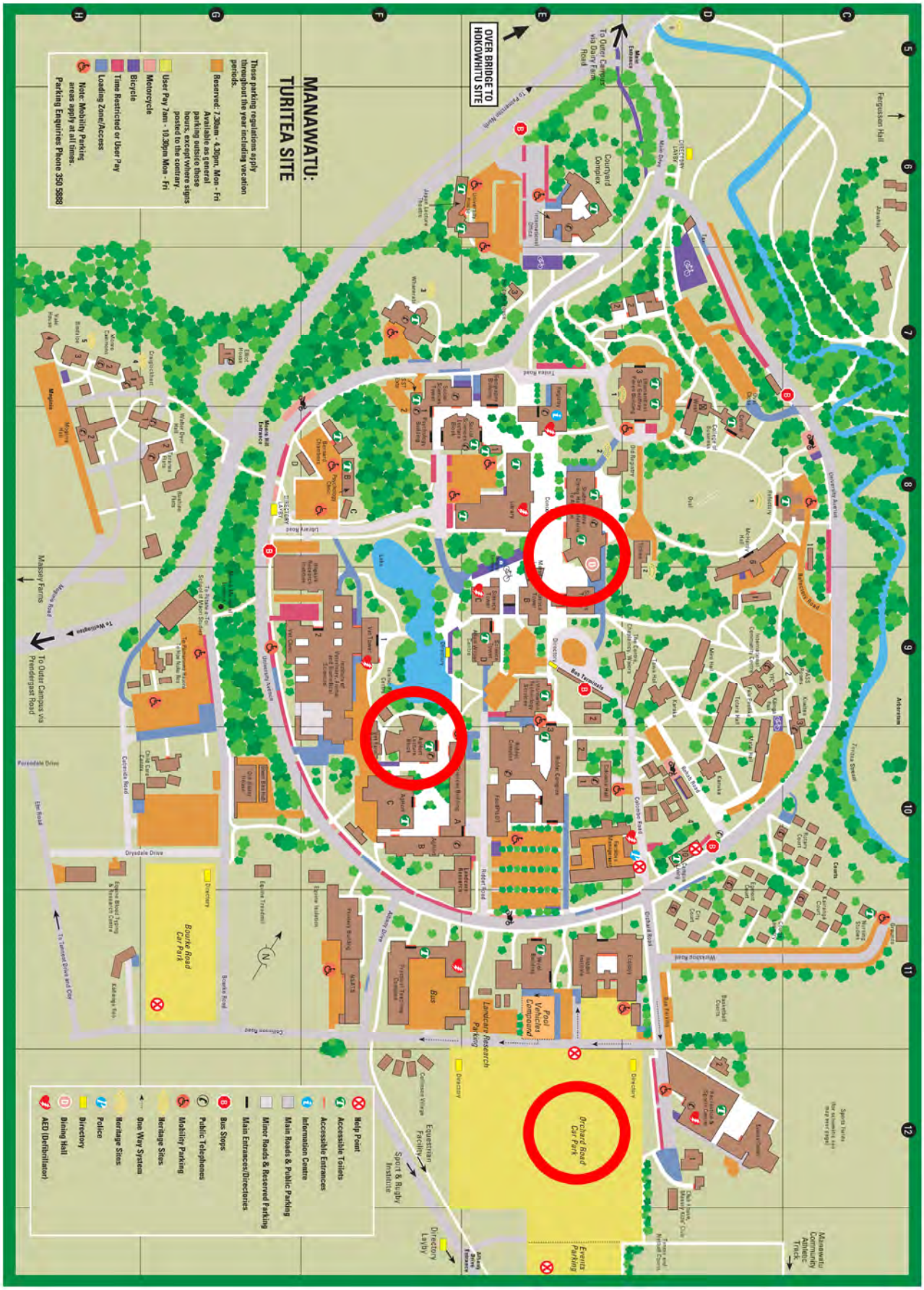
Student Union (E8)
This is where the conference lunches will be held, in the building labelled Cafeteria on the map. Finding your way onto the Concourse (which can be reached via many routes), find the building with a large, two-storey glass front, opposite the library. This is the main cafeteria. We will be sitting at the back of the room and off to the left.

Shops and cafes
There is a cafe in the "Courtyard Complex (E6)" which serves coffee and light meals, a coffee stall on the route from the main carpark across the Ring Road, and Wharerata, the "staff club" which also serves a range of meals in gracious surroundings. The MUSA shop is on the Concourse next to the Student Centre, selling mostly snack foods. There is a small snack-alcove just near the main entrance to the Student Dining Hall, and inside on the left, near the bend, is a counter which sells fancy coffees and cakes. A small cafe usually operates inside the library on the first floor. There is a bookshop behind the Student Centre (E8) and the Alumni shop is just opposite it, selling memorabilia. If you need phone cards they are available at the MUSA shop or Bennetts.

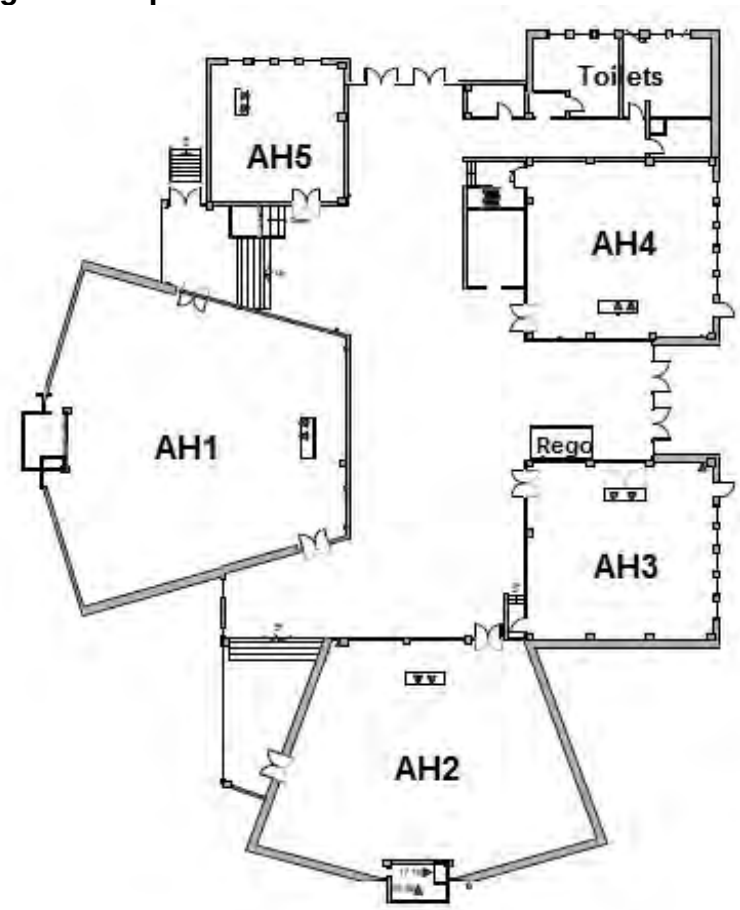
Money machines (ATMs)
There is an ATM on the outside of the Registry building, at the foot of the Concourse (E8). Another ATM is outside the MUSA shop on the main concourse.

Campus map

Red circles enclose the AgHort lecture block, the carpark and the cafetaria.



Ag Hort map



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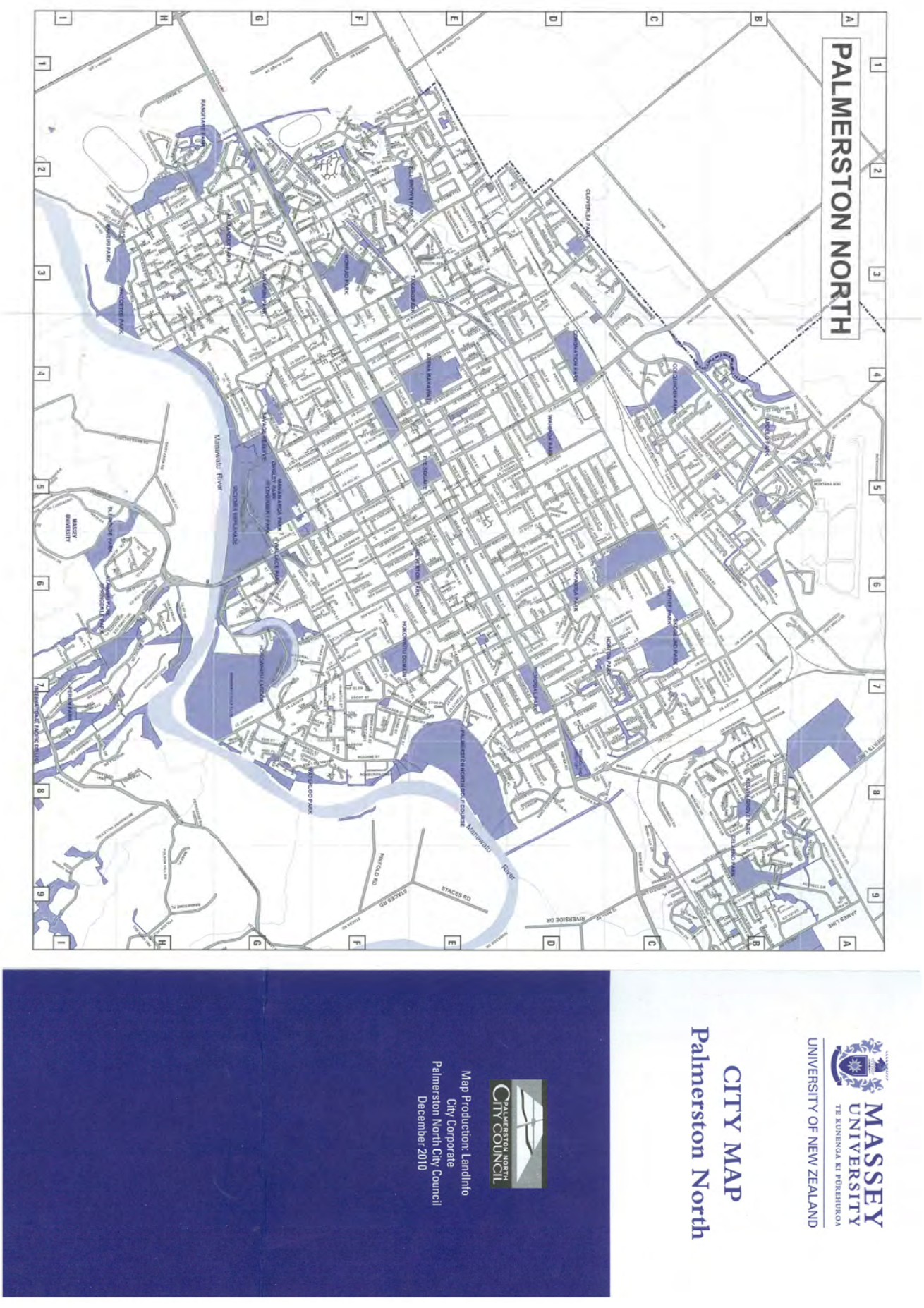
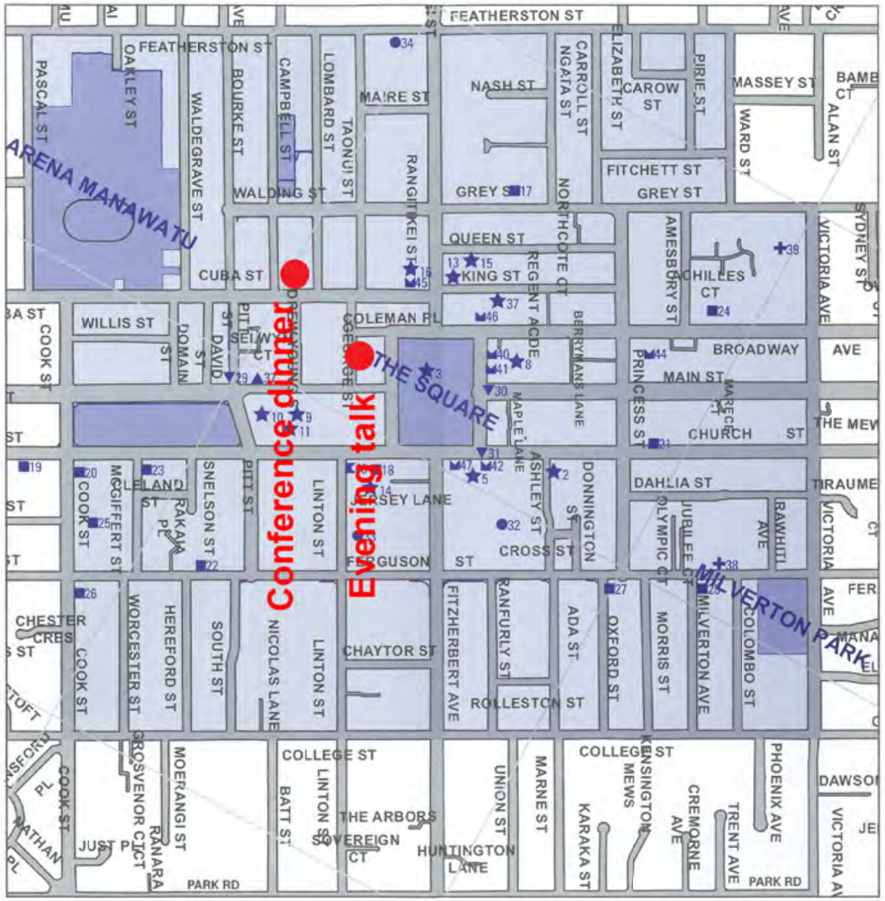
The Royal Society of New Zealand promotes, invests in and celebrates excellence in people and ideas, for the benefit of all New Zealanders — and makes telling these stories a priority. It administers research funds, publishes peer-reviewed journals, offers advice to government and fosters international research contact and co-operation.

Palmerston North city map





CITY CENTRE ENLARGEMENT

★ COMMUNITY SERVICES

1 Library
2 Police Station
3 Manawatu Visitor Centre
5 Plaza
8 Downtown Cinemas
TE MANAWA
9 - Art Gallery
10 - Museum
11 - Science Centre
13 Citizen Advice Bureau
14 Manawatu Multicultural Centre
15 Sports Manawatu
16 NZ Immigration Service
37 Regent Theatre

■ PLACES OF WORSHIP

17 Christian Community Church
18 All Saints Church
19 Baptist Church
20 Crossroad Bible Centre
21 Salvation Army
22 Seventh Day Adventist Church
23 St Luke's Lutheran
24 Cathedral of the Holy Spirit
(St Patricks)
25 Islamic Centre
26 Elim Church
27 Christian Family Assembly
of God
28 Jehovahs Witnesses

✚ DOCTORS

38 The Palms
39 City Doctors

▼ TRANSPORT

29 Intercity Bus Terminal
30 City Bus Terminal
31 Taxi Stand

BANK

40 ANZ
41 ASB
42 Bank of New Zealand
44 / 45 National Bank
46 / 47 Westpac Trust
48 Post Shop/Kiwibank

● SUPERMARKETS

32 Countdown
33 Pak n Save
34 Countdown

▲ MARKETS

37 Davis Trading (Main St)

LIQUOR BAN AREA
within this perimeter

STREET INDEX

PALMERSTON NORTH

Advice for Presenters

Talks

The **duration** of your talk should be obvious from the programme. Most speakers have a 20 minute slot, which means that they have 15 minutes for their talk, 3 minutes for questions, and 2 minutes for moving around between lecture rooms, and changing speakers. Please time your talk so that you can stick to this timetable. The session chairs will cut you off if you try to overrun. In particular, please ensure you leave time for questions and brief discussion.

Powerpoint users, please ensure your powerpoint is **loaded** onto the University system well in advance of your talk. It will then (magically) appear at the correct session time in the correct lecture room. To load it, take it to AH5 and ask Lizzie Daly or Matt Krna to help. One or the other will be in AH5 at all times. They are checking each and every talk in!

Check your powerpoint has been loaded correctly, and is **functioning** properly before your talk. Please try to do this a few hours at least before your talk, so you have time to ask us to try to deal with your problem!

Please **use the break before** your talk to meet with the session chair, and assure him/her that you: a) are present, b) are ready, c) have everything you need to give your talk, d) have tried and tested the AV facilities, and can run the presentation from the front computer, and e) know what to do with the hand-held pointer/screen changer.

Posters

The formal poster session is scheduled for the first day of the conference so that folk can meet the poster presenters early, and then have the rest of the conference to make further contacts, or follow up on the poster information. Posters will be displayed in the foyer of the conference venue for the duration of the conference. So please ensure that you are present for this late afternoon gathering.

Posters should be put up in the designated slot (see lists at the conference venue) during the morning of Monday. Display boards are designed to use velcro fasteners, and it is sensible to bring your own. Pins are not needed. Ask at the registration desk if you need velcro.

Poster presenters are asked to stand by their poster for the whole duration of the late afternoon Drinks, and Posters session, to offer guided tours of the poster's highlights, and to defend any ideas and receive feedback. Nibbles will circulate, so presenters shouldn't miss out!

The society uses a Drinks/ticket system to encourage interaction with poster presenters. Each poster presenter has a stamp, and when you feel you have interacted effectively with a questioner, then reward them with a SINGLE stamp on their Drinks ticket. Also, since each presenter has one pre-stamped drinks ticket, you can get some refreshments before you take your stand.

Guidelines for Session Chairs

Thank you for helping make the conference a success. We appreciate your efforts, which make a difference to the smooth running of the conference. Your duties are relatively straightforward, and we hope, undemanding but rewarding.

Preparation

1) Please be present in the lecture theatre for your session in the 15 minutes before it is due to start. One of our student volunteers will be present and will know how to run the equipment.
2) Check the correct session lists are displayed outsdie the door of your lecture room.
3) Take the time to meet up with the speakers in your session before the session actually starts. Check that you can pronouce their names and any unusual words in their talk titles. Learn a factoid or two you can use to introduce your speakers (keeping within 15 seconds!)
4) Ensure your speakers have all loaded their ppts or have organised any other equipment they need before the session begins.
5) Make sure your speakers are familiar with their timetable and know how to run the AV equipment before their session.
6) The main computer should be logged on and ready for your session. If not, the usercode and password will be taped to the lecturn. The system takes a few minutes to get started, so give that task priority.
7) Make sure the data projector is set to the session's introductory slide, which contains hot-links to the speakers presenting. Check that the pointer is present and working.
8) The projector should be going and projecting, and the lighting will initally be up. Check that you know how to turn the lighting down. There is usually a button on the lecturn screen which controls the lighting.
9) Please check for any messages which the conference organisers need to be passed to the audience, and make any necessary announcements as briefly as possible.
10) Ensure the timer/clock is set up and is visible to you and the speaker.

Running the session

11) Introduce the session theme, and if appropriate, acknowledge the session sponsor.
12) Introduce each speaker when it's their turn. Please keep your introduction to 15 seconds or less per speaker, so their talks can begin.
13) Hold the card up when there is 2 minutes to go, and stand up when the speaker needs to conclude. It is important that the audience gets a chance to give feedback.
14) Immediately initiate the question time, scanning the audience for hands constantly, and clearly indicating which questioner has the floor. Keep the questioner as brief as possible. A microphone is available in AH1 for questioners.
15) If a speaker finishes early, don’t start the next talk. Invite questions on previous talks until it’s time for the next speaker, or even just have some quiet time for thinking.
16) Sometimes a question session is slow starting, so have a straight-forward, open-ended question ready for the speaker, to get the discussion flowing. Sometimes a speaker might indicate something they think could sensibly be asked to initiate discussion.
17) Thank each speaker at the end of their talk, and give the audience a chance to applaud.
18) Then allow a quiet 2 minutes for those who wish to change to other rooms. During this time check that the previous speaker's talk has been closed, and that the session ppt slide has automatically reappeared.
19) At the end of the session, make any other annoucements needed, and give general thanks to all who have participated.

THANKS TO YOU!

Excursions

Departures are from outside the Ag Hort Lecture Block, on the courtyard side.

You need to book in advance for these excursions. Check at the Registration Desk early in the conference if you wish to see if there are vacant places.

Manawatu bush remnants and restoration projects

Departing 9:00am

This excursion will visit several local remnants, starting with the Atawhai Road planting of Michael Greenwood, where he pioneered his ideas on growing native vegetation. Then it will visit the privately owned reserve of Keeble's Bush, a 17 ha reserve of lowland podocarp forest which is not open to the public, for inspection of the Bush itself and its associated restoration plantings, some of the best in the country. The excursion will finish with a visit to nearby Kahuterawa Bush, with discussion about the planned restoration of this 70ha block along the Kahuterawa Stream, as part of a major biodiversity project. Lunch is at Wharerata.
Leaders: Keith Young and Roger Purchas

Managing invasive plants of the Volcanic Plateau

Departing 8:00am

A number of sites will be visited on the Central Plateau to look at progress on biocontrol of heather and work being proposed for the control of legumes (broom, gorse and tree lupin). Heather beetle *Lochmaea suturalis* is now established at several sites in and around Tongariro National Park and sites visited will show the impressive damage that this control agent is capable of. The visit will also include sites where nitrogen has been applied to heather to enhance beetle establishment and an experimental plot where the impact of biocontrol on the existing plant community has been compared with that of herbicide treatment. We will visit legume sites and discuss some of the work being done to control spread including a major initiative by several regional stakeholders to map and manage the invasion. If time allows we may visit an old man's beard site at Taihape. Lunch is at Chateau Tongariro.
Leaders: Paul Peterson and Paul Barrett

Manawatu River estuary and beach

Departing 8:00am

The Manawatu River estuary is recognised as a site of national importance to shorebirds, including iconic migrants such as the Bar-tailed Godwit, which breeds in Alaska then makes the longest known migratory flight of over 11,000 to New Zealand. Colour-banded godwits at the estuary have been the focus of detailed studies into their migration pathways and annual routines. Shorebirds will be viewed at high tide, conveniently timed for 9am, and a trip made upriver into 'Fernbird Flat', a large wetland in private ownership, home to the endemic, furtive fernbird. After lunch we will take a drive along the beach to the nearby Foxtangi dune system, to see some of the most rapidly prograding transgressive sand dune systems in the world, which represent extremely difficult areas to conserve. Jill will take visitors to see drying ephemeral wetlands and some wetlands on private land with extensive areas of rare turf species. A side trip into the back of the dunes may allow a meeting with the extremely endangered *Pimelea actea*. Lunch is at Simply Balmy cate.
Leaders: Phil Battley and Jill Rapson

Ecology of Manawatu rivers and streams

Departing 9:00am

The Manawatu River is notorious in the public media, because of its claimed high levels of pollution. This trip will visit a number of freshwater sites in the Manawatu to look at water quality issues in both rural and urban streams (and a lake if time permits). Electrofishing techniques and fish identification will be demonstrated at some sites where native fish persist in reasonable numbers. Issues around flood management of the Manawatu River will also be included in the day's outing. Lunch is at Murrayfield café.
Leader: Mike Joy

Symposia

Invasive pest management Tuesday, Wednesday morning: AH1

Organiser: Paul Barrett

The symposium is planned to include speakers covering biological control of invasive weeds and pests through the use of insect or pathogenic agents. This session may also include chemical control of weeds as well as mapping, GIS and modelling of invasions or control programmes.

Border biosecurity stocktake: Invasions of invertebrates and pathogens Tuesday: AH1

Organisers: Ecki Brockerhoff, Beccy Ganley and David Teulon

This symposium will explore invasion trends in New Zealand and other countries, highlight case studies, and review ecological impacts and opportunities for improving border biosecurity to reduce the rate of future invasions.

Metagenomic approaches to understanding ecosystems and biodiversity Tuesday morning: AH2

Organisers: Jamie Wood and Ian Dickie

Metagenomics from substrates such as soil, sediment, water, faeces can provide important insights into patterns of biodiversity and ecosystem function. This symposium is devoted to presentations that focus on metagenomic techniques and technology relevant to ecology.

Hybridisation: invasion, assimilation, adaptation Tuesday morning: AH3

Organiser: Mary Morgan-Richards

Species invasions and hybridisation are linked in a number of ways. Some invasive species are the product of hybridisation, and some invasions have resulted in the production of novel hybrids. The invasion of the genome has the potential to harness valuable genetic diversity with positive adaptive outcomes, but might also result in the loss of genetic purity. This symposium will focus on the assimilation of foreign genes in a range of systems and the advantage that hybridisation might confer on potential invasive taxa.

De-extinction Tuesday afternoon: AH2

Organisers: Phil Seddon and Phil Battley

Technological advances have opened up the prospect of species de-extinction, the resurrection of extinct species. DeExtinction recently burst upon the public scene prompting vigorous debate over this radical new conservation approach.

Cells to canopies Tuesday afternoon: AH3

Organizers: Alicia Donnellan Barraclough, Jarrod Cusens and Sebastian Leuzinger

From cells to canopies, plants are key players in the Earth's biogeochemical cycles. Our knowledge of plant physiological ecology continues to advance at a great pace, largely due to new methods that allow novel insights into both small scale processes at cellular or tissue level, and large scale ecosystem fluxes. The integration of this knowledge into ever improving ecosystem models is key to our understanding of ecosystem responses to a changing climate. This symposium will explore the latest developments taking place in New Zealand, allowing researchers to address key questions about how plants function and how vulnerable our ecosystems are to a changing climate.

Restoration of vegetation Wednesday morning: AH3

Organiser: Tessa Roberts

Ecological restoration requires the need to replace and suppress invasive species on site. This symposium aims to look into the challenges involved in reversing the native: exotic ratio and present some scientifically sound yet practical solutions.

Evolutionary ecology Wednesday: AH2

Organiser: Lizzie Daly

This symposium explores the interplay between the ecological causes of evolution and the evolutionary implications of population and community processes, with a focus on palaeontological or other historic data, including use of molecular tools.

General symposia

Avian ecology	Mon: AH2		
Waterways	Mon: AH2	Conservation	Tues: AH4
General vegetation	Mon: AH3	Native/exotic interations	Wed: AH1
General invasions	Mon: AH4	Communities	Wed: AH3

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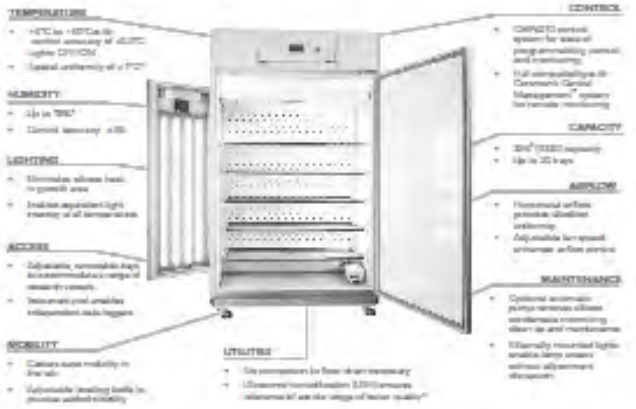

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Plenary speakers

Abstracts

Abstracts are in alphabetical order of the author's surnames.

Phill Cassey

Biological invasions of vertebrate species: pets, pests and people

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Alien vertebrate species are highly conspicuous around the world, and are a particularly costly component of human-induced global environmental change. Most of the successfully established vertebrate 'pest' species are a legacy of the bygone activities of European Acclimatisation Societies during their settlement of the New World and colonies, and the ensuing transport to-and-fro. The activities of these societies have now largely ceased and the dominant transportation of new alien vertebrate species is through their trade and keeping as pets, most often illegally.

I will discuss some of the key contributions to the discipline of 'Invasion Biology' that have arisen from the study of alien vertebrate species, and the use of comparative historical data from the Acclimatisation Societies more generally. The species introduced by the Acclimatisation societies have helped rigorously conceptualise the quantitative analysis of the invasion pathway; from transport and introduction through to establishment and spread. However, these 'Acclimatisation species' are very different from those species which are now being transported and traded as new emerging alien vertebrate species. It is unclear, therefore, how our previous analyses and findings will stack up and compare when applied across these new invasive alien species.

As a society and discipline, we are often focussed on investing increasingly diminished conservation and biosecurity funding towards established alien vertebrate pests. If we do not invest more in novel approaches and technologies for detecting (and managing) emerging pest species we may well find ourselves dealing with a whole new suite of environmental vertebrate pests for which we have very little experience at controlling, let alone eradicating.

Rachel Gallagher

Invasive species in a changing climate

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Invasive species and anthropogenically-induced climate change are two of humankind's most destructive legacies. Although both are potent drivers of global change when considered in isolation, the potential interactions between changing climate and the dynamics of invasive species present complex challenges for biological systems into the future. But how likely is it that already established invaders will benefit from climate change more than will native or even other non-native, introduced species? I argue that finding answers to this question in local, regional and global contexts will determine how effective our attempts to manage and ultimately protect communities and ecosystems from further invasions under changing climates will be.

An emerging paradigm is that invasive species, in particular weeds, will benefit from climate change by virtue of their typically wide environmental tolerances, phenotypic plasticity and dispersal capacity. This idea implies that native species will continue to be out-performed by invaders under future climates, setting up a somewhat simplistic winners and losers' mindset about how climate change may differentially affect natives and exotics. A large body of research has now accumulated making it possible to look for evidence of systematic differences in the potential responses of native and invasive species to climate change. In general, this evidence suggests that the direct effects of changing climate on plant growth (e.g. increasing temperatures, altered rainfall patterns, elevated CO_2 concentrations) will not necessarily benefit invaders any more than native species. However, I argue that the indirect effects of climate change on vegetation, in particular shifts in the frequency and intensity of established disturbance regimes (e.g. fire, floods, cyclones), are likely to facilitate new invasions by reducing the resilience of native plant communities.

A weed invasion is rarely the result of a single, isolated process. Rather, invasions occur when a collection of factors, such as disturbance, suitable climate and soil conditions, and high propagule pressure, act in concert to propel an introduced species along the invasion continuum from introduced, to naturalised, to invasive. Similarly, under future climates, a combination of drivers will determine how well native plant communities can continue to resist invasion.

Four areas are of particular importance when considering how native plant assemblages may become more susceptible to invasion as climate changes: demography, competitive interactions, successional trajectories, and enemy release. For instance, predicted increases in the severity of climate extremes (e.g. cyclones, heatwaves) may increase colonisation opportunities for weeds in intact native vegetation by promoting tree-fall or increasing mortality of climax species. Invaders which typically disperse widely and grow rapidly in highly resourced environments such as canopy gaps are likely to be advantaged by these opportunities. Therefore, improving the ability of native communities and ecosystems to resist the establishment of exotic species under future climates will be key to protecting the integrity of native vegetation. Enhancing resilience is particularly important for heavily invaded regions, like New Zealand and Hawai'i, where protecting limited areas of intact native vegetation from invasion is a high priority for conservation.

Planning for the effects of climate change on future invasions needs to begin now. Many opportunities to reduce the impact of invaders on native ecosystems over the coming century will be built on the back of the science that we are currently undertaking. Our challenge is to think ahead whilst looking back; to use our understanding of past invasions to inform the decisions which will shape the future of weed management as climate changes. Finally, we need to make connections to industry, government and the public in order to share our knowledge so that we can influence measures aimed at protecting or restoring biological systems at all levels, from local to global.

Chris Johnson

Biological invasions, trophic cascades and extinction – the view from Australia

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Australia holds the dubious record of the highest rate of mammalian extinctions in recent world history. This loss of species is primarily due to the effects of invasive predators. I argue that the impacts of these recent invasions is best understood in the light of ecological changes that have unfolded since the first arrival of people, about 50,000 years ago. Extinction of the Pleistocene megafauna, which followed human arrival, caused many ecosystem changes, one of which was the loss of top-down control by large predators. This effect was amplified during the Holocene, when growth of the human population was associated with, and may have caused, extinction of other marsupial carnivores. Australia's history of 'trophic downgrading' left the continent open to recent invasions of mesopredators. Management of these mesopredators is a major challenge for biodiversity conservation in Australia. Restoration of the function of top predators should be part of our strategy for meeting that challenge.

Maurine Neiman

Sex in the Wild (and especially in New Zealand)

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I will begin with a broad overview of the evolutionary puzzle posed by the overwhelming predominance of sexual reproduction in nature. I will then introduce my snail study system and explain why this tiny New Zealand “mud snail” is such a great model for understanding the maintenance of sex. After a brief foray into my group’s genome project and genomics research, I will focus on whether costs associated with polyploidy – extra genome copies within cells, which characterizes most asexual organisms – can help to explain why sex is so common. I will present data indicating that while these costs are likely to exist, they might only be evident under stressful conditions. I will emphasize our focus on evaluating connections between costs of polyploidy associated with building additional chromosomes when the environmental availability of the nutrients (e.g., phosphorus) that DNA is comprised of is low.

James Russell

Is New Zealand the world's eradication hotspot?

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New Zealand has a proud and enviable track record in eradication of invasive species. In 2014 we celebrate 50 years of rodent eradications (Norway rats from Maria Island in the Hauraki Gulf), and in 2015 we celebrate 100 years of ungulate eradications (goats from South East Island in The Chathams). But just how far have we come with eradications, how much further is there to go and how do we stack up against our international counterparts?

In 1964, 0.5% of New Zealand's offshore island area (i.e. excluding the principal North and South Islands) was free of introduced mammalian predators. This is typical for most archipelagos around the world (e.g. British Overseas Island Territories, Western Indian Ocean Islands). In the fifty years following we have increased that mammal-free island area to 10%, by eradication or natural die-off of mammals from over 100 islands (about a third of New Zealand's offshore islands). Although 10% of the total island area is not large, it may be a useful international target for pest-free offshore island areas for other countries to aim for, such as with marine reserve targets.

The size of islands from which rodents have been eradicated increased by an order of magnitude every decade from 1964 (1 ha) through to 2004 (11,330 ha Campbell Island), but has plateaued since then. This is not due to a lack of islands to eradicate introduced mammals from; instead the 'wall' appears to be the challenge of pest management on inhabited islands. Attitudes to pests and their control is playing an ever more important role in conservation decision-making. Eradication of invasive predatory mammals from Aotea (Great Barrier Island) and Rakiura (Stewart Island), would increase offshore island predator-free area to over 50%, and follow our Moore's law [the equivalent of the doubling of the number of computer transistors per circuit every 2 years] for island eradications. The remote and uninhabited Auckland Islands are also a clear target for invasive mammal eradication. When we compare our performance in island eradications, we have undertaken about 30% of all attempts worldwide, over twice as many as our neighbour Australia, and six times that of the United States, Mexico, or the Falkland Islands.

All these statistics exclude the principal North (Te Ika a Maui) and South (Te Wai Pounamu) islands of New Zealand. This is despite the fact that recent research suggests island conservation will need to focus on larger islands to mitigate the threat of climate change. On these principal islands some level of invasive mammal management occurs over 45% of land area, comprising pest surveillance and occasional aerial control by 1080, for both agricultural and conservation goals. However, intensive management of invasive mammals to zero density, particularly through predator-proof fences, only currently occurs across 0.25% of the principal islands (56 eco-santuaries). The Predator-Free New Zealand concept aspires towards removal of eight species of invasive mammal (3 mustelids, 3 rats, 1 mouse and 1 possum) across the whole of New Zealand. This bold goal would require up-scaling island eradication technology from islands, to fenced sites, to peninsulas, and finally to non-fenced sites. As we move towards such a goal, the distinction between a one-off island eradication and management to zero-density becomes less and less clear.

Beyond mammals, exciting advances in eradication of other species are also emerging. As for mammals, these advances are based on a solid scientific foundation of understanding the population biology of the target species to optimise control timing and methods. Bird and plant eradications have been recorded, while ant eradication is on the horizon. However, much more work is required on control and eradication of the whole suite of highly invasive species in New Zealand.

Ken Thompson

Invasive alien species; getting the measure of the problem

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There is no doubt that some alien species are an environmental and economic problem. But the world faces worse problems; aliens do not make the top three. In allocating scarce resources to dealing with all the problems we face, we need to make sure we confront only the worst invasives, and ideally those where intervention has a realistic hope of making a difference; treating *all* aliens as targets for control or eradication will not do. Here are some of the things we need to think about:

1. Don't panic. Invasions often go through an initial phase of rapid expansion, but then things settle down, and sometimes the invader even declines without any intervention. This must often be due at least partly to evolution of both the invader and the invaded community. So although early intervention is often recommended, this is not always a good idea. Things would be simpler if we were better at predicting which species will become invasive, but we are not good at that.
2. Follow the money. When the 'cost' of an invasive species is quoted, always check that those costs are real, rather than imaginary.
3. Look at the whole balance sheet. NZ agriculture depends almost exclusively on exotics, so across all alien species, the balance sheet is well in the black. No species is *all* bad. Your decision about whether attempted control makes sense may look different if you add up the costs and benefits of an alien species, rather than just focusing on the costs.
4. Attack the cause, not the symptoms. Given the wholesale transformation of the environment by humans, it's hardly surprising that the original native species are not always well adapted to the new conditions. If an invasive species is merely a symptom of an underlying environmental problem, control is unlikely to work.
5. Choose the right target. Focus on species that can be demonstrated to be causing real harm, and where some measure of control looks feasible. Do not go after species that just happen to be ugly, conspicuous, or the subject of a media campaign. NZ may be better at this than some places, but nowhere gets it right all the time.
6. Consider doing nothing. Many of the world's most successful aliens are early-successional species that thrive on disturbance; heavy-handed attempts to control them may well simply create more of the conditions that led to their success in the first place.
7. Finally, be realistic. What are you trying to achieve? If success involves recreating the Pleistocene, then you're going to fail.

Janet Wilmshurst

The history and enduring legacy of early human impacts on the vegetation of New Zealand's subantarctic islands

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The subantarctic Campbell, Auckland and Snares islands of New Zealand, lying far south of New Zealand, are recognised by UNESCO as World Heritage Sites for their unique fauna and flora. These remote, cool and wind-swept islands have attracted many human visitors since the mid-13th century when Polynesians first discovered the Auckland Islands. Although the subantarctic islands may appear pristine, history and pollen based vegetation reconstructions from the peat covered islands reveal a different story. After European discovery of the islands in the early 19th century, brief but intensive periods of exploitation and settlement marked the onset of major changes to the biota. Sealing, sheep farming, tree felling, fires, and the introduction of a range of exotic mammals and plants have all left enduring legacies.

I will present long-term vegetation histories from the islands alongside historical and photographic evidence to show how early European activities on the subantarctic islands have transformed the vegetation. Even brief sojourns on the islands have fundamentally changed the biota, and in many places it is still in the process of recovery. In particular I will show how vegetation records have resolved the invasion status of the tree daisy (*Olearia lyalli*) on the Auckland Islands; whether the recent *Dracophyllum* scrub expansion on Campbell Island has been driven by warming climates or is just recovering after the end of farming activities; and the vegetation history of the Snares. This work highlights how examining the past can provide useful insights and a longer temporal context to help inform current vegetation patterns and their future trajectories.

Offered talks

Abstracts

Abstracts are in alphabetical order of the author's surnames, even if not the presenting author, who appears in bold type and in the image.
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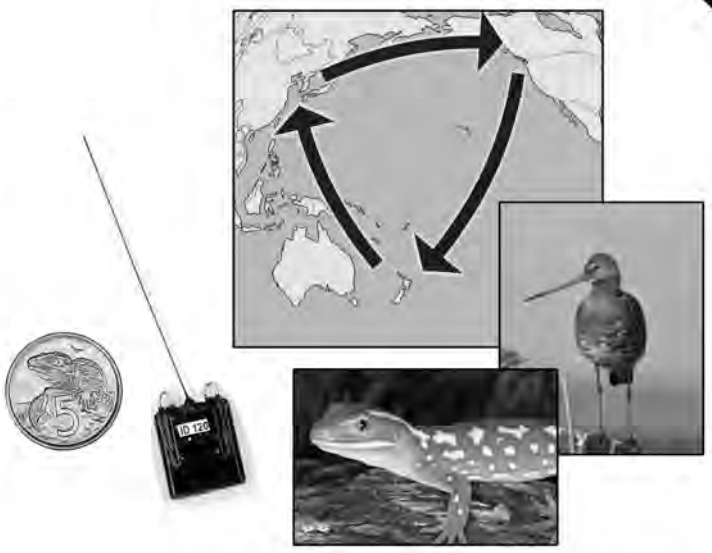

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Bird pollination in temperate ecosystems: is New Zealand the exception or the rule?

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For bird-flower mutualisms to evolve, current theory suggests two main requirements: (i) bird species should be specialised to feed on nectar, and (ii) plants should have specifically adapted 'ornithophilous' flowers. These characteristics are rarely found in temperate ecosystems, where it has long been assumed that insects provide most pollination services. However, it has become apparent that birds may be more important pollinators in these ecosystems than first thought. Notably, many New Zealand plant species once assumed to be pollinated by insects actually depend on native avifauna for their best seed set.

Bird pollination is considered uncommon in temperate areas globally and practically absent in Europe. However European passerines introduced to New Zealand readily visit native nectar-bearing flowers, and birds native to New Zealand also visit introduced plants of European origin that have nectar-bearing flowers. This study in the U.K. investigates whether the interactions between birds and flowering plants there have been overlooked and asks whether the New Zealand situation is the exception, or in fact the rule.

Decision theory meets Frankenstein: extending advances in reintroduction biology to resurrected species

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Advances in DNA technology have raised the serious prospect of resurrecting extinct species. People may recoil at the uncertainty involved in attempting to reintroduce such organisms to the wild. However, most reintroductions are fraught with uncertainty, and despite this we have done hundreds in New Zealand alone. Although all population management is subject to uncertainty, reintroductions are inherently problematic because the species has usually not been observed at the candidate site(s) prior to release, and we usually have a poor understanding of how to measure habitat quality.

Resurrected species would bring new uncertainties, partly because of unknown differences from their extinct brethren, and partly because the original species have not been observed in modern times. However, these only add to multiple levels of uncertainty that may exist with reintroductions of any species. While these uncertainties have traditionally been dealt with intuitively, advances in methodology over the last decade now allow us to explicitly confront uncertainty and optimise decisions in the face of it. In particular, structured decision frameworks provide methods for dealing with multiple objectives and varying attitudes to risk, and Bayesian hierarchical modelling provides methods for making explicit predictions about reintroductions to new sites and reintroductions involving new species. We will discuss how these methodologies could potentially be applied to proposed reintroductions of resurrected species, using the huia and kawekaweau as examples.

The origin of species in towns: A comparison of the vegetation of 11 towns in the North Island with other towns worldwide

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The regions of settlements are formed and adjusted by human activities. The result is natural habitat disappears and young habitat starts with a new composition of diaspores of foreign species introduced accidentally or on purpose and not merged indigenous species. In Europe most of the invaders only play a short role. Only 10% persist and from this, 10% stay for longer and become neophytes. For more than 3000 years, man coexists with useful and accopanying plants. So the surviving species are very well fitted for human activities. Sometimes a new genetic combination creates a better adaptation - called waif or neogenetic species. The most frequent species in settlements are integrated by this group.

In New Zealand urban floras look quite different. Where are the native species, that survive in town conditions? Only 12 % of the species found in urban areas are natives. And from them only 10 species are annuals with a short turnover.The average flora of Central European towns has 60% natives, 15% archaephytes and 25% neophytes. To draw comparisons the 50 most frequent species of the towns were considered. So towns in North America have 20% natives and up to 40% European species. In Yokohama almost the half of the species are natives and in Europe 66-75% are natives. Outlook: Some of the aliens are only in the beginning of urbanisation and will disappear after a while and properly apophytes will stay. But where are the native apophytes of New Zealand?

Does size actually matter? Disruption of plant-bird mutualisms in fragmented landscape affects breeding systems of a native tree in isolated patches

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In New Zealand, there is interest in whether native bird densities have declined so much that pollination and seed-dispersal services to plants are failing, especially in small forest remnants. I aim to detect a threshold area and isolation level under which the lack of interactions with birds adversely affects breeding systems of native plants. Through geospatial analyses I calculated effective patch sizes and connectivity indexes of 17 forest fragments on Banks Peninsula, ranging from small private covenants to large nature reserves, and in size from 2.8 ha to 1100 ha. There I measured bird densities using 5 minute counts and found that habitat isolation rather than area affects bird densities, diversity, and presence of native birds. The bird-pollinated, bird-dispersed tree Fuchsia (*Fuchsia excorticata*) is prone to inbreeding depression, pollen and seed limitation. Using the National Pollination Survey's method to measure pollen deposition on Fuchsia flowers, I found that pollination scores of females were insufficient in most sites, which suggests that hermaphrodites are likely experiencing high selfing rates there. Fruit removal was measured as a test of dispersal service, and results show that removal rates increase with site connectivity and native bird densities. Germination trials have been set up to detect inbreeding depression, while microsatellite genotyping will allow assessing mating patterns in each site, including selfing rates and extent of pollen dispersal.

Ecophysiological traits of two dominant New Zealand tree ferns

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Tree ferns dominate the understory of many New Zealand forests, suggesting a keystone role in ecosystem functioning, yet very little is known about their physiological ecology. Here we examined gas-exchange in fronds of two predominant species *Cyathea dealbata* (G. Forster) Swartz 1801 and *Dicksonia squarrosa* (G. Forster) Swartz 1802 in the lab and in the field growing in the understory and at the edge of a lowland podocarp-hardwood forest in the central North Island.

Both ferns showed very low dark respiration rates < 0.5 μmol m^{-2} s^{-1} resulting in remarkably low light compensation points (LCP) < 6 μmol m^{-2} s^{-1}, regardless of habitat light conditions. The low LCP translates into a maximisation of the daily effective photoperiod, which together with low respiratory carbon (C) losses, enables these plants to maintain a positive C balance in the strongly light-limited forest understory where maximum daily photosynthetic rates rarely exceeded 1.5 μmol m^{-2} s^{-1}. Probably in response to strong stomatal limitation (42 – 52%), *D. squarrosa* maintained high nocturnal stomatal conductance (g_s) thereby boosting early-morning CO_2 uptake but then showed low g_s during the day, whereas *C. dealbata* displayed unusually high daytime g_s and complete stomatal closure at night. This combination of functional traits seem to partially compensate for the relatively low light-saturated photosynthetic rates (6 – 9 μmol m^{-2} s^{-1}) compared to flowering plants and may thus confer a competitive advantage contributing to the tree ferns' tremendous success in New Zealand forest ecosystems and also in open habitats, where both species (*D. squarrosa* in particular) are vigorous colonisers.

Control of ferrets using 1080 and PAPP in baits and a resetting toxin delivery device

Barun, Arijana[1]; Murphy, Elaine C[1, 2]; Sjoberg, Tim[1]; MacMorran, Duncan B[3]; Aylett, Paul[3]
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Ferrets *(Mustela furo)* are widespread in pastoral habitats and are considered a vertebrate pest because they prey on native birds. Also, ferrets are carriers of bovine tuberculosis (TB, *Mycobacterium bovis),* and TBfree New Zealand currently controls ferrets by labour-intensive and costly trapping. A Lincoln University research programme, 'Pest Control for the 21st Century', funded by the Ministry of Business, Innovation and Employment seeks to advance more humane and effective tools for vertebrate pest control. As a vital part of this programme the new toxin para-aminopropiophenone (PAPP) is being developed for multiple vertebrate pests. With our partners (Connovation Ltd), we have developed a self-resetting delivery device, the Spitfire, which sprays 800 mg of toxic paste onto a pest's belly. Both PAPP and 1080 have been trialed in a Spitfire for ferrets. Ferrets were found to groom the paste from their bellies and consume a lethal dose. We have also trialed encapsulated PAPP delivered in minced beef to ferrets. Encapsulation prevented vomiting, allowing a lethal concentration of PAPP to be absorbed across the gut. We achieved mortality in 14/15 (93%) ferrets in laboratory trials and field trials are planned. The goal of this research is to provide information on the effectiveness of these new tools to enable registration, and to add to the toolbox of control methods currently used for ferret control.

Exotic dung beetles in New Zealand: evaluating potential benefits and risks

Bassett, Imogen E; Waghorn, Tania[1]; Leathwick, Dave[1]; Beggs, Jacqueline R[2]
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Introductions of new species of exotic dung beetles in recent years have sparked debate over whether potential agricultural benefits outweigh the risks of novel species' introductions. Overseas research shows that the magnitude and direction of dung beetles' effects on dung decomposition rates and dung invertebrate fauna are variable among ecosystems with different fauna, soils and climates, thereby constraining the usefulness of generalizing from overseas results to New Zealand's situation.

We experimentally excluded the introduced Mexican dung beetle (*Copris incertus*) from fresh dung to assess their effects on dung decomposition rates, nematode abundance and macroinvertebrate communities in northern New Zealand. Here we present preliminary results for decomposition and nematode abundance. Dung beetles were associated with a small but significant increase in dung decomposition over the duration of the experiment. However dung beetles also showed a weakly positive (but highly significant) association with abundance of nematodes in dung and surrounding herbage. Results to date suggest Mexican dung beetles confer both benefits and costs to New Zealand farmers, but that both of these effects are relatively weak. We will discuss these results in the context of risk analysis for novel biological control introductions.

Why do godwits migrate when they do?

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Bar-tailed Godwits show a high level of individual consistency in migration timing, with birds typically migrating north from New Zealand within the same week in March each year, even though the population departures span a month. We have monitored individual departures for 7 years at the Manawatu Estuary and 2 years at Catlins lake, Otago, and used geolocators to track birds to the breeding grounds. The reason for a wide range of departure dates is geographic – early migrants breed in the south of Alaska while late migrants breed further north, and their timing is 'refined' during stopover in Asia. Wind conditions play a role in the day-to-day departures, but the patterns of departures in the Manawatu and Otago sites indicate an underlying population structure within New Zealand godwits that has not been fully recognised. Current work is aimed at elucidating the mechanistic basis by which individuals maintain consistently different migration timetables.

Adaptive introgression in New Zealand alpine *Pachycladon*

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Plants may respond to environmental change by relying on standing genetic variation, *de novo* mutations or interspecific gene flow. The idea of adaptive introgression being a means for plants to acquire novel mutations is not new but evidence for this has been limited to very few examples. We have recently reported introgression of defense genes between closely related species of endemic New Zealand alpine cress (*Pachycladon,* Brassicaceae) and put forward the hypothesis that this might have allowed adaptation to changes in herbivore communities during several glacial cycles (Becker et al, 2013). The defense gene products determine the type of glucosinolate hydrolysis product being formed and are presumed to affect the fitness of interacting herbivores and pathogens.

We found introgression-mediated replacement of potentially non-functional alleles with functional alleles and in one instance, even observed recombination within the coding region. To further investigate the extent of introgression in natural populations of *Pachycladon*, we sequenced the genomic regions harbouring the defense genes.

This talk will summarize our findings on introgression and comparisons of candidate genomic regions. An outlook will be given on how genomic resources will be used to study adaptive introgression and the molecular evolution of glucosinolate hydrolysis in the young and fast radiating genus *Pachycladon*.

Measuring ecosystem restoration success in Auckland's Regional and Local Parks

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The Auckland Council is directly involved in the restoration of indigenous habitat in the region's regional, local and sports' park networks. Council also indirectly supports restoration activity by many community groups. Despite considerable expenditure on restoration activity by council in recent decades, there have been few attempts to quantitatively assess 'restoration success' in the Auckland Region. Formation of the Auckland Council in 2010 resulted in the commencement of several more detailed quantitative studies of the success of forest and wetland restorations within the region.

Forest restorations in east coast regional parks were assessed using indicators of vegetation composition and structure. The structure and species' composition of planted sites converged on that of remnant forest with increasing age of planting. Native species' richness also increased with planting age, and exotic species' richness, original planting composition and distance to remnant forest had no significant effects on species' recruitment to planted sites. Data from regional wetland monitoring programs also highlighted some key differences between natural and restored wetlands. Restored urban wetlands had significantly greater numbers of exotic plant species per plot, and significantly higher biomass of exotic species, compared to natural wetlands. Auckland's regional state-of-environment monitoring programme has been extended to include ongoing monitoring of representative restored indigenous habitat and the outline and future analysis of these data will also be discussed.

‘PAWS’ – Print acquisition for Wildlife Surveillance

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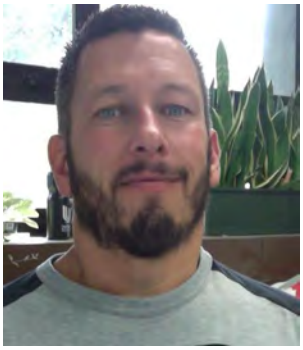
The ability to accurately monitor pest populations and detect invading (or reinvading) species is a critical component of invasive species' management and biosecurity. However, many current detection and surveillance techniques fall well below optimal requirements.

The PAWS (Print Acquisition for Wildlife Surveillance) system has been designed as a new field tool for distinguishing and recording different animal species interacting with a long-life device. The aim of the device is to improve detection and monitoring for species of concern, whilst reducing labour costs and the need for data interpretation.

Trials have already shown we can accurately identify close to 100% of key NZ mammalian pest. With recent advances, we are now focusing on applicability for tracking other invasives, such as plague skinks (aka rainbow skinks). User-friendly software and a mini camera module are now being installed to increase applications of this tool, and extend its use to the wider community. Examples of these developments and their applications are provided.

Rare or just overlooked? Conservation of species we know nothing about



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In New Zealand, species are classified according to their threat of extinction using the New Zealand threat classification system, with species being classified as ‘Nationally Critical’ (e.g. the kakapo) down to ‘Not Threatened’ (e.g. the nikau palm). If little is known of the distribution, population size and ecology of a species, it is not possible to assign a threat status to it, and the ranking of ‘Data Deficient’ is used, making it difficult to conserve what could be a threatened species.

Lichens were the last major group of organisms to be classified in New Zealand. Of the 1799 different lichens reviewed in 2009, 975 were so poorly known that they were classified as ‘Data Deficient’, with many of them only known from one or a few sites. Our research is focusing on those species that appear to be largely restricted to the Auckland region, including one that was only collected once, from Anawhata, very close to New Zealand’s largest city. The Department of Conservation has funded 2 years of our research into a handful of these species with a view to moving them into a defined threat category. The Auckland Council and Te Kawerau a Maki have recently permitted our research into species found on the coastline of the Waitakere Ranges. This presentation will review some initial progress in rediscovering and assigning threat rankings to some of our least-known native organisms.

Below-ground invasion, the coexistence of exotic and endemic earthworms in New Zealand soils

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New Zealand has 23 exotic and more than 200 endemic earthworm species. It has been reported that endemic earthworms disappeared quickly from agricultural systems due to environmental changes and soil disruption through agricultural practices. However, little is known about potential competition between endemic and exotic earthworms in New Zealand, and the capacity of exotic earthworms to also colonise native habitats. Using three sites in the South Island, we investigated the impact of aboveground vegetation (exotic vs endemic) on earthworm communities. The study sites were Bankside Reserve (Canterbury Plains), a 2.6 ha dryland reserve surrounded by dairy farms, Quail Island (Banks Peninsula), which has been undergoing native plant restoration for more than 30 years, and the Punakaiki Coastal Restoration Project (West Coast) where 130,000 native trees have been planted in retired pasture in the last seven years. In the Bankside reserve we detected incursions of exotic earthworms throughout the reserve, while endemics were never found in the pasture. In Punakaiki and Quail Island, sequential restoration plantings revealed that recolonisation by endemic earthworms increases with time after restoration. The biomass of endemic earthworm significantly increased with restoration age, and at Punakaiki, abundance did also. However, in both cases, exotic species did not disappear after restoration of native vegetation, leading to the cohabitation of the two assemblages and potential for interspecific competition.

When do plant radiations influence community assembly? The importance of historical contingency in the race for niche space

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Plant radiations are widespread but their influence on community assembly has rarely been investigated. Theory and some evidence suggest that radiations can allow lineages to monopolize niche space when founding species arrive early into sites and exploit ecological opportunities. These early radiations may subsequently reduce niche availability and dampen diversification of later arrivals.

We tested this hypothesis of time-dependent lineage diversification and community dominance using alpine vegetation data from the Murchison Mountains. We estimated ages of focal genera from published phylogenies and determined their environmental occupancy and relative occurrence across elevation and precipitation gradients.

Our analysis suggested that earlier-colonizing lineages encountered a greater availability of environmental space, which promoted diversification and greater niche filling. We thus show that radiating plant lineages dominate community assembly when they are derived from early-arriving ancestors. This is because earlier arrivals have priority over niche space, and subsequently diversify within it, thereby excluding later-arriving colonists from ecological communities by niche pre-emption.

Mamaku: *Cyathea medullaris* – pioneer and forest engineer?

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The presence of dense stands of *Cyathea medullaris* across the landscape of northern New Zealand is a relatively common occurrence on steep slopes and particularly on areas of recent disturbance such as landslides. We investigated under what abiotic conditions and disturbances such stands eventuate and their influence on successional trajectories.

Tree fern stands strongly influence the establishment and growth of woody species under their canopies by providing high levels of shade, damaging macro-litterfall, and developing deep litter layers around them. Furthermore, tree ferns deposit relatively high levels of nitrogen and phosphorus in their litter. Therefore, tree ferns have a significant role in the growth and survival of associated species and in influencing soil nutrient dynamics in early forest communities with concomitant effects on later successional tree composition.

Data from 106 vegetation plots from across the Auckland region have been analysed to identify successional trends associated with tree fern dominated systems compared to those dominated by *Kunzea ericoides*. *C. medullaris* stands appear to lead to stands dominated by angiosperms such as tawa, kohekohe, taraire, whereas *K. ericoides* stands lead to kauri, tānekaha, māmāngi. Assays of soil samples taken from randomly selected plots show the influence of *C. medullaris* on nutrient cycling. Soils under *C. medullaris* were more fertile than those under *K. ericoides*, and had little to no charcoal, suggesting that such stands do not establish after fire.

Invasions of forest insects and pathogens in New Zealand

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New Zealand is well-known as a hotspot of invasion by mammals, birds and plants; however, there is no shortage of invasive alien invertebrates and plant pathogens. We have particularly good information about invasions of herbivorous insects affecting forest trees with records going back to the 1840s. More than 250 species of herbivorous forest insects are known to be established in New Zealand. In the last century, their rate of invasion across the border was about two species per year. Although most of these insects have not become serious pests, a few are notable for their economic and environmental impacts. Records of invasive alien pathogens affecting forest trees were first made in the early 20th century, and complete records have been kept since 1981. Nearly 100 such forest pathogens (fungi, chromists and viruses) were detected since then, including some high-impact pathogens.

In this presentation, temporal trends of such invasions and their region of origin will be reviewed and compared with similar data from other countries. Case studies for some of these species, especially those with notable impacts, will be presented. Introduction pathways and relationships with international trade will be explored. Finally, the likely causes of the relatively limited ecological impacts on New Zealand's native species and natural environment will be considered.

The folly of charismatic methods: bird perches

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"The discipline of restoration ecology [provides] a litmus test for applicability of ecological theories to practice ... At the same time, restoration ecology is a subject of skepticism as an emerging science." (Choi, 2007)
Bird perches are a charismatic mega-ornamental restoration method. Early successes piqued interest in them in the 1990s, but perches had not been trialled and documented in New Zealand prior to this experiment. We tested whether bird perches in Awarua-Waituna wetland, Southland, increased arrival of bird-dispersed forest seeds into manuka monocultures. We trapped seeds under each 6.5 m perch (n = 8) and at paired controls for two years. We also used heat- and motion-triggered cameras to record visitors to perches.

The perches failed to produce an increase in abundance of arriving seed or changes in composition, but this finding was confounded by pest species' interference with seed traps under perches. If increased dispersal of forest species is the goal, seed and seedling addition is cheaper and more pragmatic. However, seed arrival is often not what limits forest regeneration. We argue that restoration ecologists need to focus on ultimate rather than proximate goals, and that failure to do so leaves restoration ecology justifiably vulnerable to criticism that it remains an art, rather than science.

Island biogeography of exotic species: exploring the turnover dynamics that underpin diversity-invasibility relationships

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The number of exotic species inhabiting large sampling areas typically increases with the number of native species. To better understand this common biogeographic pattern, I quantified the turnover dynamics of exotic and native plant species in an archipelago of small islands off the coast of Wellington for 8 consecutive years. As expected, the number of exotic species inhabiting islands scaled positively with the number of native species. However, the relationship was not isometric; natives consistently outnumbered exotics and this disparity increased on species-rich islands. Rates of species' turnover also scaled positively between exotic and native species. However, in this instance native species turned-over more rapidly between species-poor islands, while exotic species turned-over more rapidly between species-rich islands. These results were consistent with a modified version of the theory of island biogeography, which predicts exotic species (1) colonise large, species-rich islands more frequently, and (2) go extinct more frequently after arrival because they are still in the process of invading the archipelago and are present on islands in only small populations. Overall results indicate that both species' richness and species' turnover can scale positively between native and exotic species and analyses of the shape of these relationships can help shed light on the mechanisms underpinning species invasions.

The potential for "citizen surveillance" of invasive species

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For many widespread invasive species, it is not feasible to use conventional scientific methods to monitor changes in abundance at all the necessary spatial scales, which can range from farm scale to national scale. However, it may be possible to get ordinary citizens to be the 'eyes and ears' for incursions of new invasive species, or re-emergence of existing invasives after control. One option is the use of mobile-optimised web sites or phone apps with the dual purpose of collecting surveillance data from citizens, and disseminating reports of invasive species occurrence back to them.

Here we present the development of a mobile-optimised web site ('MouseAlert') to collect information about the location and spatial extent of house mice (*Mus domesticus*), a major pest in cereal production regions of Australia. Outbreaks of house mice occur sporadically, and with highly variable intensity, location and extent. MouseAlert is designed for farmers to record information on mouse activity, damage to crops, and recent on-farm mouse control. In return, farmers receive regional-scale forecasts of the likelihood of a mouse outbreak in the coming season. By building on recent advances in communications technology, apps such as MouseAlert have sufficient direct benefits to citizens to justify their sustained and increasing use. We discuss the possibilities for the use of citizen surveillance of invasive species in New Zealand.

The ethics of de-extinction

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The ethics of de-extinction are highly controversial. A recent (May 2013) Scientific American editorial came out strongly against any programme to restore extinct species. In a similar vein, the bioethicist Ronald Sandler (2013) has argued that de-extinction "does not address any pressing ecological or social problems, and it does not make up for past harms or wrongs".

In this paper we systematically assess the ethical arguments against de-extinction, one by one. We use the example of the extinct New Zealand huia as a test case, to determine whether the arguments are applicable in the context of New Zealand conservation. Based on this test case, we will then draw general lessons about when it is, and is not, ethical to resurrect an extinct species.

Introduced parasites in native NZ birds: the unexpected hotspot

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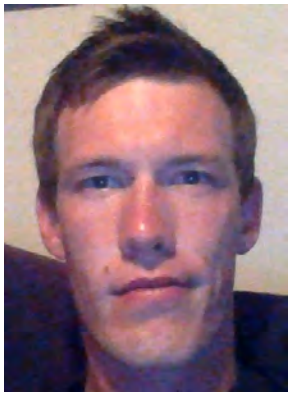
Like other oceanic islands New Zealand (NZ) wildlife has suffered the results of colonisation, in particular the introduction of animals, habitat transformation/ destruction, and the introduction of exotic diseases. Kiwi is a group of five nocturnal ground-insectivore bird species endemic to NZ. Some of the features that have allowed kiwi to have this niche became a "curse" when large carnivores and other nocturnal insectivores invaded NZ. In addition a horde of bird species were also introduced. Most of these bird and mammal species now coexist with kiwi. Predation by large mammals and competition for food are two well-known outcomes of this coexistence. The third one which we are just now learning about is sharing of parasites.

We collected and identified ectoparasites and endoparasites from brown kiwi and found that while some were endemic, some came from introduced mammals. While some parasites caused mortality, more work is needed to estimate their effect. There is a possibility that kiwi may be a reservoir of a disease of agricultural importance, posing interesting questions for both the evolution of parasite-host interactions and for wildlife management.

Allee effects and the establishment of exotic invasive bark beetles



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The dynamics of non-native populations during the establishment phase of biological invasions are often not fully understood. The probability of establishment of a founder population is thought to depend upon the initial size of the population, which affects a variety of biological processes including the ability to find mates, satiate predators or utilize host resources. Such inverse density-dependent interactions are known as Allee effects and they can create thresholds below which a species' population growth is negative, leading to extinction. The objective of this study is to quantify Allee thresholds for founder populations of introduced bark beetles (Coleoptera, Scolytinae) in New Zealand (*Hylastes ater* and *Hylurgus ligniperda)* and a native expanding population in the United States (*Ips pini)*.

Presented here are the results from the first year of data collection. The most surprising finding is that small populations of bark beetles exist in patches with very low host densities and in geographically isolated areas far from source populations. It has been hard to find a site in NZ or in the USA which the beetles have not reached, even in areas with no nearby host plants. This finding may be one reason bark beetles are such successful invaders around the world.

Patterns of divergence and extinction in land snails on the oceanic Ogasawara Islands

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How species' diversity is maintained in assemblages on islands has been a major concern in community ecology and biogeography. Neutral models such as species equilibrium theory suggest that species' richness on an island may be determined by balances between extinction and speciation over geological time scales. As an alternative perspective, several molecular phylogenetic studies have suggested that the speciation rate on an island may decrease over time, reaching a point of species richness saturation. However, few studies have addressed the long-term dynamics of species diversity on oceanic islands.

In the present study, we investigated the patterns of divergence and extinction of land snail species on the oceanic Ogasawara Islands in the west Pacific using a multidisciplinary approach. The Ogasawara Islands harbour more than 100 species of which 94% are endemic to the islands. Temporal patterns of diversification of these species, inferred from molecular phylogeny, show that divergence rates have decreased over time in some lineages. However, no significant decrease in the divergence rate was observed in other lineages, and speciation is still ongoing. Fossil records show that severe extinction, with approximately 30% of species lost, occurred at the end of the Pleistocene. Extinction is significantly more extensive in lineages with no decline of divergence rates based on molecular phylogenies. These results suggest that intermittent extinction episodes could maintain or even enhance the divergence rate, most likely because extinction provides unoccupied niches that can promote speciation by ecological process.

Climatic correlates of plant diversity across New Zealand's alpine regions

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New Zealand's alpine environment is characterised by a high degree of endemism and by distinct patterns of species' distributions and species richness. The South Island's alpine area displays a disjunct distribution of alpine plants, with two species-rich endemism centres at either end of the Island, while the northern half of the North Island has a higher number of endemic species than the southern half. The main mechanism put forward to explain this pattern in the South Island is the higher elevation and almost complete ice cover of the central region during the last glacial maximum leading to species extinctions. We here ask why, since the last glacial maximum, species have not managed to recolonise the central region from both ends of the South Island and we put forward a climatic explanation. We use published climatic and species' distribution data to ask how climatically and floristically similar the main alpine regions of New Zealand are to each other. We quantify the extent to which the central South Island acts as a climatic barrier between the southern and northern South Island, as it has done in the past due to heavy glaciation. We find that above the treeline the southern regions of the South Island are more floristically similar to the southern region of the North Island than the northern region of the South Island. Below the treeline, floristic similarity increases from south to north moving up New Zealand.

Reproductive niche conservatism during environmental change in New Zealand: apparent persistence of pollination and dispersal syndromes over 20 Myr

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Flowers (many with *in situ* pollen), fruits, cones, and seeds representing a wide range of largely mesothermal rainforest plants are present in fossil deposits dating from the Eocene and Miocene of New Zealand. Most of the flowers and angiosperm taxa recognised to date appear to represent groups with biotic pollination and the majority of the fruits recovered appear to have been animal (bird) dispersed. Many of these flowers and diaspores are also present at the site as leaves, and/or pollen. The majority of the diaspores are from genera no longer present in New Zealand, but which still occur in Australia, New Caledonia, or South America. Others, including Araliaceae and Myrtaceae, are still important components of the modern New Zealand flora. In particular, the fruits and seeds recovered from the 23 Ma Foulden Maar deposit (and the probable syndromes of other identified taxa at this site based on comparisons with living relatives) are examined at an ecosystem level and the possible implications of these pollination and dispersal syndromes are discussed in terms of possible niche conservatism.

When do trees grow? High resolution growth in an outdoor lab

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Forests play an important role in the global carbon cycle and constitute the largest pool of carbon in terrestrial ecosystems. Wood growth is the predominant sink of carbon in trees. However, the factors that drive/limit growth over short time scales (i.e. inter-day) are not clearly understood.

Mangrove forests in New Zealand are a useful model system for studying tree physiology for several reasons that will be outlined in this talk. To understand stem growth in mangroves we used point dendrometers to measure stem radius change (SRC) at high resolution. Trees exhibited clear diurnal-SRCs with maximum values between dawn and midday and minimum values around sunset. Cumulative growth curves were constructed by subtracting each daily stem radius maximum from the stem radius maximum on the subsequent day stem radius maximum. The slopes of daily stem increments were related to multiple environmental variables that influence carbon assimilation and growth in order to understand what has the strongest influence on growth. Both the timing of daily stem radius maxima and minima, and the the daily rate of increase in stem radii, varied with changing microclimate and soil conditions, most prominently vapour pressure deficit, rainfall and soil-water salinity.

Following fossils and living lineages: Investigating variation in shell shape and genetics of *Placostylus* through time

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Here we use morphological, genetic and biogeographic information of extant and sub fossil *Placostylus* landsnails to examine evolutionary processes acting on ecological timescales.

New Zealand is home to three endemic species of the southwestern Pacific landsnail genus *Placostylus* Beck, 1837. Sister groups are found in New Caledonia. New Zealand species are restricted to the Te Paki district in northernmost mainland and some offshore islands. Sub fossil remains have been recovered, and radiocarbon dated, from 13 horizons spanning a short timeframe ~5000yBP with isolated fossils dating to ~40,000yBP. These sub fossil deposits are found close to extant populations.

Shells of adult *Placostylus* are characterized by a thickened apertural lip, formed at sexual maturity, after which the growth in shell size stops. Original morphological descriptions were influenced by the size, position and number of tubercules around the aperture of the shell and other characteristics such as colour. Subsequent studies have used traditional shell measurement techniques to compare shell size and aperture between populations and species with limited success.

We explore changes between and within populations through time to the present day, testing the mode of morphological evolution, and placing modern variation into the context of variation over thousands of generations.

Next-generation biodiversity assessment across gradients of land-use intensity

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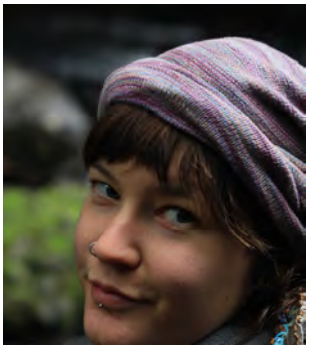
The consequences of land-use intensification for biodiversity and ecosystem function are a critical issue in ecology and land management, yet few studies have examined biodiversity across a complete land-use gradient from natural ecosystems to high-intensity agriculture. Indeed, individual studies have used such different methods of sampling that it is virtually impossible to compare results across different land-uses.

We have developed a unified sampling framework combining next-generation DNA tools with traditional field methods and direct measurements of ecosystem function. We applied this framework to the Wairau catchment across five major land-uses, from indigenous and pine forests to irrigated pastures and vineyards. The results suggest a range of different response curves, with some biodiversity and functional measures being highly sensitive or showing threshold responses to land-use intensity, while other metrics show linear tradeoffs or are insensitive. DNA results suggest strong community partitioning by land-use, particularly in groups such as fungi and soil invertebrates. We show that ecosystem functioning can, in some cases, be reasonably predicted solely using DNA methods. Further methodological development is essential to improve resolution, particularly for larger organisms (birds, plants, mammals). Nonetheless, the greatest challenges may lie in interpretation and presentation of results, particularly when engaging with end-users directly. We will present our initial efforts in this regard, developing a complete pipeline from sample collection to analysis, and automatic generation of reports for landowners.

Switching directions: testing foliar water uptake, reverse flow and hydraulic redistribution in mangrove forests



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The Cohesion-Tension theory (CTT) and the Soil Plant Atmosphere Continuum (SPAC) have long explained the big picture of water ascent in trees. However, recent research highlights that, though the CTT and the SPAC are not incorrect, they are incomplete. This study uses New Zealand mangroves as a model system for describing foliar uptake and hydraulic redistribution of water within the stem.

We tested if mangroves take up and store water through their leaves, by conducting a series of rain simulation experiments, and analysing microclimate and water flux and storage dynamics within the stem.

Preliminary results indicate leaf water uptake occurs, with leaf water potentials significantly higher in treated leaves (p=0.03) and foliar water content showing an average increase of 2.6% (p= 0.004). The magnitude depended on the time of day, with midday and afternoon eliciting the greatest response. Further analysis of stem diameter variations and sap flow will determine if atmospherically derived water contributes to water storage dynamics in mangroves.

Meta-barcoding of terrestrial biodiversity from soil DNA: methodological considerations and application to an island ecosystem

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Meta-barcoding techniques have much promise as a tool for rapid and comprehensive biodiversity assessment. The application of these methods to analysis of eukaryote communities in terrestrial ecosystems is not well studied, compared to prokaryote communities, and presents some methodological and analysis challenges.

We have investigated methodological factors that may influence the success of meta-barcoding of eukaryote communities from soil DNA, including sample size, DNA extraction method, and DNA sequencing approach, with the objective of identifying a method that allows efficient detection of a broad range of biodiversity, and detection of ecological trends and contrasts among terrestrial ecosystems.

These methods are being applied in a multi-gene meta-barcoding study of biodiversity along an ecological gradient on Hauturu (Little Barrier Island), and other comparative ecosystems within New Zealand.

Impacts of rat incursions on two populations of shore plover, and implications for island biosecurity

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As part of the shore plovers' recovery programme, populations of this endemic, Nationally Critical shorebird have recently been established on Mana Island and Waikawa/Portland Island. Rat incursions on Mana Island in 2011 and Waikawa/Portland in 2012 decimated both populations. In about 6 months, a single rat on Mana reduced the shore plover population from 10 to 4 pairs, before it was poisoned. On Waikawa/Portland, a rat reduced the population there from 37 to 4 pairs. As a result of these incursions, the recovery effort for shore plover has been set back more than a decade.

These events have reinforced the fact that shore plover are extremely susceptible to rats. The incursions have also highlighted that current biosecurity measures on islands (tracking tunnels, predator dogs, and traps), are not always effective at detecting and controlling mammalian predators that arrive.

The Global Avian Invasions Atlas (GAVIA): Using a global-scale spatial database of alien bird species to answer key questions in invasion ecology

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142 bird species are recorded as having been introduced to New Zealand, with 63 establishing successful populations. There is a similar story in Florida (211 introduced/42 established), Spain (207/33), Hawai'i (198/104), the United Kingdom (161/52), Australia (149/73), and the Mascarenes (83/40). What is it about these regions which enables this high richness of alien birds? What causes one species to succeed where another fails? What factors dictate the size of their alien range? Although substantial progress in invasion biology has come from studying birds, up until now these questions have remained unanswered due to a lack of global data.

In order to address these, and other key questions in invasion ecology, the Global Avian Invasions Atlas (GAVIA) was created at the Zoological Society of London by Dyer and Blackburn. GAVIA currently comprises 27,756 distribution records for 976 alien bird species, based on over 700 published references and substantial unpublished information obtained from more than 600 organisations and experts worldwide. This database represents the most comprehensive resource on the global distribution of alien species in any major taxon allowing the spatial and temporal dynamics of alien bird population spread to be examined.

This talk will explore the GAVIA database and present some of our preliminary findings. It will focus on the potential uses of this unique global data, and it will demonstrate how our results could be applied at a national level.

Technology advances protecting our biological heritage

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Internationally, over the last 20 years the number of tools available for the control of small mammals has declined. Through the efforts of research we have bucked this trend in NZ and retained and developed new tools.

Three new toxins have been extensively researched and registered with NZ EPA and MPI for field use, namely para-aminopropiophenone (PAPP) in 2011 for stoats and feral cats, zinc phosphide for possums in 2012 and encapsulated sodium nitrite (ESN) in 2013 for possums and feral pigs. The development of PAPP and ESN, coined red blood cell toxins, developed for humaneness, represent the first new vertebrate pesticides registered for field control of mammalian pests anywhere in the world for > 25 years.

More effective killing systems are being researched, and the first successful field trials of resetting toxin delivery devices for possum and stoat control were completed in 2013. Improved deployment strategies, integration of humane and selective toxins, lures of greater potency and improved killing devices aided by species' recognition will transform ground control for endangered species protection. Aerial application of PAPP will greatly extend the range of stoat control.

Visualising intra-landscape isolation to help map the risk of invasion: an example of common brushtail possums in the Auckland isthmus

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Public-policy decision-makers desire ecologically informed risk assessments that characterise the likelihood and severity of potential adverse effects from invasive species. These risk assessments often take the form of maps, but risk maps have generally ignored uncertainty and avoided incorporating processes such as the risk of spread.

One method that has been proposed to map risk of spread is a least-cost modelling based catchment area approach. In summary, using a raster cost-surface that represents the difficulty associated with traversing different parts of a landscape, least-cost catchments are calculated for all cells in a landscape, and the catchments' areas are then visualised as a map of intra-landscape isolation.

Using an example of the common brushtail possum (*Trichosurus vulpecula*) on the Auckland isthmus, we provide a demonstration of how least-cost modelling based catchment areas can be used to estimate and visualise intra-landscape isolation with uncertainty in order to help map the risk of invasion.

The advantages of automated palynology

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The idea of automating pollen analysis (palynology) was first proposed in 1968. Without automation, palynology may be criticized as subjective, and is also slow and laborious. Automation should lead to larger pollen counts, which will give more statistical significance to results relating to the rarer pollen types, which may well have ecological significance.

The machine to perform this, the Classifynder, has already been produced at Massey University. The pollen assemblages are mounted on slides as usual, and the slides are inspected under low magnification. All potential pollen images are recorded, and their location noted by the machine. A higher magnification lens then inspects each image and photographs it at several focal levels. The images are combined to make a completely focussed digital image of each object. The digital image is then analysed by neural network analysis and compared with data from a library of images. All the images are then classified in this way. The provisional results are then displayed for the operator to check their validity, and to amend them if necessary.

Tests show that the machine is over 90% accurate and is more consistent in its findings than groups of trained palynologists. The time is therefore appropriate for the application of the Classifynder to all the ecological and palaeoecological applications of palynology. It could have a most beneficial effect on these aspects of ecology.

The greatest problem in ecology: Why are there so many species In the tropical rain forest

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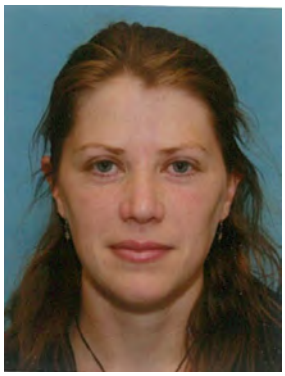
There have been many hypotheses to explain this, e.g. the greater availability of solar energy just causes it, or the Rain Forest was isolated in small patches during the Pleistocene cold phases, permitting Allopatric Speciation. These hypotheses have not stood up to detailed analysis.

The situation was opened up by the work of John Birks and Kathy Willis who showed, using palynology, that the number of taxa greatly increased in phases of high temperature during the Tertiary.

An exact mechanism has been suggested after work on the movements of tropical taxa during the Quaternary. The last Ice Age caused a cooling of c.6 degrees Centigrade in the Tropics. This led to the migration of many taxa to altitudes c. 1000m lower than previously. The reverse happened in Quaternary warm periods, often leading to isolation of sub-populations on mountain peaks. Studies of ultra-violet (UV-B) insolation show that this is much higher at high altitudes, especially in the tropics. Studies of pollen show that it is very subject to mutation by UV-B insolation. This provides all the requirements for allopatric speciation, thus explaining the high species counts in Tropical Rain Forest, Isolation of some species on individual peaks in the present worm climatic phase supports the hypothesis.

It is possible that similar events could have occurred in New Zealand.

Role of the dairy industry in New Zealand's ecological decline



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Over the past two decades there have been major increases in production throughout the New Zealand dairy industry. This has necessitated the use of inputs sourced externally, particularly fertiliser, feed supplements, and water. Contemporary New Zealand dairy farming practice incurs considerable environmental externalities, impacts that are not paid for directly by the dairy farmer. Externalities are left for the wider New Zealand populace to deal with, both regarding the economic responsibility and environmental degradation.

This study estimated the external environmental cost of intensified dairy farming in New Zealand, at a conservative amount, was higher than the 2012 dairy export revenue of $11.6 billion. Given the total negative impact of intensified dairying is likely to be underestimated, further work examining the costs and benefits of the New Zealand dairy industry is required before further intensification proceeds.

Use of artificial canopy gaps and under-planting to restore indigenous forest cover in non-harvest exotic conifer plantations

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About 7% of New Zealand's landmass is under exotic conifer plantations and in some circumstances these plantations will not be harvested. These 'non-harvest' stands present options for restoring indigenous forest communities. However, competition from exotic conifers and scarcity of indigenous seed sources are two factors commonly limiting indigenous forest succession in exotic conifer plantations.

Two separate management interventions to overcome these limitations were investigated: (1) Creation of artificial canopy gaps within an 18-year-old *Pinus radiata* plantation. (2) Underplanting of podocarp species within a degraded *Pinus ponderosa* plantation after 51-years.

Preliminary results suggest that artificial canopy gaps significantly increased light transmission with an associated increase in indigenous seedling height growth. Height growth response of *Podocarpus totara* and *Beilschmiedia tawa* seedlings reflected their respective tolerance to shade. Fifty-one years following under-planting of the degraded *Pinus ponderosa* plantation, *Dacrydium cupressinum* significantly out-performed both *Podocarpus totara* and *Dacrycarpus dacrydioides*. Under-planting ensured indigenous canopy dominants within the forest succession and overcame dispersal limitation caused by isolation from indigenous forest.

These results suggest that gap creation and under-planting are management interventions that can promote indigenous forest succession in exotic non-harvest conifer plantations in New Zealand.

Native and invasive: the changing fate of the spur-winged plover *(Vanellus miles novaehollandiae)* in New Zealand

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The southern Australian sub-species of masked lapwing *(Vanellus miles novaehollandiae)* self-introduced to New Zealand as early as 1886. However, the first breeding pair was recorded in the Invercargill area of South Island in the 1932. Known as the spur-winged plover in New Zealand, it is classified as 'native', due to its establishment prior to the introduction of the Wildlife Act 1953 and was provided full protection. Over the last 90 years the spur-winged plover has established and spread rapidly across the whole of New Zealand. The impact of the spread of this species, particularly as an aviation air-strike risk, has resulted in a reclassification of this bird onto Schedule 5 of the wildlife Act with all protection status being removed.

The range expansion and characteristics of this species were assessed in relation to known characteristics of invasive species. Range expansion was determined using presence or absence data on a country wide grid compiled from national surveys conducted from 1930 to 2004. The pattern of range expansion was well described by a logistic regression model. The pattern of expansion after initial establishment showed a lag followed by exponential growth phase consistent with many other invasive species. As with other successfully established invasive species, abiotic and biotic factors such as climate suitability, proximity to a novel vacant niche, propagule pressure and life history characteristics have apparently contributed to the successful establishment and spread of *V. m. novaehollandea* in New Zealand.

Changes in the breeding status of the southern black-backed gull (*Larus dominicanus*) on Rangitoto Island (Hauraki Gulf, New Zealand) since 1920

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The southern black-backed gull (*Larus dominicanus*) is a familiar species throughout New Zealand, and has a significant presence in Auckland City. Within the Auckland region, the species usually breeds in scattered locations around the coast, either as solitary pairs or in small groups, and occasionally atop buildings within the city. Large breeding colonies are present on Rangitoto Island only 8 km from the city's Central Business District (CBD). The proximity of these colonies to the CBD provides access to a rich supply of anthropogenic resources, and, consequently, the colonies are influenced by changes in these resources.

We compare the current status of the breeding population on Rangitoto Island with historical data, particularly those of studies carried out in the 1970s. The population exhibited rapid growth throughout the early 20th century, a pattern that is attributed to the environmental changes associated with European settlement favouring the species. Since the 1970s, the population has reduced, a trend that is correlated with actions for environmental mitigation. This pattern of population change is consistent with other populations nationwide, and with gull species globally. The availability of organic waste, and changes in the practices for treating the waste, are implicated as key drivers in the population changes. Field observations indicate that human-sourced foods are still a significant component of the gulls' diet.

Phytophthora species and the risk they pose to New Zealand's native plants and ecosystems

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Phytophthora is a group of highly destructive plant pathogens that have severely impacted numerous plant ecosystems globally. A key feature of some of the most destructive *Phytophthora* species has been their broad host range; killing small herbaceous plants through to mature forest trees.

New Zealand has a variety of different *Phytophthora* species causing disease issues within the country, most notably, *Phytophthora* taxon Agathis, which is killing our taonga Kauri (*Agathis australis*). However, of further concern is the increase of new *Phytophthora* species and new diseases appearing worldwide. What risk could new *Phytophthora* species pose to our native plants and ecosystems, and are we prepared?

Deception down under: are Australia and NZ 'hot-spots' for the evolution of deception?

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Australia and New Zealand are renowned for their idiosyncratic flora and fauna and high diversity of endemic taxa. Given this diversity, it is perhaps not surprising that Australia and New Zealand are coveted and productive field sites for behavioural ecologists worldwide.

Sexual deception, when orchids fool male insects into "mating" with flowers, is remarkably prevalent in these regions. It has evolved several times independently in Australia, and these orchids regularly self-introduce to New Zealand. Australia also appears to be a hot-spot for other types of unusual deceptive and exploitative behavioural interactions including brood-parasitism by cuckoos, and predation via sensory exploitation by crab spiders.

We offer several explanations for the prevalence of deceptive behavioural interactions down-under; addressing environmental conditions, evolutionary isolation and the introduction of invading species with deceptive behaviours, the abundance of behavioural ecologists, and the prevailing research culture.

Snail species' shapes on the sea shore: investigating the relationships between taxonomy, morphology and the environment in *Buccinulum*

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Marine snails are notoriously difficult to classify correctly. There are many examples of both cryptic species and polymorphic species. The environments the snails inhabit have strong selective pressures driving the shape of their shell, leading to both convergence and ecotypic differentiation. Identifying species' boundaries is difficult and there are few investigations combining data from morphology with genetic or ecological information.

We are investigating the drivers of variation in shell shape in a group of neogastropod molluscs found on the coast around New Zealand, *Buccinulum*. The *vittatum* complex consists of 4 putative taxa. Initial mtDNA sequence data inferred a phylogeny that is not consistent with the current taxonomy. Two of the putative taxa may be morphotypes/ecotypes of a single species and another taxon may be two separate lineages.

We will next establish species' boundaries based on many genetic markers and characterise morphological variation using landscape morphometric techniques. Possible drivers of the shell shape variation are rock substrate, wave energy, and sea temperature. Combining genetics, morphology and environmental variables will provide evidence of the potential drivers in this system.

Modelling growth of captive tree weta

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The weta is a relatively long-lived insect which has a relatively smooth growth in terms of mass, but measurements based on size appear to follow a discontinuous piecewise linear pattern. The reason is that immature weta must pass through a number of moults before they reach adulthood. The weta grows in a series of steps or instars, each separated by a moult. Each moult involves shedding the old cuticle and forming a new one.

Data were collected from Wellington Tree Weta *Hemideina crassidens* held in captivity at Massey University; measurements included a number of morphological and physiological traits of interest. The aim was to compare metabolic, growth rates and size differences between high- and low-elevation populations. The length of the weta's tibia is the variable that proved the most challenging to use for understanding the different growth patterns. We therefore single out the modelling of this variable for this talk.

We demonstrate that the model we employed, which allows for the differing length of each instar and other instar-specific variables as well as the weta-specific factors, is in fact based on the notion of exponential growth. Our model shows that weta from high elevations grow faster than those from low elevations, and that this is also dependent on the sex of the weta. In general, we find that while the actual change in tibia length increases, the rate of growth slows over successive instars.

Coexistence mediates the effect of competition on species' distributions

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There is substantial controversy on whether species interactions (particularly competition) shape species' distributions at large spatial scales. This controversy is difficult to resolve using empirical work alone due to the challenge of large-scale experimental manipulations of species' interactions. Here we argue that another branch of ecology (coexistence theory) provides powerful, underexploited tools to resolve the effect of competition on species' distributions. We show why conditions that promote coexistence reduce the effect of competition on species' distributions, we argue that experiments designed to study coexistence can be modified to anticipate the effect of competition on range limits and show how these insights can be used to effects of species' interactions across spatial scales. We use this work to argue that our ability to predict species' distributions will depend on our ability to assess large-scale coexistence mechanisms.

Biodiversity and decomposition in mixed broadleaf forest, New Zealand

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Up to 90% of global plant production enters the dead organic matter pool and the decomposition of this organic matter drives nutrient recycling, soil formation and atmospheric composition. Within forest habitats, rates of decomposition are strongly affected by the available litter resource and the faunal community associated with it. In this talk I address how species' loss will affect decomposition by describing the results of a biodiversity-ecosystem function experiment that measured rates of decomposition and characterised the associated plant litter and invertebrate communities. Study sites on Te Hauturu-o-Toi (Little Barrier Island) and in the Waitakere Ranges provide an opportunity to compare disturbed, regenerating and relatively intact forest with naturally occurring variation in floral and faunal diversity and composition.

Mating evolution in ground weta: nuptial gifts, female ornaments and mate-guarding (*Hemiandrus*: Orthoptera, Anostostomatidae)

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Hemiandrus, the most speciose genus of anostosotomatid weta, shows a remarkable diversity in reproductive biology. There is variation between species in whether females: (i) care for eggs and nymphs in burrows, (ii) receive a gelatinous mating meal (gift) from the male that is detached from the sperm capsule, (iii) possess an elaborate sex-specific abdominal ornament (secondary genitalia) and (iv) remain attached – via the ornament – to the guarding male after receiving the mating meal.

Female ornaments appear to be sexually-selected devices that have evolved from (potentially coercive) male genitalic grasping of the female's abdomen. A phylogenetic association between maternal care and presence of ornaments supports the hypothesis that in species showing maternal care, females compete for mating gifts in order to survive the 4-5 month maternal-care period during which they do not leave the burrow to feed. For the species with maternal care and female ornaments, variation in whether the (post-mating) guarding male remains attached to her remains a mystery.

A simple model for the relative sensitivity of two different presence-absence detection devices (e.g. tracking tunnels vs chew-cards) measured across a range of densities

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Presence-absence detection devices (such as tracking tunnels, chew-cards, cage traps etc) are a popular, low-cost means for monitoring relative population levels of animals. Devices differ, however, in their inherent sensitivity to the underlying true population density. In this talk I describe a simple one-parameter model that infers the relative sensitivity of two different devices. The model uses a "Poisson transform" of the proportion of detections, and major axis regression through the origin, such that the slope of the regression represents the sensitivity of one device relative to the other.

In a case study, data from tracking tunnels and chew cards deployed in Aorangi forest, southern Wairarapa, suggest that the sensitivity of tracking tunnels to rats is 2.23 times (1.74-3.02, 95% CI) that of chew-cards. Hence, tracking rates of 5%, 50% and 90% are expected to equate to chew rates of 2.3%, 27% and 64%, respectively. Greater interference of chew-cards by possums may partially explain the lower sensitivity of chewcards to rats, at this site.

Detecting invasive drywood boring species from faecal pellets and frass using DNA barcoding

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Wood boring insects such as drywood termites (*Incisitermes* spp.) and powderpost beetles (*Lyctus* spp.) are known as invasive pests in many countries. Those species usually invade as accompaniments to woods or wood products, and sometimes cause serious damage to furniture and housing. Therefore, early detection and identification of these pests are important to prevent extensive damages.

Drywood-associated insects usually nest in woody materials, and do not appear at the surface. Thus, their faecal pellets (faeces) and/or frass become the primary trace of their infection. In the present study, we attempted to identify them from faecal pellets and frass using DNA barcoding and species-specific PCR. Based upon the previously determined DNA barcodes (partial sequence of mitochondrial cytochrome C oxidase subunit I), species-specific primers were designed for powderpost beetles and drywood termites. DNA materials were prepared from faecal pellets and frass, and the primer sets were applied to the materials. Within tested insects, powderpost beetles were successfully identified from their frass with the nested PCR technique. On the other hands, the primer sets for termites did not yield any amplicon from termite pellet DNA, probably because the protozoan DNA dominated in the DNA materials.

Although further improvements are necessary for the methodology, the applicability of faecal pellets and frass for detection and identification using DNA barcoding was demonstrated.

Adapting the 'PAWS' animal monitoring tool for surveillance of insects and other small animals

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A new tool for animal detection and monitoring ('PAWS') has been developed to allow for discrimination between mammalian species by analysing their print characteristics as they cross a waterproof sensing surface. Until recently, the application of this tool has been focused on detecting NZ's native mammals. However, we have now developed an alternative surface design which is substantially more sensitive, and can detect the prints of animals much less than 1 gram in weight.

There is now potential for PAWS to be adapted for the detection and surveillance of other invasive species beyond mammals. These recent advancements have resulted in investigation of the suitability of this tool for detecting species such as invertebrates, which could open up a new era in biosecurity surveillance.

We provide examples of recent advancements in this detection technology and discuss its suitability for invertebrate monitoring.

Exploring the biogeography of fungal communities in dune grass roots with next generation sequencing

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Fungal communities below ground can be highly complex and substantially impact the plants they interact with. They can include both important mutualists, particularly arbuscular mycorrhizal fungi (AMF), and pathogens of plants. We are examining fungal biodiversity in the roots of dune grasses in New Zealand, the United States and the United Kingdom with a focus on the invasive plant marram (*Ammophila arenaria)*. Biogeography at multiple scales is being explored alongside the effects of plant host species on community structure.

DNA obtained from roots from an Auckland beach, sequenced using 454 technology, revealed at least 22 species of AMF are present. Some had previously been recorded elsewhere, while others had no sequence matches in Genbank and may therefore be endemic to New Zealand. High spatial heterogeneity in community structure was seen. In the United States, a new approach with Illumina MiSeq enabled multiple gene regions to be sequenced simultaneously with a common set of barcodes, permitting the consideration of a range of fungal groups. These gene regions each gave slightly different pictures but all suggested that marram on a Californian beach shares a common fungal community with the native grass *Leymus mollis*, that this community is different from that found in New Zealand, and that the most prolific fungal species present in dune grass roots are pathogens.

New Zealand's shame; the commercial harvesting of threatened endemic and native species

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At least six native fish species three of which are endemic are commercially harvested in New Zealand. Four fish species known collectively as whitebait two of which are endemic (family Galaxidae) are listed as threatened but harvested and sold mainly in New Zealand. Apart from regulations around harvesting times and net size there is no biomass limit to protect these species. The New Zealand endemic longfin eel (*Anguilla dieffenbachii*) is in decline but is also commercially harvested and most is exported.

There are two native eel species commercially harvested in New Zealand, the other species the Shortfin eel is found around the Pacific and is not listed as threated in New Zealand. Under a flawed quota management system (QMS) the total catch of eel biomass is limited but is not species-specific in the South Island, and thus offers no protection to the longfin.

In all these cases the species are threatened through multiple impacts aside from harvest, but this anomaly where species are listed as threatened with extinction and harvested is a sad indictment on New Zealand and must be addressed before these fish become extinct.

Blackbirds: useful substitutes for lost mid-sized native frugivores, or weed vectors?

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The New Zealand avifauna has lost numerous species, leaving few birds capable of dispersing large fruits. In theory, the relatively large-bodied introduced blackbird (*Turdus merula*) and song thrush (*T. philomelos*) could function as replacement dispersers for larger fruits. However, there is also concern they may serve to disperse exotic woody weeds, perhaps more so than endemic and native birds. Recent studies have come to opposite conclusions about the numerical contribution of blackbirds to the dispersal of native fruits: a very small contribution in Kelly *et al.* (2006), but large in Burns (2012) and Garcia *et al.* (2014).

Here we used seed analyses from faecal samples gathered during mist-netting in Kowhai Bush near Kaikoura to test whether blackbirds and song thrushes cover the large-native-seed dispersal gap or just move weeds. We also review data on blackbird densities in various habitats to see if differences in the density of blackbirds can account for the differences in blackbird importance in the different studies. We conclude that blackbirds are important dispersers of native seeds but differences in their importance reflect habitat differences, with their being more important in urban areas. In Kowhai Bush, the main contribution of blackbirds and song thrushes, not well covered by other bird species, was moving large-seeded woody weeds.

MtDNA haplotype diversity and hybridisation among house mice, *Mus musculus,* of diverse origins in New Zealand

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Searle *et al.* (2009a) reported a total of 14 mitochondrial DNA haplotypes of 3 subspecies (10 *M. m. domesticus*, 3 *M. m. castaneus* and 1 *M. m. musculus)* among 106 mice sequenced. Here we review three independent surveys documenting the haplotype diversity of house mice in New Zealand, and of hybrids between them. By further sampling, including areas not previously surveyed (to a current total of 41+ sites), including intensive searches for rare variants in selected areas, our group has identified 22 *M. m. domesticus* haplotypes (11 new), 5 *M. m. castaneus* haplotypes (2 new) and 1 *M. m. musculus* (as before). From a total of nearly 700 mice collected throughout the main and offshore islands, all nuclear DNA analyses so far have found only *M. m. domesticus*.

The South Island from latitude 45 degrees South is almost totally monopolised by hybrids of a single maternal lineage of *M.m. castaneus* probably originating from China. An identifiable boundary zone separates mice of Asian and European maternal origin in south Canterbury. Most of the northern North Island is dominated by a single lineage of *M.m domesticus* certainly imported from Britain, whereas the southern North Island is a fine-scale mosaic of multiple lineages of European *M.m domesticus* with various affinities, including isolated groups of the same *castaneus* haplotype common in the South Island.

The large geographical differences in haplotype distributions raise questions about the different processes of colonisation by, and hybridisation between, mice of diverse origins in the South versus North Islands. This review focuses attention on the potentially critical areas that have never been sampled, and on geographic variations in degree of local heterogeneity and hybridisation.

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What did it cost to save Pureora, and was it worth it?

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Pureora Forest Park is one of the most significant sites of natural and cultural history interest in New Zealand. It has a rich Maori history, followed by a period of well documented European exploitation of seemingly inexhaustible resources of high-quality native timber. Conflicts arising between people and wildlife came into sharp focus in the timber industry at Pureora in 1978, after a decade of fruitless protests against continued logging of prime conservation habitat, focussed on the North Island kokako. A series of well publicised and dramatic tree-sitting demonstrations forced the Minister of Forests to break two binding legal contracts in order to declare a moratorium on logging. We document the previously unpublished details of the compensation payments made to logging companies in 1979. In 1987 the previously powerful New Zealand Forest Service itself was disbanded, and control of the park passed to the newly created Department of Conservation.

The 1978 protests were a pivotal moment in New Zealand conservation history. Since then, the last of the timber mills have been closed, and Pureora has become a nationally important site for field experiments in conservation research and management, pest management, practical ecological restoration, and outdoor recreation. The changes were accompanied by serious social conflict, with consequences significant at national level. In many ways, this illustrates in one compact area a fundamental conflict of interests that applies in many other contexts, and hence is a microcosm of the history of New Zealand generally.

Plant-growth responses to elevated CO_2 – a reanalysis of prior observations

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Despite much elevated [CO_2] research using short-term experiments, there is still no conclusive and quantitative understanding of the growth response of plants to elevated [CO_2]. This may be partly due to a failure to explicitly account for the positive feedback during plants' exponential growth, which can increase an initial physiological enhancement of relative growth rate (RGR) into a much larger biomass enhancement.

To overcome this problem, we re-analysed experimental data from 77 prior publications to calculate the RGRs of C_3 plants and their relative enhancement under elevated [CO_2]. The RGR of unstressed plants increased by 14±2% for doubling [CO_2]. Over a wide range of [CO_2], the RGR enhancement was linearly correlated with the calculated photosynthetic enhancement, but at only half its numeric value. Surprisingly, RGR enhancements did not change significantly with temperatures from 12–40 °C, but were lower in nutrient-limited plants and higher in plants subject to water stress or grown at low irradiance.

We concluded that short-term experiments during exponential growth are cost-effective for studying [CO2] responses, but analyses must be based on changes in RGR. This makes it possible to unravel the physiological processes behind observed growth stimulations and interactions with co-limiting factors.

Invasive termite management in New Zealand: the past, present and future

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The invasiveness of introduced termites has been linked with their capability to digest wood, nest in wood and generate neotenics. In a global comparison, invasive termite management has been more successful on isolated islands than in the case of continental invasions and introductions. New Zealand's native termite fauna, with three species (Kalotermitidae and Termopsidae), is relatively species-poor. This gives pest management an advantage as any introduced termites quickly become apparent in the environment. Currently, three Australian termite species (Kalotermitidae, Termopsidae), are established in New Zealand, but are not considered significant pests to wooden structures. We discuss invasive subterranean termites in New Zealand and give a critical review of their current pest management regime with examples for *Coptotermes acinaciformis*, one of the most destructive termites worldwide. *Coptotermes acinaciformis* has been regularly intercepted at New Zealand's border since the 1930s. From the 1940s until the 1980s the eradication programme has included up to 50,000 inspected properties within the North Island. The recent improved treatment regimes for imported timbers have contributed to the low number of remaining management sites. Established standard operating procedures allow for quick and efficient management of *C. acinaciformis.* The Sentricon® system using Hexaflumuron (5g/Kg) baits works as an efficient eradication programme, inhibiting termite moults and killing the colonies. A residual risk persists for further incursions and predicted climate change may assist the establishments of introduced termites. Consequently, increased passive surveillance through public awareness will remain critical for continued success for termite management in New Zealand.

Ecoclinal trends of *Chionochloa pallens*' productivity and decomposition across an altitudinal gradient: What are the implications for endogenous C sequestration?

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Recent and projected alterations in Earth's climate have raised concerns about impacts on biological processes, especially those pertaining to carbon (C) cycling and sequestration. Ecoclinal differentiation of *Chionochloa* species can occur across altitudinal gradients, providing opportunities to assess the influence of climate within a single species.

Productivity and decomposition of *Chionochloa pallens* were investigated over 2 years via full-reciprocal translocation across five plots incrementally spaced every ≈100m in altitude on Mount Mangaweka, Ruahine Range, NZ. Productivity of *in situ C. pallens* over 2011-2013 was 135.6% greater at the lower plots compared to upper plots (P<0.05) and decreased with increasing altitude. Productivity of transplants differed between plots based on transplant origin (P<0.05) and destination (P<0.001). Translocation of *C. pallens* to lowest altitude plots yielded the greater productivity. Decomposition of *C. pallens'* leaf litter based on plot of origin did not differ between plots; however, based on plot of destination, the lowest two plots had 33% greater mass loss, than the uppermost plot (P<0.001).

Based on the ratio of aboveground productivity to decomposition (i.e. amount of C sequestered), these findings indicate less productivity is needed per unit decomposition for positive C sequestration of *C. pallens* at higher altitudes. Thus climate change may impact plant productivity and decomposition, and ultimately influence endogenous C sequestration.

Factors restricting population persistence of two *Olearia* species in New Zealand

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Land-use modification and invasive species have had a significant impact on the distribution and abundance of New Zealand's native plants, especially in the eastern South Island where many native shrubs are threatened with extinction. Habitat loss has led to small isolated populations while competition from invasive sward-forming grass species, has prevented natural regeneration. Today, numerous tree and shrub populations are dominated by large mature individuals with little or no recruitment. However, the importance of these processes may differ even among closely-related species, and the reasons for these differences are unclear.

My study investigates possible causes of decline in *Olearia lineata* (Asteraceace) - a nationally declining tree. I contrast *Olearia lineata* with non threatened, ecologically similar congener, *Olearia bullata*, to understand the factors associated with recruitment limitation. Specifically I ask: 1) what are the population demographics of *O. lineata* and *O. bullata*, and the structure of the surrounding vegetation communities and how this might impact recruitment? 2) what effect do exotic grasses have on the establishment and growth of *O. lineata* and *O. bullata*?

Results from this research will be directly relevant for implementing management strategies to aid in the enhancement of relictual *O. lineata* populations.

Forest ecosystem evolution in New Zealand over the past 20 million years – new fossils reveal complex patterns and processes

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Fossil *Lagerstätt*en often associated with volcanic maar lake deposits and amber are renowned for exquisite preservation of biota. These deposits are largely formed in anaerobic environments allowing for the rare fossilization of fragile terrestrial arthropods, as well as leaves, flowers, fruits and fungi. Well-dated *Lagerstätte* deposits in southern New Zealand make it possible to compare the habitat and compositional diversity of Miocene ecosystems with those of present day New Zealand.

For much of the Cenozoic New Zealand was a low-lying archipelago with a warm temperate to subtropical humid climate, supporting a biota with strong links to extant lineages. The Miocene environment supported a diverse range of terrestrial habitats which included Lauraceae-, Araucariaceae- and Nothofagaceae-dominated forests, with apparently distinctive biotas. The excellent representation of a number of biotic groups not found elsewhere is enabling us to assess the magnitude and importance of Pliocene–Pleistocene extinctions, diversification and immigration in shaping modern New Zealand forest ecosystems.

Causal networks reveal pathways for managing multiple disturbances to limit plant invasion

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We tested a multivariate hypothesis about the causal mechanisms underlying plant invasions in an ephemeral wetland in South Island, New Zealand. Using Bayesian structural equation modelling, we attempted to disentangle the relative importance of strongly inter-correlated processes.

We found that invasion by non-native plants was lowest in sites where the physical disturbance caused by flooding was both intense and frequent. This effect was stronger than the positive response of non-native species to high soil N supply, which was positively related to flooding. Sites flooded over a 4-year period had greater reductions in invasion than those associated with floods in the year prior to plot measurement because non-native species lacked traits for long-term persistence beneath water. Grazer exclusion had a small positive effect, with non-native species preferentially selected by herbivores.

Our results show that only species adapted to the dominant disturbance regimes may become successful invaders while species native to ephemeral wetlands have specially evolved traits that foster persistence in these sites.

Invasive.. but *benign*!? The establishment and spread of the introduced entomopathogenic fungus *Entomophaga maimaiga* in Southern Europe

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The entomopathogenic fungus *Entomophaga maimaiga* Humber, Shimazu and Soper (Entomophtorales) (Entomophtoraceae) is a pathogen of the gypsy moth (*Lymantria dispar* L., Lepidoptera: Erebidae) originating in Eastern Asia and was successfully established in populations of the gypsy moth in the USA for biological control. In 1999, it was introduced into three populations of gypsy moth in Southern Europe (Bulgaria). After the first strong epizootics were observed in 2005, the fungus was also introduced into six outbreak populations of gypsy moth in different regions of the country from 2008 to 2011. The fungal epizootics suppressed the calamities of the pest in Bulgaria completely. Over the last years we observe a range extension of the pathogen in Bulgaria; it is now present in nearly all regions of the country in which *L. dispar* occurs. Furthermore, the pathogen was since found in gypsy moth populations in other Southern European countries: Macedonia, Greece, Serbia, Croatia, and Hungary. This indicates a rapid spread of the entomopathogen and suggests *E. maimaiga* may be regarded as an invasive organism. Potential hazards of the apparently uncontrollable range extension are discussed.

Species richness of divaricate plants is strongly correlated with present-day environmental factors

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The most single controversial feature of the New Zealand terrestrial flora is the convergent evolution of a divaricate growth form in > 50 woody species. It was first interpreted as a response to frosty, droughty Quaternary environments, but opinion now favours the well-known moa-browsing hypothesis. However, the widespread persistence of divaricate plants, at least 500 years after the extinction of moa, shows this growth form must confer other advantages besides protection against avian browsing. If the divaricate growth form confers resistance to frost, drought or other environmental stresses, this should be reflected in the present-day geographic distribution of divaricate plants. We used generalised additive models to examine the environmental correlates of divaricate species' richness across 137 sites on the North Island of New Zealand. A model with five environmental variables and plot size explained 79 % of the observed variation. The largest concentrations of divaricates occurred on inland floodplains and terraces that are fertile but predisposed to frost and winter waterlogging, in drought-prone regions of the country. This pattern differs fundamentally from that of broadleaved species' richness, which previous work has shown to peak on warm, humid, well-drained sites. The present-day distribution of divaricates in New Zealand suggests they resist certain combinations of environmental stresses better than broadleaved species, and is consistent with climate being a major influence on the evolution of this growth form. However, browsing by introduced mammals could also influence contemporary landscape partitioning between divaricates and small broadleaved trees/shrubs.

Population dynamics and spread of invasive insects in response to changes in landscape structure

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The current, global mass invasion by alien invasive species is creating a rapidly growing array of unique ecological, economic and social challenges, unprecedented in magnitude in terms of its temporal rate and geographical extent. Despite the pressing management implications, the mechanisms that control exotic insect invasion remain poorly understood. Several factors, such as species life traits, propagule pressure, and, biotic and abiotic interactions (ecological resistance) are widely believed to play a critical role in controlling the spatial distribution of problem invaders. However, little is known about how species' traits and propagule pressure interact with spatial patterns of ecological resistance to determine invasion success. We present a general modelling framework for efficient evaluation of the relative influence of species' life traits, propagule pressure and spatial heterogeneity effects on their biological invasion. Spatial patterns of ecological resistance to biological invasion are characterized using a broad range of landscape metrics. We use classification and non-linear clustering methods to identify independent landscape measures for characterizing the composition and configuration of spatial patterns of ecological resistance. These landscape measures are used to establish a quantitative relationship between landscape structure and population dynamics. Rather than focusing on individual species, a more general approach is adopted where the pattern of invasion by multiple species are to be used to infer key drivers of invasion. We present a strategy to identify groups of species with similar patterns of response to ecological resistance across life strategies.

Thirsty trees? Evidence for drought avoidance adaptations in kauri (*Agathis australis*)

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Extensive rainfall deficiency in early 2013 caused the most wide-spread and severe drought in New Zealand in 70 years. Climate change modelling indicates that droughts will become more frequent and severe in some parts of the country, including the entire area where kauri (*Agathis australis*) trees are distributed. Due to soil moisture deficits, together with increasing temperatures and atmospheric evaporative demand, native and introduced vegetation is at risk of drought-induced mortality, but the details of physiological responses of endemic plants to climatic and soil conditions are virtually unknown. Kauri are known to have very weak conducting systems that are vulnerable to hydraulic failure during drought. Furthermore, kauri trees are also suffering the added threat of kauri dieback and pathogen impacts are often exacerbated by water stress. The dry period of 2013 represented an opportunity to study the impact of water stress on native vegetation in the field. Our ongoing measurements of seasonal variation in plant water relations and carbon dynamics at the Huapai Scientific Reserve include this dry period and the proceeding wet year. Our data indicate that kauri have a number of drought avoidance adaptations. Stomatal conductance values were highly conservative, minimising leaf water loss across the day. Stand litterfall increased by 72% in the dry year and this added biomass was dominated by an increase in kauri leaves and twigs. Reducing leaf area is a common physiological response to water stress to conserve plant water but this is the first time it has been recorded in kauri. Patterns in sap flow indicated some trees were accessing deeper water stores as flow rates were maintained even when soil moisture declined in the upper layers.

Wetland restoration for optimum ecosystem service provision - visualisation of the impacts of tree planting on water flow dynamics in Wairarapa wetlands

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Wetlands are vital flood management tools that store excess flood waters. Restoration and conservation of these ecosystems is critical to the maintenance of this key functional role. The restoration of formerly forested wetlands involves the re-establishment of trees (the main vegetation component) which is followed by a change in soil hydrology and the flood dynamics of the wetland.

Trees generally increase water storage within the canopy, soil and across the soil surface. This is important for flood mitigation in that it lowers the runoff rate and flood peaks. This role, although not fully established for wetlands, is determined by spatially and temporally varying factors, including antecedent soil moisture and topography, among others. Therefore, where trees are placed during restoration is critical for the success of wetlands as flood management tools. Information on the appropriate siting of trees becomes useful for the design of restoration strategies.

A scenario-ased modelling exercise using the Land Use Capability Indicator (LUCI) framework was carried out to support the analysis of the flood mitigation impacts of tree planting on areas of varying micro-topography in Wairarapa wetlands. The flood mitigation status of the wetlands is shown pre- and post-restoration. Areas that could potentially benefit from intervention for storage of excess flood waters are spatially delineated. This is important for guiding restoration of wetlands for optimum provision of ecosystem services.

Replacement of native mosquitoes by exotic species on farmland: a new scenario with a wider climatic link

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Land conversion for farming is creating new ecological scenarios for many nuisance species and vectors of disease as well as for native diversity. The Manawatu rural floodplain, formerly extensive low-lying swamp forest, is now converted to dairy farming and fodder cropping with only small fragments of native cover remaining. This has brought about a significant shift in the balance of native and invading exotic mosquito species.

A species' replacement' scenario and putative climate response are identified from light trapping data for Jan-April in three consecutive summers on three farms in this area, and in the final year also concurrently in native remnants (3 wetland, 3 forest sites) on farmland. External reference sites in a Palmerston North suburb and two larger old growth forest areas provide a perspective on species and habitat associations. A total of just under 12,000 female mosquitoes, comprising four endemic and two introduced species, were examined from 570 trap.nights.

A fortuitous sequence of seasonal weather conditions over the three years made it possible to identify a climatic link to seasonal abundance on farmland of the cosmopolitan and now dominant *Culex quinquefasciatus*, which probably invaded the area in the 1990s. Notably, high trap counts show a strong correlation with peaks in the Southern Oscillation Index. This invasion is probably facilitated by high nitrate levels in standing water (larval habitat) associated with livestock intensification. *C.quinquefasciatus* is an important vector of several human diseases but to date carries only avian malaria in NZ. It is known elsewhere for routing bird viruses into humans as spillover hosts when mosquito numbers are high.

Evaluating translocation strategies for New Zealand's green geckos

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Translocation is an essential conservation tool often used to re-establish reptile populations following anthropogenic extirpation, but is not always successful. One factor potentially limiting success is dispersal of individuals from the release site immediately after translocation and consequent non-overlap of ranges. 'Penning' (a soft-release translocation strategy) involves the use of an enclosure to restrict dispersal of translocated animals for a pre-determined period of time, with the aim of habituating animals to the release site so that they will establish a breeding population. We evaluated the utility of penning for limiting post-translocation dispersal of jewelled geckos (*Naultinus gemmeus*) through simultaneous penning and no-penning treatments via telemetry studies spanning three weeks in spring 2012 and autumn 2014. Daily movements of individuals in the un-penned groups were nearly twice those of the penned groups, their post-release dispersal was three times greater and the area that they collectively occupied at the end of the research was 4-20 times greater. When *Naultinus* geckos are released without time in a pen some individuals may disperse too far to contribute to a breeding population and, as a result, the likelihood of population establishment and the rate of population growth may be diminished. The potential advantages of penning (e.g. restricting initial dispersal; increased ease of monitoring) may outweigh the disadvantages (e.g. cost) for future green gecko translocations, and possibly other herpetofaunal translocations.

Driving Miss Daisy and Mr. Broom – vascular plant endemism and dryland conservation imperatives in South Marlborough

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South Marlborough is considered to be one of New Zealand's five mainland centres of vascular plant endemism. Key drivers for ecosystem and species diversity include a history of tectonic uplift and earthquakes; associated formation of massive upland scree systems which feed braided rivers; glaciation (presence and absence); sharp transition in rainfall from maritime (Kaikoura Coast) to dry inland basins (Molesworth); geological hotspots, particularly limestone; local landform and hydrology.

Scree and bluff plants, including species of daisy, broom and sun hebe are features of the endemic flora. Of the 79 South Marlborough endemic taxa, 44 are Nationally Threatened or At Risk and two are thought to be extinct. There are 28 limestone-obligate taxa though this geology comprises only 0.3% of the land area.

With increasing land development pressure on dryland ecosystems elsewhere in the country it is vital that indigenous species' persistence and ecosystem composition and integrity are maintained.

Development of re-setting toxin delivery devices for stoats and rats

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Rats and stoats continue to have a major impact on biodiversity in New Zealand, and improved control techniques are required to avoid further extinctions. A re-setting toxin delivery device (Spitfire) is being developed as part of a programme entitled 'Pest Control for the 21st Century', funded by the Ministry of Business, Innovation and Employment. The Spitfire works by firing a paste containing a toxin on to the belly of stoats and rats as they pass through a tunnel. The device then resets. When the stoats and rats groom the paste from their fur, they ingest the toxin. Each Spitfire is capable of approximately 100 doses and is fitted with a counter and a delay mechanism. The first successful field trial of the stoat Spitfire was undertaken in the Blue Mountains, West Otago in late 2013. Stoat abundance was significantly reduced but technical problems meant the trigger mechanism had to be re-designed. *Para*-aminopropiophenone (PAPP), the toxin used for the stoat trial, is not lethal enough for rats, so 1080, Zinc phosphide, cholecalciferol, C+C (cholecalciferol + coumatetralyl) and sodium nitrite are being investigated as alternative toxins for the rat Spitfire. Field trials are planned for both stoats and rats using Spitfires in 2014/15.

How well are District and Regional Councils in New Zealand addressing biodiversity loss?

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Regional and district councils have responsibilities to implement legislation and develop methods to maintain indigenous biodiversity and manage environmental effects. Many councils use a mix of regulatory mechanisms and voluntary incentives to encourage protection of biodiversity. Analysis of the strength of regional plans to protect wetlands is discussed. Preliminary investigations of the methods used by all 78 local authorities (regional and district councils and unitary authorities) to address indigenous biodiversity are presented.

The depth and breadth of provisions in regional and district plans varies considerably. Councils with a higher rating base have more resources to direct towards protection. These councils tend to have stronger community expectations and pressure to protect the environment and stronger regulation.

Over half of councils have some process (e.g. surveys, a schedule, criteria) for identifying significant natural areas. A significant proportion (over a third), however, have relatively limited provisions to protect biodiversity and some none at all. While all regional plans have some form of rule restricting damaging activities in wetlands, less than half have strong regulations where drainage is non-compliant.

There is a lack of national policy direction for local authorities on biodiversity and this has lead to variability in approaches and engagement. Assessment of which regulatory and non-regulatory methods work best in different situations is needed. Sharing of best practice and development of standard approaches is recommended.

The impacts of introduced mammalian predators on indigenous birds of freshwater wetlands in New Zealand: a review

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The impacts of introduced mammalian predators on the viability of bird populations in many habitats in New Zealand are well known. However, an understanding of their impacts in freshwater wetlands is lacking. We review evidence for impacts of introduced mammalian predators on freshwater birds, and use this information to make predictions about species likely to be vulnerable to predation. Extinctions and significant declines of wetland species have been numerous since humans introduced mammalian predators. Anecdotal evidence links predation the loss of 11 of 14 extinct birds that would have inhabited wetlands. Thirty species, particularly ground-nesting species, are still under threat from mammalian predators. All introduced mammalian predator species are abundant and/or widespread in New Zealand wetlands and most have been confirmed to prey upon freshwater bird species. While their precise impacts on the long-term viability of threatened bird populations have not been evaluated, evidence suggests that predation is a serious threat, warranting predator control. An evaluation using documented predation events and ecological traits suggests that six threatened wetland specialists are at high risk of predation: Australasian bittern, banded rail, brown teal, fernbird, marsh crake and spotless crake. Research is needed to help understand predator impacts on long-term viability of bird populations and to assist in developing predator control programmes.

Applying structured decision making to management of the reintroduced hihi population in Bushy Park

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One of the most important tools for species' recovery in New Zealand is reintroduction, which means translocation of threatened species to suitable and safe areas inside their historical range. Reintroduction entails many management decisions and can be challenging because of uncertainties. North America's whooping crane programme has recently pioneered the use of Structured Decision Making for choosing optimal management actions in reintroduction projects. This approach requires projecting population dynamics under different scenarios to predict outcomes of management strategies.

We applied this approach to a recently reintroduced population of endangered New Zealand forest bird hihi (*Notiomystis cincta*). 44 juvenile hihi were translocated to Bushy Park Reserve in March 2013 to increase the number of viable populations on the mainland. During the 6 months until the start of the breeding season, this release group declined to 18 males and 4 females. However during the first breeding season 16 chicks were fledged successfully. We analysed survival and reproduction based on the 18 months of the monitoring data, considering important factors affecting population establishment such as Allee effect, demographic stochasticity and post-release effects. We then modelled the population's persistence over 20 years' projection of persistence under several management actions, including additional translocation. In combination with values elicited from the Hihi Recovery Group on the different objectives involved in the programme, our model projections will be used to determine the optimal management of the population.

Opportunities for ecological restoration in the 21st century? A reintroduction plan for extinct New Zealand birds

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In his 1988 Presidential Address to the Ecological Society of New Zealand Atkinson acknowledged the dire state of our environment. He advocated ecological restoration as a means to address many of the problems we face and cited educational, aesthetic, scientific and genetic conservation benefits as positive outcomes. Atkinson stated that successful restoration programmes must have three essential ingredients: 1) a restoration goal based on historical information; 2) active intervention to restore species formerly present; and 3) monitoring of progress and further intervention where necessary. He acknowledged obstacles to New Zealand ecological restoration, primarily extinction, and lamented that the reconstitution of moa using genetic engineering was still in the realm of science fiction. As a pragmatic solution he suggested using closely related species as ecological replacements for extinct species. Just 26 years later the notion of de-extinction using modern genetic techniques is no longer science fiction but an ever closer reality. Ethical, methodological and financial issues aside, where would we start with the de-extinction of New Zealand birds? Here, we present a reintroduction plan for extinct New Zealand birds. We first divide candidate species into three extinction periods: 1) present day to first European contact; 2) European contact to first Polynesian contact; and 3) pre-human contact New Zealand. We then assess each candidate species against IUCN reintroduction guidelines following the 10 questions posed by Seddon *et al.* (2014). Finally, we offer comment on appropriate locations and release designs for reintroducing extinct species to Aotearoa New Zealand.

Mega-masts and the management of invasive mammals: will climate change lead to increased costs of control?

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Synchronous high seed production (masts) in forest and grassland ecosystems can lead to outbreaks of rodents and their predators, with subsequent high predation pressure on native fauna. The likelihood of masts by several species, including beech and tussock grasses, is positively correlated with the difference between average summer temperatures in successive years (ΔT). Also ΔT can predict directly the probability of outbreaks of house mice after beech masts.

Based on ΔT values for the last 4 decades, western areas of the South Island experience the highest frequency of localised beech masts, up to one every 2.6 years. 'Mega-masts' (defined as years with >50% of beech forest predicted to experience a mast) have occurred sporadically at a rolling average of 5.2 per 25 years. The 2014 mega-mast was predicted to extend across 85% of beech forest, potentially requiring pest control costing >50 times the average annual expenditure on aerial baiting by the Department of Conservation.

A regional climate model was used to predict ΔT values to 2100. For three scenarios, SRES A2 (regionally oriented economic development), B1 (global environmental sustainability) and the intermediate A1B, the frequency of mega-masts and subsequent high-cost pest control is estimated to change to 5.75, 4.5 and 5.5 events per 25 years, respectively. This has significant fiscal and policy implications for the Department of Conservation.

Stochastic geometry in species-rich plant communities

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Understanding when neutral or niche-based models best explain the organisation of ecological communities is fundamental to understanding the maintenance of species-rich ecosystems. Ecological processes such as competition, facilitation and dispersal leave spatial signatures in plant communities in the form of heterospecific spatial associations. Using point pattern analysis we evaluated spatial relationships between more than 10000 pairs of plant species and 3500 pairs of plant functional types in Mediterranean-type shrubland communities in Western Australia. Remarkably, very few pairs of species departed from a null model of no association, suggesting either that there is little interaction between specific species pairs or, that if there is, that we cannot detect it. If we look for the signature of species' interactions at the community-level by constructing species-accumulation curves for each individual species the same pattern holds, with few species acting as either 'attractors' or 'repellers' (centres of higher or lower than expected species richness). In other words, in these diverse ecosystems a model of random replacement of species with respect to each other ('stochastic geometry') best describes the patterns we observed – a finding which supports neutral rather than niche models, and one that has also been described in species-rich tropical forest communities.

Low foliar nitrogen levels contribute to poor performance of the heather beetle, *Lochmaea suturalis* (Thompson), as a biocontrol agent for heather, *Calluna vulgaris*, in New Zealand

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By artificially boosting foliar nitrogen levels in the exotic invasive weed heather (*Calluna vulgaris*) we have increased oviposition rate, body size and population growth rate of the heather beetle (*Lochmaea suturalis*), a biocontrol agent for heather in New Zealand (NZ). Heather beetle was introduced into NZ in 1996 but establishment success has initially been poor (7%), and population growth slow, in and around Tongariro National Park (TNP) where heather infestations are most invasive. However near Rotorua, three of three beetle releases established and population growth was rapid. Given that recent beetle outbreaks of increased frequency and severity have been linked with elevated atmospheric nitrogen input into European *Calluna* heathlands, we compared heather foliar nitrogen levels from TNP and Rotorua with those from the UK as part of our investigation into why the heather beetle has not met expectations as a biocontrol agent. Heather growing in TNP had only three quarters of the foliar nitrogen (1.14%) found at either Rotorua (1.47%) or in the UK (1.48%). Next we measured beetle performance while feeding on fertilised heather from TNP. Following a 33% increase in foliar nitrogen, beetle oviposition increased by 53% and body size by 32% (females) and 18% (males). Though establishment was not statistically improved, beetle populations grew and damaged heather faster when feeding on fertilised heather. A multi-pronged approach may be needed to improve biocontrol prospects where nutrient status appears to be contributing to genetic bottlenecking and climate matching issues previously identified.

A population genetics approach to species delimitation in the genus *Selliera* (Goodeniaceae)

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The genus *Selliera* is described as a small coastal herb and consists of only three species, *Selliera radicans, S. rotundifolia* and *S. microphylla*. These species have been described based on morphology, karyotype and geographic location; however, due to apparent hybridization and phenotypic plasticity, questions remain about species' delineation. *Selliera radicans* is described as having spatulate elongated leaves and is also present in Australia and Chile. *Selliera rotundifolia* is endemic to the south-western North Island and is most-obviously distinguished from *S. radicans* by rounder leaves with an obtuse apex and base and a preferred dune habitat. *Selliera microphylla* is distinguished from *S. radicans* only by a smaller size and inland location but reverts to a size similar to *S. radicans* when grown in a common garden. No genetic studies have been performed on this genus previously. Microsatellite markers, leaf morphology and existing karyotype data were examined across New Zealand's *Selliera* to explore species' boundaries. Leaf morphological analyses suggest that there are distinct differences among the three species. Microsatellite data revealed two genetic groupings within *S. microphylla*. Two genetic clusters were also observed in *S. rotundifolia* each of which had affiliations with different *S. radicans'* populations suggesting the round-leaf morphology may have had multiple origins. Two sites of sympatry between *S. radicans* and *S. rotundifolia* revealed contrasting patterns of gene flow. Extensive hybridization was observed at one and at the other apparent reproductive isolation has evolved. *Selliera* is proving to be a good model for the study of hybridization, speciation, and the evolution of reproductive barriers.

Invading plants in New Zealand: What are their impacts on indigenous ecosystem services?

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Terrestrial invading plants are widely studied in New Zealand in terms of their pathways, floristics and impacts on agricultural productivity. However little research is conducted on their impacts on ecosystem services of natural systems, such research requiring comparison of invaded with uninvaded systems to be definitive.

Preliminary investigations of the literature available suggest that impacts on diversity, disturbance, succession and landscape physiognomy are mostly negative, while impacts on cultural effects are variable, but largely negative or neutral. There appears to be little impact on waste treatment and food provision (perhaps because these seldom use native systems). However impacts on energy production, water regulation, provision of refugia, soils and nutrient cycling are simply unknown.

Negative impacts range from increased invasion opportunities to degradation or even loss of systems, as well as regeneration failures, genetic losses or hybridisation, reduction in water flows, and changes to soil fertility. Positive impacts are in cultural angles, erosion control, and as nurses in otherwise natural successions.

Negative impacts appear to greatly outweigh positive ones, suggesting onging costs to New Zealand's plant invasions. A meta-analysis is the desired way to proceed with these investigations.

The evolution of forest leaf traits in New Zealand in response to climate

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Leaf morphology is an outcome of the interaction between genetic constraints and optimization of leaf adaptations to the environment. Therefore, independent of taxonomy, leaf assemblages occurring in similar climates should have broadly similar leaf characteristics.

In general, New Zealand forest leaf assemblages have a smaller overall leaf size, fewer lobed and toothed margins, fewer acute apices, and a higher overall length to width ratio compared to the global physiognomic spectrum. In comparison to Early Miocene (23–12 Ma) New Zealand fossil leaf assemblages, growing in warm-temperate to subtropical conditions, modern New Zealand tree species indicate substantial physiognomic change since then, predominantly expressed in size and base shape characteristics, whereas other morphological characteristics have remained within the range of the Miocene flora.

We suggest that the modern New Zealand flora may be in disequilibrium with the environment as a result of environmental filtering during Pleistocene climatic deterioration and over-extinction in the absence of thermal refuge areas. However, certain leaf macromorphological characteristics in New Zealand, though not in line with global leaf physiognomy, appear to be consistent in Miocene New Zealand floras. This suggests that leaf traits other than leaf size are the result of an independent evolutionary history in New Zealand.

Is native forest restoration ecologically successful?

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Restoration practices were developed early in New Zealand, as our indigenous and unique fauna and flora succumbed to the pressures of reduced habitat availability and introduced pest species. However, restoration can be an extremely resource-intensive option, and whilst numerous benefits such as community engagement and education no doubt result, the success in restoring ecological function remains unknown.

Earlier native restoration plantings have now established, allowing some insight into whether ecological restoration is succeeding in heading towards a desired, representative and functioning native ecosystem. This study measured twelve established native restoration plantings throughout New Zealand, comparing each site against an area of comparable spontaneous succession and an undisturbed reference site.

Compositional, structural and functional differences were noted between the restoration sites and the sites undergoing unaided succession. These discrepancies between restoration plantings and naturally spontaneous succession may lead to slower, and/or divergent successional trajectories from the anticipated reference community. Future restoration projects need to incorporate a more scientific platform to restoration methods, planning strategically and functionally about the ecosystem they are trying to restore.

Using pest assemblages to predict invasions: Validation tests for the self-organizing map approach

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Insect invasions can have huge impacts on both natural and productive ecosystems. The main aim of biosecurity agencies is the prevention of potential invasions, as prevention is the most cost-effective option to deal with the problem. A new method has recently been developed to filter a large number of potentially invasive species to highlight those species more likely to establish in target areas of the world if given a chance to do so. The method is based on community ecological principles and artificial intelligence algorithms (self-organizing maps or SOM). The approach consists of using the algorithms to data-mine global datasets of insect distributions.

Since its first use in 2006, the SOM approach has been also applied by several other research teams. However, some problems have been anticipated and some shortcomings detected. The present work evaluated the relative importance of these problems using computational experiments and assessed the reliability and accuracy of the methodology. Our results provide new recommendations for the use of the SOM approach and species' assemblages to assess establishment risk.

DNA collection system for Mark-Recapture estimation of possum density, and TB surveillance sensitivity

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In this study we have developed a DNA collection device suitable for identifying individual possums using saliva. The device brief was: 1) the device must be cheap (<$10; ideally could be reused); 2) the device must be rat-proof (although the presence of rat saliva is not an issue); 3) the device should ideally be set off on the first possum encounter (the presence of more than one possum's DNA profile is an issue); 4) the device must protect DNA for up to 14 days in the field; 5) the device must be easy to set and inspect (can be tree mounted); and 6) the device must comply with current Animal Welfare Regulations.

In trials with captive animals we have demonstrated that we can reliably identify individual possums (using microsatellites) up to 14 days after initial encounter, provided the saliva was fully protected from UV and rain. Given this result we developed a prototype design and in an ongoing field trial the DNA device was activated 86% of the time by possums on first encounter. Due to the design, rodents were also unable to set off the device over 23 interactions and we were able to collect high quality DNA samples from the majority of these possum interactions. At the conference we will present the updated design complemented with further field trial results.

Influences of phylogeny, biogeography and host-specificity on invertebrate invasions and their impacts on native plants and natural ecosystems

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The establishment of non-native species due to human activities is an increasing environmental concern. Although just a small fraction non-native species become pests, some can cause major impacts. Systematically reviewing published records of alien and invasive species, and classifying their impacts can be helpful for risk analyses and impact prediction.

In 2008 a taxon-specific database of invasive invertebrates was developed to help evaluate risks to natural ecosystems in New Zealand and North America. The database has recently been updated using published lists and reports. It contains data on herbivorous insects (weevil, bark beetles and wood borers) and invertebrate generalist predators (spiders). Preliminary results suggest that many herbivorous insects have a considerable impact on North America's indigenous ecosystems. By contrast, New Zealand's ecosystems are less impacted and appear to display a level of biotic resistance to the herbivores, perhaps due to New Zealand's biogeographic isolation and the phylogenetic distance between its plants and the herbivores' hosts. However, such resistance may not be applicable to invasive generalist predators.

Do wildlife translocations cause pathogen pollution? A case study of Avian Malaria in North Island saddleback (*Philesturnus caruculatus rufusater*)

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Avian malaria parasites of the genus *Plasmodium* have the ability to cause extreme morbidity and mortality in naïve hosts, and their impact on the native biodiversity is potentially serious. So far, 17 different strains of avian malaria parasites have been found in 35 bird species in New Zealand. Despite the common asymptomatic nature of the infection, deaths in NZ birds caused by *Plasmodium* spp. have been recorded in South Island saddleback, yellow-eyed penguins, mohua (yellowhead), hihi and great spotted kiwi. Recent outbreaks of avian malaria in endangered New Zealand birds causing fatalities include an outbreak in captive New Zealand dotterel chicks in 1996, an outbreak in yellowhead / mohua in 2004 and mortality in a brown kiwi at a ONE (operation nest egg) facility in 2010/2011.

The main objective of this study is to examine the possibility and extent of pathogen pollution of vector borne diseases due to wildlife translocations using the New Zealand saddleback (*Philesturnus carunculatus*) and its infections with different strains of *Plasmodium* spp. as a model.

During the period 2012-2013, nine sampling trips have been done and archived material from five different locations has been examined. We found possible evidence for pathogen pollution due to wildlife translocations after saddlebacks from Hen Island have been translocated to Tiritiri Matangi Island via Cuvier Island.

Resurrection for reintroduction and the pre-selection of De-extinction candidates

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Technological advances have raised the controversial prospect of resurrecting extinct species. Species De-extinction should involve more than production of biological orphans to be scrutinized in laboratory or zoo. If De-extinction is to realize its stated goals of deep ecological enrichment, then resurrected animals must be translocated – released within suitable habitat. De-extinction is therefore a Conservation Translocation issue and the selection of potential De-extinction candidates must consider the feasibility and risks associated with reintroduction.

The IUCN Guidelines on Reintroductions provide a framework for De-extinction candidate selection. These Guidelines have been translated into 10 questions that could be addressed early on in the selection process to eliminate unsuitable reintroduction candidates. These questions have been applied to three De-extinction candidates: Thylacine, Yangtze River Dolphin, and Xerces Blue Butterfly.

The 'Spitfire' – Field trial results of a novel, resetting possum control device

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The sustained control of brushtail possums in large areas of mainland forest in New Zealand is costly and requires the repeat application of toxin or constant trapping. A high level of public opposition to aerial control with the toxin 1080 has led to the investigation of more targeted delivery of toxins. A multidisciplinary collaboration between ecologists, formulation experts and designers has led to the design of a resetting, possum specific toxin delivery device – the 'Spitfire'. The aim of this device is to enable sustained control of possum populations and to reduce labour costs incurred from the need to check traps or bait stations repeatedly.

The 'Spitfire' dispenses a measured dose of toxic gel onto the abdomen of possums which they then groom off and ingest. The device excludes access to non-target species through to a series of triggers. Each device has the ability to fire over 100 times before requiring servicing and incorporates a long-life attractant.

The first pilot trial has demonstrated considerable success with a reduction of possum abundance of over 90% and continued control during the reinvasion phase. Results from the first pilot trial and current trial will be presented.

The life history of the Lepidopteran seed predator *Cryptaspasma querula* and relationship to potential host plants

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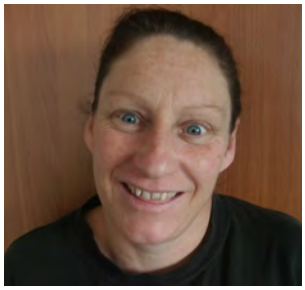
The moth *Cryptaspasma querula* is a polyphagous obligate seed predator endemic to New Zealand. Related *Cryptaspasma* have attracted attention overseas because the caterpillars can have significant effects on natural and economic seed populations. Field experiments with *C. querula* investigated infection rates, host survivability (germination/establishment), advantages of seed dispersal and host suitability. Infection of *Beilschmiedia tawa* reached over 90% for most sites surveyed. Seeds had reduced germination/establishment when infected with *C. querula*, but some were able to establish despite damage. Defleshed seeds, simulating the effects of passage through the gut of fruigovorous pigeons, still suffered drilling from *C. querula*, yet field sites showed increased numbers of establishing seeds, which may be due to seeds' faster germination following dispersal. A high density of tawa seeds resulted in less drilling damage and higher germination/establishment compared with a low density of seeds. Seeds of *Beilschmiedia tarairi* and *Quercus* sp. were utilized by *C. querula* in field trials, but *Corynocarpus laevigatus* and *Prumnopitys ferruginea* (miro) suffered little endosperm damage and are likely not natural hosts. Laboratory experiments investigating host suitability, host preferences, and life history in *C. querula* showed miro and *Elaeocarpus dentatus* to be inadequate hosts and tarairi and tawa were much more preferred. *C. querula* had higher infection rates in tawa than expected, having a strong impact on germination and establishment rates. Coupled with reduced natural seed dispersers (native pigeon), there may be consequences for tawa demography and regeneration.

Vehicle damage to the Rangipo Desert: the potential of vehicles to change the environment



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Rangipo Desert, Tongariro National Park, Central North Island, New Zealand, contains one of New Zealand's unique habitats due to the desert-like environment containing cushions, low lying species, and native grasses which create a diverse mosaic of plant species and colour. This area is under anthropogenic threat from drivers operating vehicles over the vegetation. My aim was to investigate the change to vegetation and substrates which have been driven over by vehicles.

The direct damage done by vehicles to vegetation and surrounding substrate was tested by running a simulated tyre over the substrate and plants. A plant that had been previously damaged by a vehicle was compared to a plant having had a tyre pushed over it by hand, and a control (undamaged) plant.

The substrate micro-topography changed instantly after it was run over. Intact and broken substrates were compared by creating wind and rain with a leaf blower and watering can. The change in substrate height was measured to test the amount of substrate erosion. Results show broken substrates are eroded at a greater rate than intact substrates.

The Rangipo Desert's dry and open ecosystem and vegetation is vulnerable to damage from vehicles. Vehicles cause plant die-back, increase erosion and have the potential to change the current ecosystem, by dropping exotic vegetation seed into the desert. Preventing vehicles driving into the Desert, and educating members of the public about ecosystem damage are good starting points to manage and preserve this area of Tongariro National Park, and preserve the Park.

Current and future risks of ecological impacts as a result of ant invasions

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Exotic ants present a high risk to New Zealand across all sectors: productive, environment and human health. The number of exotic ant species currently in New Zealand is almost three times that of native species, with additional species being frequently intercepted at the border. Red imported fire ants (*Solenopsis invicta*) are ranked as the highest pre-border ant threat and MPI have eradicated small incursions three times since 2001. Argentine ants (*Linepithema humile*) are the most well-known invasive species in New Zealand, and the only species for which ecological impact research has been conducted. Argentine ant invasion is associated with changes in invertebrate composition, reductions in soil microbial biomass and reduced rates of leaf litter decomposition.

We present research focussed around increasing the probability of detecting incipient populations, both newly invading and survivors of control operations. We highlight the similarities between ant and mammal pest management in surveillance and detection. It is likely that other invasive ant species in New Zealand are having negative impacts on native ecosystems and we discuss attempts to predict the risks associated with different species.

Will the real conservation geneticists please stand up? Bringing the genetics of small populations into the de-extinction debate

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The idea of resurrecting extinct species (de-extinction) is currently captivating the imagination of scientists and non-scientists alike, in part because the topic raises such a tangled web of scientific, ethical, legal, political and economic issues. As scientists, we applaud Seddon *et al.*'s recent engagement in the debate and agree that de-extinction is indeed a translocation issue.

However, as conservation geneticists, we argue that an additional question should be added to Seddon *et al.*'s pre-selection criteria for translocation candidates, namely: To avoid inbreeding depression and provide sufficient evolutionary potential, can a founder population of the appropriate size be resurrected? We also argue that the 'synthetic biology dollar' would be better spent increasing the genetic diversity of critically endangered extant species, rather than resurrecting genetically depauperate extinct species.

It's raining frass! A novel method for monitoring canopy-dwelling invertebrates

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Changes in the abundance of native invertebrate species are an important outcome measure for controlling invasive mammals. However invertebrates are notoriously difficult to measure due to high variability of their populations with time and space. Here we describe a promising method for measuring the abundance of large-bodied, canopy-dwelling invertebrates, a group shown to be affected by predation by rats and possums. The method uses the weight of frass (insect faecal material) collected in litterfall traps to estimate relative invertebrate abundance.

We monitored the relative abundance of tree weta and stick insects within mixed podocarp-broadleaf forest using frass collections along transects crossing the boundary of an area subject to aerial 1080 baiting. This control operation initially resulted in very low possum and rat abundance, although rat numbers quickly rebounded within the controlled area. Invertebrate abundance changed with rat abundance; tree weta in particular were negatively correlated with prevailing rat abundance. We compared the results of frass monitoring to another index commonly used for weta – occupancy of artificial refuges (weta 'hotels'). This confirmed the frass-based assessment of predator impacts and illustrated the pros and cons of each technique for monitoring tree weta.

Battle of the genomes following hybridization and whole genome duplication in *Tragopogon* (Asteraceae)

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Understanding the genomic consequences of polyploidization, particularly when accompanied by hybridization (allopolyploidy), provides insight into the speciation and adaptation of these novel entities. In particular, the merger and doubling of two divergent genomes can induce different genetic and epigenetic changes in the resulting polyploid.

Tragopogon (Asteraceae) is a model plant system for understanding these consequences in recently- and recurrently-formed polyploids from natural populations. We highlight recent work aimed at understanding how incipient polyploids cope with merging two divergent and essentially redundant genomes. We also discuss *Tragopogon* in New Zealand, where herbarium records indicate that hybrids have formed in the past, but there is no indication of polyploidy.

A Darwinian framework for investigating epiphyte community development

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Epiphytes are a conspicuous feature of numerous forests, yet they are poorly understood compared with terrestrial plants. We attempt to bridge this gap by modifying Darwin's theory of island subsidence, to predict how epiphyte communities might change during the growth, maturation and eventual death of host trees. More specifically, we predict that there are three stages of epiphyte community development: (1) an initial stage where host trees are devoid of epiphytes because they lack sufficient structural support; (2) a second stage where trees abruptly acquire epiphyte communities as adult trees; (3) a hypothetical stage where epiphyte communities progress through a period of rapid decline following host tree mortality.

To test our model predictions, we censused epiphyte communities on 371 host trees from six New Zealand tree species. We tested model predictions by first assessing the relationship between epiphyte species' richness and host tree size. We then tested whether relationships between epiphyte richness and host tree size differs between host species. Results were consistent with model predictions. Host trees abruptly acquired epiphyte communities as adults. However, the acquisition point varied between host species. Larger tree species consistently acquired epiphyte communities at later stages of ontogeny compared with smaller hosts. The rate at which epiphyte species' richness increased with host tree size, also varied between tree species. This unifying concept in epiphyte research, provides an essential framework to investigate how epiphyte communities develop during tree ontogeny.

Arrival mechanisms for weeds at Kapiti Island

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Kapiti Island has been a wildlife reserve for over 100 years, and much of the land has reverted to native forest. However, many open habitats remain where a range of weeds can establish, plus the threat of shade tolerant weeds in mature forest.

Based on field work carried out from September to December 2013, I present known and suggested arrival mechanisms for weeds found on Kapiti Island. These weeds have overcome the challenge of bridging a 5 km seawater gap to arrive from the mainland.

A major entry point for weeds is three privately owned islands to the southeast of Kapiti Island, the closest is only 500m offshore. Major concerns here are *Chysanthemoides monilifera* (boneseed) and *Lycium ferocissimum* (boxthorn), both of which are bird dispersed. Weeds that arrived by the hand of well-meaning humans include *Metrosideros excelsa* (pohutakawa) and *Pittosporum crassifolium* (karo). If any of these weeds became established on the dry, steep western slopes of the island they would be very difficult to remove.

The realized climatic niches of freshwater invertebrates: are they stable?

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Despite much effort put into preventing invasions, some species manage to escape surveillance. This failure is partly due to some gaps in our understanding of invasion success. In particular, when we are trying to predict potential suitable areas for invasive species, we are usually assuming that those species will have the same environmental preferences as in their native range.

An analysis was carried out to detect if there are significant similarities between the realized climatic niches in the native and invasive range for invasive freshwater invertebrates. We used the global distribution information of 21 invasive freshwater invertebrates and 35 climatic variables such as temperature, precipitation, solar radiation and soil moisture.

Initial results suggest that for many of the species, the overlap of the native and invasive climatic niche is relatively low, suggesting several competing hypotheses influencing invasion success. This information should be carefully considered when modelling potential suitable areas for invasive species outside of their current range.

Indian Ringnecks: from pets to pests - Assessment of the status, potential distribution and impacts of exotic *Psittacula krameri* in Australia

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The Indian Ringneck Parakeet (*Psittacula krameri*) is the most widely introduced parrot in the world, and is recognized as an agricultural pest within its native range, and through competition with native wildlife. Currently, Indian Ringnecks are one of the most popular exotic pet birds in Australia, and escaped individuals are regularly found in the wild. The species is considered to be highly likely to establish feral populations.

We collected all available information on the presence of Indian Ringnecks incursions from government agency reports, citizen science projects, and from missing pets webpages, and used comparative analysis and species' distribution models to assess the status, potential distribution and impacts.

We recorded 918 Indian Ringneck incursion events for the period 1999-2014, concentrated within or around the six largest Australian capital cities. Incursions were best predicted by factors related to human presence and activity. Over 18% of Australia appears to be suitable habitat for Indian Ringnecks, particularly the area in the south-east and south-west coasts. However, due to the distribution of the incursions, only a small proportion of this habitat would probably be available to be invaded, limiting the capacity of the species to cause damage to critical agricultural assets. Finally, learning from previous experience, we suggest that monitoring escaped individuals and prompt interventions on localized feral populations would be the best management action for preventing the establishment of Indian Ringnecks in Australia.

The effects of single aerial 1080 operations on common forest birds over 3 years in the South Island, New Zealand

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The aerial application of the most widely used pest control toxin, Sodium Fluoroacetate (1080), is considered a pivotal part of New Zealand's ecosystem management, yet its effects on non-target species are controversial. Reported effects on non-target species have ranged from no effect to direct mortality. However the past methodology and temporal scope required to infer effects on the forest community is questionable.

We conducted a 5-6 year replicated before-after control-impact study of a one-off aerial 1080 operation in New Zealand forests to investigate knowledge gaps surrounding non-target forest communities. Five minute bird counts, tracking tunnels and chew cards were used to monitor animal presence in both Beech and Mixed Podocarp/Broadleaf forests in the South Island, New Zealand.

During the first three monitoring periods, possums' relative abundance significantly declined post treatment and remained low, compared to an 80% increase at control sites. Interestingly, relative abundance of some bird species significantly increased, indicating a positive short- to mid-term response from the 1080 operation. These results support growing evidence that modern aerial 1080 operations have limited non-target effects.

A comparison of invertebrate communities inside and outside a fenced mammal-proof reserve: Zealandia Sanctuary, Wellington, NZ: preliminary results

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Introduction of non-native mammalian species has caused a decline in native animal abundance in many islands. In particular, possums, rats, mice and stoats have had an enormous and negative impact on larger invertebrate species, such as endangered weta species, in New Zealand. *Zealandia* is a fenced mainland reserve with no rats, possums and stoats (mammal exclusion), and annual control of mice. Outside the fence, there is pest control by Wellington City Council, but mice, rats and stoats are still present. We aim to identify differences in invertebrate communities between this fenced area (where birds and reptiles are their main predators) and a non-fenced area, where birds and mammals are important predators.

This study was conducted in and around the sanctuary in summer 2014 and involved monitoring mammals (with tracking tunnels and chew cards) and insects (non-lethal pitfall traps and weta houses) as well as surveying vegetation and birds along four transect lines inside and outside *Zealandia*.

Analyses of single taxa (orders and families) showed no significant differences in abundance due to mammal exclusion, except for Collembola (springtails). Ordination, however, suggested some difference in overall community composition. Hedgehogs were the most abundant mammalian predator outside the fence. Weta houses were occupied by tree weta and beetles after three days of setting up. Further investigation, increasing the number of samples and analysis of covariates, is planned to understand the patterns revealed thus far.

Productivity, not hawkweed invasion, influences indigenous vegetation recovery following grazing removal on the Upper Waitaki Basin floor, New Zealand

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Factors controlling the restoration of depleted short-tussock grasslands are poorly understood. We investigated effects of mouse-ear hawkweed ('hawkweed', *Pilosella officinarum*) cover, and a gradient of environmental productivity and stress associated with landform and soil type, on the rate and pattern of indigenous vegetation recovery from grazing in the highly-modified 1000-ha Lake Tekapo Scientific Reserve in the north of the Upper Waitaki ('Mackenzie') Basin, between 1993 and 2011.

Indigenous vegetation recovered in the 18 years following removal from grazing despite high levels of initial modification and exotic cover-dominance. Hawkweed invasion did not retard recovery; to the contrary, the extent and rate of recovery was higher on more productive landforms with higher initial hawkweed cover. The pattern of change across the reserve was consistent with grazing having exerted a powerful constraint on the growth and biomass of both indigenous and exotic palatable species prior to reservation, and with soil moisture limitations constraining productivity and hence the rate of indigenous vegetation recovery, and also delaying the timing of hawkweed invasion.

The loss of a celebrated species, the Māori dog: I ahatia te kurī?

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Domesticated species have travelled with humans throughout the world and are integrally woven into the development of human culture. The kurī or Māori dog (*Canis familiaris*) was the only domesticate brought by Polynesian explorers to successfully establish in New Zealand. Its loss is therefore both intriguing and important, given its high cultural value as a companion animal celebrated in oral tradition, as a prized species whose skins were sewn into the cloaks of chiefs, and as a vital food source. What specific factors contributed to its likely hybridisation and loss in the mid-19th century?

One hypothesis is that widespread resource stress prior to European settlement led to kurī decline and ultimately its loss. However resource switching after European settlement, together with changes in cultural and societal attitudes, could also lead to the loss of kurī. I discuss evidence of societal attitude change in 19th century Māori language and English language newspapers, providing examples of negative language use and semantic shifts. In addition, I present initial stable isotope data from kurī hair that provides insight into kurī diet, and will contribute to exploring hypotheses of resource stress.

I hangā tahi haere mai te kurī i te taha o te tangata, ā, tērā pea i noho tata mai hei hoa mō te tangata mō ngā tau 15,000. Engari kua ngaro ētahi tūmomo kurī pēnei i te kurī Māori. Ko te tangata te pūtake o ēnei ngarohanga, he āhuatanga kē atu rānei te take? Ka tātari ahau i ngā tuhinga me ngā kōrero tuku iho e pā ana ki te kurī, he aromātai i te whai wāhitanga mai ki ngā whakapono me ngā tikanga a te Māori, ā, i pēhea te huri o aua tikanga i te taenga mai o Tauiwi.

Borne on the wind; Understanding the significance of natural pathways of plant pests into New Zealand and Australia

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This project aimed to identify the pest and pathogen biosecurity risks posed to Australia and New Zealand by long distance natural dispersal pathways. Much attention has been given to human-assisted transport of biosecurity threats but there has been limited research on the natural dispersal of species across national borders. Wind-borne plant pests and pathogens have been implicated in a number of incursions worldwide.

A literature review and survey of biosecurity personnel were undertaken to quantify the actual and potential biosecurity risks of naturally dispersed plant pests and pathogens, to determine whether biosecurity threats from natural dispersal were being underestimated and to assess whether the perceived risk is commensurate with the actual risk.

Eight pathways were identified: three into New Zealand (from Australia, Africa and the Pacific region); and five into Australia (from 'The North' (PNG, Indonesia), New Zealand, Africa and the Pacific region). Both normal and extreme weather events (cyclones) were found to be feasible dispersal mechanisms. Case studies for each pathway and weather condition were investigated in more detail.

The project also identified several knowledge gaps concerning the identities of suspected exotic incursions, pathways used to gain entry, rapid detection and identification methods, and effective surveillance programmes.

How agent-based models are assisting in determining optimal and economic benefits of weed control strategies

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Whilst economic models can calculate the costs and benefits of different weed management strategies, many have to assume a uniform rate of weed spread that is either under management or spreading without control. They do not take in to consideration the heterogeneous nature of the landscape and the resultant differences in costs and benefits at specific locations. Whilst land managers often report on the effectiveness of control programs in terms of the number of inspections and/or extent of area treated, rarely is there the ability to:

i) Calculate the benefit: cost ratio of programs (the productive value of the area protected over time),
ii) Optimise the strategy by balancing costs with future benefits, or
iii) Allow for adaptive management scenarios.

To address these issues we have developed an agent-based weed dispersal model in Net Logo with in-built economic evaluation and management strategies components. A STELLA®-designed plant growth and dispersal model was converted into a spatially explicit Net Logo model with a dynamic interface to allow for “on the fly' interactions with land managers.

We are testing its performance on a real incursion of an invasive grass in Victoria, Australia and will use the validated model to project the spread of this weed over a ten-year period. This will compare the costs and benefits of current control measures with a change in strategy to reflect either an increase or decrease in the funding of the weed’s control. The interactive nature of the model will allow land managers to visualize/calculate the effects of decisions.

De-extinction as an aspirational end-goal for New Zealand conservation

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With existing eco-systems under siege, the very idea of de-extinction – of resurrecting extinct species through bio-tech conjuring tricks – may seem a distraction we can little afford. Given on-going environmental degradation, loss of biodiversity, and threats from invasive organisms, conservation effort in New Zealand is powerfully inspired by a sense of urgency; unless we act now, we may witness the demise of many species currently teetering on the brink of extinction. In light of this urgency, de-extinction could appear an unnecessary extravagance at best, and a potential source of dangerous complacency at worst.

But the developing debate over de-extinction raises important questions about the ultimate objectives of our conservation efforts. If short term goals are to save endangered species, and medium term goals to restore ecosystems, then what are our long term goals? If it is to return NZ’s conservation estate to its former glory, it makes sense to save and re-establish endangered species such as kakapo. Yet does this not also entail re-introducing charismatic extinct species like the huia and moa back into their natural range *if we can*?

And if moa or huia filled important roles in NZ’s ecosystems, reviving these species goes hand-in-hand with restoring ecosystem health. Furthermore, if de-extinction has a legitimate role in NZ's conservation future, then it has a significant bearing on its present, too: costly, long-term conservation projects will be more easily sold to the New Zealand public if they have aspirational end-goals that are bold and inspiring. The idea of returning living moa and huia to our native bush certainly satisfies this requirement.

Developing monitoring methods for rare and cryptic species: a case study of the Australasian bittern

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Detecting and monitoring species that are present in low numbers is a challenge for conservation managers regardless of whether the target species is native or invasive. This challenge is confounded further when species have additional cryptic characteristics e.g. are secretive or well camouflaged. Yet, reliable detection methods for such species are essential, as too often the damage caused to native populations cannot be reversed by the time the problem has been identified.

Here we present advances in the development of several reliable monitoring methods for the Australasian bittern (*Botaurus poiciloptilus*), a native, cryptic wetland bird that is also Endangered. Current methods for this species rely upon detecting male bitterns via their booming call, the only conspicuous cue for this species. To determine the optimum time and conditions to detect males we used generalised linear mixed models to predict the calling-rate at Whangamarino wetland. Results showed that calling-rate was predictable in terms of time of day, time of month, cloud cover and rainfall, but some spatial and temporal variation remained unexplained. We also explored species with similar cryptic challenges to see if methods such as thermal imagery and the use of dogs can solve our current inability to detect female and juvenile bitterns.

Through understanding what restricts our ability to detect/monitor a species, we can identify species with similar monitoring challenges, potentially allowing solutions to be shared across disciplines.

Uncovering the impacts of invasive house mice on lizard and invertebrate populations

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A suite of invasive mammalian species now preys on indigenous fauna in New Zealand, where bats were the only native terrestrial mammals. House mice (*Mus musculus*) are ubiquitous small omnivores whose importance as predators is unknown because effects of larger mammals often mask their impacts. Mice are frequently the only mammals remaining in fenced biodiversity sanctuaries, and sometimes become abundant in the absence of the larger species. Therefore, understanding the consequences of mice alone is increasing in urgency.

We are assessing impacts of mice on native animals in a grassland–shrubland matrix at Macraes Flat, North Otago. We used devices to detect mice, lizards and invertebrates at 49 random locations within 4000 ha. Mouse presence coincided with few or zero detections of skinks, geckos and invertebrates. All taxa were distributed across degraded, intact and mixed grass-shrub habitats, but mice were detected only in the last. This spatial distribution may change following high seed production (masting) by indigenous tussock grasses, which leads to periodic increases of mouse populations. The next stage of this project is experimental comparison of mouse prey species' abundance between sites with and without mice.

Ancient environmental metagenomics: the potential, and limits, to using aDNA for reconstructing New Zealand's prehistoric ecosystems

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New Zealand is a dynamic landmass, and our terrestrial ecosystems are constantly responding to change. But this is not a new phenomenon. Throughout history climate change, natural disturbances (e.g. earthquakes and storms) and the arrival of novel organisms have impacted the composition and functioning of NZ ecosystems. By understanding the long-term responses of ecosystems to these perturbations it is possible to gauge natural trajectories of ecosystems, and establish thresholds for managing these in the present-day.

Ancient DNA (aDNA) analysis of environmental samples is a relatively new tool with which we can study past ecosystems. DNA offers the potential to study new types of organisms and communities (e.g. microbial), which have not been resolvable using traditional palaeoecological approaches. However, as with many other fields in their infancy, there are still many unknowns and potential issues, particularly in regards to the sources and longevity of aDNA in different sediment types, biases in taxonomic representation, and the recognition and exclusion of modern contamination. In this talk I will review the potential insights that environmental aDNA may provide, as well as discussing the caveats.

Seed ecology of the endangered shrub *Muehlenbeckia astonii*

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Muehlenbeckia astonii is a nationally endangered shrub exhibiting widespread recruitment failure in the wild. I investigated seed germination, longevity and dispersal to determine factors constraining regeneration and population persistence.

Twenty-four percent of untreated *M. astonii* seeds germinated, while cold stratification increased germination success significantly (76%). *M. astonii* seeds germinated after three years burial under soil in the field.

Skinks (*Oligosoma* spp.) at Kaitorete Spit, Canterbury, ate *M. astonii* fruits. Of 1,159 skink scats collected over two fruiting seasons, 10.5% contained seeds, with peak seed presence in February 2012 (33.3%). Of the 122 *M. astonii* seeds in skink scats, 40 (32.8%) were visibly immature, seven (5.7%) were damaged and five were seed pieces.

Skinks dispersed 51.6% of *M. astonii* seeds beyond the parent canopy, some as far as 10 m. Skink deposition of *M. astonii* seeds declined with increasing distance from the nearest fruiting plant. Germination was lower for mature *M. astonii* seeds from skink droppings (25%) than from plants (50%). No visibly immature seeds from skink droppings germinated.

High seed germination suggests low seed viability is not limiting *M. astonii* regeneration in the wild. *M. astonii* has the potential to form a soil seed bank, which may temporarily buffer small, isolated populations from local extinction. Lizards may enable *M. astonii* seeds to escape from any negative parental effects. However, skinks destroyed c. 43% of seeds ingested and reduced germination success of mature seeds.

Messages from the burning bush: comparing the flammability of New Zealand plants

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Wildfires can have considerable impacts on ecosystems and infrastructure in New Zealand, with approximately 3000 wildfires occurring each year, burning around 6000 ha of land. These impacts are likely to increase under global climate change as modelling studies point to more severely fire-prone weather and greater fire danger, particularly in drier parts of the country. Hence, there is a clear need to understand the drivers and patterns of fire activity across the NZ landscape.

A key determinant of fire spread is the flammability of plant species, i.e. their capacity to burn. There have been only limited studies of plant flammability in NZ (e.g. ranking of species by experts or measurements of leaf ignitability), and none which have examined the flammability of shoots. We addressed this gap by measuring three components of flammability (combustibility, consumability and sustainability) on 70 cm-long terminal shoots of 60 native and exotic species.

Preliminary results provide broad support for the flammability rankings derived from expert opinion. Native species with low flammability included *Griselinia littoralis* and *Pseudopanax arboreus*, while *Cyathea, Dicksonia, Leptospermum* and *Kunzea* were among the most flammable taxa, as previously reported. Invasive species from fire-prone environments, such as *Ulex* and *Eucalyptus*, also had high flammability, suggesting the potential for such species to modify fire regimes in landscapes where they dominate. *Lophozonia menziesii* had surprisingly high flammability, although it mostly occurs in wet environments, and so may only burn under extreme weather conditions. These results are of use to fire managers seeking species with low flammability to plant as 'green firebreaks' and for ecologists seeking to understand how fires have and will influence NZ vegetation in the past, present and future.

The state of tree protection in urban Auckland: facilitating a weedy city?

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Changes to the Resource Management Act that came into effect in 2012 have seen the loss of generalised urban tree protection policies. In Auckland, this means that legislation protecting the urban forest now applies only to specific individual trees listed on a Schedule of Notable Trees, with the exception of certain Significant Ecological Areas. We examined the effectiveness of this tree protection tool for protecting urban biodiversity. We investigated: 1) the species' composition of the trees listed on the Schedule of Notable Trees, and 2) the relative contribution of geographical variables (suburb age, dwelling density, socio-economic deprivation and tree cover) in explaining spatial variation in notable-tree density. Tree cover in urban Auckland was just 6% of the land area, 63.2% of which was on private land. Of these trees, approximately 15% were protected. Popular native and exotic species were protected in large numbers, whilst only a single individual of a rare and threatened native species was listed. Approximately 50% of the 6988 trees listed on the schedule were exotic species. Nineteen per cent of the exotic individuals were recognised weed species, the most abundant of which was Phoenix palm (253 individuals). Older suburbs, and those with higher density housing, had higher numbers of scheduled trees, whilst there were fewer scheduled trees in suburbs with higher levels of socio-economic deprivation. We conclude that tree protection in urban Auckland is insufficient to safeguard urban biodiversity and, in its current state, is likely to facilitate invasions by popular environmental weeds.

My enemy's enemy is my friend: Tri-trophic interactions between a predator-parasite-host assemblage in New Zealand

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New Zealand's dynamic geological past has generated many biological oddities. Arguably the most unusual is the largest endemic moth, the Puriri moth (*Aenetus virescens*). Larvae grow to 100mm, spending ~6 years as wood-boring parasites feeding on host tree phloem. Larvae excavate "7" shaped tunnels into host trees, building silk and frass webbing to cover the tunnel entrance. Webbing potentially conceals larvae from predatory parrots, the North Island kaka (*Nestor meridionalis septentrionalis*), which consume *A. virescens* by excavating bark and wood from trees.

Despite this remarkable life history, the ecological role of *A. virescens*, in particular the relationship with host trees and predators, is poorly understood. I propose a trade-off exists between the effort required from larvae to parasitize a host tree, and the protection which host trees provide from predating kaka. I hypothesise that: 1) *A. virescens'* host choice is not random; 2) larvae select host trees based on wood density and phloem reward; and 3) kaka attacks are correlated with a host's parasite load.

Preliminary results indicate *A. virescens* preferentially select specific tree species as hosts. Furthermore, kaka attacks are correlated to a host tree's parasite load. This tri-trophic system presents a novel predator-parasite-host relationship whereby predators directly influence parasites and their hosts.

A spatially-explicit individual-based approach of optimal foraging in heterogeneous landscapes: effects of perception

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Foraging success is crucial to the survival and fitness of organisms. As animals move into previously unexplored locations (e.g., invasive species), movements reflect their perception and recognition of important environmental factors. However, it is not yet clear how perceptual ability influences patterns of movement in spatially heterogeneous landscapes.

We used a spatially explicit individual-based model to explore the effect of perception on the optimal foraging of free-ranging animals. In our model, landscape heterogeneity was represented by the amount of food resources in each patch, and the spatial autocorrelation in resource availability between these patches. Factors such as speed, energy cost of travelling, and resource replenishment rate were assessed for their influence on foraging efficiency.

We demonstrate that perceptual ability aids foraging success in landscapes that resources are evenly dispersed but not in settings where resources are highly clustered. Our study provides quantitative insights into how cognition (such as visual and olfactory sensitivity) influences when and where animals move, and how movement patterns are driven by interactions between animals and their environments.

Posters

Abstracts

Abstracts are in alphabetical order of the author's surnames, even if not the presenting author, who appears in bold type and in the image.
Abstracts with the same first author are in alphabetical order of the title.

The Horizons Region is vast and varied; stretching from Ruapehu in the north to Horowhenua in the south, west to Wanganui and east to Tararua. Horizons Regional Council works to sustainably manage the Region's land, air and water resources on behalf of our communities.

At Horizons, we seek to create opportunities for our Region to grow economically and socially in a way that preserves or enhances environmental and social values. Biosecurity and biodiversity are two key aspects of our business as we work to preserve our patch of native New Zealand.

Innovative and effective management of invasive weeds and pests and active management and restoration of remnant habitats of native flora and fauna are key to successfully managing our Region's natural heritage. Horizons is proud to sponsor the 2014 conference of the New Zealand Ecological Society in Palmerston North as we continue to develop our knowledge and improve our practices to the benefit of our Region.

Accounting for inter-species interference and predicting optimal experiment duration using chew-track cards

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Pest monitoring methods need to provide unbiased accurate estimates of pest densities and locations, while also taking into account time-in-field and costs. We used chew-track-cards (CTCs) in New Zealand's largest Ramsar wetland to investigate the amount of time required for sufficient sensitivity, and to examine the potential for species to bias detection rates of other species.

We found a significant difference in cumulative detection rates, resulting in a lag for rat detections. We found that either rat and possum detections were depressed by the presence of the other species, independent of the amount of bait left on CTCs. A minimum of 5 nights would detect at least 60% of observations compared with the standard 7-night period for rats and possums, while ameliorating lag effects.

A shorter monitoring period may allow more transects or complementary methods to be undertaken, but should be considered against the benefits of a nationally standardised duration of monitoring and lag effects for rats. Implications for practice suggest CTCs remain one of the most sensitive pest monitoring tools for rats and possums; however at high densities, saturation and inter-species interference effects are likely to blunt the comparative utility of the index.

The ontogeny of leaf spines: Progressive versus retrogressive heteroblasty in two New Zealand plant species

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Most plants change shape as they grow. However, ontogenetic changes in morphology (i.e. heteroblasty) can differ markedly among species and the role heteroblasty might play in plant defence is poorly resolved. We use a model selection approach to characterise heteroblasty in leaf terminal spines produced by two perennial plant species native to New Zealand. *Aciphylla aurea* (Apiaceae), a perennial herb that inhabits alpine scrublands, exhibited "progressive" heteroblasty. Seedlings produced soft, entire leaves with sharpened tips. However, as plants matured they produced compound leaves with sharpened tips that were far more rigid, giving rise to a strong degree of spinescence at adulthood. On the other hand, *Podocarpus totara* (Podocarpaceae), a tall tree inhabiting cool-temperate forests, exhibited "retrogressive" heteroblasty. Leaf rigidity and leaf circularity increased during development, while the size of terminal leaf spines peaked at intermediate heights, resulting in a peak in spinescence at the sapling stage of development. These results indicate that the mode of spinescence heteroblasty varied between species in ways that appear to facilitate defence at life history stages when plants are most susceptible to attack from large herbivores (i.e. adult plants are better defended in scrublands, while saplings are better defended in woodlands). However, results also showed that spinescence was reduced in very young plants, suggesting that the ontogenetic development of spinescence may be constrained at very early ontogenetic stages, perhaps because younger plants lack the energetic resources to structurally reinforce leaf spines.

The role of rapid evolution and phenotypic plasticity in explaining morphological change in introduced plants

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Invasive species have been recognised as a major driver of global environmental change. However, the main factors that facilitate their successful establishment and subsequent range expansion following colonisation remain relatively unclear. It has been suggested that invasive species possess more plastic traits that can enhance their fitness in novel environments. Alternatively, there has been growing recognition of the role that rapid evolution may play in the success of invasive species, once established in a new environment.

Data from herbarium specimens were used to examine change in morphological traits [plant height, dry leaf mass per area (LMA), leaf area and leaf shape] for 40 plant species introduced to Australia and New Zealand over the last 150 years (Buswell *et al*. 2010). To identify if morphological change was (i) driven by rapid evolution in response to novel selection pressures or (ii) an expression of phenotypic plasticity as a species spread across an environmental gradient, specimens were geo-referenced and morphological traits were modelled in relation to climatic factors and time, using a spatial regression (GLS).

Initial analysis of the invasive species *Arctotheca populifolia* in Australia, has shown a significant relationship between leaf area and climate (→ plasticity) and between plant height and time (→ evolution) and plant height and climate (→ plasticity). Further analysis, in conjunction with common garden experiments, will help to elucidate the physiological basis of rapid evolution, phenotypic plasticity or both, as drivers of observed morphological change. This information can be used to indicate how these two mechanisms contribute to a species' "invasiveness" and improve predictions of areas susceptible to invasion.

Do forests fall silent directly following 1080 drops? Monitoring bird conspicuousness with acoustic recorders – Aims and methods

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1080 (sodium fluoroacetate) is used widely in New Zealand to control several introduced mammal species. However, controversy still remains over its impact on native birds. This study is part of a wider research program to determine the response of birds, as well as other biodiversity indicators (primarily invertebrates), to 1080 possum-control in Aorangi Forest Park (Wairarapa). A recent application of 1080 occurred in August.

We have acoustic recorders spread across five treatment sites and two reference sites. Acoustic recorders are programmed to record 40 – 60 minutes after sunrise and sunset each day during tri-annual field work periods. Most of these recorders were deployed in December 2012. However, a second set of 24 acoustic recorders (Song Meter SM2+) were deployed immediately prior to the recent 1080 application; these recorders were evenly spread between treatment and reference sites and recorded for at least four weeks before and after the application of poison. The acoustic data from all recorders will be sub-sampled to elucidate trends in bird conspicuousness.

With the data collected from the second set of recorders we aim to: i) directly test the hypothesis that forests fall silent immediately following the application of 1080 poison; and ii) determine optimal strategies for sub-sampling large bioacoustic data sets.

Resprouting by New Zealand plants following fire

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Fire is one of the most pervasive disturbances worldwide. While most New Zealand ecosystems have a long history of infrequent fires, in the 750 years since human settlement widespread burning has wrought large-scale changes to the vegetation. Most NZ plant species lack obvious adaptations to fire, likely due to this lengthy evolutionary time scale when fires were infrequent and irregular. One adaptation (or, more correctly, exaptation, i.e. trait co-opted from another purpose) exhibited by many NZ plants is resprouting, the vegetative regeneration of plants in response to defoliation. Resprouting has likely evolved in response to disturbances other than fire and so is a fire exaptation in many NZ species. To understand how NZ plants were affected by fire in the past and to predict how they will respond to this disturbance in the future, it is helpful to catalogue their resprouting patterns.

We draw on recent studies to erect a conceptual framework for the study of resprouting by plants following fire and then use a literature review and our own observations from wildfires to categorise the vegetative responses to fires in native and exotic woody species in NZ. The conceptual model begins by determining whether or not a species can resprout after fire. If it does resprout, the location of this regeneration is assigned to broad categories (aerial, basal, or below-ground), and further sub-categories based on bud location (e.g. apical, epicormic, lignotuber, root collar). Then the biomass of these shoots is estimated to determine the resprouting vigour of the individual plant. Finally, the survival of the resprouts and the individual are tracked over time to determine the ultimate success of this response to a given fire.

Plant biodiversity to bolster beneficial invertebrate populations

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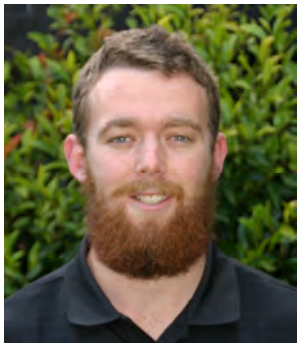
Invertebrate species can provide pollination and pest suppression (beneficials), which are key services to cropping systems, but this is not occurring as beneficials are absent or low in numbers. Habitats that increase the abundance of beneficials may help. To discover if plantings influence the abundance of beneficials, we compared the abundance of invertebrates in plantings established as shelterbelts with those in the absence of plants (bare fence lines) in December 2012 and April 2013. The shelterbelts comprised common species (e.g. Macrocarpa, Pine), or a mixture of exotic and native species (e.g. Kapuka, Cabbage tree). In a second study (December 2013, March 2014) we examined plantings chosen as resources for managed honey bees ("Trees for Bees") (e.g. Hebe, Rosemary) and compared these with bare fence lines. Intercept and pitfall traps were set up in the different field margin types and left out for two-week periods. Common shelterbelts caught more pests (*Nysius huttoni*, *Costelytra zealandica*) and fewer *Apis mellifera* than bare fence lines; mixed shelterbelts caught more Bibionidae (crop pollinators). "Trees for Bees" caught more pollinators (*Lasioglossum, A. mellifera*) and predators (Araneae, Coccinellidae) than bare fence lines. Traps along the bare fence lines caught the most parasitic wasps and *Oxysarcodexia varia.* Thus, the number of beneficials was increased by the change in habitat. Future work is needed to determine whether this increased beneficial abundance increases services in nearby arable crops.

Are low producing plants species sequestering more carbon than high producing plants species? A test within the *Chionochloa* genus



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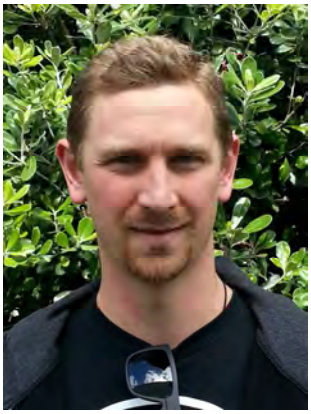
Global climate change and its effect on ecosystems and human life, has made carbon cycling a critical research field. Long-term storage of carbon in the soil, or carbon sequestration, is the end product of the balance between productivity (CO_2 fixed in plant tissue) and decomposition (CO_2 released during litter breakdown).

Low producing and slow growing plants have been shown to produce tissues resistant to external stress, resulting in a poor quality litter recalcitrant to decomposition. High producing plants generally produce good quality litter which is readily decomposable. As a result, low producing plants may be sequestering more carbon into the soil pool, and long time carbon storage, than high producing plants.

To test this, annual productivity, litter decomposition rate, and litter quality of 25 tussock grass species and subspecies in the genus *Chionochloa* were measured. Annual productivity was measured by marking tillers. Species biodiversity was also recorded for each plot to see if productivity is positively influencing biodiversity. Litter decomposition rate is being measured in the Lab by incubated CO_2 trapping of litter and soil in Agee jars. Secondary plant metabolite levels will be analysed and correlated against litter decomposition rate. Identifying relationships between productivity and carbon sequestration, as well as traits associated with increased carbon sequestration, may aid in reducing atmospheric CO_2 levels and in the conservation of these species.

Investigation into the naturally occurring fungal species associated with an invasive species: *Selaginella kraussiana* (African Club Moss)



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Selaginella kraussiana (African club moss) is an invasive ground cover, establishing in shady damp conditions in bush areas, home gardens and waterways across most of New Zealand. Invasion by this species has been found to cause reduced species richness of native plants and suppressed seedling growth. Despite this, there has been little research into the biological control of *S. kraussiana*. Recently, populations of *S. kraussiana* with apparent dieback symptoms have been reported and two fungal isolates with varying degrees of pathogenicity have been recorded recently from material in New Zealand. With this in mind we have surveyed two populations at each of seven sites of *S. kraussiana* and one population of *S. moellendorffii* to get an understanding of the fungal species present. One population of each of the native club mosses *Lycopodium deuterodensum* and *L. volubile* were included for comparison. A total of 78 genetically different fungal isolates were found, most of which were only isolated from *S. kraussiana*. Two fungal isolates were shared between native lycopods and *S. moellendorfii* and one isolate of *Epicoccum nigrum* was found on both *S. kraussiana* and *L. deuterodensum*. Not all of these fungal isolates will be pathogenic and pathogenicity trials are currently underway.

New Zealand's exotic daisies have it easy: pre-dispersal seed-predation of daisy flower heads by insects

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The Asteraceae, or daisy family, is highly diverse and well represented in New Zealand, by both native and exotic species, many of which have naturalised and become important weeds. In their native range, a suite of, often host-specialist, insect herbivores and seed predators target daisies. Pre-dispersal seed predators that feed on the developing seed within capitula are often highly host specific, and have a reduced chance of being successfully imported with the plant. New Zealand's naturalised daisies have been found to experience very low levels of pre-dispersal seed-predation from insects. There is also evidence, both for and against, for seed predation declining with increasing altitude.

The main aims of this study were to quantify pre-dispersal insect seed-predator damage in native and naturalised daisies in the Boyle and Nina Valley areas of the Southern Alps, and to compare the richness and abundance of these insects for each species. An additional aim was to test for a relationship between altitude and pre-dispersal seed-predation. Fifty flower heads from eight native and eight naturalised daisy species were sampled and dissected. Naturalised daisies suffered lower proportions of seed-damaged capitula than native daisies, which had very high damage caused by a diversity of native insects. Naturalised daisies experienced both a lower richness and a lower abundance of insect seed-predators than native daisies. Higher altitudes resulted in fewer capitula with insect-damaged seed. These findings show a high asymmetry in seed predation between exotic and native daisies. Enemy release could be an important reason for the success of exotic daisies in New Zealand.

A novel method for measuring diurnal leaf growth using a thermal camera

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Rates of photosynthesis are often used as a proxy for plant growth. However, recent evidence shows that growth is mostly driven by environmental parameters directly, rather than via photosynthesis. The few existing studies show that diurnal leaf growth fluctuates strongly and does generally not match photosynthetic activity. The methods available to non-destructively measure temporal patterns of leaf growth are few and are often not suited for night-time or field applications.

Here, we present a novel approach for measuring high-resolution leaf growth, using a state-of-the-art high-resolution infrared camera.

Image sequences of a growing leaf that was fixed with small clips, threads and weights in the focal plane of the camera were captured in 10-minute intervals. Because no illumination is needed, it was possible to measure day and night. The thermal images were analysed in two different ways: the area of the leaf was either calculated by tracking markers on the clips, or, alternatively, the leaf area was separated from the background via temperature differences. Besides leaf growth, leaf and air temperature was measured and used to explain growth patterns.

Early results for *Vica fabia* (cv. Coles Prolific) show that it is possible to detect changes of the growth rate within an interval of less than ten minutes. Growth patterns showed almost linear growth over night.

Population structure and individual movements of *Rattus rattus* at low population density in the Wellington region

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We will calibrate ink based tracking cards and coreflute chew cards to absolute ship rat (*Rattus rattus*) density over a study site, 100 ha, which has low ship rat density due to ongoing control by diphacinone bait stations. A mark-recapture program will run over a forest fragment that will be monitored for 9 months with tracking and chew cards.

We will also investigate the home ranges and daily movements of juvenile ship rats at high and low densities using radio telemetry, to make a comparison to published and observed home ranges and daily movements of adult ship rats.

Further to this, we will characterise the population structure and dynamics of ship rats that are found in a forest range that has recently had an aerial 1080 operation. Repopulating ship rats consist of both rats that have survived the operation, and individuals that are reinvading from the perimeter. Mark-recapture and radio tracking will provide information on population structure, individual characteristics and home ranges of repopulating ship rats in the area.

Water and carbon relations in trees of the kauri forest

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Forests play a vital role on our planet. Not only do they provide valuable ecosystem services to the human population, they are also a large carbon sink and an important part of the hydrological cycle. Recent studies show increasing drought-induced forest mortality worldwide and our changing climate could pose a serious threat to New Zealand forests as well. One of the most iconic ecosystems in New Zealand is the kauri forest and so far we have a very limited knowledge about its physiological processes. But how will we detect changes when we know so little about the physiology of the kauri forest trees right now?

The scope of this project is to shed some light on the water relations and carbon allocation in four typical kauri forest species: kauri (*Agathis australis*), totara (*Podocarpus totara*), tanekaha (*Phyllocladus trichomanoides*) and rewarewa (*Knightia excelsa*). In order to achieve that we will measure xylem sap flow, water potential, stomatal conductance, water storage capacitance and non-structural carbohydrate concentrations. The physiological data will give us insight into the trees' physiological mechanisms and their response to climatic and soil conditions. The final part of the project will look into the connection of physiology, climate and the stable isotope signal in leaves and tree rings. We will present preliminary data of the diurnal patterns of water use collected in winter and spring 2014 and provide a first evaluation of the differences in water relations between the four study species.

A study of the epiphytic water (phytotelmic) community of the native *Collospermum hastatum* (Colenso) Skottsb. (Monocotyledonae) in New Zealand

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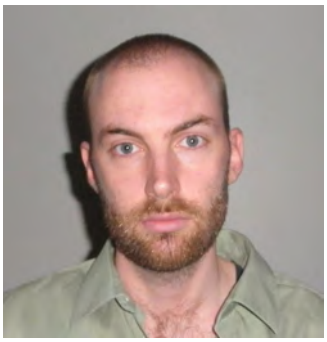
Plants that grow epiphytically are often adapted to hold water in a central cup or in leaf axils to maintain hydration, given that they cannot access soil water. These bodies of water, called phytotelmata, are miniature temporary aquatic ecosystems. This water frequently contains a variety of microorganisms. The New Zealand native epiphyte *Collospermum hastatum* is known to hold water within the leaf axils; however, aside from a study on mosquito larvae, an assessment of communities within this habitat has never been undertaken. To remedy this lack of knowledge, water samples were obtained from the leaf axils of *Collospermum* from the Auckland region and investigated microscopically.

A range of cyanobacteria, fungi, *Euglena* and ciliates were present within the phytotelmata. Plant material, including trichomes and fern spores, was also identified. No micro-algae were detected. Possible reasons for this absence are discussed in this poster.

Creating low-maintenance, biodiverse meadows in Auckland parkland



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Grasslands/meadows are important natural spaces in urban settings providing many ecosystem services, however, they are expensive to maintain. Reducing mowing frequency would lower the amount spent on equipment, petrol, and labour, as well as considerably reducing motor emissions, but such reduced mowing would only be worthwhile if the ecosystem services provided by these meadows are maintained. The Waikumete Cemetery Wildflower Sanctuary supports a diverse assemblage of native plants and exotic wildflowers, and is only mowed once a year. Here I propose research to understand the factors that control this low-maintenance, high-biodiversity system and whether this ecosystem could be used as a model elsewhere.

Grasslands are dynamic systems with numerous species all competing for space. A survey of fifty 1 m^2 plots will be conducted to gather information on species' composition and environmental characteristics. Through multivariate analysis, trends in community composition will be identified along environmental gradients. Species traits data from the literature and databases will be included in the analysis. Experiments will be conducted to further explore the effects of soil nitrogen and mowing regime. Reduction in available soil nitrogen will be used to influence ecosystems so it is more difficult for weeds to dominate, and a targeted mowing regime will be tested to disrupt weed life cycles before they can produce seed.

Grasslands contain complex communities but with careful study of this model system we hope to develop a formula for the creation of diverse and low-maintenance urban meadows.

Effects of the invasive *Homo sapiens*: impacts on cave ecosystems

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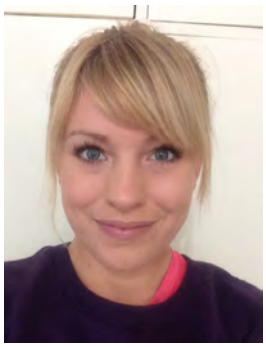
Changing land use is a major threat to all natural environments and biodiversity. The historical habitat loss and deforestation led to the extirpation of many species, the extinction of others and the endangerment of entire ecosystems. Currently, the intensification of land use to maximise profits and production from land already severely altered is a major issue in New Zealand. One major aspect of the New Zealand freshwater environment has been largely neglected by this enquiry; the response of subterranean ecosystems, both caves and aquifers.

This study sought to establish the effects of human land use on the composition and health of cave stream communities. This was achieved through the comparative analysis of cave and surface streams under different land use regimes. In addition, riparian zone and catchment variables related to agricultural land use were analysed to find their impacts on stream health and diversity. Cave and surface streams were different in composition and land use was influential in explaining differences in community composition. The effects of land use were present but less pronounced in cave streams, however, indicating cave ecosystems are less susceptible to the negative effects of the invasive *Homo sapiens* than the more productive surface systems.

Risk pathways of argentine ants (*Linepithema humile*) and the plague skink (*Lampropholis delicata*) from Rodney district businesses to the islands of the Hauraki Gulf



Morgan, Shanti[1]; Marshall, Andrew[1]; Cook, Jeff[2]; Ward, Darren[3]; Galbraith, Mel[1]; Fraser, Diane[1]
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The islands of the Hauraki Gulf provide a unique biological ecosystem for New Zealand's endemic and endangered flora and fauna, and have been identified as areas of national significance for protection. The plague skink (*Lampropholis delicata*) and the Argentine ant (*Linepithema humile*) have been identified as invasive species within New Zealand. Both are known to extend their invasive range via human mediated dispersal, particularly by the transportation of materials such as soil and building materials either by individuals or businesses.

A risk assessment was conducted on commercial businesses in selected areas in the Rodney District, of their potential as invasion pathways for pests to the islands in the Hauraki Gulf. Each business was visited and surveyed for storage and distribution of materials and products, packaging requirements, site hygiene, the extent of suitable habitat for both *L. humile* and *L. delicata*, the destination of the materials/goods, and the presence/absence of both of these invasive species on site. This resulted in a Property Risk Score.

The results showed that 77% presence of *L. delicata* and 100% of *L. humile* were found within those businesses that were defined as 'high risk' by the property risk score. This resulted in the identification of 17 priority risk pathways from Rodney district businesses to Hauraki Gulf islands.

Species' ecology – the distribution and abundance of forest invertebrates

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Forest invertebrates are often sampled using pitfall traps and the abundance of taxa compared among habitats, seasons, locations and treatments. We use data from nine locations within the Te Paki region to show that habitat and season effects on abundance are species' specific.

Four species of cave weta (Rhaphidophoridae) were collected in pitfall traps over 12 months. Although more *Neonetus variegatus* fell into pitfall traps during the late summer (Feb, March) than at any other time of the year, this pattern was not the same for *Pachyrhamma* n. sp. Three cave weta species were trapped in larger numbers in pine forest than in either native scrub or forest, but this pattern was not the same for *Pallidoplectron* n. sp. We recommend sorting adult cave weta to generic level before analysis, and to species' level where possible. We hope the website wetageta.massey.ac.nz will aid further work in identification and the study of cave weta species' ecology.

Managing plague skink (aka rainbow skinks) and invasive ant spread in the nursery industry

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This poster reviews the role of the nursery industry in potential spread of plague skinks (*Lampropholis delicata*, also known as rainbow skink) and invasive ants (Argentine ants (*Linepithema humile*) and Darwin's ants (*Doleromyrma darwiniana*)), through the transport of plants and nursery materials.

The transport of nursery stock between nurseries and sensitive restoration sites is identified as a key pathway for the spread of these species. We developed a 'pathway management plan' to provide practical guidance for the detection and containment of these invasives. This poster includes a review of current best practice for plague skink and invasive ant detection and control, as well as management recommendations and future areas of research. Nursery management, including general tidiness and staff awareness and participation, were identified as crucial to early detection and successful containment.

Utilization of a restored urban wetland by waterbirds

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With the loss of natural wetlands, artificial and restored wetlands are becoming increasingly important as habitats for waterbirds. When the restored Waiatarua Reserve was opened in 2004 it was claimed to be the largest urban constructed wetland in New Zealand. The 75 hectare reserve is located in urban Auckland about 10 Km from the CBD 'as the waterbirds fly'. Restoration was managed by Auckland City Council and took 15 years from inception to completion. The primary roles were to provide stormwater treatment, recreation and off-leash dog exercise areas while providing sanctuary for communities of wetland birds. Although the return of waterbirds to the reserve has been recorded by members of Friends of Waiatarua, Auckand City Council employees and local bird watchers this information is not available as published records.

Between 25 July and 12 December 2009 we surveyed the wetland using five minute counts at 12 sites around the wetland to assess its utilization by waterbirds and, in part, as an evaluation of the success of the restoration.

Data collected over this period suggest that the habitat supports a wide range of waterbirds. These birds exhibit a range of foraging behaviours including waders, active vertebrate predators, and diving, dabbling, filtering and herbivorous waterfowl. The surrounding grasslands are also utilized for foraging and roosting. Breeding activity is also documented for a range of birds over this period. The results suggest that the restoration is providing sanctuary for communities if waterbirds.

Desert Road invasive legume control project

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The Central Plateau of the North Island has a long history of both natural and cultural disturbance which has resulted in a patchy distribution of forest, seral tussock grasslands and shrublands. Tussock grasslands have progressively disappeared in European times due to conversion to pasture or exotic forest, depletion by overgrazing and/or burning, and through invasion by woody native plants and exotic weeds. Weedy legumes like broom (*Cytisus scoparius*), gorse (*Ulex europaeus*) and tree lupin (*Lupinus arboreus*) are invading these tussock grasslands and may increase soil fertility in an otherwise nutrient poor environment altering successional trajectories.

During 2013 a memorandum of understanding was drafted to formalise an agreement between eight organisations (Department of Conservation, NZ Defence Force, Lake Rotoaira Forest Trust, Waikato Regional Council, Horizons Regional Council, New Zealand Transport Agency, Genesis Energy and Transpower) to work collaboratively to protect the Desert Road landscape from the adverse effects of invasive legumes. Mapping legume spread was identified as a key component to defining the problem and helping to achieve control.

To date broom and gorse distribution and density have been mapped by analysing aerial photography taken over a 26 000ha area running parallel to the Desert Road, SH1. Maps will be used to identify low density out-lying infestations, which will be controlled first to help prevent further spread. Later control efforts will aim to reduce the size of larger infestations. This project will require sustained commitment over decades from the organisations and communities involved due to the long-lived seed banks of all three species.

The role of nonstructural carbohydrates in assessing plant physiological responses to drought

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Plants are exposed to stress factors resulting from climate change, with drought being the most important one affecting plant life. Better understanding of how drought affects plant physiological mechanisms and plant mortality is of utmost importance. Mechanistic explanations of how plants die have not been conclusive and are continuously revised. Nonstructural carbohydrates (NSC) are thought to be key determinants of how plants cope with drought.

Here, we aim to use mangroves and New Zealand native angiosperms and gymnosperms to shed light on the role of NSC in low soil water potential stress, caused both via drought and salinity. We do this by experimentally manipulating NSC, drought, and salinity in seedlings of the New Zealand mangrove species *Avicennia marina*.

Secondly, we will manipulate NSC in seedlings of native gymnosperm and angiosperm communities to determine their responses to differential levels of NSC at the onset of drought. Thirdly, we aim to manipulate NSC in mature trees of *A. marina* and relate NSC levels to salinity stress. This will for the first time shed light on differences between the role of NSC in seedlings vs. mature trees in terms of drought response.

Distribution and community composition of lichens on mature mangroves (*Avicennia marina* subsp. *australasica*) in New Zealand

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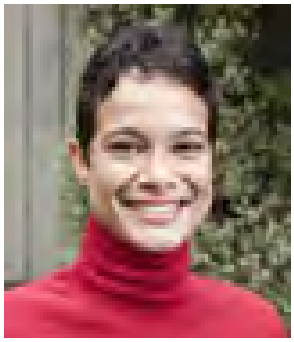
Whilst there is a global trend of mangrove loss, mangroves in New Zealand have been steadily spreading and this is usually attributed to increased sedimentation caused by erosion from urbanization and agricultural development. This expansion has led to public submissions for removal of mangroves. Some mangrove removal has occurred, despite there being limited understanding of what the effects would be on epiphytic plant and/or lichen communities on mangroves. Lichens have been recorded from mangroves in New Zealand, but no previous systematic study has been carried out to assess their diversity.

This study investigated species' richness, abundance and community composition of lichens in association with mature mangroves at 20 sites in the upper North Island of New Zealand. A total of 112 species were collected from the 20 study sites. Richness at each of the 20 study sites ranged between 18-39. Of these species, one was 'Nationally Endangered', five were 'Naturally Uncommon', and 27 were 'Data Deficient'. Species, richness correlated positively with diameter at breast height (DBH) and the presence of some individual species also correlated positively with DBH. Kaipara sites formed a distinct cluster on the Multi Dimensional Scaling plot showing their similar communities. This study shows that mature mangroves are important habitat for lichen communities, including uncommon and threatened species.

Ecological thresholds as constraints to the growth and survival of woody tree species in degraded grassland in the South Island's dryland zone



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New Zealand's dryland zone contains some of the country's most threatened ecosystems and is also the least well protected. Natural regeneration of native forest and shrubland species in dryland ecosystems is often limited by several environmental and anthropic factors that affect the establishment and growth of seedlings. This research is focusing on better understanding some of these factors (thresholds) and how they can be manipulated to enhance restoration success at two sites in New Zealand's eastern South Island, all of which were previously farmed and are now dominated by a rank growth of exotic grasses.

A combination of grass removal treatments (cultivation, mulch, and herbicide) and shade was established to try to determine the ecological thresholds that may be limiting growth of native woody seedlings in these areas. Probability of survival (S), Relative Height Increment (RHI), fluorescence (Y), δ13C analysis, and soil moisture were measured for two summers. Although there is some variation among species, the overall results show that grass removal and shade result in the highest probability of seedling survival (S≥ 83%, 95% CI) and enhance seedling growth (mean RHI ≥ 0.72). On average, Y-values and δ13C analyses showed that seedlings were not under water stress for most of the experimental period (Y ≥ 600; δ13C= -29.6‰ ± 1.3‰). This may indicate that the growth and survival responses observed in this experiment can be the result of reduced competition between the exotic plants and the native seedlings promoted by the grass removal treatments and perhaps improved soil physical conditions, rather than water stress *per se*.

Drought sensitivity and response strategies of native vegetation in Auckland region

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Under climate change scenarios predicted for New Zealand, seasonal drought is forecast to increase in intensity, thus increasing the frequency of soil moisture deficits across the country. Soil moisture is an important factor in the determination of plant community structure and particularly for seedling recruitment, as the limited root systems of seedlings make them highly susceptible to drought stress. Further, drought survival strategies and hydrology preference have been shown to influence species distribution patterns. Thus, climate change may alter recruitment patterns and subsequent plant distributions.

Seedlings of eighteen species commonly found in native forests around Auckland and used extensively in rehabilitation projects were subjected to a manipulative dry-down experiment. Leaf gas exchange and water potentials were measured at four-week intervals for twelve weeks. Plant vigour was assessed with a wilting index throughout the experiment and harvested samples were assessed for total growth and ratios of above and below ground biomass.

Preliminary findings show that sensitive species include *Piper excelsum*, *Geniostoma ligustrifolium*, and *Hebe stricta* while tolerant species include *Agathis australis, Kunzea ericoides,* and *Laurelia novae-zelandiae.* Findings will contribute to literature focused on seedling recruitment in drought scenarios, as well as indicate which plant species commonly recommended in catchment rehabilitation planting are more drought resistant.

Novel multiple-kill control devices for feral cats

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Feral cats (Felis catus) represent a significant threat to endangered species and are one of the most damaging predators worldwide. Current cat management is labour intensive, costly and restricted to single kill traps, live capture, shooting or toxins. The focus of our research is to investigate cat behaviour around a novel multiple-kill control device (Spitfire). The Spitfire delivers a known amount of toxic paste onto a cats belly area that is licked off while grooming. Different versions of the Spitfire are being developed to target other pest species in NZ – they all use the same basic firing mechanism, but have different housings and a range of different toxins. The cat Spitfire will deliver PAPP (para-aminopropiophenone) to the cat's belly, In a pilot trial, 3/3 feral cats died from ingesting PAPP sprayed onto their stomach fur. Cats are compulsive groomers and spraying their belly with a toxin is providing a novel pathway for toxin ingestion, rather than poison meat baits which degrade rapidly within the environment.

Feral cats are notoriously hard to control and much of this research has focused around Spitfire housing. All housing models have been developed to increase cat interaction rates while reducing non-targets from entering. Models differ in length, height, wire mesh attachments and ramps leading up to raised housing models. Of these, several of these housing prototype models have been field evaluated with positive results.

Seasonal dietary differences and lack of sexual dimorphism in weasels

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We studied the diet of weasels *(Mustela nivalis vulgaris*) caught on Purerua Peninsula, Bay of Islands, by examining gut contents of 17 individuals caught over summer (n=7) in 2011 and 2012 and winter (10) in 2012. The weasels were trapped over an area of 1,700 hectares that has been under integrated pest management (IPM) for almost five years on the same operational basis. The diet of weasels varied significantly between the seasons; weasels caught in the winter consumed mainly rodents and invertebrates and summer-caught weasels ate rodents, invertebrates, reptiles, and birds. Weasels consumed native invertebrates and copper skinks, supporting previous studies and suggesting that weasels have greater effects on biodiversity loses than previously acknowledged.

Weasels were larger on average than those caught in a national survey and the body weights and head-body lengths were similar between males and females. We suggest that larger size and lack of sexual dimorphism may have resulted from the predator management in Purerua Peninsula, with cats and stoats being reduced and thus allowing weasels of larger size and sexually monomorphic to take advantage of larger prey available.

Microclimate and ecosystem processes within a *Phytophthora* Taxon *Agathis* (PTA) affected kauri forest.

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The novel *Phytophthora* species *Phytophthora* taxon *Agathis* (PTA) kills kauri seedlings and trees of all ages and is present in many of the remaining kauri stands throughout Auckland and Northland. The loss of Kauri trees could lead to changes in stand microclimatic conditions and ecosystem processes such as carbon and water cycling. Since March 2013, we measure tree growth, litter fall (i.e. leaves, twigs, etc), throughfall (i.e. rainfall which falls to the forest floor from the canopy), and microclimatic properties in the vicinity of minimally and medium/highly infected Kauri trees in the Waitakere Ranges.

Growth rates of medium/highly infected trees tended to be lower compared to minimally infected trees. We found less litter under medium/highly infected trees compared to minimally infected trees. Lower amounts of kauri reproductive material were found under highly infected trees. Photosynthetically active radiation (PAR), at the forest floor, differed between infection classes. Further, the amount of throughfall was higher underneath medium/highly infected trees.

Microclimatic conditions and the changes in the magnitude and composition of the litter will influence decomposition rates and thus the amount of carbon released back into the atmosphere. An understanding of the consequences of PTA on ecosystem processes is crucial to improve our understanding of pathogen related disturbances and to inform future management decisions.

Turf-forming herbs of New Zealand's ephemeral dune wetlands: their ecology, habitat preferences and environmental ranges

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Sand dunes are being destroyed worldwide through changing land use and recreational activities. This increases threats to resident plant species. Ephemeral dune wetlands are distinct environments, composed of native turf species, including *Eleocharis neozelandica, Gunnera dentata, Isolepsis basilaris, Lilaeopsis orbicularis, Limosella lineata, Myriophyllum votschii, Ranunculus acaulis* and *Selliera rotundifolia*. They occur in the dune slacks between dunes. Very little is known about how coastal plants respond to loss, restriction and change to their habitats.

Regional distinctiveness in sites is common, as large numbers of threatened species can be found within the dune slacks. A national survey was conducted to determine the geographical range of these focal species and in what habitat types they occur. Sites were chosen based on local botanical knowledge, and were required to have a minimum of three focal species present. These sites were surveyed with transect lines and regularly spaced quadrats. The micro topography was also measured for each site, to determine if any of these species had a microsite preference. At each wetland a general list of environmental factors was completed as well as establishing the depth of the water table.

Currently an experiment is running to determine the tolerance of each of these focal species to stress, namely waterlogging, shade, burial, addition of nutrients and the effect of trampling. The broader scale issue is how to conserve these ecosystems due to their large numbers of vulnerable and threatened plant species and their transient nature.

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Programme for NZES 2014, Massey University, Palmerston North, 16-21 November 2014

FINAL as at 12 November, 2014.

The presenting author's name is in bold. Papers are filed in the Abstract book under the name of the first author, who is listed first in the programme. The presenting author, if not the first author, is also listed. Other authors are listed in the Abstract book.

Sunday

9.00am-9pm	**Student session - Venue AH3**
5-7pm	**Welcome gathering - One7Five Bar, Distinction Hotel**
6-8pm	**NZES Council meeting - Venue AgHortA 1.40b**

Monday

8.00-8.45am	**Registration**
8.45-9.00am	*Chair: Phill Battley* **Welcome: VC Steve Maharey; House-keeping: Paul Barrett and Jill Rapson**
9.00-9.55	**Keynote: Phill Cassey:** Biological invasions of vertebrate species: pets, pests and people - Venue AH1
9.55-10.30	**Young scientist's plenary: James Russell:** Is New Zealand the world's eradication hotspot? - Venue AH1
10.30-11	***Tea break***

	AH1	AH2	AH3	AH4
	Chair: Ecki Brockerhoff, Beccy Ganley	Chair: Emma Williams	Chair: Chris Lusk	Chair: Matt Krna
11.00-11.20	Border biosecurity stocktake: **Ganley,** Beccy: *Phytophthora* species and the risk they pose to New Zealand's native plants and ecosystems	Avian ecology: **Kelly**, Dave: Blackbirds: useful substitutes for lost mid-sized native frugivores, or weed vectors?	General vegetation: **Blanchon**, Dan: Rare or just overlooked? Conservation of species we know nothing about	General invasions: **Vall-llosera Camps**, Miquel: Indian Ringnecks: from pets to pests - Assessment of the status, potential distribution and impacts of exotic *Psittacula krameri* in Australia
11.20-11.40	Border biosecurity stocktake: **Brockerhoff**, Ecki: Invasions of forest insects and pathogens in New Zealand	Avian ecology: **Galbraith**, Mel: Changes in the breeding status of the southern black-backed gull (*Larus dominicanus*) on Rangitoto Island (Hauraki Gulf, New Zealand) since 1920	General vegetation: **Silberbauer**, Rob: The life history of the Lepidopteran seed predator *Cryptaspasma querula* and relationship to potential host plants	General invasions: **Byrom**, Andrea: The potential for "citizen surveillance" of invasive species
11.40-12.00	Border biosecurity stocktake: **Stanley**, Margaret: Current and future risks of ecological impacts as a result of ant invasions	Avian ecology: **Battley**, Phil: Why do godwits migrate when they do?	General vegetation: **Wotton**, Debra: Seed ecology of the endangered shrub *Muehlenbeckia astonii*	General invasions: **Wyse**, Sarah: The state of tree protection in urban Auckland: facilitating a weedy city?
12.00-12.20	Border biosecurity stocktake: **Rovira**, Marona: Influences of phylogeny, biogeography and host-specificity on invertebrate invasions and their impacts on native plants and natural ecosystems	Avian ecology: **Fraser**, Diane: Native and invasive: the changing fate of the spur-winged plover (*Vanellus miles novaehollandiae*) in New Zealand	General vegetation: **Aubert**, Marine: Does size actually matter? Disruption of plant-bird mutualisms in fragmented landscape affects breeding systems of a native tree in isolated patches	General invasions: **Asmus**, Ulle: The origin of species in towns: A comparison of the vegetation of 11 towns in the North Island with other towns worldwide
12.20-1.40	***Lunch***			
	Lunchtime talk: Jill Mellanby: Introduction to publishing (12.45-1.30pm) - Venue AH4			
	Chair: Beccy Ganley	Chair: Mel Galbraith	Chair: Debra Wotton	Chair: Susan Walker
1.40-2.00	Border biosecurity stocktake: **Ide**, Tatsuya: Detecting invasive drywood boring species from faecal pellets and frass using DNA barcoding	Avian ecology: **Dyer**, Ellie: The Global Avian Invasions Atlas (GAVIA): Using a global-scale spatial database of alien bird species to answer key questions in invasion ecology	General vegetation: **Clarke**, Amy: Climatic correlates of plant diversity across New Zealand's alpine regions	General invasions: **Burns**, Kevin: Island biogeography of exotic species: exploring the turnover dynamics that underpin diversity-invasibility relationships
2.00-2.20	Border biosecurity stocktake: **Chase**, Kevin: Allee effects and the establishment of exotic invasive bark beetles	Avian ecology: **Panfylova**, Julia: Applying structured decision making to management of the reintroduced hihi population in Bushy Park	General vegetation: **Smith**, Ange: Vehicle damage to the Rangipo Desert: the potential of vehicles to change the environment	General invasions: **Zhang**, Jingjing: A spatially-explicit individual-based approach of optimal foraging in heterogeneous landscapes: effects of perception
2.20-2.40	Border biosecurity stocktake: **Boyer**, Stéphane: Below-ground invasion, the coexistence of exotic and endemic earthworms in New Zealand soils	Avian ecology: **Williams**, Emma: Developing monitoring methods for rare and cryptic species: a case study of the Australasian bittern	General vegetation: **Lambert**, Michelle: Factors restricting population persistence of two *Olearia* species in New Zealand	General invasions: **Bassett**, Imogen: Exotic dung beetles in New Zealand: evaluating potential benefits and risks
2.40-3.00	Border biosecurity stocktake: **Roige**, Mariona: Using pest assemblages to predict invasions: Validation tests for the self-organizing map approach	Avian ecology: **Castro**, Isabel: Introduced parasites in native NZ birds: the unexpected hotspot	General vegetation: **Brock**, James: Mamaku: *Cyathea medullaris* – pioneer and forest engineer?	General invasions: **Krejcek**, Susanne: Invasive termite management in New Zealand: the past, present and future
3.00-3.30	***Tea break***			
	Chair: Ecki Brockerhoff	Chair: Ian Henderson	Chair: Ange Smith	Chair: Kevin Burns
3.30-3.50	Border biosecurity stocktake: **Weiss**, John: Borne on the wind; Understanding the significance of natural pathways of plant pests into New Zealand and Australia	Waterways: **Foote**, Kyleisha: Role of the dairy industry in New Zealand's ecological decline	General vegetation: Wyse, Sarah; **Curran,** Tim: Messages from the burning bush: comparing the flammability of New Zealand plants	General invasions: **Terry**, Jon: Arrival mechanisms for weeds at Kapiti Island
3.50-4.10	Border biosecurity stocktake: **Linde**, Andreas: Invasive.. but *benign!?* The establishment and spread of the introduced entomopathogenic fungus *Entomophaga maimaiga* in Southern Europe	Waterways: **Marapara**, Tapuwa: Wetland restoration for optimum ecosystem service provision - visualisation of the impacts of tree planting on water flow dynamics in Wairarapa wetlands	General vegetation: **Moore,** Simon: Driving Miss Daisy and Mr. Broom – vascular plant endemism and dryland conservation imperatives in South Marlborough	General invasions: **Walker**, Susan: Productivity, not hawkweed invasion, influences indigenous vegetation recovery following grazing removal on the Upper Waitaki Basin floor, New Zealand
4.10-4.30	Border biosecurity stocktake: **Lustig**, Audrey: Population dynamics and spread of invasive insects in response to changes in landscape structure	Waterways: **Joy,** Mike: New Zealand's shame; the commercial harvesting of threatened endemic and native species	General vegetation: **Lusk,** Chris: Species richness of divaricate plants is strongly correlated with present-day environmental factors	General invasions: **Rapson**, Jill: Invading plants in New Zealand: What are their impacts on indigenous ecosystem services?
4.30-6.30	***Posters and drinks session - AgHort Lecture Block Foyer***			
7.00-8.00	Evening talk: **Ken Thompson**: Science, myths and gardening - Venue Palmerston North Library (in town, off George St)			

Tuesday

Chair: Chris Bycroft

9.00-9.45 — **Te Tohu Taiao Plenary: Janet Wilmshurst:** Palaeoecology and Ecology: it's just a matter of time - Venue AH1

9.45-10.30 — **Plenary - Maurine Neiman:** Sex in the Wild (and especially in New Zealand) - Venue AH1

10.30-11 — ***Tea break***

	AH1	AH2	AH3	AH4
	Chair: Simon Fowler	Chair: Jamie Wood, Ian Dickie	Chair: Mary Morgan-Richards	Chair: Martin Bader
11.00-11.20	Pest Managament: Mapping and modelling — **Etherington**, Thonas: Visualising intra-landscape isolation to help map the risk of invasion: an example of common brushtail possums in the Auckland isthmus	Meta-genomics — **Dopheide**, Andrew: Meta-barcoding of terrestrial biodiversity from soil DNA: methodological considerations and application to an island ecosystem	Hybridisation + Invasion — **Tate**, Jennifer: Battle of the genomes following hybridization and whole genome duplication in *Tragopogon* (Asteraceae)	Conservation — **Anderson,** Sandra: Bird pollination in temperate ecosystems: is New Zealand the exception or the rule?
11.20-11.40	**Pech**, Roger: Mega-masts and the management of invasive mammals: will climate change lead to increased costs of control?	**Dickie**, Ian: Next-generation biodiversity assessment across gradients of land-use intensity	**King**, Kim: MtDNA haplotype diversity and hybridisation among house mice, *Mus musculus*, of diverse origins in New Zealand	**Godfrey**, Jonathon: Modelling growth of captive tree weta
11.40-12.00	**Lee**, Bill: Causal networks reveal pathways for managing multiple disturbances to limit plant invasion	**Johansen**, Renee: Exploring the biogeography of fungal communities in dune grass roots with next generation sequencing	**Wehi**, Cilla: The loss of a celebrated species, the Māori dog: I ahatia te kurī?	**Torres,** Ursula: The realized climatic niches of freshwater invertebrates: are they stable?
12.00-12.20	**Weiss**, John: How agent-based models are assisting in determining optimal and economic benefits of weed control strategies	**Wood**, Jamie: Ancient environmental metagenomics: the potential, and limits, to using aDNA for reconstructing New Zealand's prehistoric ecosystems	**Voelckel**, Claudia: Adaptive introgression in New Zealand alpine *Pachycladon*	**Flenley**, John: The advantages of automated palynology

12.20-1.40 — ***Lunch***

Lunchtime meeting: AGM: (1-2pm) Venue AH2

	Chair: John Dowding	Chair: Mick Whittle	Chair: Miko Kirschbaum	Chair: Dan Blanchon
2.00-2.20	Pest Management: Monitoring — **Blackie**, Helen: 'PAWS' – Print acquisition for Wildlife Surveillance	De-extinction — **Opening comments by Trevor Mallard. Seddon**, Phil: Introduction and contextualisation of De-extinction	Cells to canopies — **Mcinnes-Ng**, Cate: Thirsty trees? Evidence for drought avoidance adaptations in kauri (*Agathis australis*)	Conservation — Sweetapple, Peter; **Barron**, Mandy: It's raining frass! A novel method for monitoring canopy-dwelling invertebrates
2.20-2.40	**Irie**, Kenji: Adapting the 'PAWS' animal monitoring tool for surveillance of insects and other small animals	**Seddon**, Phil: Resurrection for reintroduction and the pre-selection of De-extinction candidates	**Bader**, Martin: Ecophysiological traits of two dominant New Zealand tree ferns	**King**, Kim: What did it cost to save Pureora, and was it worth it?"
2.40-3.00	**Hartley**, Stephen: A simple model for the relative sensitivity of two different presence-absence detection devices (e.g. tracking tunnels vs chew-cards) measured across a range of densities	**Steeves**, Tammy: Will the real conservation geneticists please stand up? Bringing the genetics of small populations into the de-extinction debate	**Donnellan-Barraclough**, Alicia: Switching directions: testing foliar water uptake, reverse flow and hydraulic redistribution in mangrove forests	**Myers,** Shona: How well are District and Regional Councils in New Zealand addressing biodiversity loss?
3.00-3.20	**Ross**, James: DNA collection system for Mark-Recapture estimation of possum density, and TB surveillance sensitivity	**Armstrong**, Doug: Decision theory meets Frankenstein: extending advances in reintroduction biology to resurrected species	**Taylor**, Amanda: A Darwinian framework for investigating epiphyte community development	**Monks**, Jo: Evaluating translocation strategies for New Zealand's green geckos

3.20-3.50 — ***Tea break***

	Chair: Kim King	Chair: Tammy Steeves	Chair: Alicia Donnellan-Barraclough	
3.50-4.10	Pest Management: Toxin Delivery — **Eason**, Charlie: Technology advances protecting our biological heritage	De-extinction — **Campbell**, Doug: The ethics of de-extinction	Cells to canopies — **Cusens**, Jarrod: When do trees grow? High resolution growth in an outdoor lab	
4.10-4.30	**Barun**, Arijana: Control of ferrets using 1080 and PAPP in baits and a resetting toxin delivery device	**Whittle**, Mick: De-extinction as an aspirational end-goal for New Zealand conservation	**Kirschbaum**, Miko: Plant-growth responses to elevated CO2 – a reanalysis of prior observations	
4.30-4.50	**Shapiro**, Lee: The 'Spitfire' – Field trial results of a novel, resetting possum control device	**Parker**, Kevin: Opportunities for ecological restoration in the 21st century? A reintroduction plan for extinct New Zealand birds	**Krna**, Matt: Ecoclinal trends of *Chionochloa pallens*' productivity and decomposition across an altitudinal gradient: What are the implications for endogenous C sequestration?	
4.50-5.10	**Murphy**, Elaine: Development of re-setting toxin delivery devices for stoats and rats	General discussion.	**Griffiths**, Georgianne: Biodiversity and decomposition in mixed broadleaf forest, New Zealand	
5.10-5.30	Van Vianen, Josh; **Roberts**, Kim: The effects of single aerial 1080 operations on common forest birds over 3 years in the South Island, New Zealand	Closing statements / Summary / Where to from here	**Flenley**, John: The greatest problem in ecology: Why are there so many species in the tropical rain forest?	

7-11pm — ***Conference dinner - Venue Distinction Hotel***

Wednesday

9.00-9.55	*Chair: Dave Kelly* **AERA Keynote: Chris Johnson:** Biological invasions, trophic cascades and extinction – the view from Australia - Venue AH1			
9.55-10.30	**Young scientist's plenary: Rachael Gallagher:** Invasive species in a changing climate - Venue AH1			
10.30-11	***Tea break***			
	AH1	**AH2**	**AH3**	**AH4**
	Pest management: Impacts Chair: Elaine Murphy	Evolutionary ecology Chair: Anne Gaskett	Restoration Chair: George Perry	
11.00-11.20	**Dowding**, John: Impacts of rat incursions on two populations of shore plover, and implications for island biosecurity	**Lee**, Daphne: Forest ecosystem evolution in New Zealand over the past 20 million years – new fossils reveal complex patterns and processes	**Forbes**, Adam: Use of artificial canopy gaps and under-planting to restore indigenous forest cover in non-harvest exotic conifer plantations	
11.20-11.40	**O'Donnell**, Colin: The impacts of introduced mammalian predators on indigenous birds of freshwater wetlands in New Zealand: a review	**Reichgelt**, Tammo: The evolution of forest leaf traits in New Zealand in response to climate	Burge, Olivia; **Kelly,** Dave; The folly of charismatic methods: bird perches	
11.40-12.00	**Wilson**, Deb: Uncovering the impacts of invasive house mice on lizard and invertebrate populations	**Daly**, Lizzie: Following fossils and living lineages: Investigating variation in shell shape and genetics of *Placostylus* through time	**Bishop**, Craig: Measuring ecosystem restoration success in Auckland's Regional and Local Parks	
12.00-12.20	**Peterson**, Paul: Low foliar nitrogen levels contribute to poor performance of the heather beetle, *Lochmaea suturalis* (Thompson), as a biocontrol agent for heather, *Calluna vulgaris* , in New Zealand	**Chiba**, Satoshi: Patterns of divergence and extinction in land snails on the oceanic Ogasawara Islands	**Roberts**, Tess: Is native forest restoration ecologically successful?	
12.20-1.40	***Lunch*** *Lunchtime talk and workshop: Andrea Byrom: "What is Predator Free New Zealand?" (1-1.40pm) - Venue AH4*			
	Native/exotic interactions Chair: Margaret Stanley	Evolutionary ecology Chair: Lizzie Daly	Communities Chair: Cilla Wehi	
1.40-2.00	**Vergara**, Olivia: A comparison of invertebrate communities inside and outside a fenced mammal-proof reserve: Zealandia Sanctuary, Wellington, NZ: preliminary results	**Gaskett**, Anne: Deception down under: are Australia and NZ 'hot-spots' for the evolution of deception?	**Conran**, John: Reproductive niche conservatism during environmental change in New Zealand: apparent persistence of pollination and dispersal syndromes over 20 Myr	
2.00-2.20	**Schoener**, Ellen: Do wildlife translocations cause pathogen pollution? A case study of Avian Malaria in North Island saddleback (*Philesturnus caruculatus rufusater*)	**Pilkington**, Kay: A population genetics approach to species delimitation in the genus *Selliera* (Goodeniaceae)	**Brandt**, Angela: When do plant radiations influence community assembly? The importance of historical contingency in the race for niche space	
2.20-2.40	**Yule**, Kirsty: My enemy's enemy is my friend: Tri-trophic interactions between a predator-parasite-host assemblage in New Zealand	**Gemmel**, Michael: Snail species' shapes on the sea shore: investigating the relationships between taxonomy, morphology and the environment in *Buccinulum*	**Godsoe**, William: Coexistence mediates the effect of competition on species' distributions	
2.40-3.00	**McIntyre**, Mary: Replacement of native mosquitoes by exotic species on farmland: a new scenario with a wider climatic link	**Gwynne**, Darryl: Mating evolution in ground weta: nuptial gifts, female ornaments and mate-guarding (Hemiandrus: Orthoptera, Anostostomatidae)	**Perry**, George: Stochastic geometry in species-rich plant communities	
3.00-3.30	***Tea break***			
3.30-4.30	*Chair: Bill Lee* **Keynote Conclusions: Ken Thompson:** Invasive alien species; getting the measure of the problem - Venue AH1			
4.30-5	***Prize-giving; Farewell: Phil Battley - Venue AH1***			

Thursday	*Conference excursions - Organiser: Paul Barrett*
Friday	*NVS workshop: Venue AH5 - Organiser: Elise Arnst*