BIODIVERSITY: 2010 and beyond

NEW ZEALAND ECOLOGICAL SOCIETY CONFERENCE

22–25 November 2010
University of Otago, Dunedin

Programme and Abstracts

NEW ZEALAND ECOLOGICAL SOCIETY

http://www.nzes.org.nz/

Miss E. L. Hellaby
Indigenous Grasslands
Research Trust

BIODIVERSITY: 2010 and beyond

Welcome and conference overview

Welcome to 'Biodiversity: 2010 and beyond', the 2010 annual conference of the New Zealand Ecological Society.

The theme of this year's conference recognises and celebrates 2010 as the United Nations International Year of Biodiversity. To acknowledge this, we present ten symposia examining a range of topics related to biodiversity. There are nine plenary speakers, from Canada, the United Kingdom, the USA, and New Zealand, and more than 90 contributed oral and poster presentations. The subjects covered are diverse and we are sure you will find many to interest you. We extend a particular welcome to the students presenting many papers throughout the conference, and to our overseas guests.

In addition to discussing organisms and ecosystems, several symposia explicitly consider biodiversity in relation to human populations – cultural perspectives, production lands, and urban environments. Others examine aspects of managing and protecting biodiversity – assessment, prioritisation and reporting, and reintroduction and pest management. Two special forums are offered: a workshop as part of the 'Cultural perspectives' symposium, and a discussion panel as part of the 'Production lands' symposium. These meetings are described later in this Programme.

A successful conference depends on voluntary efforts by a great many people. We particularly thank the organising team, symposium convenors, and field trip organisers. Many people have helped in other ways, most notably the student volunteers who will assist to make things run smoothly. We are especially grateful to Gretchen Brownstein, who with unlimited cheer and energy has managed most of the details, including registration, entertainment, and venues.

This conference has been supported generously by many organisations (see inside front cover). We express heartfelt thanks to our principal sponsors, Landcare Research and the Department of Conservation, and to the organisations that have supported symposia, visiting speakers, the panel discussion, and other components of the conference (see following section on symposia and plenary speakers). Without these funds this conference would not have been possible. Indeed, this conference has surpassed recent NZ Ecological Society conferences in numbers of registrations, talks, and posters.

Perhaps the biodiversity of the Otago region near Dunedin has helped to draw people to this conference. Our three field trips, to Macraes Flat, the Orokonui Ecosanctuary, and the Otago Peninsula, have been very popular; we hope to hear that they were successful and educational and that the participants enjoyed good weather!

We wish you an enjoyable three days and hope you return home with new ideas and new perspectives.

Deb Wilson and Bill Lee

Conference co-convenors

Organisers of Biodiversity: 2010 and beyond

Many people have contributed to planning and running this conference. We especially thank Gretchen Brownstein, who managed the logistics of both the main conference and the Student Day, and Logan Elliott, who ran our logo competition and arranged many details early in the process. We are grateful to Elly Lang (administration, accounts, and word processing); Britt Cranston, Konnie Gebauer and Annika Korsten (Student Day); Christine Bezar (editing), Cissy Pan (graphics) and Susan Sheppard (Ecological Society administration); Peter Johnson, Sue Maturin and Pascale Michel (judges of logo competition); Kelvin Lloyd, Phil Seddon, Dan Tompkins, Yolanda van Heezik, Susan Walker (scientific committee); Sam Clark (website design and hosting); and Kath Dickinson, Murray Efford, Ian Jamieson, Graeme Loh, Catriona MacLeod, Sir Alan Mark, Bruce McKinlay, Geoff Rogers, and Mike Thorsen, for support and assistance at various times. Ribbonwood Nurseries and the Department of Botany (University of Otago) kindly loaned plants for decoration. Very many thanks go to the team of student volunteers, led by Gretchen Brownstein. These people, wearing red conference T-shirts, can help if you have any questions during the conference.

Conference logo and biodiversity painting

The conference logo was designed by Esther Riley of Christchurch, who describes its '…loose circle of organisms, representing the globe, life-cycles and changes over time. The slight interlocking of the forms implies the interrelationships within an ecosystem.'

The painting on our cover is by Lynette Hartley, also of Christchurch. She writes: 'Biodiversity is a huge, almost infinite, topic covering pretty well anything and encompassing a wide range of meanings and timescales, but the date 2010 is a very finite thing. …the conference will cover a small fraction of the various aspects of New Zealand biodiversity, but the biodiversity itself will carry on…well beyond 2010. I therefore drew plants and animals bursting out of the container in which we (the conference goers or scientists) have been examining them.

The logo and painting were the successful entries to a competition held to find a logo to fit the conference theme.

Symposia and plenary presentations

Keynote presentation: As far as the eye could see... Professor Kevin Gaston

Professor Gaston (University of Sheffield) is a leader in the fields of biodiversity and conservation. His research focuses on biodiversity and macroecology; its central unifying theme is the study of variation in the geographic distributions of species. Particular emphasis is given to geographic (or macro) scale patterns and dynamics, and their consequences for conservation.

Sponsor: Ecology Research Group, University of Otago (Director: Colin Townsend)

Animal reintroductions and the problem of post-release dispersal

Reintroductions have become one of the standard tools for threatened species recovery. Although the methods used to catch, transport and release animals with minimal stress and mortality have improved over the years, our understanding of the factors influencing dispersal from a release area, and how this can jeopardize reintroduction project success, is still poor. This symposium will review the ways in which post-release dispersal can affect the reintroduction project outcomes. Speakers will present empirical studies based on a range of species – from seabirds to small forest passerines - where dispersal is a critical issue.

Convenors: Ian Jamieson and Phil Seddon (University of Otago)

Biodiversity and ecosystem function

The effect of biodiversity on the functioning of ecosystems has been the focus of much ecological research over the last decade. Ecosystem function has been viewed as the flux of energy and matter within ecosystems and inter-specific interactions are primarily responsible for that flux. To date there has been a preoccupation with the experimental manipulation of biodiversity, primarily within autotrophic communities, to determine how ecosystems function. However, such manipulations are not done in the context of an evolutionary stable re-arrangement of the interacting species and, although considerably more demanding, the study of real communities may be more enlightening.

Convenor: Nod Kay (Scion)

Biodiversity and production lands: the benefits and the risks

This symposium aims to highlight current research investigating the benefits and risks that land management practices pose to biodiversity within and beyond New Zealand's production land boundaries. The symposium will cover a wide range of production environments, including agriculture, cropping, and plantation forest ecosystems.

Two plenary speakers will discuss the benefits and challenges that interdisciplinary research presents for sustainable land management in production landscapes. Professor Dave Raffaelli (University of York) will discuss the application of the Convention on Biological Diversity's Ecosystem Approach for maintaining biodiversity and ecosystem services in the UK's production landscape. Jon Manhire (The Agribusiness Group, Christchurch) will examine the environmental effects, and social and economic consequences, of different farming practices in New Zealand, in the context of community stakeholder and market demands.

To facilitate a lively discussion about the current and future biodiversity management challenges and opportunities facing New Zealand's production industries, a panel discussion will be held at the end of the symposium. Representatives from industry and local and regional government organisations will be actively encouraged to attend this meeting and participate in this discussion, which will be chaired by Grant Blackwell (Office of the Parliamentary Commissioner for the Environment).

Convenors: Steve Pawson (Scion) and Catriona MacLeod (Landcare Research and ARGOS)
Sponsors: ARGOS will offer a prize for the Best Student Paper in the Production Lands symposium. AGMARDT is a major sponsor of this symposium, supported by contributions from ARGOS, Scion and Parliamentary Commissioner for the Environment.

Cultural perspectives on biodiversity research and management

This 1.5-day symposium aims to highlight opportunities and challenges for cross-cultural environmental research and management in New Zealand and throughout the world. Although many participants will examine approaches of different cultures defined along ethnic lines, the symposium also invites contributions concerning the enablers and barriers for cross-cultural collaboration and co-discovery of how best to conserve biodiversity and the environment when the different 'cultures' are considered as: manager, researcher, educationalist or policy maker institutions; theoretical or applied traditions of research; scholarship from the humanities and sciences; and different religious approaches to society and biodiversity. Expect challenge, honesty, and surprise, but above all else, diversity in how best to achieve a shared quest for improved environmental and social wellbeing.

Two plenary speakers will start the symposium discussion off: Chief Randall Kahgee from Canada will describe his Saugeen-Ojibway First Nation's experiences of working with ecological scientists in Ontario and their success and frustrations to influence biodiversity and conservation management in their tribal area. Professor Te Ahukaramū Charles Royal will also give a plenary address. Charles is co-director of Ngā Pae o Te Māramatanga, New Zealand's Māori Centre of Research Excellence. He is also an accomplished musician and long term researcher and expert on Mātauranga Māori (which includes the Traditional Ecological Knowledge of Māori). He has chosen to talk about revitalisation of Mātauranga Māori, including its practice for improved environmental stewardship.

There will be a prize for the Best Student Paper in the Cultural Perspectives symposium. A workshop and on-line discussion forum (http://biodiversityvoice.wordpress.com/) will also be dedicated to furthering debate of key issues relating to cultural aspects of biodiversity research and management.

Convenors**:** Henrik Moller, Corey Bragg (Centre for Study of Agriculture, Food & Environment, University of Otago), Jenny Rock (Centre for Science Communication, University of Otago)
Sponsors**:** Ngā Pae o Te Māramatanga, University of Guelph (Canada), New Zealand Ecological Society

Ecology and conservation of indigenous grasslands

New Zealand indigenous grasslands face increasing threats from land-use change at a time when their biodiversity and ecosystem service values are being highlighted. The symposium will provide science-perspectives on how we can sustain grassland ecosystems. The keynote speaker is Professor Alan Knapp (Colorado State University) who has had a long association with the NSF-funded Konza Prairie Konza Prairie LTER program. Alan has a distinguished career investigating grasslands in North America and more recently southern Africa, in both C3 and C4 systems. Of relevance to NZ is his interest in water and carbon cycles in grasslands, shrub encroachment, and sustaining grassland systems in the face of climate change.

Convenor: Bill Lee (Landcare Research)
Sponsor: Miss E.L. Hellaby Indigenous Grasslands Research Trust

Macraes Flat: Research and management in an changing environment

Macraes Flat or 'Macraes', 50 km northwest of Dunedin, is a generic name for an area where intensive conservation research and management has been done over the last 20 years, initially on grand and Otago skinks but more recently on broader ecological relationships. The work has led to the purchase of land for conservation purposes. At the same time on adjacent blocks agricultural land use has intensified.

This symposium will review the wide-ranging research that has taken place, and present perspectives on how it has influenced conservation and land use management. Recent grand and Otago skink conservation has emphasised an adaptive management philosophy in learning how to manage habitats and predators of these two critically endangered species to prevent extinction. Other research has focused on the biology of other species of lizards, predator prey relationships, meso-population dynamics of mammals and vegetation communities, and changes in plant community structure as a result of land use and conservation management change. The Macraes work is an ongoing multidisciplinary research and management project.

The Symposium is complementary to the Macraes Flat conference field trip. Background information on grand and Otago skinks can be found here: www.doc.govt.nz/conservation/native-animals/reptiles-and-frogs/lizards/grand-and-otago-skinks

Convenor: Bruce McKinlay, Department of Conservation

Molecular ecology of New Zealand's biota

New Zealand's biota is ecologically and evolutionarily unique and commands interest from biologists the world over. The modern tools of molecular ecology now allow us to examine questions about our flora and fauna that were previously unanswerable. This symposium will highlight recent work in molecular ecology on elements of the New Zealand biota, with an emphasis on the biology rather than the molecular tools. The symposium will start with a plenary talk by Professor Chris Simon (University of Connecticut) entitled Using molecules to understand the evolution of NZ cicada biodiversity.

Convenor: Hamish Spencer (University of Otago)
Sponsor: Allan Wilson Centre for Molecular Ecology and Evolution

Systematic biodiversity assessment, prioritisation and reporting

Diverse pressures from invasive species and land use change drive ongoing biodiversity decline in New Zealand. Various agencies and individuals take multiple actions to stem the decline, ranging from pest control to designing regulation. A central challenge for all players is how to maximise the positive difference made by their actions to alleviate pressures on biodiversity, across a wide range of biodiversity components, usually for a given (limited) budget.

Key questions are: "How can we better assess what actions will deliver most for biodiversity protection as a whole, and prioritise them?" "How should we quantify and compare the marginal benefits of different conservation actions and their contributions to slowing the decline?" "How can we more robustly measure and more honestly report on status and trends in biodiversity, and the difference we have made, across the full range?" "What tools and methods can help?" and "What are the blockages to applying them within agencies and institutions?".

We invite presentations on concepts, and quantitative models and methods, and practical applications that advance and link systematic biodiversity measurement, prioritization of biodiversity actions and work, and reporting on the difference those human activities made to biodiversity in New Zealand.

Convenors: Susan Walker, Jake Overton (Landcare Research), Theo Stephens (Department of Conservation)

Urban ecology: where social and biological sciences need to meet

Biodiversity in urban areas is increasingly being recognised for its own value as well as for its role in promoting human well-being and providing opportunities for urban dwellers to encounter nature as part of their every-day lives. People have been described as being at the beginning, middle and end of all biodiversity conservation issues, and nowhere is this more evident than in urban areas. The challenge of developing an understanding of human motivations, perceptions and preferences, and how these can be influenced to improve biodiversity, requires a cross- disciplinary approach combining biological and social expertise. This symposium will explore the boundary where the ecological sciences meet the social sciences.

Convenors: Yolanda van Heezik (University of Otago) and Monica Awasthy (Victoria University)

Weta evolutionary ecology

Weta are both widespread and abundant in New Zealand but little is known of basic weta biology. In this symposium we aim to highlight recent advances and challenges in weta ecology in New Zealand. We hope to encourage vigorous debate on highly topical themes such as weta diet, putative ecosystem services, population dynamics, and management techniques.

Mary Morgan-Richards will open the symposium by discussing tree weta as model organisms for understanding climate change. In some of her previous work, she has compared five hybrid zones in a single tree weta species (Evolution 57:849). She will describe some of the molecular ecology and field research that underpins our understanding of tree weta distribution patterns and shifts, and implications for climate change from an evolutionary perspective.

We invite presentations that explore any aspect of weta ecology or evolution, including both theoretical and applied perspectives.

Convenors: Cilla Wehi, Mary Morgan-Richards, Steve Trewick (Massey University)

NZES award presentations

New Zealand's freshwater crisis: the triumph of economists over ecologists. Dr Mike Joy (Massey University), winner of 2009 NZES Ecology in Action Award.

Retaining mountain diversity: facing the challenges. Professor Katharine Dickinson (University of Otago), winner of 2009 NZES Te Tohu Taiao Award for Ecological Excellence.

Social Events and Poster Session

Welcome and registration reception**:** *Monday 22 November, 6:00–7:00 pm at the Otago Museum* (419 Great King Street, see maps at end of book). This is your first chance to catch up with old friends and make new contacts. The registration desk will be open, and wine and finger foods will be served.

Wine and cheese poster session**:** *Tuesday 23 November, 5:00–6:15 pm in the University College (UniCol) Common Room*. Please come along and enjoy a glass of wine or beer while viewing the posters. There will be a ballot box for you to vote for the Best Student Poster award.

Movie night**:** *Tuesday 23 November, 8:00–9:30 pm in Archway 4*. We have selected four ecological films by local filmmakers, which will be presented by Splashroom Media. The directors will be on hand to introduce the films and answer questions.

Conference dinner**:** *Wednesday 24 November, 7:00–10:00pm in the Dunedin Town Hall* (1 Harrop Street, entrance from Moray Place, see map). There will be live music and New Zealand Ecological Society awards presentations. Please remember to bring your dinner ticket and name badge with you.

General Information

Registration: The Registration Desk is located in the main foyer on the ground floor of University College and is open from 8:00 am–6.00 pm on Tuesday and 8:00 am—5:00 pm on Wednesday and Thursday. If you require any information or assistance, please do not hesitate to speak with one of the volunteers at the desk.

Name Badges: Name badges must be worn throughout the conference as they serve as proof that you are part of the conference. Your name badge is also your lunch ticket and will enable entry into NZES events.

Conference Bags: To help reduce waste and encourage recycling, we are not supplying conference bags or satchels. If you haven't brought along a bag from a previous conference, or your favourite backpack, briefcase, or anything else to use to carry around your abstract book and other assorted stuff, then we have a small supply of bags from various other past conferences that have been donated for you to borrow or take away.

Conference Food and Drink: Morning tea, lunch, and afternoon tea are provided during the conference, served in the University College Dining Hall. Please be ready to show your name badge at the door. Special dietary requirements have been addressed; please ask the caterers if you have any questions or concerns.

T-shirts: Conference t-shirts are available at the Registration Desk for $25. There are only a limited number so availability is first come, first served.

Computers, email and telephone: Two computers are available for internet access and checking emails. These are located in the Study Room on the ground floor of University College. We hope to have wireless internet access available in time for the conference.
A pay phone is located outside the Archway Lecture Theatres.

Cell phones: Please remember to turn off your cell phone or put it on silent when in the lecture theatres.

Smoking: Smoking is not permitted anywhere inside the venues. If you smoke, please do so outside and away from doorways.

Health and Safety: Each venue has its own procedures in the event of a fire or other emergency. We encourage conference participants to read the information on evacuation procedures and pay attention to safety announcements. In case of emergency dial 111 immediately. On a University phone dial 1 first for an outside line, i.e. 1-111.

Medical Care:

Dunedin Urgent Doctors and Accident Centre
479 2900
45 Hanover Street

Dunedin Hospital
474 0999
201 Great King Street

Dunedin North Pharmacy
477 6556
Corner of Great King Street and St. David Street

Transport around Dunedin:

Bus timetables: see www.orc.govt.nz

Taxis:

City Taxi	0800 771 771
Dunedin Taxis	03 477 7777
Otago Taxis	03 477 3333
Southern Taxis	03 476 6300

Airport Shuttles:
Shuttle services operate a door-to-door service to and from the airport, for approximately $25 to $40. There are three main operators in town:

Kiwi Shuttles	03 487 9790, www.kiwishuttles.co.nz
O'Brien Shuttles	03 488 2658, www.obrienshuttles.co.nz
Super Shuttle	0800 748885, www.supershuttle.co.nz

Parking: Free all day parking is available in some streets around the University of Otago campus. For more information, please see www.dunedin.govt.nz/services/parking/where-can-you-park

Restaurants: There are many restaurants around town. Most are located in the Octagon and along George St. Ask for a list from the Registration Desk.

What to do around Dunedin: If you are keen to see a bit of Dunedin, such as the Botanic Gardens, Otago Museum, Art Gallery, Otago Peninsula or just walk in the bush, the Registration Desk has information and maps.

Presentations

Instructions for Oral presenters: Please read the following instructions carefully for a smooth presentation.

- Please note the day, time and session number of your talk in the Conference Programme.
- Speakers are asked to identify themselves to the session chairs 10 minutes before the start of their session.
- Please keep to your allocated time.
- For plenary presentations, the time allocated is 30 minutes plus 10 minutes for questions.
- For all other papers the time allocated is 15 minutes plus 5 minutes for questions.
- The chairperson will inform you when 15 minutes have passed, and will stop you after 18 minutes.
- Oral presentations need to be loaded onto the system a half a day in advance. To do this, speakers should report to the lecture hall in which they will be speaking with their talk on a USB or CD in Power Point Windows format (preferably a .pptx or .ppsx file). An assistant (in red t-shirt) will help you to load your talk onto the system.
- The filename should include your last name and session number (see the Conference Programme) so that it can be filed correctly.
- Once you have loaded your talk, please check that it is functioning properly in that lecture hall. Check this as early as possible before your talk so as you have time to sort out any problems.

Instructions for Poster presenters: Posters will be displayed in the University College Common Room, throughout the conference.

- Each poster has been allocated a number and a place on the poster boards.
- Please get your poster number from the Programme (pages o–q), and locate the corresponding space in the University College Common Room.
- Posters must be put up no later than 1:25 pm on Tuesday.
- Velcro dots will be available for mounting your poster. Assistants (in red t-shirts) will be there to help you as needed.
- Please be next to your poster during the poster session on Tuesday at 5.00–6.15 pm.
- Posters must be removed by Thursday at 4:00 pm.

Instructions for Session Chairs: Thank-you for agreeing to chair a session. Below are some guidelines to keep the sessions running smoothly.

- Take the time to meet with your speakers before the session starts.
- Check that all your speakers have loaded their talks before the session begins
- Make sure all your speakers are familiar with their timetable and know how to run the AV system. There will be someone in the lecture theatre to help with equipment if needed.
- The session starts on time, regardless of whether people are still arriving.
- Please keep speakers within time, give them a warning at 15 minutes AND STOP THEM AT 18 MINUTES.
- Leave time for changing between speakers: roughly 2 minutes.
- If the speaker finishes early, don’t start the next talk early. Invite questions or discussion on previous talks until it’s time for the next speaker.

New Zealand Ecological Society Awards

Best student NZES Conference Paper

The society makes an annual award to the student who is judged to have presented the best oral paper at the Society's annual conference. All papers (including joint papers) presented solely by students at the main conference are eligible for consideration. Note that this award does not consider papers presented at the student session of the conference.

At conference registration you will have received a voting form. Please vote for the best student presentation you saw during your time at the conference. You do not have to have seen every student presentation to vote. These will be collected immediately before the afternoon tea break during the last day of the conference (Thursday 25 November; look for the ballot box). Please consider factors such as the presentation, the quality of research and/or results, the length of the talk (in the allocated time; was there time for questions?), the response to questions, and the use of good and appropriate visual aids. **On voting forms, please vote for one student only for this award.**

Best student NZES Conference Poster

The society makes an annual award to the student (senior author) who is judged to have presented the best poster at the Society's annual conference.

At conference registration you will have received a voting form. Please vote for the best student poster you saw during the wine and cheese poster session on Tuesday 23 November. You do not have to have seen every student poster to vote. These will be collected during the poster session. Please consider factors such as presentation, quality of research and/or results, visual appeal, clarity of message, whether the poster is easily read, and good understanding of the research by the student. **On voting forms, please vote for one student only for this award.**

Both the **Best student NZES Conference Paper** and **Best student NZES Conference Poster** awards will be presented at the closing ceremony of the conference.

Other New Zealand Ecological Society Awards, Grants and Scholarships

The New Zealand Ecological Society offers several other awards, prizes and scholarships. These include:

Te Tohu Taiao – Award for Ecological Excellence

Honorary Life Membership

NZES Ecology in Action Award

Best Publication by a New Researcher

Student Travel Grants

The Kauri Seed Programme Scholarship

For further information about these Awards/Grants and Scholarship please refer to the New Zealand Ecological Society website, or contact the NZES Awards Convenor at www.newzealandecology.org/awards-grants

Workshop:

Cultural perspectives on biodiversity and management

The workshop will be held during the morning of Thursday, 25 November (day following the oral presentations of the Symposium). Its goal is to provide ***a space for open and active discussion about issues surrounding cross-cultural environmental research and management***.

The lead-up included **An interactive blog for debate http://biodiversityvoice.wordpress.com/** We invited prospective workshop participants to submit topics for discussion, along with a rationale of its importance to cultural perspectives on researching or managing biodiversity. These topics were then posted on the blog, which hosted dialogue/debate prior to the conference.

At the conference **workshop**, the proposer of each topic facilitates (or co-facilitates) a discussion group. The workshop runs in an **open-space format**, in which one large room is used to host separate discussion groups. These groups, centred on specific topics, are fluid (people can move between them if they want) and they all coalesce in the end to form a large group synthesis of thoughts and ideas.

Our goal was to solicit discussion topics from the conference collective and get discussion going well before the conference itself so that the workshop can be more focussed and thoughtful. We also aimed to proactively knit the symposium papers and posters together with the workshop discussions, to provide an opportunity for delegates to debate the issues even if they cannot attend the workshop itself.

This project, fostering **dialogue & productive debate** about important issues involving **science & society**, is the result of a collaboration between Dr Jenny Rock, **Centre for Science Communication** , the postgraduate students in the Centre, enrolled in the Critical Thinking in Science Communication class, and Prof Henrik Moller (**CSAFE**) (all University of Otago). The students are key designers, orchestrators and moderators of the blog for debate, and other aspects of this **experiment in progressive modes of science communication.** We welcome your feedback so that we can judge the success of this approach; an evaluation sheet will be provided at the workshop and on-line on the blog site.

Panel discussion:

Maximising biodiversity in production landscapes

The final 90 minutes of the symposium on *Biodiversity in production lands: the benefits and the risks* will be devoted to a panel discussion beginning at 3:25 pm on Thursday 25 November. Panellists will debate current and future challenges, and opportunities for maximising biodiversity within production landscapes. The aim is to find some consensus on how competing land uses can work together to maximise the potential benefits derived from enhancing this biodiversity. Panel participants will be asked to discuss the incentives, mechanisms and monitoring tools required to motivate the production sectors and other parties to maximise biodiversity in production lands. This panel discussion was made possible by funding from Agmardt (www.agmardt.org.nz). Panel participants are:

Grant Blackwell, who will chair the panel discussion, is a senior researcher at the Office for the Parliamentary Commissioner for the Environment and a lead author on its recent report entitled ‘How clean is New Zealand?’ Grant was formerly a postdoctoral fellow in the environment team of the Agricultural Research Group on Sustainability (ARGOS).

Jon Manhire works for The Agribusiness Group, developing practical strategies in response to environmental, economic and social drivers - both regulatory and market based in primary industries. He also leads a large applied sustainability research programme, the Agricultural Research Group on Sustainability (ARGOS).

Dave Raffaelli (University of York, UK) is Director of UKPopNet, a collaborative Natural Environment Research Council network focused on science for sustainable landscapes and livelihoods, and former Director of the NERC DIVERSITAS international, interdisciplinary project office bioSUSTAINABILITY, concerned with developing the science of conservation and sustainable use of biodiversity, in particular exploring the science–policy interface.

Tom Lambie is an ECan commissioner, current Chancellor of Lincoln University and Chairman of the Opuha Water Partnership as well as an organic dairy farmer and former National President of Federated Farmers of New Zealand.

Alistair Mowat has been Innovation Leader at ZESPRI for the past 10 years, focused on a range of projects relating to fruit quality, productivity and sustainability. Previously, a scientist at HortResearch for 16 years, he worked on persimmon and kiwifruit eco-physiology.

Nick Pyke is the Chief Executive Officer for the Foundation for Arable Research and a former Director of Dairy InSight NZ Inc. Prior to joining the Foundation in 1995, Nick was a scientist at HortResearch, MAF Technology and DSIR.

Kit Richards is the environmental manager for Australasian forest management company P.F. Olsens Ltd and the environmental and social research theme leader for Future Forests Research.

Theo Stephens is a Department of Conservation scientist working on economic instruments for biodiversity conservation, currently focused on biodiversity offsets and ways to measure conservation achievement.

Greg Carlyon is the Group Manager Regional Planning and Regulatory, at Horizons Regional Council. He previously led the initiation and development of Horizon's new combined regional policy statement and regional plan ('One Plan'), and now has overall responsibility for the council's policy, science, consents and compliance teams.

Peter Clinton (Scion) leads a FRST-funded research programme, Protecting and Enhancing the Environment through Forestry (PEEF), which aims to enhance the economic, social, cultural and environmental benefits of forestry through the application of new forest management practices.

Bill Lee (Landcare Research) leads a FRST-funded research programme that aims to reverse the decline of terrestrial indigenous biodiversity by providing practical strategies and improving the capability of land management, regulatory and policy agencies, to achieve substantial biodiversity gains.

Student Day – Sunday 21 November

The Conference Student Day is an opportunity for students to meet, participate in workshops, and practise their presentations in an informal, social and friendly environment. The two workshops this year are led by Dr Robin Mitchell of Golder Associates (NZ) Limited and Professor Robert Poulin of the Department of Zoology, University of Otago. Robin has held a variety of ecological positions around the world, working with NGOs and community-based groups. His workshop covers what a career in consultancy entails and what skills students need to be successful in this type of career. Robert is a professor who has authored two books, edited three books, and authored or co-authored 21 book chapters and 380 journal articles. He is also currently an editor for three journals. Robert's workshop is about publishing, with hints on topics from how to structure a paper to how to get published in top journals. The student day also includes a variety of talks by students on their own research. At the end of the day there is a BBQ and a chance to socialise with fellow students.

Field trips – Monday 22 November

Three full-day field trips are available.

Macraes Flat: Grand and Otago skink management areas

Organisers: Mike Thorsen and Konnie Gebauer

A field trip to the Macraes Flat area (40 km north of Dunedin) to explore current issues in the management of low altitude tall tussock grasslands and their inhabitants, which include threatened grand and Otago skinks. Local conservation managers will lead small groups of about 10 people, to observe and discuss approaches to ecosystem-scale management and the benefits and difficulties of protecting threatened flora and fauna in tussock grasslands. Techniques to be presented include mammal-proof fencing, extensive predator removal, photographic mark-resight and rock occupancy surveys of skinks, and conservation of rare plant communities. Departs from University of Otago at 8 am and returns by 5 pm.

Orokonui *Ecosanctuary: Otago's flagship biodiversity restoration project*

Organiser: Chris Baillie (Orokonui Ecosanctuary)

Of the 15 million hectares that make up the South Island, there are only a tiny 300 hectares where introduced predators – including humans – cannot harm our native animals, and where introduced herbivores cannot consume our vulnerable native plants. Those 300 hectares are the Orokonui Ecosanctuary. The Ecosanctuary is home to 17 species of native birds, 10 species of native fish, several reptiles and a number of rare plants. The Ecosanctuary pest proof fence and pest monitoring programme provides the largest area of safe habitat in the South Island, vital for the survival of our rare and threatened forest species. The Ecosanctuary has re-introduced South Island (SI) kaka, saddleback, robin, the Otago jewelled gecko and *Carex inopinata*. Rifleman, fernbirds, kereru, tui and bellbirds are flourishing here. A detailed itinerary is available here. The field trip will examine the restoration process and the conservation of rare species in this nature reserve. Please bring good walking shoes. Departs from the Otago Museum at 9 am and returns by 4.30 pm.

Otago Peninsula. In the footsteps of Richdale: New Zealand's seabird capital, and first UNESCO biosphere reserve?

Organiser: Dave McFarlane (Yellow-eyed Penguin Trust)

Otago Peninsula (9,600 ha) is home to several iconic species, notably the royal albatross and yellow-eyed penguin, which form the basis of a multi-million dollar nature-based tourism industry. Pioneering conservation and research work on both species was carried out by Dunedin school teacher Lance Richdale. The field trip will examine the conservation of these species, plus the NZ sealion and jewelled gecko, with visits to reserves and presentations by researchers. The field trip sits within the framework of recent initiatives by the newly formed Otago Peninsula Biodiversity Group to begin large scale possum eradication across the peninsula as part of an ambitious ecological restoration project. Neville Peat will present the case for the peninsula as New Zealand's first UNESCO Biosphere Reserve and discuss the Richdale Biography Project. Departs from University of Otago at 8 am and returns by 5 pm.

Conference Overview

Venues:

Plenary sessions: **Castle 2** lecture theatre
Other talks: **Archway** lecture theatres (1–4)
Poster session: University College **(UniCol)**
Lunches and morning teas: University College **(UniCol)**
Welcome and registration reception: **Otago Museum**
Cultural workshop: **Te Tumu** (School of Māori, Pacific and Indigenous Studies)

Monday 22 November 1800-2000
Otago Museum: Welcome and Registration Reception

Tuesday 23 November			
Castle 2	Conference Opening Plenary: Kevin Gaston Plenary: Chris Simon		
Morning tea (UniCol)			
Archway 1	**Archway 2**	**Archway 3**	**Archway 4**
1 Contributed papers	2 Contributed papers	3 Urban ecology	4 Molecular ecology
Lunch (UniCol)			
Castle 2	Plenary: Charles Royal		
Archway 1	**Archway 2**	**Archway 3**	**Archway 4**
5 Cultural perspectives	6 Macraes Flat	7 Urban ecology	8 Molecular ecology
Afternoon tea (UniCol)			
9 Cultural perspectives	10 Macraes Flat	11 Urban ecology	12 Molecular ecology
Poster session (UniCol)			
Film night (Archway 4)			

Wednesday 24 November			
Castle 2	Welcome and Notices Plenary: Chief Randall Kahgee Plenary: Alan Knapp		
Morning tea			
Archway 1	**Archway 2**	**Archway 3**	**Archway 4**
13 Cultural perspectives	14 Ecosystem function	15 Contributed papers	16 Grasslands
Lunch			
Castle 2	Plenary: Kath Dickinson		
Archway 1	**Archway 2**	**Archway 3**	**Archway 4**
17 Cultural perspectives	18 Ecosystem function	19 Reintroduction & dispersal	20 Grasslands
Afternoon tea			
21 Contributed papers	22 Contributed papers	23 Reintroduction & dispersal	24 Grasslands
AGM (Archway 1)			
Conference Dinner (Dunedin Town Hall)			

Thursday 25 November			
Castle 2	Welcome and Notices Plenary: Mike Joy Plenary: Jon Manhire		
Morning tea			
Archway 1	**Archway 2**	**Archway 3**	**Archway 4**
25 Biodiversity assessment	26 Weta	27 Contributed papers	28 Production lands
Lunch			
Castle 2	Plenary: Dave Raffaelli		
Archway 1	**Archway 2**	**Archway 3**	**Archway 4**
29 Biodiversity assessment Contributed papers	30 Weta Contributed papers	31 Contributed papers	32 Production lands
Afternoon tea			
33 Production lands: Panel discussion	34 Contributed papers	35 Contributed papers	36 Contributed papers
	Archway 2		**Archway 4**
	Video link		Conference Closing

Thursday 25 November
Morning tea
Te Tumu
Cultural perspectives: Workshop
Lunch

Conference Programme

Tuesday 23 November, MORNING	
Time	**Venue: Castle 2**
0845–0900	Conference opening and welcome
0900–0940	**Keynote presentation. Kevin Gaston:** As far as the eye could see...
0940–1020	**Plenary. Chris Simon:** Using molecules to understand the evolution of NZ cicada biodiversity
1020–1050	**Morning tea at UniCol**

	Venue: Archway 1	**Venue: Archway 2**
	1 Contributed papers Chair: Murray Efford	**2 Contributed papers** Chair: John Innes
1050–1110	**Mike Thorsen**: Spatial patterns in recruitment of large-fruited plants on northern New Zealand islands with or without the NZ pigeon *Hemiphaga novaeseelandiae*	**Margaret Stanley**: Do Argentine ants have impacts on ecosystems?
1110–1130	***Rocío Jaña**: Spatial relationships between bird-generated seed rain and tree composition in a mixed conifer–angiosperm forest in New Zealand	***Habteab Habtom**: Biotic and abiotic resistance to Argentine ant invasion
1130–1150	***Ellen Hume**: Does native revegetation lead to the restoration of plant-herbivore interaction networks	***Anne Tomlinson**: Effects of the native millipede (*Spirobolellus antipodarus*, Spirobolellidae) and the exotic species (*Oxidus gracilis*, Paradoxosomatidae) on decomposition processes in plant microcosms
1150–1210	**Jo Hoare**: Evaluating correlations among bird population trends in a forest where introduced mammalian predators are controlled	***Alwin Sky**: Exploring patterns in saproxylic invertebrate communities by rearing insects from different timber resources
1210–1230	***Abby Grassham**: Relationships between the tantalus monkey and forest structure in a West African montane forest	**James Russell**: Automatic track recognition of footprints for identifying cryptic species
1230–1325	**Lunch at UniCol**	

* indicates presentations eligible for student prizes

Tuesday 23 November, MORNING		
Time	**Venue: Archway 3**	**Venue: Archway 4**
	3 Symposium: Urban ecology: where social and biological sciences need to meet Chair: Yolanda van Heezik	**4 Symposium: Molecular ecology of New Zealand's biota** Chair: Hamish Spencer
1050–1110	**Yolanda van Heezik**: Urban areas: integrating human dimensions with conservation biology	**Richard Newcomb**: Pheromone evolution and speciation in New Zealand leafroller moths by differential gene regulation
1110–1130	**Wayne Linklater**: Relationships between urban biodiversity and contemporary ecological knowledge in Wellington, New Zealand, and East Bay, San Francisco	**Crid Fraser**: New Zealand's role in maintaining Southern Hemisphere seaweed diversity
1130–1150	*__Monica Awasthy__: Citizen science as a tool for wildlife monitoring in residential ecosystems: what can it tell us about kererū habitat selection?	**Raisa Nikula**: Does kelp rafting drive dispersal among populations of intertidal invertebrates?
1150–1210	**Catherine Neilson**: Urban Ecology : Taking it to the streets – linking science with design and development practice in the built environment	**Kirsten Donald**: The host's role in shaping parasite evolution: comparative phylogenies of New Zealand whelk (Gastropoda: Buccinidae: *Cominella*) parasites
1210–1230	**Debbie Hogan**: The public policy framework where social and biological sciences meet – biodiversity conservation in Dunedin City beyond 2010	**Martyn Kennedy**: The speed of slug formation: Limacisation of *Schizoglossa* (Mollusca: Pulmonata: Rhytididae)
1230–1325	**Lunch at UniCol**	

* indicates presentations eligible for student prizes

Tuesday 23 November, AFTERNOON	
Time	**Venue: Castle 2**
1325–1405	**Plenary. Charles Royal.** Ecology and Indigeneity: some thoughts from Mātauranga Māori
1405–1410	5 minutes for walk back to Archway theatres

	Venue: Archway 1	**Venue: Archway 2**
	5 Symposium: Cultural perspectives on biodiversity research and management (Day 1) Chair: Hori Parata	**6 Symposium: Macraes Flat: Research and management in a changing environment** Chair: Bruce McKinlay
1410–1430	**Maui Hudson**: Cross-cultural partnerships in research: indigenous contributions to analysis and theory building?	**Andy Hutcheon**: Fences or traps: spatial scale and cost-benefit analysis informs protection choices for critically endangered skinks
1430–1450	**Michael Stevens**: Say what (you mean)? Nature and nativism in New Zealand	**Nathan Whitmore**: Building a population of the critically endangered skink *Oligosoma grande* from scratch: simulation, trial, estimation and reassessment
1450–1510	**Hēmi Whaanga**: *Kei ngaro i te moa*: Whakataukī and the relationships between biological, linguistic and cultural diversity	**Mandy Tocher**: A pasture land grand skink population: what can it tell us?
1510–1540	**Afternoon tea at UniCol**	
	9 Symposium: Cultural perspectives on biodiversity research and management Chair: Jacqueline Beggs	**10 Symposium: Macraes Flat: Research and management in a changing environment** Chair: Bruce McKinlay
1540–1600	**Steve Crawford**: Is there such a thing as 'Indigenous Science'?	**Deb Wilson**: Abundance of small skinks in predator management treatments at Macraes Flat
1600–1620	***Monica Gratani**: Is validation of indigenous ecological knowledge a disrespectful process? A case study of traditional fishing poisons and invasive fish management in the Wet Tropics, Australia	**James Smith**: Small-scale predator control does not benefit lizards: meso-predator release or scale issues?
1620–1640	**John Kuange**: Spirit or species? Conserve or kill? The role of differing cultural perspectives in conservation failures	**Alison Cree**: Do thermal and reproductive characteristics place the lizards of Macraes Flat at risk from global warming?
1640–1700	***Megan Caldwell**: Present knowledge, past behaviour: Understanding ancient traditional resource and environmental management systems	Discussion
1700–1815	**Wine and cheese poster session at UniCol**	
2000–2130	**Film night in Archway 4**	

Tuesday 23 November, AFTERNOON		
Time	**Venue: Archway 3**	**Venue: Archway 4**
	7 Symposium: Urban ecology: where social and biological sciences need to meet Chair: Monica Awasthy	**8 Symposium: Molecular ecology of New Zealand's biota** Chair: Hamish Spencer
1410–1430	**Tom Myers**: Biodiversity of a botanic garden	*__Shauna Baillie__: Genetic diversity of an abundant New Zealand passerine after dramatic geographic distribution shifts due to habitat loss
1430–1450	**Myfanwy Emeny**: Encouraging community biodiversity initiatives in an urban environment	*__Sheena Townsend__: Inbreeding depression, multilocus heterozygosity and fitness in a small, inbred population of South Island robins
1450–1510	*__Alice Ryan__: Relationships between pigeon density and residents' environmental behaviour, attitudes and beliefs	**Nick Dussex**: Unexpected genetic population structure in the Kea (*Nestor notabilis*)
1510–1540	**Afternoon tea at UniCol**	
	11 Symposium: Urban ecology: where social and biological sciences need to meet Chair: Wayne Linklater	**12 Symposium: Molecular ecology of New Zealand's biota** Chair: Hamish Spencer
1540–1600	*__Ed Waite__: The birds and the bees in the trees: the role of isolated specimen trees in supporting urban biodiversity	**Jon Waters**: The importance of history: molecular data reveal dynamic responses to environmental change
1600–1620	**Kelly Booth**: Methods of mitigating stresses upon poorly understood urban biota: North Shore city's beetles demonstrate stress responses at the community level	**David Hawke**: The isotopic ecology of moa (Aves: Dinornithiformes) in late Holocene North Canterbury, based on aDNA–identified individuals
1620–1640	**Jon Sullivan**: Wild ecology in domesticated Canterbury: habitat use and phenology of birds, butterflies, and mammals in urban and rural Christchurch	**Rochelle Constantine**: Genetic diversity and Identity of Maui's dolphins: Initial results of 2010 summer surveys
1640–1700	**Kelvin Lloyd**: Ecology of the Dunedin Town Belt	**12 Contributed paper** **Bruce Burns**: Pest-proof fencing for conservation in New Zealand: the story so far
1700–1815	**Wine and cheese poster session at UniCol**	
2000–2130	**Film night in Archway 4**	

Wednesday 24 November, MORNING	
Time	**Venue: Castle 2**
0830–0840	Welcome and notices
0840–0920	**Plenary. Chief Randall Kahgee:** Strategic relationships between Indigenous communities and Western ecologists: the Saugeen Ojibway Nation experience
0920–1000	**Plenary. Alan Knapp:** Global change and grassland ecosystems
1000–1030	**Morning tea at UniCol**

	Venue: Archway 1	**Venue: Archway 2**
	13 Symposium: Cultural perspectives on biodiversity research and management (Day 2) Chairs: Chief Ralph Akiwenzie and Shaun Ogilvie	**14 Symposium: Biodiversity and ecosystem function** Chair: Rod Hay
1030–1050	**Janet Stephenson**: Cultural consequences of loss of abundance and biodiversity	**Nod Kay**: Biodiversity and ecosystem function in populations of *Pinus radiata*
1050–1110	**Nigel Scott**: The Ngāi Tahu Customary Fisheries Protection Areas Project: restoring rangatiratanga	***Alex Fergus**: History, functioning and future of subantarctic Campbell Island ecosystems
1110–1130	**East Otago Taiāpure Management Committee**: The long road to community-led fisheries management	***Matthew Krna**: Effects of climate manipulations on the production and decomposition of Antarctic vascular plants
1130–1150	**Paul Borell**: Customary kaimoana management within Tauranga Rohe Moana	**Jason Tylianakis**: Functional biodiversity under land-use intensification: Separating cause and consequence
1150–1210	**Jim Williams**: Wetland communities	**Ian Dickie**: Biodiversity and ecosystem function in wood and woody ecosystems
1210–1230	**Rob McGowan**: Impacts of the loss of biodiversity on the continuation of rongoā Māori (traditional Māori medicine)	**Steve Wratten**: Farmland biodiversity – evaluating and enhancing it
1230–1325	**Lunch at UniCol**	

Wednesday 24 November, MORNING		
Time	**Venue: Archway 3**	**Venue: Archway 4**
	15 Contributed papers Chair: Mike Thorsen	**16 Symposium: Ecology and conservation of indigenous grasslands** Chair: Jim Crush
1030–1050	**Jacqueline Beggs**: The sounds of silence: where did the dawn chorus go?	*__Emily Fountain__: Conservation of the weevil *Hadramphus tuberculatus*
1050–1110	*__Josie Galbraith__: Nesting ecology of the eastern rosella	**Barbara Barratt**: Effects of tussock grassland disturbance by agricultural development on Coleoptera biodiversity, community structure, and exotic species invasion.
1110–1130	**Karin Ludwig**: Are Stewart Island robins ratwise? Implications for translocations from predator-free island sanctuaries back to the mainland	*__Jagoba Malumbres-Olarte__: Smoking hot spiders: effects of fire on tussock grassland spider communities
1130–1150	*__Helen Nathan__: Advance, invading hordes! Population growth and detectability of mice on Saddle Island	*__Claudio de Sassi__: Importance of the bigger picture: differential phenology and sensitivity of species determines the response of insects to global environmental changes
1150–1210	**Andrea Byrom**: Interactions among invasive mammals in a New Zealand forest ecosystem: a large-scale manipulative experiment	***Scott Graham**: Temperature responses of root respiration, soil organic matter decomposition and rhizosphere priming in tussock grassland soils
1210–1230	*__Georgina Pickerell__: Going with the flow: mammalian predator presence on islands in New Zealand's braided rivers	**Stephen Hartley**: Spatial patterns in the distribution of grassland plants: from metres to hundreds of kilometres
1230–1325	**Lunch at UniCol**	

Wednesday 24 November, AFTERNOON	
Time	**Venue: Castle 2**
1325–1405	**Plenary. Kath Dickinson:** Retaining mountain diversity: facing the challenge
1405–1410	5 minutes for walk back to Archway theatres

	Venue: Archway 1	**Venue: Archway 2**
	17 Symposium: Cultural perspectives on biodiversity research and management (Day 2) Chair: Jeji Varghese	**18 Symposium: Biodiversity and ecosystem function** Chair: Rod Hay
1410–1430	**Shaun Ogilvie**: Māori knowledge of naturally-occurring toxins in NZ plants – potential for animal pest control	**Ecki Brockerhoff**: Forest biodiversity and ecosystem function: Effects of biodiversity on herbivory in forests
1430–1450	**Hori Parata**: He turangawaewae mo ngā kiore: a refuge for the kiore	**John Sawyer**: Assessment of the conservation status of estuarine ecosystems in the lower North Island
1450–1510	**Mochamad Indrawan**: Effective participation as key to establishment of protected areas: Lessons from the Togean Islands National Park, Sulawesi, Indonesia	**Mel Galbraith**: Tiritiri Matangi Island: enhancing biodiversity in a pohutukawa 'desert'
1510–1540	**Afternoon tea at UniCol**	
	21 Contributed papers Chair: Dave Forsyth	**22 Contributed papers** Chair: Corinne Watts
1540–1600	**Lynette Hartley / Dave Forsyth**: Creation of a national deer faecal pellet count database and its use to estimate long- term changes in deer abundance in New Zealand	***Ilse Corkery**: The tuatara–fairy prion relationship: An interspecies interaction influenced by thermal benefits?
1600–1620	**Philip Grove**: Monitoring extent of Canterbury freshwater wetlands by remote sensing, 1990–2008	**Joanna Buswell**: Factors promoting rapid evolution in introduced plant species
1620–1640	**Colin Townsend**: The complex ecological impacts in streams of multiple anthropogenic stressors	**Sergio Cortina**: Community forest management and biodiversity in a pine-oak forest in Mexico
1640–1700	**Martin Krkosek**: Cycles, stochasticity, and density dependence in pink salmon population dynamics	***Josef Beautrais**: A bioclimatic model for predicting the potential distribution of *Senecio glastifolius*: conceptual challenges for modellers and decision-makers
1715	**Annual general meeting (AGM) of the New Zealand Ecological Society (Archway 2)**	
1900	**Conference Dinner at the Dunedin Town Hall**	

Wednesday 24 November, AFTERNOON		
Time	**Venue: Archway 3**	**Venue: Archway 4**
	19 Symposium: Animal reintroductions and the problem of post-release dispersal Chair: Ian Jamieson	**20 Symposium: Ecology and conservation of indigenous grasslands** Chair: Dave Kelly
1410–1430	**Phil Seddon**: Should they stay or should they go now? Reintroductions and the challenge of post-release dispersal	**Melanie Harsch**: Observed and predicted shifts at the NZ *Nothofagus* treeline using growth, recruitment and mortality rates measured over 15 years
1430–1450	**Colin Miskelly**: Should I stay or should I go? Attempts to anchor pelagic fairy prions to their release site on Mana Island	*__Laura Young__: Dispersal of seeds of fleshy-fruited alpine plants: the roles of kea, introduced mammals and other frugivores
1450–1510	**John Innes**: Kokako translocations – a review	**Geoff Rogers**: Of birds, beasts, fire, and physiognomy: what role evolutionary insights in managing today's grass guilds?
1510–1540	**Afternoon tea at UniCol**	
	23 Symposium: Animal reintroductions and the problem of post-release dispersal Chair: Ian Jamieson	**24 Symposium: Ecology and conservation of indigenous grasslands** Chair: Bill Lee
1540–1600	**Laura Molles**: Song playback in mainland bird translocations: the answer to post-release dispersal?	**Peter Espie**: Exotic species invasion affects biodiversity in indigenous tussock grasslands
1600–1620	*__Kate Richardson__: Influence of individual condition and transmitters on post-release dispersal of reintroduced hihi	**Andrea Byrom**: Removal of livestock increases native vegetation richness and alters shrub recruitment and invasive mammal dynamics in dry grassland/shrubland ecosystems
1620–1640	**Ian Jamieson**: Age-bias settlement of South Island saddleback in a mainland reintroduction	**Larry Burrows** / **Jim Morris**: Ecosystem services in the High Country
1640–1700	**Doug Armstrong**: Modelling dispersal from reintroduction sites as a function of landscape connectivity	**Sir Alan Mark**: NZ rangeland protection: the catch-up challenge
1715	**Annual general meeting (AGM) of the New Zealand Ecological Society (Archway 2)**	
1900	**Conference Dinner at the Dunedin Town Hall**	

Thursday 25 November, MORNING	
Time	**Venue: Castle 2**
0830–0840	Welcome and notices
0840–0920	**Plenary. Mike Joy:** New Zealand's freshwater crisis: the triumph of economists over ecologists
0920–1000	**Plenary. Jon Manhire:** Biodiversity in productive lands – market signals, responses and relative performance
1000–1030	**Morning tea at UniCol**

	Venue: Archway 1	**Venue: Archway 2**
	25 Symposium: Systematic biodiversity assessment, prioritisation and reporting Chair: Theo Stephens	**26 Symposium: Weta evolutionary ecology** Chair: Cilla Wehi
1030–1050	**Susan Walker**: Linking biodiversity reporting, resource allocation and data gathering in New Zealand with a common framework	**Mary Morgan-Richards**: Understanding climate change: tree weta as model organisms
1050–1110	**1050–1120 Simon Ferrier**: Achieving effective employment of whole-landscape modelling approaches to systematic biodiversity assessment: challenges and solutions	**1050–1110 *Niki Minards**: Competitive exclusion and cold adaptation of two tree weta species
1110–1130		**1110–1130 Corinne Watts**: Monitoring giant weta using footprint tracking tunnels.
1130–1150	**1120–1150 John Leathwick**: Development of a systematic approach to conservation planning for New Zealand's rivers and streams	**1130–1150 *Tarryn Wyman**: Mutualism or opportunism? Tree fuchsia (*Fuchsia excorticata*) and tree weta (*Hemideina*) interactions
1150–1210	**Fleur Maseyk**: Minimising decline and maximising protection: region-wide biodiversity assessment and prioritisation	*__Kate Lomas__: Unique tympanum of the Auckland tree weta *Hemideina thoracica*
1210–1230	**Jake Overton**: The Vital Sites model for conservation planning and reporting	*__Melissa Griffin__: Are tree weta (*Hemideina crassidens*) herbivores?
1230–1325	**Lunch at UniCol**	

Thursday 25 November, MORNING		
Time	**Venue: Archway 3**	**Venue: Archway 4**
	27 Contributed papers Chair: Susan Wiser	**28 Symposium: Biodiversity and production lands: the benefits and the risks** Chair: Nick Pyke
1030–1050	**Dave Kelly**: Don't try this at home: mast seeding, site productivity, and common mistakes	**Sam, Karen & Andrew Simpson**: Mixing farming and conservation: a High Country Farm Model
1050–1110	**Becky Bell**: Is the pollen limited tree *Fuchsia excorticata* (Onagraceae) also seed limited?	**James Lambie**: Totara Reserve Regional Park: Challenges to sustaining biological diversity in a productive landscape
1110–1130	**Patrick Kavanagh**: Mistletoe macroecology; species richness and host ranges of Australian Loranthaceae	**Catriona MacLeod**: Do organic farming systems support higher bird densities?
1130–1150	*__Ben Myles__: Towards an understanding of the New Zealand "beech gap": phylogeographic evidence from *Nothofagus menziesii* chloroplast DNA	**Jacqui Todd**: Invertebrate biodiversity in organic and IPM kiwifruit orchards
1150–1210	**Susanna Venn**: Marching up the mountain? Mechanisms of high altitude woodland expansion into the Australian alpine zone	*__Kerry Borkin__: Production landscapes as bat habitat: valuable or costly?
1210–1230	*__Annika Korsten__: Life at the edge: plant responses to extreme alpine environments in New Zealand and Australia	*__Jennifer Shanks__: The role of patch connectivity in maintaining plant diversity in remnant taraire forest in the Manukau Ecological District south of Auckland
1230–1325	**Lunch at UniCol**	**1230–1250 Dan Tompkins**: Synergistic effects of glyphosate formulation and parasite infection on fish malformations and survival
		1250–1325 Lunch at UniCol

Time	Venue: Te Tumu (School of Māori, Pacific and Indigenous Studies)**
	Symposium: Cultural perspectives on biodiversity research and management (Day 3) Chair: Jenny Rock
1030–1140	Cultural Proposition Discussions 1–8. Proposer, Facilitator and Reporter pre-appointed for each proposition.
1140–1230	Group report-backs to plenary of workshop participants

****Te Paparahua room, mezzanine floor. Enter through Te Paparewa (performance) area on the ground floor, and go up the stairs in front of you.**

Thursday 25 November, AFTERNOON	
Time	**Venue: Castle 2**
1325–1405	**Plenary. Dave Raffaelli:** Managing landscapes for their benefits using the Ecosystem Approach
1405–1410	5 minutes for walk back to Archway theatres

	Venue: Archway 1	**Venue: Archway 2**
	29 Symposium: Systematic biodiversity assessment, prioritisation and reporting Chair: Theo Stephens	**30 Symposium: Weta evolutionary ecology** Chair: Niki Minards
1410–1430	**Tim Park**: Regional council drivers and approach to monitoring biodiversity	**Cilla Wehi**: Sex- and season-dependent behaviour in the Auckland tree weta
1430–1450	**29 Contributed papers** **Pascale Michel**: Bryophyte – vascular plant interactions in New Zealand forest ecosystems	*__Hannah Larsen__: Seed dispersal by scree weta
1450–1510	**Anne Gaskett**: Mimicry and deception by dung mosses (Splachnaceae)	**30 Contributed papers** *__Cheryl Krull__: Estimation of rates and impacts of feral pig ground disturbance in the Waitakere Ranges
1510–1540	**Afternoon tea at UniCol**	
	33 Symposium: Biodiversity and production lands: the benefits and the risks. Chair: Grant Blackwell. Closing remarks: Alistair Mowat	**34 Contributed papers** Chair: Jenny Rock
1540–1600	**1525–1640 Panel discussion**	**1540–1600 Duane Peltzer**: Biotic indirect effects of plant invaders: small things matter!
1600–1620		**1600–1620 Mark St John**: Home vs. away effects of litter decomposition in two New Zealand habitats; expect the unexpected
1620–1640		**1620–1640 Susan Wiser**: using boosted regression trees and fuzzy clustering to map and validate a national-scale quantitative classification of New Zealand forests
1640–1700	**Conference closing and farewell. Venue: Archway 4** (Video link to Archway 2)	

Thursday 25 November, AFTERNOON		
Time	**Venue: Archway 3**	**Venue: Archway 4**
	31 Contributed papers Chair: Kath Dickinson	**32 Symposium: Biodiversity and production lands: the benefits and the risks** Chair: Kit Richards
1410–1430	**George Perry**: Spatial patterns in age and size structure in mixed *Nothofagus* forest, Nelson Lakes National Park	**Steve Pawson**: Role of plantation forests in biodiversity conservation in New Zealand: Opportunities for threatened species
1430–1450	*__Monique Wheat__: Exploring *Phytophthora* taxon Agathis associated kauri dieback in the Waitakere Range using dendrochronology and spatial analysis	**David Norton**: Drivers of biodiversity change in agricultural ecosystems
1450–1510	*__Josh van Vianen__: Conservation of New Zealand's coastal cresses: genetic influences on the response to the new plant viruses	**Nick Dickinson**: Environmental integrity using a restoration ecology toolbox in Canterbury
1510–1540	**Afternoon tea at UniCol**	
	35 Contributed papers Chair: John Barkla	**36 Contributed papers** Chair: Adrian Monks
1540–1600	**Simon Moore**: Role of the Department of Conservation in biodiversity protection on private land in Nelson/Marlborough – what's changed in the last 10 years?	**Pen Holland**: When possums attack: Predicting location specific tree mortality using browse damage indices
1600–1620	**John Innes**: New Zealand sanctuaries 2010. What, and where, are they?	**Carlos Rouco**: Where do possums live in the drylands?
1620–1640	**Yanbin Deng**: Assessment of significant natural areas in the Thames–Coromandel District for prioritising biodiversity management	**Richard Clayton**: Management of animal and plant pests in New Zealand – patterns of control and monitoring by regional agencies
1640–1700	**Conference closing and farewell**. **Venue: Archway 4** (Video link to Archway 2)	

Poster Session Programme

Tuesday 23 November

1700–1815 (Posters will be displayed throughout the conference also.)
Venue: UniCol

Presenter	Title	Poster Number
Olivier Ball	Importance of native forest remnants for conservation of ground beetles (Coleoptera: Carabidae) endemic to the Te Paki Ecological District	**10**
***Andrew Barnes**	Effects of forest edges on dung beetle community structure and ecosystem function	**11**
Diane Barton	Preference between non-target hosts *Nicaeana cervina* and *Irenimus egens* by the parasitoid *Microctonus aethiopoides* in the laboratory	**12**
***Paul Berentson**	Integrating ecological and sociological influences to evaluate city-wide voluntary community planting in Wellington, 1990–2010	**29**
Paul Borell	Homai te Wai Ora ki a Au: Give to me the water of life!	**1**
***Kerry Borkin**	Do long-tailed bat home ranges change after clearfell harvest?	**18**
Hazel Broadbent	NVS Express: A data entry, validation and analysis tool for Recce description and permanent 20 x 20 m plot data	**32**
***Delyse Campbell**	Factors limiting natural forest regeneration in a Nigerian montane grassland	**33**
***R. M. Chepape**	Medicinal plants used in the treatment of livestock diseases in Vhembe region, Limpopo Province, South Africa	**5**
***Britt Cranston**	Gender and facilitation: Gynodioecious cushion *Silene acaulis*	**34**
Melanie Davidson	Hedging our bets; integrating native plants into agricultural systems	**25**
***Lisa Denmead**	Determining the causes of changes in land snail diversity and abundance due to livestock trampling	**26**
***Tom Etherington**	Visualising species isolation across a landscape: an aid to ecological decision-making	**38**
Richard Ewans	Ungulate impacts and commercial helicopter deer recovery in the alpine grasslands of Fiordland National Park	**45**
***Alex Fergus**	European 'biodiversity experiments' – exploring applications in New Zealand grassland production systems	**46**
***Konnie Gebauer**	Home range estimates of endangered grand skink populations in native tussock grassland and exotic pasture grasslands	**47**
***Monica Gratani**	Integrating traditional ecological knowledge in freshwater management: from theory to practice	**3**
***Ben Hancock**	Ecosystem services provided by spiders in viticulture	**13**
***Kim Harris**	Gradients of habitat modification in mid-altitude indigenous tussock grasslands – impacts on invertebrates and the endangered grand skink, *Oligosoma grande*	**48**

David Hawke	Relationship between 13C/12C and C:N ratio of terrestrial invertebrates at the marine–terrestrial interface	**14**
Alex James	Modelling garden waste dumping	**30**
***Jessica Kerr**	Role of olfactory and visual cues in host finding by pine bark beetles and wood borers	**15**
***Young Kim**	Invasive potential of Moreton Bay fig (*Ficus macrophylla*) in New Zealand	**44**
***Susanne Krejcek**	Interactions between coastal *Senecio* spp. and their insect herbivores	**16**
***Symone Krimowa**	Resource selection by feral pigeon in Wellington City: the importance of people	**31**
John Kuange	The disconnect between what people want for their forested lands and what planners and politicians are offering in Papua New Guinea	**4**
***Danelle Kara Lekan**	Marine management, public outreach and perception of a customary closure	**2**
Carolyn Lundquist	Mangroves in New Zealand: trifles or triffids?	**39**
Luo Peng	Spatial variations in methane emissions from Zoige alpine wetlands of Southwest China	**40**
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Abstracts

Modelling dispersal from reintroduction sites as a function of landscape connectivity

Oral presentation

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It is important to be able to predict dispersal from reintroduction sites, both to assess site suitability and to decide how many individuals should be released. The key parameter is connectivity of the target site to surrounding habitat, and this can be assessed a priori using GIS-based indices reflecting the dispersal behaviour of the species. We apply a connectivity index developed from dispersal data from juvenile North Island robins to predict post-release dispersal of the same species in two different circumstances. First, we modelled data from 147 radio-tracked robins translocated to 17 small (5–56 ha) forest fragments near Benneydale in the central North Island from 2005 to 2009. Here we simultaneously modelled the probability of leaving the fragment and the probability of transmitter failure over time to account for uncertainty about fates of undetected birds. We included effects of sex, time since release, and time of year released in the model as well as connectivity. Second, we modelled data on 'apparent survival' of robins reintroduced to 14 sites (31–1100 ha) around the North Island from 1997 to 2007. Here we only knew which birds were known to be present next breeding season, which is affected by survival and detection probabilities as well as dispersal. Nevertheless, apparent survival was strongly correlated with the connectivity index, presumably due to dispersal. In both cases we were able to estimate the probability of the birds remaining at a release site as a function of connectivity, and put a confidence interval around that probability, providing useful guidance for future mainland reintroductions.

Citizen science as a tool for wildlife monitoring in residential ecosystems: what can it tell us about kererū habitat selection?

Oral presentation

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Wildlife in urban areas is reported to be steadily increasing around the world. However, monitoring wildlife in urban areas is

an enormous logistical challenge, particularly given the inaccessibility of privately owned property. Researchers can overcome this obstacle by designing studies that utilise the skills of citizens. Citizen science is emerging as a viable and increasingly popular means of collecting data over large geographic areas. Recent technological advances have enhanced our ability to involve and communicate with citizens. Here we apply an online sightings database (www.kererudiscovery.org.nz) to investigate habitat selection of a native bird in urbanised landscapes. Kererū (*Hemiphaga novaeeslandiae*; New Zealand pigeon) are large, easily recognisable, fruit-eating pigeons that are widely dispersed, highly mobile and becoming more abundant in New Zealand's cities. More than 800 sightings of kererū in the Wellington Region were submitted online over a 4-year period (2005–2009). We used satellite imagery, and citizen's descriptions of their gardens to test what local and landscape factors influence kererū habitat choice. Interestingly, while native food sources appear to be the most important factor in determining kererū presence, kererū do not avoid built structures such as roads and buildings. These results might explain why deaths from vehicle and glass collision are so commonly reported for kererū. We highlight our work as a case study in the value of collaborations between scientists and volunteers to broaden the scope of research and enhance the ability to collect scientific data, especially in complex, human-occupied, habitats.

Genetic diversity of an abundant New Zealand passerine after spatial distribution shifts due to habitat loss
Oral presentation

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Habitat loss due to forest fragmentation, novel predators and exotic disease can inhibit gene flow and enhance drift by altering the distribution of populations. We hypothesised that dramatic geographic shifts in the distribution of New Zealand bellbirds *Anthornis melanura* would be associated with low genetic diversity and allele frequency shifts. Using samples collected from throughout the geographic range of this species, we used microsatellite and mitochondrial DNA to assess population structure, genetic diversity, levels of inbreeding, population bottlenecks and number of migrants (*Nm*). Bayesian clustering and PCA found that bellbirds at two remnant islands and the subantarctic population were genetically divergent from each other and all other subpopulations. Significant genetic divergence (*F*-statistics) was detected among all sampling locations with two exceptions: Hauturu and Tongariro, and two Dunedin sites. In these cases ongoing migration or recent separation were likely contributing factors. Contrary to our expectations, bellbirds had relatively high levels of genetic diversity (mean *He* = 0.69 and *Ar* = 5.2) and most populations were in mutation–drift equilibrium. Ar was significantly

correlated with historical but not contemporary *Nm* estimates. Taken together, our study reveals that genetic erosion was more subtle in bellbirds than other endemic passerines. Bottlenecks and inbreeding levels in urban areas and small remnant islands, however, suggest that genetic contribution of migrants was resource limited. We suggest that the extent to which migration can counteract drift even in abundant well-flighted species is limited by ecological, behavioural or demographic barriers and habitat loss.

Importance of native forest remnants for conservation of ground beetles (Coleoptera: Carabidae) endemic to the Te Paki Ecological District

Poster presentation

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Pitfall trapping for ground beetles (Coleoptera: Carabidae) was conducted in three habitat types (native forest, pine plantation, and shrubland) across the Te Paki Ecological District. Nine species of Carabidae were trapped in total. The four flightless species *Mecodema* 'Te Paki', *Tuiharpalus moorei*, '*Parabaris*' *hoarei*, and *Kupeharpalus embersoni*, all Te Paki endemics, were restricted to native forest sites. *Mecodema* 'Te Paki' was found only in the centre and east of the ecological district, while *T. moorei* was only found in the centre and west. Abundances of both species appeared to peak around summer. '*Parabaris*' *hoarei* was only found in the centre of the district with a peak in spring. The most abundant and widespread of the endemic flightless species was *K. embersoni*, with numbers peaking in summer and winter. All other carabids trapped were flighted. Of these, the most abundant was the native tiger beetle *Cicindela tuberculata* (pine and shrubland), which showed a sharp rise in numbers between February and March. Two further native species, *Cicindela spilleri* (pines) and *Pentagonica vittipennis* (native forest), and two exotic species, *Anomotarus variegatus* and *Mecyclothorax ambiguus* (both only found in pines), were also trapped, but in very low numbers. Our results indicate that populations of different carabids peak at different times of the year at Te Paki. In addition, carabids from pine and shrubland sites were all flighted species with wide distributions. Conversely, most of the carabids from native forest habitats were flightless Te Paki endemics, illustrating the importance of this much reduced habitat type for the conservation of these species.

Effects of forest edges on dung beetle community structure and ecosystem function

Poster presentation

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Anthropogenically created habitat edges have pervasive impacts on the distribution and persistence of invertebrate species in forest ecosystems. The response of species to edge effects can be highly dependent on variability of species traits (response traits), which may in turn co-vary with traits that are important in ecosystem functioning (effect traits). Therefore, non-random loss of species, due to traits conferring higher susceptibility to extinction, may also result in the loss of functionally important species across a habitat-edge gradient. In tropical ecosystems, dung beetles (Coleoptera: Scarabaeinae) are one of the most functionally important taxonomic groups providing critical ecosystem services such as nutrient cycling and secondary seed dispersal. However, there have been no studies that have quantified the effects of habitat edges on dung beetle abundance, species richness, species traits, and ecosystem function in forest remnants. We compared dung beetle community structure at forest edges, both protected and unprotected from intense livestock grazing, in a severely fragmented montane-forest landscape surrounding the Ngel Nyaki forest reserve in Nigeria. Preliminary results show significant effects of livestock exclusion on edge response functions in dung beetle abundance, species distributions, and dung removal rates. Further analysis of species trait distributions will be carried out to determine whether there is a correlation between species' response and effect traits in dung beetle communities. This research will provide insight for future management efforts in forest remnants surrounded by anthropogenic landscapes.

Effects of tussock grassland disturbance by agricultural development on Coleoptera biodiversity, community structure, and exotic species invasion

Oral presentation

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The diversity of Coleoptera communities in native tussock grassland at four sites, two in Otago (Deep Stream and Mount Benger) and one each in Canterbury (Cass) and the North Island Central Plateau (Tukino), was compared. At each site the

impact of disturbance on the communities was investigated at three levels of agricultural development: native tussock; tussock oversown with exotic pasture species; pasture cultivated and sown from tussock. The exotic component of the coleopteran fauna was also compared in these native and disturbed grassland communities. In total, 27 Coleoptera families were recorded across the four sites, the most abundant being Staphylinidae and Curculionidae. At most sites, carnivores were the predominant trophic group followed by herbivores. Species diversity was higher in the native or oversown sites compared with the cultivated treatments at most sites, and it was highest at the Otago sites and lowest at Cass. A total of 19 exotic Coleoptera species were found at the four sites, the highest number at Deep Stream, but the highest percentage of species that were exotic was found at Cass. The density of exotic species was consistently higher in the cultivated treatments compared with the native and oversown treatments. The only exotic species that was found at all four sites was the pasture pest Argentine stem weevil (*Listronotus bonariensis* (Kuschel)), present at all cultivated treatments at each site, and some oversown and native tussock treatments. Curculionidae was the most common family amongst the exotic Coleoptera, represented by five species.

Preference between non-target hosts *Nicaeana cervina* and *Irenimus egens* by the parasitoid *Microctonus aethiopoides* in the laboratory

Poster presentation

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Microctonus aethiopoides, introduced to New Zealand in 1982 as a biocontrol agent for adult *Sitona discoideus,* is credited with reducing damage by this weevil to lucerne. It also attacks several native weevils in agricultural and native grassland environments including *Nicaeana cervina* and *Irenimus egens*. In laboratory host range studies *I. egens* was parasitised more than *N. cervina* while in field investigations the reverse was found to occur. However the laboratory investigations, while conducted under similar conditions, were not directly comparable and the apparent differences in species susceptibility warranted further investigation. This study aimed to determine, if under equitable laboratory conditions, *M. aethiopoides* displayed a preference for either *I. egens* or *N. cervina* by caging 3 female and 1 male *M. aethiopoides* for 48 h with 20 *I. egens,* 20 *N. cervina* or a mixture of 10 of each species. The weevil populations were maintained for 4 weeks and parasitism assessed by *M. aethiopoides* pre-pupae emerging from their hosts and dissection of surviving weevils after this time. In both single-species and mixed-species cages parasitism of *I. egens* (36 and 37% respectively) was greater than of *N. cervina* (17 and 12%) ($P < 0.05$). The level of parasitism of both species was unaffected by the weevils being caged as single or mixed species. The results confirmed earlier laboratory findings suggesting that *M. aethiopoides* prefers, or

develops more successfully on *I. egens* compared with *N. cervina*. This differs from field results, indicating that laboratory tests do not necessarily reflect what happens in natural environments.

A bioclimatic model for predicting the potential distribution of *Senecio glastifolius*: conceptual challenges for modellers and decision-makers

Oral presentation

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We present a bioclimatic model for predicting the potential distribution of the environmental weed *Senecio glastifolius* (holly-leaved senecio) in New Zealand. This species is invasive to sensitive coastal areas between Wellington and Whanganui, and continues to spread. The likely future distribution and impacts are, as yet, unknown. Static predictions will be coupled with a dynamic model of dispersal, parameterised from historical records indicating rates and pathways of spread. In addition to making predictions for *S. glastifolius*, we are developing new approaches for assessing and communicating uncertainty inherent in species distribution modelling. An understanding of the limitations of species distribution models, and the conceptual assumptions being made, is essential for environmental managers to make informed decisions from model predictions.

The sounds of silence: where did the dawn chorus go?

Oral presentation

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Common, widespread species are important for ecosystem structure and function. Although such species have declined in some parts of the world, for most ecosystems there is a lack of information about changes in the population status of common species. We studied the abundance of common, widespread forest birds in Nelson Lakes National Park using standardised 5-min bird counts, carried out over a 30-year timespan. There was a significant change in the bird community structure during this period. Five native species (bellbird, rifleman, grey warbler, New Zealand tomtit and tūī) declined in abundance during the 30 years. All of these species declined in abundance at low but not high altitudes, and the decline was substantial for all but New Zealand tomtit and tūī. Three other native species

increased in abundance (silvereye, yellow-crowned parakeet and New Zealand robin). There was no change in the abundance of introduced blackbirds. We suggest that invasive alien species are the most likely cause of the ongoing declines in common native species. A peak in brushtail possum abundance and the arrival of a new species of *Vespula* wasp were two large changes in Nelson Lakes forests that occurred during this study. Both are likely to have added to the ongoing impacts of predation by introduced rats and stoats. We suggest that it is necessary to actively manage introduced species in order to maintain populations of widespread, common native bird species in New Zealand.

Is the pollen-limited tree *Fuchsia excorticata* (Onagraceae) also seed limited?

Oral presentation

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The New Zealand native tree *Fuchsia excorticata* (tree fuchsia) has a declining adult distribution because of possum herbivory, and is known to be pollination limited. However, pollination limitation will not be of any consequence for overall plant densities if *F. excorticata* is not also seed limited. We studied the seed bank and seed limitation in relation to distance from parent trees at sites with high and low pest control in Nelson and Canterbury. The *F. excorticata* seed bank declined with distance from parent and was 81% larger at sites with pest control, presumably because higher bird numbers give consistently better pollination and increase seed input to the soil. In sowing experiments, the numbers of seedlings emerging were higher closer to parents, and were significantly increased by sowing seed (7-fold increase, showing seed limitation), and by caging plots (2-fold increase, showing herbivore limitation). Therefore, the pollination limitation that *F. excorticata* experiences due to lack of suitable pollinators causes a reduced seed set which affects the soil seed bank and level of seedling emergence. Fortunately, control of mammalian pests seems to reverse this negative effect, increasing pollination, seed banks and seedling emergence. This shows community-wide benefits of controlling pest mammals.

Integrating ecological and sociological influences to evaluate city-wide voluntary community planting in Wellington, 1990–2010

Poster presentation

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We are evaluating the success of Wellington City Council's programme providing free plants for residents to plant road reserves. Our study aims to establish what factors influenced plant survival, and whether planting also suppressed weeds, facilitated succession or increased floral biodiversity. Longitudinal records over 20 years (1990–2010) including the number of each species planted and their location are being interrogated and years 5, 10 and 15 compared with current vegetation data from field surveys. Initial results of these comparisons will be presented. We will describe the next stages of the study to investigate the biotic (e.g. patch size and distance from other patches, patch composition), abiotic (e.g. site aspect, exposure, soil type) and human factors influencing success. Questionnaires completed by programme participants will be used to determine whether factors such as attitudes to urban biodiversity, community group involvement in plantings, and level of follow-up care have influenced planting success. Our overall aim is to integrate ecological and social perspectives to better understand the implementation and outcomes of urban restoration projects.

Methods of mitigating stresses upon poorly understood urban biota: North Shore City's beetles demonstrate stress responses at the community level

Oral presentation

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Urban sprawl is an increasing trend around the world, with large-scale conversion of land to suburban roading and housing reducing native habitat area. Although there is in many ways a trade-off between the land-use requirements of humans and New Zealand's native biota, potential exists to maintain high native biodiversity within urban areas, particularly within urban reserves that are left in native vegetation cover. New Zealand's urban reserves have been found to host many native and endemic species, particularly invertebrates. If we are to maintain these populations long term, we must address the stresses that living in an urban environment places upon native species. Understanding of these stresses is often hindered within poorly ecologically understood taxa, particularly the invertebrates. This study examines methods by which we can assess urban stresses upon poorly understood taxa and create

conservation strategies for them. In particular, isolation effects upon the beetles of North Shore City, Auckland, are used as a model.

Customary kaimoana management within Tauranga Rohe Moana

Oral presentation

Paul Borell

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Decline in the number of customary fishing authorisations being issued by Tangata Kaitiaki (customary fisheries managers) within the Tauranga ‘rohe moana’ (our ‘marine area’) is occurring because of overfishing and stock depletion, invasive predators (e.g. starfish) and pollution. Sewage overflows into Tauranga Harbour and runoff from the surrounding developed land has increased the risk of contracting norovirus from eating kaimoana (seafood). Another important contributing factor is the non-user-friendly data collection process currently in place, coupled with a lack of understanding amongst harvesters of the vital importance of catch statistics for guiding customary management and calculating allowable catch. An insufficient number of Ministry of Fisheries compliance officers also encourages some users to gather without statutorily required authorisations, so iwi (tribal groups) will need to train their own group of passionate Honorary Fisheries Officers to be active throughout our rohe moana. The management and sustainability of gathering our kaimoana is more generally and seriously threatened by a lack of research and reliable stock assessments. Researching the whakapapa (family links) of our most common species and development of breeding programmes to support free-range fish farming could help fill our oceans with the biodiversity that existed in the past. Our iwi began restoration by establishing a rāhui (Fisheries Act Section 186 closure) and more recently by establishing a mātaitai (customary fishing reserve) around Mauoa (Mount Maunganui). Ensuring harvest sustainability and restoring biodiversity of Te Rohe o Tangaroa (the realm of Tangaroa, the guardian of the sea) will maintain our cultural practices, the health and safety of iwi, and our mana moana (our ability to share the sea with whom we choose).

Homai te Wai Ora ki a Au: Give to me the water of life!

Poster presentation

Paul Borell

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Water quality is declining throughout the world, including in Aotearoa, because of diversion of water, drainage of swamps that previously cleansed the water, clearing of stream and riverbanks, and increased discharge of sewage, pollutants and nutrients. Our marae are places of gathering, wānanga (schools), hauora (health centres) and karakia (prayer) – the perfect headquarters from which we launch our attack on these threats to wai ora (healthy water). They are the places from which our kaitiakitanga (environmental stewardship) will grow and our communities will flourish through the sharing and caring for the biodiversity of our environment. Our marae also link into wider networks to co-ordinate ecological landscape restoration. My own marae is part of the 'Kaimai Catchments Forum', where 54 community groups, including 13 iwi (tribal groups), are working to identify key waterways for restoration. We invite adjoining landowners to our marae for a cultural experience, to share the vision of sustainable farming practices, and to co-develop plans for riparian planting, management of invasive plant and animal pests, and raise awareness of the importance of natural habitat and wetlands. Through the commitment of our Māori people and the help of our neighbours we are advancing specific programmes to give us all back the water of life.

Do long-tailed-bat home ranges change after clearfell harvest?

Poster presentation

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The impact of clearfell harvest on home ranges of bats is poorly understood, but home ranges may alter as both roosting and foraging opportunities change. New Zealand's long-tailed bat (*Chalinolobus tuberculatus*) is resident in exotic plantation forest, but no investigation of their home range has taken place there. To test our prediction that home ranges would be smaller post-harvest due to reductions in the older stands that bats prefer to roost within, bats were captured and radio-tracked over three summers in an intensively managed plantation forest, and their home ranges determined. Home ranges were traditional, overlapping between years, and when bats were in different reproductive conditions. Home range sizes and range spans of bats were smaller post-harvest than pre-harvest. Post-harvest home ranges of repeatedly radio-tracked female bats overlapped with their pre-harvest home ranges but changed

slightly; suggesting that clearfell harvest operations result in bats either moving slowly into less familiar areas or contracting their home ranges. These reduced home ranges may be the result of the creation of new edges – areas of high invertebrate density – where male bats prefer to fly, the avoidance of travel through open areas, and small colony sizes post-harvest meaning bats do not need to travel far to have exclusive foraging grounds. Small home ranges may increase vulnerability to local extinction by isolating populations in small forested areas. Bats may be able to access larger areas if treelines are retained through harvested areas.

Production landscapes as bat habitat: valuable or costly?

Oral presentation

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Many New Zealand landscapes have little native forest cover remaining and are largely mosaics of plantation forestry, pasture, and native regenerating areas. Long-tailed bats are generally associated with native forests, but have been reported using plantation forests throughout New Zealand. However, the relative use of *Pinus radiata* plantations by bats had not been quantified in comparison with the alternative habitat types: pasture and native regenerating areas. By monitoring echolocation call rates, we found that bat activity was highest for the oldest *P. radiata* stands, lowest in pasture, and moderate in native regenerating areas. This result justified further research into bat ecology within plantation forests. We found records of bats using plantation forest from Northland to South Canterbury, thus greatly increasing the area bats were previously assumed to inhabit. However, small colony sizes, and high rates of reuse of poorly insulated, relatively short term roosts suggest populations are more limited than those in previously studied rural mosaic and native forest habitats. Forestry operations coincided with colony size declines, as well as reductions in the numbers of roosts used. Consequently, declines in plantation forest area may also result in reduced bat populations. Bats' use of plantation forest and pastoral landscapes indicate that protection measures should not be restricted to native forest to protect native fauna. This research highlights the importance of mature forest, regardless of native or exotic status, and suggests production landscapes are valuable because they provide increased area for bats to inhabit, and costly because of impacts of clearfell harvest operations.

NVS Express: A data-entry, validation and analysis tool for Recce description and permanent 20 x 20 m plot data

Poster presentation

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The National Vegetation Survey Databank (NVS) is a physical archive and computer databank containing records from approximately 77 000 vegetation survey plots. The plot-based vegetation data stored in NVS can offer unique insights into vegetation distribution and dynamics over regional and national scales. The NVS team have recently developed a freely available software package called 'NVS Express', which has been specifically designed for the purpose of entering and analysing permanent-plot and Recce data collected using standard methodology. NVS Express is a Windows-based program, designed for ease of use and interpretation of data. This program will help users to summarise and better understand their data, without having to use advanced statistical packages. Usage of NVS Express should improve data quality, management, security and accessibility.

Forest biodiversity and ecosystem function: effects of biodiversity on herbivory in forests

Oral presentation

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There is increasing recognition that biodiversity has an important role in the functioning of ecosystems and in providing ecosystem goods and services. Most evidence to date has come from manipulations of grassland and agricultural ecosystems, but less is known about more complex ecosystems such as forests. A review and meta-analysis of the effects of tree diversity on herbivory showed that mixed forests are significantly less affected by insect herbivores than single-species forests. However, this effect depends on the degree of host specificity and the identity of the tree species in the mixture. Effects of biodiversity on herbivory were most pronounced when mixed forests were composed of taxonomically distant tree species. Case studies have provided insights into the mechanisms that are ultimately responsible for these observed patterns, including decreased accessibility of host trees and enhanced activity of natural enemies. These findings are particularly relevant for plantation forests and other forest types that are characterised by low species and genetic diversity. New Zealand's plantation forests have only rarely been affected by notable levels of insect herbivory, despite their lack of tree diversity. But this is largely explained by the lack of

pine-adapted insect herbivores in New Zealand, although sporadic outbreaks by a few polyphagous native insects and some introduced insects have occurred. Some options for the enhancement of biodiversity in plantation forests are presented, which may improve the regulation of insect herbivore populations.

Towards robust exchanges: evaluating the ecological outcomes of environmental compensation agreements in New Zealand

Oral presentation (Student Day)

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There is growing interest in the use of environmental compensation as one tool to address continued biodiversity decline and the impacts of development proposals. Compensation in a resource management context in various forms has been used for a number of decades, but is becoming more widely accepted. At the same time, there is concern that environmental compensation agreements are merely providing leverage for development projects that would otherwise be inappropriate to be given approval. An understanding of the factors influencing planning and decision-making process, the quality of compensation agreements, and the extent to which we are generating positive ecological outcomes is a clear information gap in New Zealand. The statutory context in New Zealand and the variables associated with the planning process influence compensation agreements and in the absence of clear formal guidance such agreements are likely to be highly variable in content and potential outcomes. Levels of compliance with compensation agreements worldwide are typically found to be low, and in addition to this lack of effective implementation, the absence of clear stated goals means that the process of compensating for the loss of natural capital is likely to be ineffective. This research programme intends to consider the above matters with specific reference to environmental compensation agreements under the Resource Management Act 1991.

Pest-proof fencing for conservation in New Zealand: the story so far

Oral presentation

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The use of fences designed to exclude all exotic mammals from natural habitats is a recent conservation strategy being applied

on the main islands of New Zealand for ecosystem restoration and fauna conservation. As well as contributing to conservation outcomes, it has focused and galvanised public involvement in conservation. Between 1999 and 2009, 28 areas covering a total of 8369 ha have been enclosed by 113 km of pest-proof fences and almost completely cleared of mammalian pests. Fenced areas have been located to exploit landscape features such as peninsulas, catchment boundaries, or fragments. Over this 10-year period, 63 translocations (mostly reintroductions) of 40 species have been made to these sites. This is similar to the number of translocations made to pest-free offshore islands in New Zealand over the same period. Notable species translocated to or managed within pest-proof-fenced areas include: (1) several highly threatened species in which protection by fences is a key strategy to prevent extinction; (2) seabirds at new or existing nesting sites; and (3) several species reintroduced to the main islands of New Zealand after a substantial absence. The removal of pest mammals from the ecosystems enclosed by pest-proof fences is leading to changes in the composition of residual communities, and increasing the abundances of pest-sensitive populations as they are released from previous limits imposed by pest predation or herbivory. Failure to eradicate or reinvasions of mice (*Mus musculus*) are, however, an ongoing challenge. Nevertheless, fences must now be considered an important component of any national conservation strategy.

Ecosystem services in high-country lands

Oral presentation

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Globally markets are increasingly being explored as a tool for attracting increased public and private investment into conservation efforts. Changes to the tenure of New Zealand high country lands has created an interest in the value of ecosystem services and the role that society can play in the preservation of indigenous grasslands and natural landscapes on private lands. Many ecosystem services can be attributed to high country lands including visual amenity, biodiversity, water and ecosystem carbon, but we are a long way from resolving how the value of those services can be determined or marketed. Other changes are also affecting high country lands, with reductions in sheep flocks, increases in exotic woody weeds and increases in recreationists and tourists. How will farmed indigenous grasslands be affected by these changes? We have initially investigated one aspect of ecosystem services relating to changes in land use. We estimated the response of ecosystem carbon to reductions in grazing. We measured carbon pools on lands retired from grazing for many years and compared them with measurements from lands that have continued with grazing as normal. Samples were analysed for carbon and results will be discussed.

Factors promoting rapid evolution in introduced plant species

Oral presentation

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Understanding how often and when species undergo rapid evolution is vital to understanding the role it plays in shaping species traits, species distribution, and the way that species respond to environmental change. Previous research has given examples of rapid evolution in a variety of taxa, but lack of studies on multiple species simultaneously means we have next to no information on how often or under what circumstances it is likely to occur. We used herbarium specimens to examine change in plant height and leaf traits through time for 40 plant species introduced to Australia and New Zealand. Sixty-five percent of species in Australia and 41% in New Zealand showed evidence of rapid evolutionary change through time, suggesting rapid evolution could be much more common than previously thought. We then used this information to test a serious of factors that could be used to predict the likelihood that introduced plant species undergo rapid evolutionary change in response to novel environmental conditions in their new range. We found that neither life history, number of native congeners, nor plant height was able to predict the magnitude of change in these populations. In addition, we found no evidence that species in some clades are more likely to change than others. Because there have been no previous studies of rapid evolution across such a broad range of species, this sort of synthesis has not been possible before. Our results suggest it is difficult to predict rapid evolutionary change in response to novel environmental conditions.

Interactions among invasive mammals in a New Zealand forest ecosystem: a large-scale manipulative experiment

Oral presentation

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Invasive mammals pose a threat to biodiversity conservation in New Zealand. To identify the mechanisms that drive interactions among mammal pests, we imposed a large-scale pest removal experiment in North Island podocarp–broadleaved forest. We manipulated rodents (rats and mice) and their

predators (stoats) and competitors (possums). We (1) measured the effect of food availability on pest abundance ('bottom-up' effects); (2) determined the ability of top-order predators to limit lower trophic level pests ('top-down' effects); (3) quantified the competitive use of resources by pests; and (4) measured the impact of rodents on a native invertebrate (tree weta) and on tree seed production. Between-year variation in ship rat abundance was strongly dependent on food available as seedfall. This response was modified by the presence of possums as competitors. When we removed possums from the system, rat populations reached higher densities than in the presence of possums. Removing stoats did not appear to significantly influence rat population dynamics. Removing rats from the system led to transitory increases in mouse populations, although mice were more susceptible to within-year variation in food. Despite the observed increase in house mice, sites with rats removed showed significant increases in ripe rimu seed falling from the trees and in the number of tree weta using artificial houses. We used these ecological relationships to develop models that predict (1) temporal variation in rodent abundance, (2) responses of rodents to the removal of other pest species and (3) the relative benefits of alternative pest control strategies to protect native biota.

Removal of livestock increases native vegetation richness and alters shrub recruitment and invasive mammal dynamics in dry grassland/shrubland ecosystems

Oral presentation

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Increasing areas of seral non-forest ecosystems in the eastern South Island of New Zealand are being retired from pastoral use through Crown Land Reform. Conservation agencies are now responsible for thousands of hectares of grassland/shrubland ecosystems that are often under-represented in legal protection. Consequently, former pastoral lease lands potentially have high conservation values and require management that takes into account future transition to shrub dominance. We investigated the effects of livestock exclusion on native biodiversity in dry grassland/shrubland vegetation communities by comparing sites where grazing ceased 10–30 years ago paired with sites where grazing has continued. Ungrazed sites had significantly higher native vegetation richness and lower exotic richness than grazed sites. Ungrazed sites also had significantly more native shrubs than grazed sites, higher shrub cover, and higher shrub fruit productivity. Cessation of grazing had variable effects on shrub recruitment rates, probably complicated by competition with introduced pasture grasses. Differences between grazed and ungrazed sites were reflected in the invasive mammal community; grazed sites were typically associated with higher abundances of rabbits and hedgehogs whereas hares,

possums and mice were dominant in ungrazed sites. Removal of livestock grazing can have profound effects on long-term successional trajectories of grassland/shrubland ecosystems and the potential impacts of invasive mammal pests. By quantifying ecological community responses to retirement of land to the conservation estate we can support evidence-based management of such ecosystems.

Present knowledge, past behaviour: understanding ancient traditional resource and environmental management systems

Oral presentation

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Traditional resource and environmental management is the use of traditional ecological knowledge in the manipulation and management of natural resources and ecosystems. Traditional resource and environmental management systems (TREMS) embody the social contexts within which traditional resource management takes place. TREMS include world views, use rights, proper behaviours, languages, rituals and other *intangible* aspects of resource management, and are largely invisible when studying the past. Instead, archaeological remnants of TREMS are made up of management features and resource remains. However, by integrating information from traditional knowledge holders with archaeological studies of resource management features, researchers are beginning to understand complex TREMS used in the past. This paper examines traditional resource and environmental management and TREMS within the context of ongoing community-based research on intertidal resource management features in Northern Coast Salish territory, southern British Columbia, Canada.

Factors limiting natural forest regeneration in a Nigerian montane grassland

Poster presentation

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Tropical forests are being cleared at a faster rate than any other forest system. This study investigates the factors limiting the establishment of seedlings in the grasslands of Ngel Nyaki montane forest reserve, Nigeria. It aims to address (1) whether distance from the forest edge affects establishment into grasslands and (2) whether fencing promotes seedling

establishment in grasslands. The results indicate that a number of factors impede tropical forest recovery in these grasslands. Although there was an abundance of forest seed in seed rain at various distances from the forest edge, seed bank surveys show that post-dispersal processes are limiting the survival, and establishment of seed in grasslands. Distance had no significant effect on the seed bank, seed predation, seedling abundance and herbivory in grasslands. However, grazing does have a significant effect on seed bank densities and seedling abundance. Our research shows that the establishment of woody species in the grasslands around the Ngel Nyaki forest reserve is slow. However, although fencing may maintain species already established or actively planted in grasslands, it may not actively facilitate regeneration. Therefore, restoration efforts may need to look at promoting the establishment of either native tree seedlings or early-successional shrubs to successfully facilitate the regeneration of forest into grasslands which may in turn further promote seed dispersal into grasslands and restrict the competitive effects of pasture grasses.

Medicinal plants used in the treatment of livestock diseases in Vhembe region, Limpopo Province, South Africa

Poster presentation

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Traditional medicine is very important in the Venda area but available literature does not cover ethnoveterinary uses. Open-ended questions and group focus discussions were used to investigate knowledge of ethnoveterinary medicine (EVM) in the Vhembe region. Thirty-seven individuals (24 males, 13 females) were interviewed. EVM practices involved the use of plants as remedies, collected from the wild and prepared mainly as infusions and decoctions for internal use, leaving the sap for local applications. Cattle, followed by sheep and goats, were predominantly owned by old men, who by themselves treat their livestock for worm and tick infestations. There were 47 EVM remedies made in total – prepared primarily from leaves, followed by bark – from 33 plant species belonging to 22 plant families. The families with the most species were Fabaceae (six species), Asteraceae and Rubiaceae (three species each), and Combretaceae and Euphorbiaceae (two species each). The plants recorded were: *Aloe marlothii, Asparagus falcatus , Bolunsathus speciosus, Carissa bispinosa, Cassytha filiformis, Cephalanthus natalensis, Combretum molle, Dicerocaryum eriocarpum,Diospyros lycioides, Ehretia rigida, Elaeodendron transvaalensis, Elephantorrhiza burkei, Garcinia livingstonei, Gladiolus dalenii, Hyperacanthus amoena, Maerua angolensis, Ochna holstii, Prunus persica, Pseudolachnostylis*

maprouneifoloia, Pterocarpus angolensis, Rhus lancea, Rothmania capensis, Senna petersiana, Solanum incanum, Synadenium cupulare, Tagetes minuta, Terminalia sericea, Trema orientalis, Turrae obtusifolia, Vernonia colorata, Vernonia corymbosa, Xanthocersis zambesiaca and Ximenia americana.

Management of animal and plant pests in New Zealand – patterns of control and monitoring by regional agencies

Oral presentation

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Significant resources are spent annually in New Zealand controlling pests to mitigate impacts on native biodiversity and agricultural production, but there are few reliable estimates of the benefits. Concerns have been expressed about inconsistent monitoring methodologies, differing frequencies and intensities of control across organisations, and poor definition of desired outcomes. We conducted a survey of animal and plant pest control and monitoring by regional agencies, to identify issues with current practice and to provide advice on improvements. Fifteen regional agencies in New Zealand were asked about the pest control and associated monitoring undertaken during 2005–2008. We recorded the pests targeted, the control work done and its operational details, any result and/or outcome monitoring conducted, and estimated costs. About 21% of the NZ$20 million expenditure on pest control was for monitoring. Excluding compliance (62%), monitoring changes in pest populations accounted for 31% of the total monitoring expenditure, whereas only 7%was spent measuring response in the resource that was supposedly being protected. The most common monitoring design (71%) comprised a single treatment area with no non-treatment area, in which only results were monitored. Only three programmes (4%) had both treatment and non-treatment areas and both results and outcome monitoring. Such limited outcome monitoring severely constrains the ability of regional and local authorities to provide robust justification for their pest management activities and expenditures. Improved outcome monitoring requires better design of and additional resources for monitoring programmes, improved institutional/political support for long-term programmes, and better definition of long-term outcomes and objectives for pest management.

Genetic diversity and identity of Maui's dolphins: initial results of 2010 Summer surveys

Oral presentation

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Surveys of the critically endangered Maui's dolphin (*Cephalorhynchus hectori maui*) were conducted along the known range of the subspecies by small boats from 4 February to 2 March 2010. To assess genetic diversity and estimate abundance via capture–recapture analysis of genotypes, a total of 37 skin samples were collected using a minimally invasive biopsy dart. Genotyping at 16 microsatellite loci confirmed that diversity is low (average of 3 alleles) but the combined probability of identity (i.e. match by chance; $P_{ID} = 2.9 \times 10^{-6}$) was sufficient to provide confident identification of 26 individuals (10 males: 16 females): 17 of which were sampled once, 7 sampled twice and 2 sampled three times. Short-term individual movements were inferred from resamples, which occurred across distances up to 26.4 km in 5 days. Sequencing of the mtDNA control region confirmed that 24 of the 26 individuals represented a single haplotype 'G', the only haplotype detected in Maui's dolphins since 1988. However, the other two individuals represented two haplotypes characteristic of the Hector's dolphin subspecies. As both of these individuals are female, there is potential for these haplotypes to persist in Maui's dolphins via maternal inheritance. Further analyses are underway to confirm the subspecies origin of these two individuals and to estimate abundance and trends of the population, by comparison to samples collected from 2001 to 2006. In any case, the discovery of these new maternal lineages, formerly presumed to have been lost in this subspecies, is encouraging news for the preservation of genetic diversity in Maui's dolphins.

The tuatara–fairy prion relationship: an interspecies interaction influenced by thermal benefits?

Oral presentation

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Tuatara (*Sphenodon punctatus*) and petrels such as the fairy prion (*Pachyptila turtur*) share a close ecological relationship that has been recorded since the 1800s. However little is known about the thermal aspects of the tuatara–petrel coexistence within burrows. A consistent, alternative source of heat to solar

radiation could be a beneficial resource for a reptile. Living in close proximity to an endotherm such as a seabird may therefore be an attractive option. We asked the question, can the presence of a bird within a burrow increase a tuatara's body temperature enough to provide a fitness advantage? We explored this relationship through the monitoring of tuatara body temperatures and behaviour, as well as analysing data on burrow microclimates and the burrow systems of tuatara and fairy prions. Additionally, data from captive-bred tuatara provide insight into the behavioural responses of tuatara to different temperature regimes. We found that variation in microclimate may influence the attractiveness of burrows for use by tuatara. This study provides us with a greater understanding of the mechanisms and conditions that underlie this interspecies interaction and the impacts that a seabird has on a tuatara's thermal ecology.

Community forest management and biodiversity in a pine-oak forest in Mexico

Oral presentation

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Community forest management has frequently been pointed out as a way to protect forests while generating financial income to rural communities. Mexico has the largest number of community forest enterprises oriented toward the commercial production of timber and, at the same time, is a high biodiversity country. Nevertheless the role of community forestry in biodiversity conservation is still a controversial debate. We studied the short-term effect of some silviculture treatments in common use in Mexico on the diversity of woody plants in a pine-oak forest in the highlands of Chiapas State. The forest belongs to an ethnically mixed community. Sampling plots were established in logged areas of two different management stages and in non-logged areas during 2009. The latter served as the control treatment. Adult trees and saplings of woody species were inventoried, canopy openness was measured and soil variables controlled. Canopy openness was higher in logged plots. Although differences in species richness and dominance were small, floristic distances were clearly shown between treatments for both adult trees and saplings. Several species that need shadow were replaced with other species adapted to a greater exposure to sunlight. In conclusion, if community forestry, as it is practised today, maintains and expands forest cover, it does not maintain the same group of woody plants. To find the right balance between timber production and biodiversity conservation, more research is needed. It is particularly important to study the spatial combination of protection and production forest areas.

Gender and facilitation: gynodioecious cushion *Silene acaulis*

Poster presentation

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Gynodioecious plants contain both hermaphrodite and female (male sterile) individuals, although sex expression can be highly variable. Typically gynodioecious, *Silene acaulis* cushions, for example, can range from fully dioecious, to trioecious, hermaphroditic, or gynodioecious. A survey of 80 *S. acaulis* was taken at each of a low and high elevation site in Glacier National Park (Montana, USA) to determine the ability of hermaphrodite and female individuals to facilitate other alpine vascular plants, as well as the cost of facilitation incurred by the cushion. Species diversity in paired plots (inside cushion vs. outside cushion), cushion size, gender, specific leaf area (SLA), flower number, seeds/fruit, and seed size were quantified. Contrary to previous studies, frequency of hermaphrodite individuals increased with elevation from 50 to 58% while females slightly decreased (41–38%). Individuals with intermediate sex expression (having both hermaphrodite and female flowers) were also identified (frequency: 5% at low and 19% at high elevation). Species diversity was higher in both female and hermaphrodite plots compared with open paired plots, suggesting both sexes are effective facilitators. Individuals at the high elevation site are expected to be more effective facilitators, although this analysis has not yet been completed. There appears to be no cost of facilitation either to hermaphrodites or females as flower number, seeds/fruit, seed size, and SLA showed no correlation with percent cover of beneficiary species which can sometimes be as high as 80%.

Is there such a thing as ‘Indigenous science’?

Oral presentation

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When people express opinions on the question of 'Indigenous science', the responses seem to fall into two contrasting and complex answers. Some respond 'no', arguing that (a) it is inappropriate to impose a value-laden construct like science upon Indigenous communities, or (b) there is a fundamental disconnect between the empirical basis of science and the spiritual basis of Indigenous beliefs. In contrast, others respond 'yes', arguing that (a) it is inappropriate to assume that non-

Western cultures lack the cultural sophistication to have developed their own versions of scientific thinking, or (b) all humans naturally possess a common set of mental faculties, including those which constitute the essence of scientific thinking. The goal of our paper is to frame this debate in terms that are specifically designed to help local-knowledge holders from both Indigenous and Western cultures. We define fundamental terms and concepts related to knowledge systems in general, especially for learning processes related to the accumulation and evaluation of knowledge. We review the modern application of 'Western science' as a culturally specific technique for active acquisition of reliable knowledge about the natural world. Finally, we evaluate scholarly assertions regarding the existence and operation of 'Indigenous sciences'. Ultimately, we conclude that the operation/compatibility of science in an Indigenous knowledge system can only be evaluated with active assistance of the Indigenous knowledge holders themselves. In order to facilitate cross-cultural discussion of these issues, we present specific recommendations for local-knowledge holders (Indigenous and Western) to create their own reciprocal knowledge exchange protocols.

Do thermal and reproductive characteristics place the lizards of Macraes Flat at risk from global warming?

Oral presentation

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A recent international analysis suggests that 20% of lizard species are at risk of extinction over the next 70 years from the direct effects of temperature on emergence. Should we be concerned for the lizards of Macraes Flat? This site houses one of the most species-rich assemblages of lizards in mainland New Zealand, including two endangered skinks. Our studies focus on two, non-threatened model species, the sun-basking McCann's skink (*Oligosoma maccanni*) and the primarily nocturnal common gecko (*Hoplodactylus maculatus*). Field monitoring suggests that thermoregulation in these live-bearing species is currently constrained by low summer temperatures (e.g. only 49% of spring–summer days provide basking temperatures that enable preferred body temperature of McCann's skinks to be reached). Laboratory studies confirm that greater basking opportunity leads to shorter pregnancies, but without any change in offspring number (relative to maternal size) or offspring sex ratio. Furthermore, in McCann's skinks, basking opportunity during pregnancy has only minimal effects on offspring performance in early juvenile life. Thus, warmer summers should allow earlier birth, without obvious detriments to offspring. Warmer summers may allow common geckos, currently constrained to biennial reproduction, to reproduce annually, as in warmer locations elsewhere. However, uncertainties remain about the impacts of possible changes in summer cloud cover (which could limit opportunity to reach preferred temperature) and of warmer winters. The wider,

ecosystem-level changes that might result from climate change, in a habitat where dispersal is increasingly limited by agricultural development, are more difficult to predict.

Hedging our bets: integrating native plants into agricultural systems

Poster presentation

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The Canterbury Region had nearly 300 000 km of hedgerows and shelterbelts in the early 1990s, typically made up of *Pinus radiata, Cupressus macrocarpa*, or *Ulex europaeus*. While this area is likely to have been reduced through the advent of pivot irrigation systems, hedgerows and shelterbelts are still a predominant feature in the Canterbury agricultural landscape. One of the potential benefits to be gained from hedgerows and shelterbelts is the possible resources such plants can provide to insect pollinators. However, only two pollinating insect species have been recorded visiting the common exotic hedgerow and shelterbelt species mentioned above. We hypothesised that native plants could support a greater diversity of insect pollinators, while also being less likely to act as reservoirs for economically important insect pests (insect herbivores actively managed in agricultural systems) compared with exotic plant species. Thus, native plants could be ideal for shelterbelts and hedgerows in the agricultural landscape. We selected native plants based on their presence in Canterbury, assuming such plants would establish more readily in the region, and evidence of visits from pollinating insects. We examined published information to determine the host–plant interactions of these native plants and vegetable and arable crops commonly grown in Canterbury with insect herbivores. We identified the insect herbivores associated with 73 native plant species all of which had evidence of visitations by between 1 and 27 insect pollinator species. Only 10 of these native species had records of insect herbivores also defined as pests within vegetable and arable crops.

Importance of the bigger picture: differential phenology and sensitivity of species determines the response of insect communities to global environmental changes

Oral presentation

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The world and its ecosystems are undergoing rapid change, and nearly two-thirds of the services provided by nature to

humankind are found to be in decline worldwide. Ecological research has produced a wealth of studies showing how focal species react to 'global environmental change' (GEC) drivers. However, the magnitude of response varies greatly across organisms and systems, frustrating attempts to extrapolate from a species-to-species approach to how real-world ecosystems react to environmental change. In a field study in the Lewis Pass area, characterised by extensive subalpine tussock grasslands, I am currently examining how two main GEC drivers impact insect herbivores at the community scale. Using an altitudinal gradient to simulate increasing temperature, and adding a fertilisation treatment to simulate increased atmospheric nitrogen deposition in a split plot design, I sampled all above-ground lepidopteran larvae over a period of 11 months. I found that both temperature and nitrogen affected herbivore community composition. The differential responses of species to these drivers underpinned the observed composition shifts, with a select few opportunistic organisms dominating the community under higher temperatures and nitrogen availability. Furthermore, different species had contrasting responses in terms of their phenology, and this partly drove the observed shifts in the community composition. This study provides insights on the conservation of the moth and butterfly fauna of tussock grasslands, known to be in severe decline. Furthermore, it highlights the importance of studies at a community level, as single-species studies may give misleading results.

Assessment of significant natural areas in the Thames Coromandel District for prioritising biodiversity management

Oral presentation

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The Coromandel Peninsula hosts a broad range of indigenous ecosystems and critical habitats for threatened species. To identify and prioritise the areas in greatest need of biodiversity management, Environment Waikato completed a 'desktop' inventory and ranking of significant natural areas (SNA) in the Thames-Coromandel District. We identified distinct natural sites in six ecosystem categories using existing information, including recent aerial photography and spatial data of indigenous dryland and wetland vegetation. Sites were assessed against 11 criteria in the Waikato Regional Policy Statement to determine a level of significance. The assessment found that SNA cover 58% of the Thames-Coromandel District, with over half of the total SNA area ranked internationally significant. More than 100 rare and/or threatened species are recorded, including some found nowhere else (e.g. Coromandel striped gecko (*Hoplodactylus stephensi*)), and the peninsula contains significant strongholds of the Archey's (*Leiopelma archeyi*) and

Hochstetter's (*L. hochstetteri*) frogs. The Coromandel Peninsula is indeed one of New Zealand's important 'hot spots' for biodiversity. Approximately 66% of the area of SNA is protected land, most of which includes submontane and montane ecosystems with relatively high levels of indigenous character and resilience. The remaining 33% of SNA are unprotected and occur largely in coastal, lowland and wetland areas. Priorities for management are SNA with little or no protection that may form corridors and provide buffers to protected SNA. Objectives include: increasing landowner awareness of the value of SNA; improving habitats and ecosystem resilience through planting, fencing and pest control; and reviewing and updating policies regarding subdivision provisions in coastal, lowland and wetland areas.

Determining the causes of changes in land snail diversity and abundance due to livestock trampling

Poster presentation

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Land-use intensification is increasing worldwide as the need for resources grows due to the growing human population. The increased fertiliser inputs and animal stocking rates that are part of increasing the yield in a production system have negative impacts on surrounding native ecosystems. Livestock grazing has negative impacts through nutrient addition, soil compaction, reduction in litter, destruction of topsoil structure, and reduction of plant biomass. This has important implications for the conservation of small forest remnants in lowland New Zealand, many of which are on private land, and not fenced for stock exclusion. The New Zealand land snail fauna is among the most species rich in the world, many of the c. 1400 known species are rare and important, with an endemism rate potentially as high as 99.5%. Previous research in 30 native forest remnants on farmland in the Waikato Region found there were strong effects of livestock trampling on the diversity and abundance of land snails. We intend to carry out a controlled trampling experiment using a mechanical cow hoof to determine the effects of livestock trampling on snail diversity and abundance in leaf litter. Through treatments involving litter manipulation, trampling of soil and litter, and different trampling intensities (simulating changes in stocking rates), we aim to determine the causes of changes in diversity and abundance of snails due to livestock trampling. Determining how animal stocking rate increases affect native fauna will be important if we are to derive effective management schemes, while still retaining agricultural productivity.

Biodiversity and ecosystem function in wood and woody ecosystems

Oral presentation

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The focus of conservation has shifted from a biodiversity paradigm to a much greater emphasis on 'ecosystems services', including carbon sequestration. These paradigms can be in conflict as biodiversity and ecosystem services may not always be positively correlated. I will illustrate a clear case of negative biodiversity and ecosystem function relationship in wood decay fungi, discuss mechanisms, and show how these results extend from the laboratory microcosm to the field. I will then present a more complex dataset on woody succession into conservation grasslands in New Zealand and simultaneous effects on carbon sequestration, biodiversity, and ecosystem functioning. Increasing carbon sequestration under both a native and non-native woody succession is associated with a loss of biodiversity in some, but not all, functional groups. Together these studies suggest that positive biodiversity and ecosystem function relationships cannot be assumed to occur widely in ecology nor in conservation.

Retaining mountain biodiversity: facing the challenges

Plenary presentation

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Threats to indigenous mountain biodiversity come in various forms and are accelerating. We need to get better at synthesising our knowledge, recognising also that 'one-size-does-not-fit-all' and that straightforward latitudinal hemispheric comparisons of mountain systems are unwise given that the effects of altitude, latitude, physiography and the degree of continentality shape them in both subtle and obvious ways. One unifying factor, however, is in the delivery of water. Indeed, mountains have been referred to as the world's 'water towers', with the influence of land cover type on water supply, and the contribution of biodiversity to these services, becoming better understood and appreciated. Worldwide, snow cover patterns are changing, glaciers and ice-sheets are retreating, and there are some very serious implications for the sustainability of livelihoods and for the diversity of people that mountains will support in future. The cascading and complex influences of climate-driven changes in the atmosphere, and in temperature, precipitation, wind and fire regimes, on mountain communities and the interactions that occur within and between them are not easy to tease apart. At the same time, species alien to these

environments are being deliberately planted or are dispersing into mountain regions by various means. Establishing direct causes and effects of changes in biodiversity are not trivial problems to address. Globally, whilst there are some increases in mountain research and a commitment to the establishment and maintenance of long-term data sets which should aid in assessing and more effectively addressing future changes, mountain biodiversity and cultural diversity are disappearing fast. In facing the challenges ahead, we need to go beyond identifying threats and documenting changes, to providing realistic solutions.

Environmental integrity using a restoration ecology toolbox in Canterbury

Oral presentation

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Sustainability of production landscapes relies on appropriate provision of ecosystem services, not least to avoid compromising environmental integrity. Native soils and above- and below-ground biota are heavily modified but natural processes deliver ecosystem services, including fertility, waste management and water quality. Links between biodiversity and functionality are weakly proven, apparently independent of economic drivers and largely beyond the mindset of land managers. This paper questions the extent to which the available palette of native plants combined with established ecological knowledge can be used to provide added value to production landscapes in lowland Canterbury. Restoration ecologists have already made significant inroads into addressing the paucity of remnant vegetation and underrepresentation of native species. But where is the evidence that this provides advantages beyond the aesthetics and what are the opportunities to make a positive contribution to environmental problems along a gradient from irrigated dairy through dry pasture sheep farming and lifestyle blocks to urban areas? After a Northern Hemisphere career in restoration ecology, the author questions where his own particular set of research skills and biases could have most impact in Canterbury? Plying the wares of his restoration trade with a trusted toolbox, he tries to understand how the soil has changed, both structurally and functionally, and the role of native vegetation in sustainability. Existing knowledge and progress with restoration of native species are considered in the context of whether optimisation of ecosystem services really can be practically founded within appropriate economic arguments. This paper seeks critical comment and constructive guidance.

The host's role in shaping parasite evolution: comparative phylogenies of New Zealand whelk (Gastropoda: Buccinidae: *Cominella)* parasites

Oral presentation

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The relationships between parasites infecting four New Zealand intertidal predatory whelks species in the genus *Cominella* (*C. glandiformis, C. virgata, C. adspersa* and *C. maculosa*) were examined. Initially *Cominella* spp*.*, collected from around New Zealand, were inspected for parasites, which were dissected and preserved in ethanol. Then robust molecular phylogenies were constructed based on the parasite's nuclear ITS1 and mitochondrial 16S and COI sequence data. *Cominella* spp*.* were infected with a large range of parasites, representing at least six different families, including Microphallidae, Echinostomatidae, Strigeidae, Opecoelidae and two, as yet, unidentified families. The level of *Cominella* host specificity varied between families, e.g. echinostomes were specific to *C. glandiformis*, whereas strigeids could infect three different *Cominella* host species (*C. glandiformis, C. virgata* and *C. adspersa*). Statistical parsimony networks were then constructed for each family of parasites in order to examine the effects of geography, first-intermediate host specificity and definitive host on intraspecific parasite population structure. We hypothesise that the definitive host has more bearing on intraspecific population structure than either geographic range or first-intermediate host specificity. Furthermore we argue that parasites that utilise a bird as the definitive host will exhibit less intraspecific structure than those that use a fish.

Unexpected genetic population structure in the kea (*Nestor notabilis*)

Oral presentation

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The kea (*Nestor notabilis*) is an endemic alpine parrot of the South Island of New Zealand. After 150 years of persecution, it was fully protected in 1986, but the species is still declining over its whole range. Here I present data from 10 microsatellite markers for 239 kea from nine populations along the length of the South Island. Kea are known to have considerable dispersal capabilities and are sometimes sighted far from their alpine habitat. It is therefore expected that such a potential for gene flow would make distant populations less genetically differentiated. However, we found a significant isolation by distance (IBD) pattern. Moreover, three distinct genetic clusters

were identified with few areas of genetic admixture. Our data suggest that kea populations may have been separated during the last glaciation. We discuss possible causes for this unexpected population structure, including social behaviour and call differences as a barrier to dispersal and the 'beech-gap' hypothesis.

East Otago Taiāpure: the long road to community-led fisheries management

Oral presentation

East Otago Taiāpure Management Committee[1], Chris Hepburn[2], Anne-Marie Jackson[3], Nigel Scott[4], Henrik Moller[5]

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The long journey towards active community-based management of fisheries will be described by members of the East Otago Taiāpure Management Committee and advisors. The Taiāpure (a customary fisheries area, enacted under the Fisheries Act 1996) was first mooted in 1989 in response to concerns by elders about the decline of the local pāua (abalone, *Haliotis iris*) fisheries. The Taiāpure was established in 1999 and a management committee was appointed in 2001. Four representatives and the chair come from the local Rūnaka Kāti Huirapa ki Puketeraki, while the other four represent commercial and recreational fishers, and local interest groups (River-Estuary Care Waikouaiti-Karitāne, University of Otago). Twenty years since the idea for the Taiāpure was first put forward, some protection for pāua and other important species locally will be provided from 1 October 2010 through new regulations stipulating much reduced bag limits and a closure to pāua gathering at a key cultural site. These new regulations will be further supported with targeted pāua reseeding and monitoring programmes to determine the success of the management measures instigated by the East Otago Taiāpure Committee. We will describe barriers and enablers for establishing the new regulations process and in particular consider the role of ecological science alongside mātauranga (traditional knowledge) in bringing them about. The motivation behind the Committee's goal of restoring fisheries and habitats within and surrounding the taiāpure is summed up in the Ngāi Tahu whakataukī – *Mō tātou, ā, mō kā uri ā muri ake nei* – For us and our children after us.

Encouraging community biodiversity initiatives in an urban environment

Oral presentation

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The community is an integral part of biodiversity protection and restoration in an urban environment. Local councils have an important role in engaging the environmental community and the wider community with biodiversity conservation. With so many different landowners over a relatively small space, this has to involve getting the community involved on public land and getting them involved on their own property. To successfully improve biodiversity conservation, these initiatives need to be backed by robust science. Both ecological sciences and social sciences are necessary, to ensure messages are being communicated in an effective way and that those messages are current and accurate. However, there remains a need to bridge the gap between the people doing the science and the people in our urban communities who can make use of it.

Exotic species invasion affects biodiversity in indigenous tussock grasslands

Oral presentation

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Invasive exotic species are globally recognised as a major ecological factor affecting indigenous biodiversity. Long-term monitoring studies in New Zealand montane grasslands show a consistent trend of increasing exotic colonisation. In the Acheron Valley, Marlborough, cover of the adventive hawkweed *Pilosella officinarum* (formerly *Hieracium pilosella*) increased by 83% between 1969 and 2001. Short tussock (*Festuca novae-zelandiae, Poa colensoi*) cover decreased by 75% and the number of vascular species by 79%. Across the Mackenzie Ecological region *P. officinarum* cover increased from 14% in 1990 to 28% by 2000. On a semi-arid free-draining basin floor site *F. novae-zelandiae* live basal area decreased from 148.9 cm^2/m^2 in 2000 to 0.5 cm^2/m^2 in 2008. The number of indigenous vascular species decreased by ~61% between 1960 and 2008. In Otago tall tussock (*Chionochloa rigida*) grassland at 910 m *Hieracium lepidulum* cover increased from 285 cm^2/m^2 in 2005 to 2616 cm^2/m^2 in 2010 in ungrazed exclosures, but only increased from 2 to 14 cm^2/m^2 in grazed grassland. Similar trends occurred at 1200 and 1220 m. Implications for biodiversity management are discussed.

Visualising species isolation across a landscape: an aid to ecological decision-making

Poster presentation

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The ability to visualise complex ecological processes in order to differentiate conditions across a landscape is an important component of ecological decision-making. This is especially true for factors such as spatial isolation, as isolation has both positive and negative ecological associations depending on the species and location under consideration. For example, isolation is a positive factor when eradicating invasive species, and a negative factor for reintroduction programmes. Assuming that spatial isolation is a function of landscape structure, I present a technique that uses a graph-theoretic approach to quantify the relative levels of spatial isolation one part of a landscape has to other parts of the landscape. These relative isolations can then be visualised in such a way as to allow for comparison of isolation for a species across a landscape, and for comparison of isolation between species. Such comparisons would be useful in planning ecological management activities where the potential for spatial spread of a species is of concern.

Ungulate impacts and commercial helicopter deer recovery in the alpine grasslands of Fiordland National Park

Poster presentation

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A vegetation monitoring programme was established in early 2006 to monitor trends in the impacts of deer on the alpine grasslands and herbfields of Fiordland National Park. The rationale was to provide supporting evidence to promote deer control should the 2001–2006 hiatus of commercial helicopter deer recovery have continued. However widespread commercial helicopter deer recovery resumed in late 2006 in Fiordland National Park and the monitoring programme was remeasured over 2008 and 2009 to assess whether any changes in deer impacts had occurred. The vegetation monitoring method used counted browsed and unbrowsed plants of selected palatable alpine herbs (*Celmisia verbascifolia*, *C. holosericea*, *Dolichoglottis scorzoneroides*, and *Ranunculus lyallii*) on groups of five belt transects (50 x 2 m) at 44 sites across Fiordland National Park. Between 2006 and 2008/09 there was a strong overall reduction in browse levels, particularly at sites and on species where browse levels were relatively high to start with. The overall abundance of deer sign

(measured by deer pellet group counts on each transect) halved during the same period. In the Murchison Mountains area where long-term intensive deer control has been carried out by the Department of Conservation, deer browse levels and deer sign were negligible for both measurements. Approximately 15 000 deer were removed from Fiordland National Park between 2006 and 2009 through commercial helicopter deer recovery, mostly from alpine grassland habitats. Further decreases in the impacts of deer on alpine grassland ecosystems in Fiordland National Park would be expected if commercial helicopter deer recovery continues at current levels.

History, functioning and future of subantarctic Campbell Island ecosystems

Oral presentation

Alexander J. F. Fergus[1,2], Colin Meurk[3], Shelley McMurtrie[4], Steve Wagstaff[3], Norm Judd[5], Nigel Prickett[6], Atholl Anderson[7], Ian Lynn[3], Alex James[4], Mark Crompton[8], Jo Hiscock[9]

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The United Nations decreed 2010 to be the International Year of Biodiversity; this was likely a nod to the bicentenary of the discovery of subantarctic Campbell Island. Forty years ago ecologists began monitoring our southern-most ecosystem in earnest; the gradual removal of sheep concluded in 1991; and almost a decade has passed since the world's largest successful rodent eradication. Given this background, 2010 is an opportune point in eco-cultural time for a research expedition. The Campbell Island Bicentennial Expedition (CIBE) aims to reconstruct the island's ecological history; decipher how the island's ecosystems function; quantify the recovery of the biota; and assess any remaining ecological threats. The diversity of the expedition team – which includes among its ranks ecologists, archaeologists, historians, and geomorphologists – strengthens our grasp of the island's ecology in the context of glacial, postglacial, and human history. The expedition is the first project of the newly incorporated 50 Degrees South Trust, established to foster research-led management of New Zealand's subantarctic islands. Beyond our research questions the outputs of the expedition will emphasise Campbell Island to be more than a fascinating biotic refuge but also a promising model system. An accelerated response to abiotic change is a demonstrated characteristic of species and ecosystems in marginal environments; biotic changes on Campbell Island will provide valuable data that can be extrapolated to more northerly ecosystems. The main purpose of this pre-talk is to invite suggestions and questions from a diverse local and international ecological audience 2 weeks before our departure to Campbell Island.

European 'biodiversity experiments' – exploring applications in New Zealand grassland production systems

Poster presentation

Alexander J. F. Fergus[1,2], Eric Allan[3], Jana A. Petermann[4], Andreas Prinzing[5], Bernhard Schmid[1]

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Ecologists in Europe and North America have championed so called biodiversity-ecosystem functioning experiments. The core of this ecological subdiscipline is experimental manipulation of species richness and its quantified effect on productivity. Two decades of heated argument over results and mechanisms have driven the fine-tuning of experimental designs and the development of statistical techniques. The result is a handful of conclusions that the various antagonists can agree upon; consequently such experiments are ongoing. Grasslands have been the experimental system of choice as the speed of ecological processes permits meaningful results within a PhD career. In Europe these studies often share a suite of species many of which are common to grassland production systems in New Zealand. Given this overlap it is both frugal and potentially valuable (to both conservation and production) to explore New Zealand applications of the results of European biodiversity experiments. Bolstering exotic biodiversity within production systems might well favour protection of indigenous biodiversity in surrounding systems. For example, diverse communities with differing resource acquisition traits exploit resources (like nutrients or water) in a more complementary manner, reducing fertilisation and irrigation requirements. Resistance to pests and pathogens also increases with diversity as density-dependent effects are diluted; increasing phylogenetic diversity may be particularly relevant here. Selecting supplementary species for a grassland production system in New Zealand is complicated as very few of our indigenous species are palatable to our favourite ruminants. Any additional species must therefore be naturalised, non-aggressive, somewhat productive exotics; potential risks and benefits of this are discussed.

Achieving effective employment of whole-landscape modelling approaches to systematic biodiversity assessment: challenges and solutions

Oral presentation

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I first introduce a general modelling framework for integrating multiple pattern- and process-related factors into biodiversity conservation assessment, and prioritisation of actions, across whole landscapes. Options are explored for tailoring implementation of the framework to suit planning processes varying markedly in purpose, and in availability of data, time, funding, and expertise. The framework allows considerable flexibility in the nature of employed biodiversity surrogates (species-level, discrete or continuous community-level) and spatial data structures (polygonal planning units, or fine-scaled raster), the level of sophistication with which each of the three modelling components is implemented (from simple target-based assessment to complex process-based modelling approaches), and the forms of higher-level analysis supported (biodiversity status assessment and reporting, optimal plan development, priority mapping, interactive scenario evaluation, site-based assessment). I then offer a personal perspective on successes and failures in applying systematic biodiversity assessment approaches such as this to real-world conservation assessment and planning activities during the past 15 years, identifying what I regard as key challenges in achieving effective application, and suggesting practical ways of addressing these.

Back to the future: conservation of the weevil *Hadramphus tuberculatus*

Oral presentation

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The rarest weevil in New Zealand, *Hadramphus tuberculatus*, was last sighted in 1922 and presumed extinct until its rediscovery in 2004. It is classified as Nationally Endangered and historical records suggest that the weevil was once widespread in tussock grasslands throughout Canterbury. *Hadramphus tuberculatus* is host plant specific and lives on speargrass (*Aciphylla* spp.). The only known remaining population is at Burkes Pass Scenic Reserve, but further surveying has recently extended the range of this population into private land adjacent to the reserve. Since 2005 the Burkes Pass Scenic Reserve and other potential *H. tuberculatus* sites have been surveyed for the weevil by visual searches and pitfall traps. Searches have resulted in no new populations. For all captured weevils, mark–recapture was applied to determine population size, movement, and survivability. A tarsus was collected from all weevils found. The mitochondrial gene cytochrome c oxidase 1 (CO1) and nuclear gene internal transcribed spacer II (ITSII) regions were analysed for weevils collected in 2007 and summer 2009/10. Molecular analysis suggests the population maintains some genetic diversity and mark–recapture shows a relatively healthy and mobile population exists. DNA from pinned museum specimens of the weevil has also been collected so that historical populations can be compared with current populations to develop knowledge of the phylogenetic structure, population genetics and evolutionary

past of the species. The molecular information will be used to develop predictions for the sustainability and evolutionary pathways for *H. tuberculatus* that will help with management decisions.

New Zealand's role in maintaining Southern Hemisphere seaweed diversity

Oral presentation

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Many of New Zealand's marine taxa are endemic. Three of the five currently recognised species of southern bull-kelp (*Durvillaea*), for example, are found nowhere else in the world. As molecular research delves into the DNA of some of these marine flora, we are discovering that New Zealand's seaweeds are even more diverse than previously thought. Studying patterns of genetic variation across broad geographic scales can not only contribute to our knowledge of seaweed systematics, but also help us to understand the ecological factors that drive this variation, and the ways in which seaweed species disperse and diversify. This talk will outline phylogeographic patterns observed within southern bull-kelp (*Durvillaea*). Specifically, we demonstrate: (1) high levels of genetic diversity within the widespread species *D. antarctica*, with five highly divergent lineages observed, some of which likely represent distinct species; (2) molecular and morphological evidence that *D. antarctica* in southern New Zealand can be split into at least two largely sympatric species, which ecologists must consider when undertaking intertidal studies, and (3) that although transoceanic drifting of buoyant adult bull-kelp can facilitate colonisation events, ecological barriers such as habitat discontinuities (e.g. long sandy beaches) can inhibit gene flow among established populations. Finally, we will compare the patterns observed in *Durvillaea* with the emerging results of similar studies on a range of other southern seaweed taxa such as *Adenocystis utricularis, Bostrychia vaga* and *Herpodiscus durvillaeae*.

Nesting ecology of the eastern rosella

Oral presentation

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A number of hole-nesting bird species have been introduced to New Zealand over the last 200 years and have established wild

populations within native systems – some very successfully. The impacts that these exotic cavity-nesting birds are having on communities of native hole-nesters are largely unknown. This study focused on the nesting ecology of an introduced parakeet, the eastern rosella (*Platycercus eximius*). Rosella nest-site use and selection was investigated at the microhabitat, macrohabitat and landscape scale. Additionally, preliminary nesting niche comparisons with native hole-nesting birds were made in an attempt to understand what impact the use of cavity resources by eastern rosella may have on native species. We found the overall availability of cavities in the forest sites studied to be low. Within these sites, rosella were found to nest in areas where more potential nest sites were available, typically where the forest was more mature. The characteristics of nest sites used by rosella overlapped in a number of respects with those of native cavity-nesting birds, particularly red-crowned kākāriki (*Cyanoramphus novaezelandiae*). Consequently rosella can be considered a genuine competitor for nest sites where they occur together in sympatry with their native counterparts.

Tiritiri Matangi Island: enhancing biodiversity in a pohutukawa 'desert'

Oral presentation

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Pohutukawa (*Metrosideros excelsa)* was planted on Tiritiri Matangi during the ecological restoration phase of the island as a 'nursery crop' to give shelter to other, slower growing trees. Pohutukawa is unusual in that it is both a nursery crop and a canopy tree – a tree which grows quickly, yet provides part of the canopy in a mature coastal forest. Approximately 90 000 pohutukawa were planted, making it a major component of the revegetation programme in which a total of 280 000 trees were planted. Advice at the time of planting indicated that the 'strike rate' for the small trees would be around 30%. Instead, in some areas approximately 90% of the trees grew while the lowest survival rate was 60–70%. Now some areas of the island are covered in a pohutukawa monoculture. These areas are noted for relatively poor invertebrate and bird assemblages. Pilot work undertaken to create artificial 'light wells' has indicated that selective removal of pohutukawa initiates gap succession, replacing the monoculture with considerable plant diversity. A project to extend this pilot work within areas of very dense pohutukawa has been initiated with the aim of encouraging regeneration and biodiversity diversification within the forest. This is a long-term project that may increase significantly the overall biodiversity of the island. Data collected at regular intervals from the time of 'thinning' through regeneration and diversification will aid both the island and other conservation projects in which such monocultural environments exist.

Mimicry and deception by dung mosses (Splachnaceae)

Oral presentation

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Plants use diverse signals such as scents, colours, and shapes to influence animal behaviour. Although this is best known for flowering plants, mosses are amongst the most ancient agents of plant–animal behavioural manipulation and sensory exploitation. Mosses in the family Splachnaceae are unusual because they grow only on animal remains such as carcasses, bones, dung, and old bird nests. How can mosses locate, colonise, and spread between such patchy and ephemeral habitats? Most mosses must rely on passive spore dispersal by water, but the Splachnaceae have several unique features suggesting they exploit insect vectors for spore dispersal: brightly coloured ornaments, adhesive yellow spores, and appalling odours reminiscent of rotting carcasses or faeces. We analysed signalling and insect attraction to three Splachnaceae mosses: *Splachnum ampullaceum*, *Splachnum pensylvanicum*, and *Tetraplodon mnioides*. We analysed the scents produced by the mosses and their potential odour models, herbivore and carnivore dung, and experimentally tested insect attraction to synthetic odours associated with herbivore, omnivore and carnivore dung. Investigating such poorly known and ancient plant–insect interactions provides considerable insight into the origins and evolution of more modern relationships including pollination, frugivory, and seed dispersal, and how apparently specific symbioses can survive environmental change.

As far as the eye could see...

Plenary presentation

Kevin J. Gaston

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Variety is one of the hallmarks of life on Earth. Indeed, geographic variations in species richness and composition were some of the earliest ecological patterns to be empirically clearly documented. These have continued to attract much attention from ecologists, both from pure and applied perspectives, stimulating important advances in theory and management. There is, however, a risk that such a focus becomes disproportionate, leading to the fundamental significance of the quantity of life being overlooked or undervalued. In this talk I will outline some of the key patterns, processes and implications of the quantity of life.

Home range estimates of endangered grand skink populations in native tussock grassland and exotic pasture grasslands

Poster presentation

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The threatened grand skink *(Oligosoma grande)* is one of New Zealand's largest skink species, and has been the subject of research investigations for over two decades. Grand skinks inhabit schist rock-tors in native tussock grasslands and exotic pasture grasslands. Faster population declines have been recorded in the exotic pasture grasslands. Grand skinks have been occasionally sighted in vegetation surrounding rock-tors but no information is available on the extent of use of the vegetation surrounding rock-tors. Past home-range estimates have been derived from mark–resight and mark–recapture data that are biased towards locations of skinks on rock-tors. During this study a total of 58 grand skinks in pasture and tussock grasslands where fitted with VHF radio transmitters with locations being recorded up to three times per day. Home range sizes were compared between the two habitat types as well as between female and male skinks. Additionally, movement data were analysed to test for differences in daily movement activities between the two habitat types.

Temperature responses of root respiration, soil organic matter decomposition and rhizosphere priming in tussock grassland soils

Oral presentation

Scott Graham[1,2], Peter Millard[2,3], John Hunt[2], Graeme Rogers[2], Jason Tylianakis[1], David Whitehead[2]

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Up to 80% of ecosystem respiration is derived from soil and, as rates of soil respiration are sensitive to temperature, enhanced respiration in response to increasing global temperature could present a positive feedback to global warming. Soil respiration consists of two components, autotrophic respiration activities of roots and associated rhizosphere (R_A) and heterotrophic breakdown of soil organic matter (R_H), and these are known to have distinct temperature sensitivities. Application of these responses in models to forecast the rate of global warming is further complicated because of the large effect of plant roots on the rate of heterotrophic soil organic matter decomposition, the so-called priming effect, and the paucity of data to quantify these interactive effects. In this study we investigated the short-

term temperature responses of R_A and R_H in relation to rhizosphere priming in microcosms of *Poa cita* using a novel isotopic approach. The temperature response of soil respiration was found to be regulated primarily by R_A, which accounted for 74% of total soil respiration on average. While R_H comprised a smaller proportion of soil respiration, it did exhibit a similar sensitivity to temperature. Similar rates of R_H were found in microcosms in either the presence or absence of plant roots, indicating no substantial priming effects at any temperature. While priming was not observed in this study, we present a framework for further investigation into temperature effects on rhizosphere priming, which could be applied to other soil and vegetation types.

Relationships between the tantalus monkey and forest structure in a West African montane forest

Oral presentation

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The 7.2-km^2 submontane Ngel Nyaki Forest is the largest remaining forest of its type on the Mambilla Plateau, Taraba State, Nigeria. Lying within the highly biodiverse Cameroon Highlands Ecoregion, Ngel Nyaki is of a rare forest type containing a range of endemic and endangered plant, bird and animal species including the Nigerian chimpanzee. The forest faces encroachment by increasing cattle grazing, burning and hunting, therefore its conservation is paramount for the long-term survival of this unique flora and fauna. The tantalus monkey (*Chlorocebus tantalus tantalus*) currently remains a common frugivore at Ngel Nyaki, with a semi-terrestrial lifestyle, often entering grassland to move between forest fragments and to feed on insects. This behaviour, combined with a long gut retention time, provides the potential for tantalus to disperse forest seeds into grassland habitats. Habitat use and seed dispersal by tantalus and the subsequent germination success of seeds in the habitat to which they were dispersed indicate tantalus do play a role in maintaining forest structure, and with suitable conservation actions this role could be used to aid conservation efforts at Ngel Nyaki, and elsewhere.

Integrating traditional ecological knowledge in freshwater management: from theory to practice

Poster presentation

Monica Gratani[1], Frank Royee[2], James Butler[3], Damien Burrows[4], Peter Valentine[5]

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There is an increasing need for the documentation of values that indigenous Australians place on fresh water in order to include them in freshwater management. However, a very few projects have been conducted so far in Australia to document indigenous values for freshwater environments and related knowledge and none of them has resulted in a practical tool to enhance participation of indigenous Australians in freshwater management. The present project contributes to fill this gap. The project is aimed to document indigenous values for freshwater environments, develop community-based indicators to monitor the status of those values and to combine indicators in a 'cultural index of river health' that can be easily integrated in modern freshwater management. The implementation of such an index would ensure not only the inclusion of indigenous values and knowledge but also the empowerment of indigenous communities in freshwater management. This approach provides ecological benefits for the environment and social and economic benefits for indigenous communities involved. The present project tests this approach by conducting a case study with the Malanbarra Yidinji community, who are traditional owners of the Goldsborough Valley, in the Wet Tropics World Heritage Area. The project uses a collaborative research approach, to ensure a high level of community participation. By providing a practical tool for the inclusion of indigenous values, knowledge and people in current freshwater management the case study suggests an innovative path to integrate indigenous and scientific knowledge in modern natural resource management.

Is validation of Indigenous Ecological Knowledge a disrespectful process? A case study of traditional fishing poisons and invasive fish management in the Wet Tropics, Australia

Oral presentation

Monica Gratani[1], Frank Royee[2], James Butler[3], Damien Burrows[4], Peter Valentine[5]

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Despite the growing recognition of the contribution that indigenous ecological knowledge (IEK) can make to modern 'Western' science-based natural resource and environmental

management (NREM), integration of the two knowledge systems has not reached its full potential in Australia. Many authors advocate a more systematic integration of Indigenous people and their knowledge in NREM to achieve both environmental and social outcomes. However, there are few examples of frameworks to achieve this, and none clarify what validation is, whether it should occur and how it can be respectful of indigenous cultures. In this paper we assess the opportunities and limitations of validation processes using a case study of traditional fishing poisons and invasive fish management in the Wet Tropics of Australia. The study was conducted with a co-research approach between the Aboriginal holders of the IEK and science-based biologists. We jointly carried out scientific laboratory trials of the efficacy of fish poisons on invasive tilapia and native fish species with the direct input of the holders of the IEK. Retrospective interviews with indigenous participants showed that the IEK holders did not find the experience of validation disrespectful, but rather empowering and necessary for their IEK to be understood and appreciated by holders of scientific knowledge (SK) and included in modern NREM. Based on our experiences we present a framework for the potential future design of collaborative validation processes to improve (1) the integration of IEK into mainstream NREM and (2) the acceptance of SK within indigenous communities in Australia.

Carbon cycling in floodplain ecosystems: out-gassing and photosynthesis transmit $\delta^{13}C$ signal through stream food-web

Oral presentation (Student Day)

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Natural braided river floodplains typically possess high groundwater – surface water exchange. This exchange is vital to the overall function and structure of these complex ecosystems. Spring-fed streams on the floodplain are hot spots of benthic invertebrate diversity and productivity. In this paper $\delta^{13}C$ values of both dissolved inorganic carbon (DIC) and food-web components of five springs are used to assess the sources of carbon to spring food-webs. Partial pressures of CO_2 in upwelling water ranged from 2 to 7 times atmospheric pressure, but rapidly approached equilibrium with the atmosphere downstream commensurate with ^{13}C enrichment of DIC. Speciation modelling and a laboratory out-gassing experiment suggested that downstream changes in pH could be explained solely by CO_2 out-gassing. However, survey results indicated both out-gassing and photosynthetic drawdown by aquatic plants controlled the net stream flux of CO_2. A whole-stream manipulation indicated out-gassing to be the primary effect at the spring source, which was confirmed by invariant diel pH. At 1296 m downstream from the spring source a large diel shift in pH indicated a plant effect on CO_2, which might contribute to the overall downstream gradient in $\delta^{13}C$ of DIC. Within the first 1296 m the gradient in δ^{13} DIC was transmitted through three

trophic levels of the spring food-web. These findings indicate strong dependency on groundwater carbon by spring stream food-webs and strong hydrologically mediated linkages connecting terrestrial, subsurface and aquatic components of the floodplain.

Are tree weta (*Hemideina crassidens*) herbivores?

Oral presentation

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Although tree weta (*Hemideina* spp.) are a distinctive orthopteran group in New Zealand, information of their general ecology is lacking, especially with regard to their diet. Members of the family Anostostomatidae are largely carnivorous or scavengers, for example ground weta (*Hemiandrus* spp.) and tusked weta (*Anisoura, Motuweta* spp.). In contrast, tree weta are generally thought to be herbivorous, consuming a diet largely made up of leaves. We used a straightforward choice experiment in captivity to investigate whether, if given the choice, the Wellington tree weta (*H. crassidens*) would eat leaves more often than other potential foods (moths, fruit or seeds), as expected of an obligate herbivore. When it was found that tree weta would indeed consume a variety of food types including dead insects, the question was asked what effect the presence of protein in their diet has on weta growth and reproduction. Female tree weta have been reared in captivity from juveniles to adult, to contrast growth with and without protein. Weekly measurements were made to track their growth, and once adult, the weta were mated and provided with substrate to lay eggs. It is predicted that the protein-fed weta will result in larger animals with greater fitness (i.e. lay more eggs).

Monitoring extent of Canterbury freshwater wetlands by remote sensing, 1990–2008

Oral presentation

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In 2003 Environment Canterbury provided the Department of Conservation with data for the Waterbodies of National Importance (WONI) freshwater wetland project. A final report and GIS layers were produced by Landcare Research under contract to the Department in August 2008. The WONI current wetland database identified 2004 distinct freshwater palustrine wetlands within Canterbury Region, ranging in size from 0.5 ha

to over 1500 ha. Trends in extent of the region's remaining freshwater wetlands over the period 1990–2008 were examined using a combination of satellite imagery and aerial photographs. Most of these showed no detectable change over the monitoring period. However, 102 wetland sites showed a significant (>25%) reduction in area extent; 42 showed some (<25%) reduction in extent, and one wetland increased in area. Wetland loss across the region has slowed compared with the massive reduction of the late 19th to early 20th century, but continues. While most past wetland loss was from the low plains, more recent wetland reduction has been concentrated in the foothills, inter-montane basins and valley floors of the high country. The Lees Valley, Ashburton–Heron Basin, Upper Rangitata Valley and Mackenzie Basin all showed the largest examples of wetland reduction over the 1990–2008 monitoring period, associated with general land-use intensification occurring in these parts of the region.

Biotic and abiotic resistance to Argentine ant invasion

Oral presentation

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Ecological studies overseas show that Argentine ants significantly alter invertebrate communities, including displacement of many native ant species. Based on temperature requirements for development, degree-day models predict Argentine ants to be able to spread throughout much of lowland New Zealand including parts of the South Island. However, in a laboratory study we found that activities of Argentine ants depend on the relative abundance and behaviour of native ant species, as well as temperature. At 20°C Argentine ants successfully displace the native *Monomorium antarcticum* if they are at higher abundance than *M. antarcticum* or if both species are at equally low density. At the same temperature Argentine ants succeed in fights against the native *Prolasius advenus* only if they are kept at a higher abundance than *P. advenus*. However, at lower temperatures, even if they are at higher density, Argentine ants are unable to displace the native species, *M. antarcticum* and *P. advenus*. All three species significantly reduced their foraging abundance and walking speed at lower temperatures, but Argentine ants seemed to be most affected by these changes, and their attacking behaviour dramatically reduced. This implies that although there are a number of places with temperatures suitable for development (i.e. nest temperatures above 16–20°C), biotic resistance at cool temperatures (12–20°C) could play a role in preventing or delaying Argentine ants from establishing in every place they arrive.

Ecosystem services provided by spiders in viticulture

Poster presentation

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Biological control of pests is estimated to be worth US$400 billion per year and this is threatened by the use of pesticides. Pressure on this ecosystem service will increase as the world's food demand intensifies over the coming decades. Vineyards have low biodiversity compared with other environments. Use of conservation biological control (CBC) methods generalist predators, such as spiders, may deliver a 'broad spectrum' biological control service in vineyards. CBC is the enhancement of the number and/or fitness of biocontrol species present in the environment, reducing the use of chemical sprays. This promotes biodiversity while benefiting viticulture. Spiders can account for a quarter of the eggs of moth pests in cotton crops, higher than in other crops. Cotton crops provide a source of extra-floral nectar that improves development and reproduction of some spider species. Surveys will be conducted in New Zealand vineyards with different management techniques to identify the range of spider species present. The contribution of spiders to the observed predation rate will also be measured throughout the vineyards using prey baits and video analysis. Stomach dissections will detect which species utilise extra-floral nectar. Of the suitable species, molecular analysis of spider gut contents will identify which spider species predate upon different pests. Combining these findings will highlight spider species that may be suitable as biocontrol agents for viticulture.

Gradients of habitat modification in mid-altitude indigenous tussock grasslands – impacts on invertebrates and the endangered grand skink, *Oligosoma grande*

Poster presentation; oral presentation on Student Day

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Grasslands are one of the most geographically extensive, diverse and productive biomes on Earth, yet despite their importance, temperate grasslands have been neglected and are considered 'beleaguered'. Reflecting the global trend, the conservation priority of New Zealand's tussock grasslands has historically been very low. Due to the direct and indirect effects of human activities, such as grazing, fire and conversion to pasture, New Zealand's indigenous grasslands have been severely modified. This doctoral project takes a holistic approach at examining New Zealand tussock grassland ecosystems, initially investigating how vegetation structure can be used to quantify gradients of modification. Gradients of change are often used in ecology, yet rarely defined. This

research therefore aims to quantify an important theoretical question about the nature of gradients and how they can be used in ecology. The effects of this gradient of modification will be evaluated within a range of faunal groups, in the Macraes Flat and Old Man ecological districts. Abundance and population structure of the critically endangered grand skink, *Oligosoma grande,* is assessed throughout the project using photo-resight techniques. Vegetation structure is quantified using a modified height-frequency method. Diversity and abundance of invertebrates will be assessed throughout the project, after pilot studies to assess appropriate trap design. Results from the first season's vegetation sampling and grand skink photo-resight will be discussed, as well as an outline of the study objectives, including the development of a rapid assessment method of quantifying gradients of habitat modification.

Observed and predicted shifts at the New Zealand *Nothofagus* treeline using growth, recruitment and mortality rates measured over 15 years

Oral presentation

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Significant changes in survival and distribution of alpine vegetation are expected in New Zealand, based on global patterns of treeline advance. Thus far, research on *Nothofagus* treeline advance has been equivocal. In this study, we attempt the first detailed demographic assessment of abrupt treelines by evaluating changes in growth, mortality and recruitment at five *Nothofagus* spp. treeline sites in southern New Zealand. All *Nothofagus* stems at or above treeline at these sites were mapped and measured (height) on three occasions over 15 years, allowing us to estimate rates of seedling growth, recruitment and mortality in order to project stem number into the future. Stem number increased above treeline over the 15-year study duration but stem distribution above treeline did not change; 90% of all stems and of new recruits occurred within 10 m of the treeline edge. Modelled growth, mortality and recruitment rates varied by time period, transect and stem size. Projected numbers of stems above treeline after 100 years suggests that the number of tree-size stems will increase but the rate of change will vary considerably. Our data demonstrate that the abrupt New Zealand *Nothofagus* treeline has begun advancing but at rates far below expectations based on climate warming. The relative inertia of the treeline to climatic change results from recruitment limitation. Based on model results, we do not expect *Nothofagus* treeline expansion to significantly affect tussock grassland survival. Results are consistent with models and experiments at abrupt treelines globally.

Creation of a national deer faecal pellet count database and its use to estimate long-term changes in deer abundance in New Zealand

Oral presentation

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Introduced deer have been extant in New Zealand for many decades and there is interest in the dynamics of populations for interpreting impacts and for evaluating harvesting options. Faecal pellet counts, an index of abundance, have been conducted on New Zealand's public conservation land since the 1950s. We first describe the development of a database to enable archiving of faecal pellet count data. The National Ungulate Pellet Survey (NUPS) database is managed by the Department of Conservation (DOC) and aims to safeguard New Zealand's faecal pellet data and to facilitate the use of these data. We then investigate temporal changes in deer pellet frequencies at the national, island and DOC Conservancy spatial scales using data from NUPS. A quadratic model with different trends for each conservancy best explained the NUPS pellet frequency data during 1952–2010: pellet frequencies were highest during the 1950s–1970s and then declined to minimums in the 1980s and 1990s and then increased in the 2000s. However, the temporal intensity of measurements was highly variable among conservancies, with several not apparently collecting data in the 1990s and 2000s. The limitations of these data, and hence our analyses, are discussed.

Spatial patterns in the distribution of grassland plants: from metres to hundreds of kilometres

Oral presentation

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Species display many different distribution patterns, and there have been several attempts to characterise the traits that move species along an axis from rarity towards commonness or back again. Here we examine a complementary question related to species' distribution patterns: for a given number of individuals why are some species very aggregated in space and others widely scattered? We begin by characterising the aggregation

(or scattering) of ~70 grassland species, recorded in 28 0.6-ha plots located across Molesworth Station, New Zealand. The degree of aggregation is measured at fine and medium scales (from 1 to 50 m). We also examine the national distribution patterns of Hebes (*Veronica* spp.) at scales from 2 to 100 km. Finally, we ask which ecological traits, if any, are good predictors of aggregation at each of these three scales.

The isotopic ecology of moa (Aves: Dinornithiformes) in late Holocene North Canterbury, based on aDNA-identified individuals

Oral presentation

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Despite an abundance of fossils, study of New Zealand's megafauna has been handicapped by an overly speciose taxonomy resulting from previously unrecognised sexual dimorphism. Application of aDNA techniques to fossil bones has led to a recently published molecular taxonomy comprising nine species in three families. Here, we apply this taxonomy to an analysis of the isotopic ecology of 176 molecularly identified and sexed individuals from four sympatric moa species in North Canterbury. Isotopic enrichment ($^{13}C/^{12}C$; $^{15}N/^{14}N$) of tibiotarsus bone collagen showed clear isotopic separation at family level, implying that the molecular taxonomy also has an ecological basis. Within the Emeidae, some overlap occurred between adjacent species in isotopic space, with an unexpected inverse relationship between $^{13}C/^{12}C$ and body size as measured by tibiotarsus length. Juvenile *Euryapteryx curtus* occupied the same isotopic space as adult emeids, being closest to adult female *Pachyornis elephantopus*. These results can be interpreted within a context of an open forest environment with dispersed glades. The results of the study emphasise the significant advances possible in ecological understanding that can be achieved with the application of molecular techniques.

Relationship between $^{13}C/^{12}C$ and C:N ratio of terrestrial invertebrates at the marine–terrestrial interface

Poster presentation

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Stable isotopes are widely used in food web and animal migration studies, but potential confounders are plentiful. One such is the organism's lipid content, the $^{13}C/^{12}C$ of lipid typically

being more depleted than tissue such as muscle. Consequently, differences in whole-animal $^{13}C/^{12}C$ may reflect nutritional status rather than dietary differences. However, the literature on this topic is dominated by vertebrates and freshwater invertebrates. This poster reports whole-animal $^{13}C/^{12}C$ and C:N data gathered in the course of several studies in coastal locations or in seabird breeding areas. Results showed all possible responses. Pseudoscorpions (*Apatochernes* sp.) from blue penguin burrows showed the expected decrease in $^{13}C/^{12}C$ with increasing C:N, presumably reflecting changes in lipid content. In contrast, coastal earwigs (*Anisolabis littorea*) from a seabird island showed an increase in $^{13}C/^{12}C$ with increasing C:N. Despite a wide range of C:N, kelp flies (*Coelopa* sp.) and forest litter amphipods (unid. Talitridae) showed no effect on $^{13}C/^{12}C$. Despite the absence of a relationship between $^{13}C/^{12}C$ and C:N ratio, forest litter amphipods displayed a significant difference in C:N between a Westland petrel colony and a control site without petrel inputs. We conclude that whole-animal C:N ratio can provide important information about invertebrate ecology, but that researchers need to take care when selecting tissue type for isotopic analysis.

Evaluating correlations among bird population trends in a forest where introduced mammalian predators are controlled

Oral presentation

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The indicator species approach is widely used in ecology as a shortcut to measuring attributes of species and ecosystems. Although a variety of indicator species concepts are in use, few attempts have been made to evaluate indicators of population trends. Many conservation decisions rely on the assumption that multiple populations will respond similarly to management. We investigated correlations among bird population trends in a mixed podocarp–hardwood forest (Kakahū Bush) in New Zealand in which introduced mammalian pests are controlled. Our dataset included 18 bird species commonly detected in 5-min bird counts over a 9-year period. We used a Bayesian modelling approach to examine correlations in population trends (based on mean annual counts) between species and investigated whether life history traits can be used to predict correlated trends between species, using generalised linear modelling. Population increases were detected in seven of the 18 bird species over the 9-year period of the study. Population trends were significantly correlated for 18% of species pairs (of which 68% were positive correlations). Correlations among nine species were always positive; these species form a potential indicator pool. Traits were not useful for predicting correlated population trends, but the species considered in this study exhibit little variation in traits. We demonstrate that species affected by a shared ecological driver can exhibit similar population trends and provide support for evidence-based use

of the population indicator species concept as a cost-effective alternative to monitoring whole communities.

The public policy framework where social and biological sciences meet: biodiversity conservation in Dunedin City beyond 2010

Oral presentation

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As the largest city by land area within New Zealand, Dunedin City has a diverse range of ecosystems extending from alpine to harbour, coast and islands. This diversity creates an environment that contributes towards the identity, character and quality of life for residents in Dunedin City. The Dunedin City Council has legal responsibilities to promote the economic, environmental, social and cultural well-being of the residents of Dunedin. The Resource Management Act 1991 requires sustainable management of natural and physical resources, including areas of significant indigenous biodiversity and ecosystems. The strategies, plans and policies of Council outline the vision, goals and objectives to achieve such responsibilities, managing resources, providing services and infrastructure to meet the needs of the community. A number of strategies, plans and policies will be reviewed in the next few years, including the Biodiversity Strategy 2007 and the Dunedin City District Plan. While broad-level visioning and strategic objectives to achieve biodiversity conservation may be undertaken with minimal science, it is necessary that detailed policy and its implementation is informed by science. The review process provides the opportunity to consider alternative approaches and strengthen the policy framework. The challenge is to develop a policy framework, informed by science, that facilitates biodiversity conservation actions that are integral to landowners' management of their property while achieving a city-wide vision for biodiversity.

When possums attack: predicting location-specific tree mortality using browse damage indices

Oral presentation

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Brushtail possums (*Trichosurus vulpecula*) have been implicated in the dieback and mortality of several native tree species in New Zealand forests. The impacts of browse damage operate over multiple spatial scales, from the biting and chewing of leaves, to the decline in health and subsequent

death of individual trees, and the loss of entire species from regions. Browse damage and tree mortality are both highly variable in time and space, and because individual trees may be targeted for browse, lowering herbivore density cannot guarantee lower mortality rates for preferred trees. Predicting the benefits of pest control in new locations therefore requires a model of how foliage consumption from individual trees drives mortality rates at the larger spatial scale at which foraging decisions are made. We present a predictive model for tree mortality due to possum browse in mixed forest. This is based on a generic model of foliage growth, turnover and herbivore consumption for individual trees, and accounts for among-canopy browsing behaviour resulting from foraging choices and food availability at the site scale. Foliar browse data from 19 sites across the North Island were used to derive a relationship between browse damage and leaf growth rates, and to parameterise the model for kāmahi (*Weinmannia racemosa*). The model qualitatively and quantitatively replicates the observed mortality patterns of kāmahi trees at two independent sites, and indicates by how much foliage-consumption must be reduced at each site in order to protect kāmahi from possum-browse-induced mortality.

Cross-cultural partnerships in research: indigenous contributions to analysis and theory building?

Oral presentation

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Te Hau Mihi Ata is a research project that aims to envision a new future by facilitating and describing processes of knowledge exchange and innovation that occur at the nexus of differing cultural paradigms. The project builds on previous research, which discussed Māori perceptions of new technologies and interactions between Māori and scientists, to understand how Māori knowledge systems might adapt and evolve to incorporate new science-based information, to explore whether mātauranga-inspired understandings might encourage new avenues of scientific exploration, and to develop tools and processes that facilitate innovation. The genesis of the project arose from both community concerns at the framing of mātauranga Māori (Indigenous knowledge) as only relevant in a traditional context, and a new philosophical positioning of mātauranga Māori within the national science policy environment that encouraged researchers to 'unlock' the innovation potential of Māori knowledge, people and resources. These divergent motivations were responses to the increasing interaction and involvement of Māori in the research, science and technology sector and debate about the merit of mātauranga Māori within the emergent knowledge economy. This presentation explores the relative understandings of Western science and Indigenous knowledge in terms of

analysis and theory-building, and discusses ways in which experts in science and mātauranga Māori might better engage to support innovation and produce mutually beneficial outcomes.

Does native revegetation lead to the restoration of plant–herbivore interaction networks?

Oral presentation

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In regions that have been subject to severe habitat degradation, restoration intervention is often the only option available to mitigate or reverse biodiversity loss. Although restoration is often founded on a broad conceptual goal of improving native biodiversity, the majority of studies focus solely on revegetation and restoration of plant species composition. Reinstating overall community composition and structure is critical for the stability and functioning of ecosystems upon which we depend, but these aspects are rarely studied. By quantifying the interactions between plant species and their associated invertebrate herbivores, I aimed to determine whether native revegetation leads to the restoration of plant–herbivore interaction networks and ecosystem function. I collected herbivores from vegetation at seven restoration sites in mid-Canterbury, New Zealand, comprising a chronosequence of time since native revegetation, as well as from two ancient podocarp remnants that acted as reference sites of what interaction-network structure might be expected to converge to in an intact natural system. The fraction of potential interactions realised in the network decreased with increasing time since revegetation, and was attributable to an increase in total species diversity, whereas the presence of exotic species did not alter the complexity of the networks. This has positive implications for restoration management techniques, as restoration practitioners may be able to actively promote the rapid return of plant–herbivore interaction-network structure by simply planting a more diverse assemblage of species.

Fences or traps: spatial scale and cost–benefit analysis informs protection choices for critically endangered skinks

Presentation: Oral presentation

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Grand skinks (*Oligosoma grande*) and Otago skinks (*O. otagense*) are two of New Zealand's largest and most endangered lizards. Endemic to and once widespread across Otago they are now relict to a few populations covering less than 10% of their former range. With both species facing imminent extinction without intervention, the Department of Conservation (DOC) took aggressive action to determine effective strategies. Three years of experimental management and response monitoring showed that both exclusion of mammalian predators using mammal-proof fences and intensive trapping were effective in enabling substantial population increase. Trapping is flexible and has a relatively low initial cost but requires a buffer in the order of 1 km to create conditions in which the skinks recover, whereas fencing requires substantial initial investment and protects all of the enclosed habitat. Analysis of the benefits (area of grand and Otago skink habitat effectively protected) and costs of the two techniques led DOC to expand its trapping operation at Macraes Flat to cover more than twice the initial area. The Central Otago Ecological Trust, seeking to protect a small area of Otago skink habitat in their historical range near Alexandra for a trial reintroduction, found exclusion fencing a more cost effective solution. Using economic models of borrowings by commercial and government agencies, the most cost effective management tool was highly dependent on spatial scale. For lizard species in the Otago schist country, fencing was only marginally more cost effective than trapping for areas less than about 20 ha. For larger areas, trapping rapidly exceeded fencing in cost-effectiveness.

Effective participation as key to establishment of protected areas: lessons from the Togean Islands National Park, Sulawesi, Indonesia

Oral presentation

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This study considers the establishment of parks and protected areas in relation to governance issues. Taking the example of the Togean National Park (Gulf of Tomini, Central Sulawesi, Indonesia), this paper shows how complicated and time-consuming the process of park establishment can be when considering the existence of highly varied interest groups. Involving multiple stakeholder groups can alleviate the risk of failure that yields a 'paper park'. Thus, for park management to be sustainable, in particular there have to be democratic processes established beginning with the planning stages.

Kokako translocations – a review

Oral presentation

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In total, 151 kōkako have been translocated to 16 sites in 65 translocations since 1981. Of these 16 sites, a new breeding population established at nine, and it is too soon to assess whether birds have bred at a further three sites. Six of the translocations were to offshore or lacustrine islands, from where birds could not escape the managed area to which they had been translocated. I review the post-release movement behaviour of all translocated kōkako, except in relation to acoustic anchoring, which is covered by another speaker. The small number of kōkako translocated at a time (mean 2.3) is due mostly to the difficulty of catching birds, and has prevented strong experiments about translocation methods. Evidence from transmittered and banded birds is that colonising individuals initially roam widely and then settle in territories, while later-arriving individuals also roam widely but settle near conspecifics – behaviour akin to natal dispersal. Some kōkako have remained within managed areas to which they have been translocated in most cases where reasonable numbers (10–20 birds) are moved, although large (>1000 ha) managed areas are more likely to better retain such birds.

New Zealand sanctuaries 2010: what, and where, are they?

Oral presentation

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Biodiversity sanctuaries, defined as sites that are experimentally restoring ecosystems to indigenous dominance and full species complement, are new, inspiring and innovative initiatives that have galvanised communities around New Zealand to local conservation. These projects aim to control or eradicate a broad range of pests; reintroduce missing species; manage a permanent and substantial risk of reinvasion by pests; and most involve collaboration between local communities, Department of Conservation, dedicated trusts and a range of other entities. We have identified a network of 48 such sites (>25 ha) on the New Zealand mainland, totalling 37 805 ha. Of this area, 26% is protected by pest-proof fences, 57% has sustained pest control with no fence, and 17% is near-shore islands, either marine or lacustrine. The total sanctuary area is only 0.15% of the New Zealand mainland. In contrast, nine million hectares is under sustained possum management by the Animal Health Board against tuberculosis, and large-

scale or intensive pest control is also undertaken for threatened species such as kōkako, kiwi, kakī, pateke and grand and Otago skinks. However, the key future requirements for ecosystem restoration in New Zealand are large-scale, multi-species pest control tools and initiatives. We describe some Department of Conservation pest control projects attempting this.

Modelling garden waste dumping

Poster presentation

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It is commonly suspected that dumping garden waste at road ends and carparks contributes to the spread of weeds. However, there is very little evidence, other than anecdotal, to back this up. Data collection is a tricky problem with so much area to watch, so we have turned to mathematical modelling to try and provide some answers. By developing a very simple mathematical model of weed spread we aim to confirm when garden dumping might contribute to the spread of weeds. This information will be used to focus and prioritise management efforts, and perhaps weed awareness campaigns, where they will be most effective.

Age-bias settlement of South island saddleback in a mainland reintroduction

Oral presentation

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During reintroductions, individuals can suffer high mortality immediately after release due to stress or injury. Reintroductions can also suffer from high rates of dispersal from the release site. This is particularly problematic for avian mainland reintroductions where the species is often dependent on local predator control. Few reintroduction studies have investigated the effects of age or pre-translocation territorial status on establishment patterns because such information is often unknown. We sourced banded South Island saddlebacks of known age, sex and breeding status from Ulva Island and estimated post-release survival inside a mainland fenced reserve (Orokonui Ecosanctuary) using mark–resight analysis. Results suggested three stages of mortality/dispersal: early loss of individuals within first 3 weeks of release, followed by a more gradual loss of individuals over the next 7 weeks, and then no losses until the start of the breeding period (21 weeks post-release), when five single individuals disappeared over a short

period of time. Overall, 31% (*n* = 38) survived to the beginning of the breeding period, but a disproportion was of the fledgling one-year-old age class (at release). We conclude that a gradual period of post-release dispersal was the main reason why the final population (nine birds) was so low, and that territorial adult birds were more likely to disperse than juveniles. We recommend that follow-up translocations either selectively harvest younger birds or transfer eggs and augment resident clutches to increase recruitment rate inside mainland sanctuaries.

Spatial relationships between bird-generated seed rain and tree composition in a mixed conifer–angiosperm forest in New Zealand

Oral presentation

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The spatial pattern of seed dispersal by animals constitutes a key determinant of regeneration patterns in New Zealand forests, where many tree species produce fleshy fruits. Movement of seeds away from parent trees may enhance seedling survival and promote coexistence and diversity. However, in forests with high dominance of one species, seed movement may be directed towards the trees of that species and concentrated below their canopy. We tested the hypothesis that avian dispersers generate significant dissociations between adult trees and seedfall in a mixed conifer–angiosperm forest in south-western New Zealand. We mapped adult trees of 13 species (bird and wind dispersed), and avian-dispersed seedfall at Okarito Forest, where rimu (*Dacrydium cupressinum*) accounts for >65% of basal area. Rimu dominated the seed rain, accounting for 91% of the dispersed seeds. Using SADIE indexes we tested the level of spatial aggregation (*I*a) of the seed rain and the level of spatial association (χ) between seed rain and adult tree basal area. Although *D. cupressinum* seeds were collected in all the seed traps, there was no significant association between them and the abundance of *D. cupressinum* trees, but there was with the basal areas of angiosperms in the plot. These results indicate that the birds are intensively consuming *D. cupresinum* fruits; however, they preferentially use angiosperm trees as perching/rest sites, increasing the relative number of seeds dropped under their canopy. Hence, the spatial pattern of seedling density will be partly determined by the responses of frugivores to spatial position of angiosperm trees in the forest.

New Zealand's freshwater crisis: the triumph of economists over ecologists

Plenary presentation

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A decade into the 21st century and the omnipresent downward trend in New Zealand's biodiversity since human colonisation is gathering momentum. Despite two decades of the aspirational and much lauded Resource Management Act 1991 (RMA) most measures of the state of the environment are showing degradation and this deterioration is mirrored by an escalation in the number of species on the threatened species list. In this the United Nations International Year of Biodiversity New Zealand now has the shocking record of 2788 species listed as threatened. Freshwater ecosystems exemplify biodiversity declines with rates of extinction estimated to be five times higher than terrestrial systems. This accelerated rate of loss in fresh waters is not surprising given that fresh waters integrate all the impacts occurring on land. New Zealand's freshwater species typify this increased rate of decline over that of terrestrial systems with now more than half of native fish species, our freshwater crayfish and freshwater mussel on the threatened list. Given the 5-fold higher rate of extinction globally in fresh waters then these declines are surely portents of terrestrial declines yet to come. The dominance of economic rather than ecological goals for central and local government has meant that the role of environmental protection has fallen much more onto non-government organisations (NGOs) and individuals. The realisation soon comes to anyone participating in biodiversity protection in New Zealand that the organisations and individuals exploiting the environment are almost always much better resourced than the protectors. This economic imbalance has meant that the RMA legislation and its processes have been effectively undermined. The economic advantage is always with the exploiter thus there is a never-ending queue of 'developers' lining up to take advantage of limited resources leading to degradation that can best be described as 'death by a thousand cuts'.

Strategic relationships between Indigenous communities and Western ecologists: the Saugeen Ojibway Nation experience

Plenary presentation

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Prior to colonial contact, Indigenous customary laws established homelands, governance, and protective

relationships to the lands and waters that sustained the Indigenous communities. In post-colonial Canada as in New Zealand, the Crown has a fiduciary responsibility to engage in meaningful consultation with Indigenous communities whenever there are environmental or resource management issues that could affect the communities in their traditional territories. The Crown has a fundamental need to ensure that the Indigenous communities have sufficient access to technical expertise with which to consider these management issues and to evaluate the proponents' burden of scientific proof. The Saugeen Ojibway Nation (SON) (Chippewas of Nawash First Nation and Saugeen First Nation) has a long history of proactive and innovative engagement with Western scientists to improve communication between the knowledge systems, and to provide the Indigenous communities with the best available analyses with which to develop defensible opinions. SON's strategic and tactical experience in these cross-cultural engagements is demonstrated with three case studies: (1) negotiation of formal SON-Crown protocols regarding consultation/accommodation/reconciliation, especially the role of scientific evaluations; (2) creation of a powerful SON–Bruce Nuclear Power Development partnership to address longstanding environmental and ecological concerns based on sponsored graduate research programmes; and (3) establishment of SON-sponsored faculty positions (biology, environmental assessment, mathematics/statistics) at the University of Guelph to address key uncertainties regarding management of SON's Constitutionally protected commercial fisheries. There is little doubt that Indigenous communities will be taking a much greater role in future management decisions in their traditional territories. From SON's perspective, ecologists must rethink their approach to working with Indigenous people and their knowledge systems.

Mistletoe macroecology: species richness and host ranges of Australian Loranthaceae

Oral presentation

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Contemporary investigations of broad-scale patterns in biology have proved invaluable, as they shed light on a range of questions in evolutionary ecology. One group of organisms that has yet to benefit from macroecological analyses is the mistletoes. Mistletoes are a paraphyletic group of parasitic plants subject to a variety of unusual processes that affect their spatial patterns of species richness and their host range (list of known host species). We tested for macroecological correlates of species diversity and host ranges in 65 species of Australian mistletoes in the family Loranthaceae. Results indicate that productivity is a poor predictor of mistletoe diversity and that mistletoe host ranges increase with the diversity of potential hosts. We conclude that mistletoe diversity varies across macoecological scales differently to that of non-parasitic plants. We also provide preliminary support for the long-standing but

untested hypothesis that mistletoe species inhabiting regions with high host diversity evolve to exploit many host species, while species inhabiting regions with low host diversity evolve to become host specialists.

Biodiversity and ecosystem function in populations of *Pinus radiata*

Oral presentation

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There is a growing recognition of the importance of space and trophic interaction in understanding such fundamental ecological issues as the role of biodiversity in ecosystem stability and productivity. However, there is considerable apprehension about scaling the insights from synthetic autotrophic communities and models, to predictions for natural, multi-trophic ecosystems. This concern may be overcome through comparisons of the ecological relationships between species diversity and productivity in natural, common, ecosystems. Bioassays of naïve, polyphagous invertebrate defoliators showed that the allocation of resources to defence against defoliators in *Pinus radiata* from spatially distinct populations was inversely proportional to the geographic range of the host plant and to the biodiversity of the host plant's associated insect community. Leaf nitrogen parsimony may be the primary defence strategy. As leaf nitrogen is the primary determinant of forest productivity, the results suggest that ecosystem function is not derived from biodiversity per se, but from the evolutionary resolution of the relative strengths of top-down and bottom-up processes dictated by the trophic complexity of a community.

Don't try this at home: mast seeding, site productivity, and common mistakes

Oral presentation

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There has been increasing recent interest in the relationship between site productivity and mast seeding, because it affects both theoretical questions (such as what evolutionary factors favour masting) and practical ones (such as when and where pest control will be required). However, the topic of resource effects on masting is full of pitfalls, and the literature is full of papers that have fallen into one or more of them. Here I review some of the more common mistakes to avoid, and summarise what we can learn from the good studies. The worst mistakes

include: (1) confusing mast seeding with demographic turnover; (2) seeking the perpetually elusive ‘mast year’; (3) using inappropriate spatial scales; and (4) seeing cycles where there are none. We know with some confidence that different economies of scale have different implications for masting under elevated resource conditions, and that lower productivity generally increases seedfall variability. Less clear is exactly how the masting time series is expected to change with elevated resources, how internal plant resource dynamics constrain seed crops, and what are the physiological mechanisms that determine plant responses. I will illustrate these points with recent published and unpublished examples, from grasslands and woody systems.

The speed of slug formation: limacisation of *Schizoglossa* (Mollusca: Pulmonata: Rhytididae)

Oral presentation

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Phenotypic innovation is at the heart of many biological questions, but the rate at which major phenotypic change occurs is not well understood. Many differences among closely related taxa seem to be more ‘variations on a theme’ than significant evolutionary novelties. Nevertheless, major phenotypic changes are evident in a number of groups. Possibly one of the better examples (because it has happened repeatedly in the course of gastropod evolution) is the evolution of the slug body form from shelled gastropod ancestors, so-called ‘limacisation’. Apart from the obvious morphological change involved in the loss or reduction of the shell, major changes in basic anatomy, physiology and behaviour also occur. Moreover, a number of taxa, ‘semi-slugs’, have not completely lost their shell and offer insights into the processes required during limacisation, which are sometimes obscured in fully shell-less slugs by the wholesale nature of the changes. Members of the rhytidid genus *Schizoglossa*, known as paua slugs, are carnivorous semi-slugs from the northern North Island. Apart from the paua slugs all members of the subfamily Paryphantinae are snails, suggesting that limacisation occurred after the schizoglossan ancestors split from the rest of the paryphantines, but before speciation within the genus. We use nuclear and mitochondrial DNA sequences for multiple samples of all the extant species of *Schizoglossa*, together with relaxed molecular clock methods for dating evolutionary events in a phylogenetic context, in an effort to more precisely estimate the time involved in these first steps towards slugdom.

Role of olfactory and visual cues in host finding by pine bark beetles and wood borers

Poster presentation

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The pine bark beetles *Hylastes ater* and *Hylurgus ligniperda* and the longhorn beetle *Arhopalus ferus* are European pests of pines that were accidentally introduced into New Zealand. These insects are abundant within plantation forests, making them good experimental systems for testing insect host location. We conducted a large-scale trapping trial near Nelson to examine to what extent such beetles use olfactory cues (e.g. monoterpenes emitted by conifers) and visual cues (e.g. the colour and silhouette of trees) to find host material. Our ultimate aim was to provide new information on attractant and repellent stimuli to improve the understanding of host selection in insects, refine monitoring methods, and to devise new tools for the management of wood borers and bark beetles. There were significant effects of both visual and olfactory cues for all three species. The highest catches were in black (host mimicking), panel flight-intercept traps containing attractant (α-pinene and ethanol) and the lowest in clear or white (non-host mimicking) traps without attractants. The repellent (green leaf volatiles) when present on traps with attractant, significantly reduced catches of *Hylastes ater* and *Hylurgus ligniperda*, but had no significant effect on *A. ferus*. Non-host volatiles occurring in natural landscapes could have the potential to act as repellents, lowering pest outbreaks in more diverse vegetation compared with monocultures. Future research should explore the use of repellents from natural vegetation resources that could influence host finding in wood borers and bark beetles.

Invasive potential of Moreton Bay fig (*Ficus macrophylla*) in New Zealand

Poster presentation

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Moreton Bay fig (*Ficus macrophylla*, Moraceae) is a hemi-epiphytic plant species native to Australia, widely planted throughout the North Island of New Zealand since the 1850s. Its only pollinator, fig wasp *Pleistodontes froggatti*, was not present in New Zealand until its presence was first confirmed in the Auckland region in 1993. Moreton Bay fig seeds are now no longer sterile and it is reproducing in New Zealand. Moreton Bay fig produces large quantities of fruits (syconia) that can act as an all-year-round food source for both native and exotic frugivores such as birds and rodents. Its hemi-epiphytic nature

can also directly impact its host by strangling and eventually replacing it entirely. These properties make Moreton Bay fig a potential invader that can threaten the native biodiversity of New Zealand. Surveys in 2009 confirmed the presence of *P. froggatti* and pollination of Moreton Bay fig fruits in all regions except Wellington in the North Island, and the existence of a substantial wild population of seedlings in Auckland's various urban areas. Although most of the seedlings were still in their epiphytic stage, they had established on more than 33 plant species commonly growing in New Zealand, of which seven of them were native species, such as pūriri (*Vitex lucens*) and pohutukawa (*Metrosideros excelsa*). It may be too early to tell whether the Moreton Bay fig is invasive or a benign adventive, but it can potentially impact native biodiversity should it become invasive.

Global change and grassland ecosystems

Plenary presentation

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Understanding and predicting the dynamics of ecological systems has always been central to ecology. Today, ecologists recognise that in addition to natural and human-caused disturbances, a fundamentally different type of ecosystem change is being driven by the combined and cumulative effects of anthropogenic activities affecting Earth's climate and biogeochemical cycles. This type of change is historically unprecedented in magnitude, and as a consequence, such alterations are leading to trajectories of ecological responses that differ radically from those observed in the past. Through long-term studies at the Konza Prairie Long-Term Ecological Research site, and complementary short- and long-term experiments in the central grasslands region of the United States, we have been trying to better understand the mechanisms and consequences of ecological change in grassland ecosystems. We have learned that, depending on the mechanism(s) driving change, these grasslands can display significant lags in response prior to rapidly altering their functional relationship with environmental drivers and that the long-term hydrologic regime of a grassland ecosystem may influence both the magnitude and direction of responses to global change factors. Forecasting the future of grasslands would benefit greatly from comparative studies designed to permit ecologists to assess the relative sensitivity of these ecosystems to future drivers of change.

Life at the edge: plant responses to extreme alpine environments in New Zealand and Australian snowbanks

Oral presentation

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Plant functional trait analysis, without reference to individual species and their taxonomic identity, can be used as an approach to describe plant strategies along environmental gradients across various ecosystems. Plant functional traits are morphological, physiological or phenological plant features that indirectly impact on growth, reproduction and survival. Here, our study aims to elucidate potential shifts of alpine plant traits along snowmelt gradients in New Zealand and Australian snowbanks. Snowbanks form when snow accumulates on the lee side of landform features such as depressions and ridges, where snow persists significantly longer than in the adjacent landscape. The later succession of snowmelt results in steep abiotic gradients (e.g. water/nutrient availability) as well as variation in growing season length of early and late exposed plant species. We measured the timing of snow release and vegetation patterns for six snowbanks in Central Otago, New Zealand, and six snowbanks in the Snowy Mountains, Australia. We collated selected traits (specific leaf area, leaf dry matter content, seed mass and height at maturity) for the most abundant vascular plant species at each site and determined the relationships between their distributions and the snow-melt gradient. Our results summarise patterns of plant functional responses to snow-melt gradients in alpine assemblages at several geographic scales. This approach allows us to explore which plant functional traits, and hence plant species, may particularly be at risk with predicted earlier snow release due to global warming.

Interactions between coastal *Senecio* spp. and their insect herbivores

Poster presentation

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We aim to quantify the network of interactions between a community of herbivorous insects and four related *Senecio* plants that co-occur in beaches around Wellington and the Kapiti Coast: *Senecio lautus* (native), and the introduced species *S. skirrhodon*, *S. elegans* and *S. glastifolius*. The

community of herbivorous insects that utilise these plants is a modern-day mixture of native and introduced insects. However, not all insects have equal preferences for all plants. Our field experiment will present sentinel plants in different species mixtures and in different densities to explore how the colonisation of plants by insects is affected by species (= evolutionary and long-term ecological history), local density of conspecifics and local density of heterospecifics. Of particular interest is the potential for indirect interactions between native and introduced species, e.g. competition mediated by a shared herbivore that is attracted to one plant but 'spills over' to adjacent plants of a related species.

Resource selection by feral pigeon in Wellington City: the importance of people

Poster presentation

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Feral pigeons in Wellington impact the community by feeding on refuse and inhabiting buildings and parks. Feral pigeons are also fed by members of the public and so diverse, conflicting opinions are held about them. As such, feral pigeon management is an ongoing ecological and social challenge to city governments. We investigated resource and habitat use by feral pigeons in central Wellington City using line-transects to quantify and compare resource use and availability. Results show the importance of human sources of food to feral pigeons, including associations with cafes, outdoor seating, and rubbish bins. Our study explains variation in the density of feral pigeons within the urban landscape. It indicates the importance of modifying human behaviour as the most direct way of controlling pigeon population density by controlling food availability. The next stage of our study is the survey of opinions and actions of owners and managers of retail food outlets towards feral pigeons in central Wellington. We describe this study and speculate about its outcomes.

Cycles, stochasticity, and density dependence in pink salmon population dynamics

Oral presentation

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Complex dynamics of animal populations often involve deterministic and stochastic components. A fascinating example is the variation in magnitude of 2-year cycles in abundance of pink salmon (*Oncorhynchus gorbuscha*) stocks along the North Pacific rim. Pink salmon have a 2-year anadromous and semelparous life cycle, resulting in odd- and even-year lineages that occupy the same habitats but are reproductively isolated in time. One lineage is often much more abundant than the other in a given river, and there are phase switches in dominance between odd- and even-year lines. In some regions the weak line is absent and in others both lines are abundant. Our analysis of 33 stocks indicates these patterns likely result from stochastic perturbations of damped oscillations due to density-dependent mortality caused by interactions between lineages. Possible mechanisms are cannibalism, disease transmission, food depletion, and habitat degradation by which one lineage affects the other, although no mechanism has been well-studied. Our results provide comprehensive empirical estimates of lagged density-dependent mortality in salmon populations and suggest that a combination of stochasticity and density dependence drives cyclical dynamics of pink salmon stocks.

Soil carbon and the proposed relationship to plant productivity and litter decomposition of *Chionochloa* species in New Zealand tussock grasslands

Oral presentation (Student Day)

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The heightened concern regarding climate change and elevated atmospheric carbon dioxide (CO_2) levels has led to increased investigation of these processes and the role of soil carbon (C) sequestration and storage. The global soil C pool (2500 Gt) is approximately 3.3 and 4.5 times larger than the atmospheric and biotic C pools, respectively. The process of soil C sequestration may play a vital role in mitigating the effects of elevated atmospheric CO_2 concentrations and the impending threats of climate change. Factors that influence soil C sequestration and storage include: climate, land use history, soil properties and organisms, as well as vegetation type. The vegetational community can largely be determined by climatic factors that select for specific plant ecophysiological traits, which can in turn influence terrestrial C cycling. Species with high growth rates tend to contribute greater amounts of easily decomposable above-ground litter, whereas species with slow growth rates contribute low-quality above-ground litter that is more recalcitrant to decomposition, which may influence soil C dynamics. Plant productivity, the quality and quantity of litter produced, and litter decomposition may play important roles in the sequestration of C from the atmosphere to the soil. The

Chionochloa species within the tussock grasslands of New Zealand are ideal to investigate this issue since the genus occupies a wide range of habitats with climatic variations, differing soil types and land use histories. Hypotheses, rationales and proposed methods will be discussed as to how this research will enhance the understanding of C dynamics in New Zealand tussock grasslands.

Effects of climate manipulations on the production and decomposition of Antarctic vascular plants

Oral presentation

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The Antarctic Peninsula is experiencing profound effects of climate change, which is impacting the terrestrial environment. The two vascular plant species on the Peninsula, used as bioindicators for climate change, are *Deschampsia antarctica* and *Colobanthus quitensis*. Both species show alterations in photosynthesis, growth and reproduction in response to climate change. We employed a 2x2 factorial design on intact microcosm cores of tundra with a 25% increase of supplemental precipitation and warming with IR heaters that elevated plant canopy and soil temperatures by 1° and 2°C respectively. After 2 years of climate manipulations the above-ground plant biomass was significantly greater under both supplemental precipitation and warming relative to controls. The above-ground biomass of *D. antarctica* tended to be greater under supplemental precipitation, whereas the aboveground biomass of *C. quitensis* under warming was significantly greater by 42%. The $\delta^{13}C$ isotopic signature of live *C. quitensis* tissue was more negative under warming, suggesting that stomatal conductance may have been altered and caused greater fractionation of C through photosynthesis. Increased photosynthesis from warming of both species can result in greater biomass of both species which may ultimately increase litter production. The mass loss of decomposing *D. antarctica* and *C. quitensis* litter was greater with warming by 20.4 and 14.4% respectively; this can most likely be attributed to the significant reduction of holocelluose content under warming, possibly through microbial decomposition of this constituent. The increased plant productivity and decomposition of litter under climate change scenarios may influence the C and N cycling in Antarctic tundra.

Estimation of rates and impacts of feral pig ground disturbance in the Waitakere Ranges

Oral presentation

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Feral pigs (*Sus scrofa*) are widespread in New Zealand and concerns have been raised as to their effect on native plants and animals, the effect of ground rooting on the surrounding environment, and the transfer of pathogens from one area to another, especially the newly discovered kauri root rot disease (*Phytophthora* taxon *Agathis*). However, no studies have been conducted in New Zealand to assess and quantify the impact of feral pigs. Recent research has uncovered the importance of interactions between above- and below-ground components of an ecosystem and how these interactions affect above-ground vegetation communities. Ground disturbance by pigs may directly destroy vegetation communities and/or indirectly alter them via modification of soil characteristics and below-ground systems. Therefore, to develop appropriate pig management strategies we need to determine the links between pig abundance and rates of ground disturbance, and also between ground disturbance and soil nutrients and vegetation communities. This study aims to parameterise a ground disturbance and recovery model using transect monitoring and exclosure plots. Factors such as aspect, canopy type, drainage and litter cover will also be measured to determine the potential drivers of pig rooting. This research will provide estimates of recovery time after an area has been disturbed, set thresholds for pig disturbance levels and through this help develop control strategies that protect the long-term viability of vegetation communities.

Spirit or species? Conserve or kill? The role of differing cultural perspectives in conservation failures

Oral presentation

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Conservation in the developing world is about more than preservation of species and habitats in protected areas; in some places conservation is inextricably linked to cultural survival and ecological services such as food security. Many conservation and research projects in the developing world appear to have evolved from having Indigenous peoples at the periphery to them now being central to project design and implementation. Despite this, many such projects still fail due to conflicts with Indigenous peoples. We discuss possible reasons

why conservation projects fail in terms of project design (i.e. site-selection biased to biological over cultural values, inadequate understanding of human cultures, commodification of nature, differing objectives and expectations, bias to biological science over social science) and implementation (i.e. differences in the understanding of exchange relationships and perceptions of 'conservation', failure to use science to complement existing traditional ecological knowledge, poor communication). We illustrate these points using projects from Melanesia and then propose an approach to address some of the problems identified. Until conservationists acknowledge and address their limited understanding of the Indigenous people they work with, more projects will fail and opportunities to conserve biodiversity, cultures and ecological services will be lost.

The disconnect between what people want for their forested lands and what planners and politicians are offering in Papua New Guinea

Poster presentation

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In Papua New Guinea (PNG) over 75% of people live in rural areas and 97% of land is in customary ownership, and bottom-up planning is constitutionally mandated. Forests therefore play an important role in livelihoods and culture, and indigenous peoples have control over the way their forests are used and developed. In such a context it might be expected that forests are conserved at higher rates than on alienated land, and that planning would reflect local perspectives. Neither are the case in PNG, which has among the highest rates of forest degradation in the world and where industrial logging and clearance for agricultural monocultures are still the development options of choice for planners and politicians. To understand the development priorities of local people and their use of forests, we surveyed 161 people from six villages in two provinces in PNG. We found 98% of respondents in Manus Province and 54% in New Ireland Province depend heavily on their forest for food and other resources. Across all villages low-impact activities and non-cash benefits from development were most highly ranked. Despite these priorities, the only options currently being offered to local people – under the auspices of provincial forestry plans – are large-scale and destructive activities that offer cash benefits. There is a disconnect in PNG between landowners and planners and politicians. Alternative forms of development, such as Payments for Ecosystem Services, may be a better fit with the perspectives of local people than what is currently being offered.

Totara Reserve Regional Park: challenges to sustaining biological diversity in a productive landscape

Oral presentation

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Totara Reserve was officially established as a regional park in 2006. The park bridges a gap between the manicured town and city parks of the Manawatu Plains and the rugged public conservation estate of the Ruahine Ranges. The aim is to give visitors to the park a safe and accessible, yet biologically rich, experience of native New Zealand. Although the core area of the park is extensively modified by natural causes, fragmentation, selective logging, fire, and wandering stock, the park is considered the finest forest remnant in the Manawatu Plains Ecological District. Protection of existing ecological values is afforded through fencing, and pest plant and animal control. There are dreams of augmenting the existing biological diversity through reintroductions of plants and animals that should be present but are missing. The area of indigenous forest of the park consists of a core area of approximately 340 ha of lowland podocarp and tawa forest with contiguous corridors of mixed native scrub extending into farmland gullies. Ecological constraints and challenges presented by the small size of the core area and the surrounding land use are issues to overcome if the vision for the park is to be realised. General-public perceptions of animal welfare and non-target effects of pesticides also present a challenge. This presentation explores whether the present management regime is making a significant positive contribution to sustaining the biological diversity of the park and whether the challenges present insurmountable obstacles to the dream of increasing the biological diversity.

Seed dispersal by scree weta

Oral presentation

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New Zealand tree and ground weta consume and disperse the seeds of fleshy-fruited plants, but ecological relationships between fleshy-fruited plants and their weta dispersers are poorly understood. We investigated a new weta–plant relationship between the alpine scree weta (*Deinacrida connectens*) and the mountain snowberry (*Gaultheria depressa*) by conducting a series of laboratory trials. We explored how changes in body size throughout the ontogeny of *D. connectens* might affect the seed fate of *G. depressa* after consumption. Specifically we asked whether (a) *D. connectens* frequently disperse *G. depressa* seeds, (b) larger weta consume and

disperse a higher proportion of seeds than smaller weta and (c) larger morphs have a greater potential seed dispersal shadow. From 40 weta scats collected from the field we found 4587 intact *G. depressa* seeds, and an additional 1945 intact seeds from 15 *D. connectens* individuals that we collected from the field and housed in laboratory conditions. Experimental results showed that on average, 32% of the seeds consumed by weta are passed intact, and there is a positive relationship between weta body size and the proportion of seeds passed intact. We also found a positive relationship between weta size and potential distance travelled per night. We concluded that throughout the ontogeny of *D. connectens*, animals switch from seed predators to seed dispersers, which, with further investigation, may lead to evidence of a mutualistic relationship.

Development of a systematic approach to conservation planning for New Zealand's rivers and streams

Oral presentation

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New Zealand's freshwater resources are under increasing demand for a range of purposes, and increasing risk of degradation as a result of human activities. Various actions have been initiated to manage these demands and pressures, including the development of a systematic approach to identifying riverine ecosystems with high conservation value. Here we describe key components of this work. Using a GIS network database that describes key environmental and biological attributes of 567 000 river and stream segments we developed a biologically trained environmental classification of all rivers and streams to group together river segments having similar ecological characteristics. The selection, weighting and transformation of environmental variables used to define the classification was based on analyses of relationships between species turnover and environment based on extensive distribution data for fish and macroinvertebrates. Information about the geographic distribution of river classification groups was then combined with spatially explicit descriptions of human pressures and analysed using site prioritisation software (Zonation) to identify sets of catchments or sub-catchments having high conservation value. Specific methods were developed to allow for the consideration of requirements for upstream–downstream connectivity. Results are being used to guide the prioritisation of management actions both within the conservation estate and on private land. Other applications include assessment of the relative protection of different river types, and identification of currently unprotected sites that best complement those ecological values contained within the public conservation estate.

Marine management, public outreach and perception of a customary closure

Poster presentation

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In New Zealand, present and future marine conservation involves an interplay between scientists, tangata whenua, the wider community, and policymakers. Scientists engaged in planning and management support a diverse public's understanding of marine conservation. This is particularly so where livelihoods, religious, spiritual and customary practices depend on healthy marine ecosystems. This research involves collaboration with mana whenua, Ngāti Toa, and the wider community to monitor paua (*Haliotis iris*) and kina (*Evechinus chloroticus*) in a customary marine closure in Pukerua Bay, 30 km north of Wellington. The research team includes two Ngāti Toa first-year Te Rōpū Āwhina whānau members and iwi volunteers assisting in the field and laboratory. Participants will share their research experiences with iwi during an annual Āwhina community event in 2011. The students and I, supported by Te Rōpū Āwhina members and Ngāti Toa rangatira, will hold a hui to discuss research results and work towards a collaborative wānanga pūtaiao programme. The programme will encourage the sharing of perceptions and knowledge to increase an understanding of marine conservation. The programme will assist Ngāti Toa iwi members and emerging Āwhina Māori and non-Māori scientists and technologists to exchange ideas and explore the interrelationships between kaitiakitanga and Pukerua Bay research. The programme will be designed to create an ongoing relationship based on whānau values and assisting Ngāti Toa members of all ages to increase their participation and success in science and technology as a means of enhancing their kaitiakitanga role.

Relationships between urban biodiversity and contemporary ecological knowledge in Wellington, New Zealand, and East Bay, San Francisco

Oral presentation

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An individual's level of ecological knowledge is an important component in determining conservation-related behaviour, but factors that influence levels of ecological knowledge have gone largely unexplored in many contexts. A positive relationship between local biodiversity and ecological knowledge is often assumed but the direction and magnitude of the relationship is unknown. Environmental knowledge can also be moderated by a wide range of other variables, including subject age, sex, education, and socio-economic status. To examine the possible drivers of ecological knowledge we conducted 2000 stratified random household surveys in Wellington, New Zealand, and East Bay, San Francisco, USA. Avian diversity and abundance – highly visible components of biodiversity – were measured at sites where households were also surveyed for their ecological knowledge related to birds. Response rates were relatively high and comparable (>40% and 30% respectively). We adopted an information theoretic approach to examine a priori hierarchical models (with random effects for site and city) to compare and test alternative hypotheses in regards to the primary drivers of ecological knowledge. Results will be presented and their implications for biodiversity restoration in urban centres discussed.

Ecology of the Dunedin Town Belt

Oral presentation

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The Dunedin Town Belt forms a more or less continuous tract of forest and amenity areas that stretches through the northern and central hill suburbs of Dunedin, occupying an area of approximately 115 ha of prime real estate. Native and exotic forests in the Town Belt are largely restricted to sites on hill slopes, while sports fields or mown amenity grasslands dominate areas of flattened topography. The Dunedin City Council commissioned an ecological survey of the Town Belt in 2005, following on from previous assessments at roughly decadal intervals. This presentation summarises information collected during the 2005 survey, which involved walk-through

surveys, vegetation plots, 5-min bird counts, and pitfall trapping of invertebrates. The Town Belt has significant indigenous biodiversity values, including elements of primary alluvial and coastal forest, 131 local native (263 exotic or non-local natives) plant species, 15 indigenous (13 exotic) bird species, and 19 invertebrate orders. The distributions of plants, birds, and invertebrates are influenced by different Town Belt habitats. Ecological processes in the Town Belt illustrate contrasting relationships between indigenous and exotic flora and fauna and the effects of past management practices. Several native plants that have been displaced from forest floors by invasive ground-cover weeds have found new homes in artificial habitats maintained by mowing. Invasion of the forest understorey by non-local native trees and shrubs, particularly kanono (*Coprosma grandiflora*) and rangiora (*Brachyglottis repanda*), has caused widespread regeneration failure of locally-native canopy trees, and recently resulted in a large-scale clearance of these species from indigenous forests in the Town Belt. On the other hand, exotic elm trees in the Town Belt provide a key food source for Dunedin kererū (*Hemiphaga novaeseelandiae*).

Unique tympanum of the Auckland tree weta *Hemideina thoracica*

Oral presentation

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The New Zealand tree weta (*Hemideina thoracica*, Ensifera: Anostostomatidae) produce stridulation calls, but the function(s) of the calls and the way in which they are perceived in the context of intraspecific communication are unknown. In this research I focus on the physiology of weta hearing and the role of acoustic communication. *Hemideina thoracica* tympana possess typical ensiferan prothoracic tibial ears consisting of paired tympanal membranes, internal tracheal tubes and vesicles. The tympana of *Hemideina* are much thicker than those of most other hearing insects. Given the large size and thickness of the tympanum, it may be expected to lack responsiveness to incident sound pressure. Yet, the tympana are highly sensitive to a calling frequency of 3–4 kHz. This study used microscanning laser Doppler vibrometry to determine how such a tympanal membrane vibrates in response to sound. The tympanum displays a single resonance set at the calling frequency of the male tree weta. This is an unusual example of an insect's tympanum acting as a filter to impose narrow band frequency tuning on the ear. The tympanum is divided into two distinct regions, a thickened region and a surrounding transparent and uniformly thin region. The thick region constitutes the thickest tympanal cuticle reported for any insect ear, and appears to act as a damping mass on the oscillation of the thin region. Here I present a new model showing how the thick region confers a mechanical gain onto the activation of the sensory hearing organs.

Are Stewart Island robins ratwise? Implications for translocations from predator-free island sanctuaries back to the mainland

Oral presentation

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Most of our viable native bird populations only exist on predator-free offshore islands. These populations are often used as a source for translocations to establish new populations on other island and mainland sites. Predator recognition is a trait crucial to the survival of birds on the mainland or where predators are abundant. Therefore, we tested predator recognition in two Stewart Island robin (*Petroica australis rakiura)* populations. One on a predator-free island refuge (Ulva Island), and the second, a nearby population at Freshwater Flats (Stewart Island), where robins coexist with rats. We video-recorded robins collecting worms in close proximity to three types of stimuli: baseline (no new object), control (brown box) and a rat model. Robins at Freshwater Flats were more responsive to the rat model and took longer to collect worms when the rat model was present in comparison with robins on Ulva Island. These results suggest that loss of predator awareness may hinder the survival of birds translocated from predator-free islands back to the mainland. Interestingly, some of the birds tested on Ulva Island were themselves translocated from Freshwater Flats 10 years ago. These birds reacted in a similar way to Ulva-Island-bred birds, and were less responsive to the rat model compared with birds currently living at Freshwater Flats. This suggests that predator recognition can be lost in just one generation.

Mangroves in New Zealand: trifles or triffids?

Poster presentation

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While mangroves are indigenous and an integral part of functioning estuaries, the increase in mangrove abundance in recent decades in many estuaries in north-eastern New Zealand has resulted in many authorised (and unauthorised) mangrove removals. Unfortunately, minimal information is available on long-term recovery (and likelihood of success) of the clearings, and the key physical and ecological processes underlying the rehabilitation process. We surveyed the effects of a recent resource consent to clear 92 ha of mangroves in Tauranga Harbour in 2010. Mangrove trees were mulched, with mulch material left at the site and subsurface root material left intact. We sampled three replicate transects across

the sandflat – mangrove removal – intact mangrove landscape at each of three sites (Te Puna, Waikaraka, Waikareao), chosen to maximise understanding of recovery across a gradient of hydrodynamic exposure, sediment characteristics, and other environmental variables. Observations from photo quadrats, counts of large epifauna and infauna, depths of mulch layer, and cores for sediment characteristics indicate minimal signs of recovery. Short-term results indicate that mulch does not disperse, and has unpredicted adverse impacts on recovery, including high biological oxygen demand (BOD) resulting in anoxic sediments, deoxygenation of the water column during outgoing tides, abundant sulphide-reducing bacteria, and subsequent release of nutrients and colonisation of mulch zones by nuisance algae. Our results will assist in providing the background scientific information necessary to inform future mangrove management and community expectations on suitable sites and methods for mangrove removal, short-term localised impacts and expected time to recovery.

Spatial variations in methane emissions from Zoige alpine wetlands of Southwest China

Poster presentation

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This study's aim was to understand the spatial variation of methane emissions from alpine wetlands in Southwest China at a field-scale in two phenological seasons, namely the peak growing season and the spring thaw. Methane emission rates were measured at 30 plots, which included three kinds of environmental types: dry hummock, *Carex muliensis* and *Eleocharis valleculosa* sites. There were high spatial variations of methane emissions among and within different environmental types in both phenological seasons. Mean methane emission rates ranged from 1.1 to 37.0 mg CH4 m–2 h–1 in the peak growing season and from 0.004 to 0.691 mg CH4 m–2 h–1 in the spring thaw. In the peak growing season, coefficients of variation averaged 38% among environmental types and 64% within environmental types; while in the spring thaw, were on average 61% among environmental types and 96% within environmental types. The key influencing factors in the peak growing season were the standing water table and plant

community height, while in the spring thaw, no significant correlations between factors and methane emissions were found.

A comparative study of antibacterial activities of wild and cultivated plants used in ethnoveterinary medicine

Poster presentation

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Farmers generally collect fresh plant materials from the wild for ethnoveterinary uses instead of cultivating and drying important materials in order to protect biodiversity. We used the microplate method for minimum inhibitory concentration (MIC) determination to compare wild with cultivated and fresh with dry plant materials. MIC values ranging from 1.25 ml to 0.01 ml were recorded and 0.3 mg/ml was considered the cut-off point between effective and non-effective inhibition. Multilevel (hierarchical) linear models, both unadjusted and adjusted, were employed, with plant name considered level 2 or higher and actual observation level 1 or lower. Crude estimates of the odds ratio indicated that 'wild' is 0.57 times less likely than 'garden' to yield MIC values > 0.3 mg/ml (P = 0.005). Also, 'fresh' is about 4.195 times more likely than 'dry' to yield MIC scores > 0.3 mg/ml (P < 0.001). Adjusting for conditions ('dry and fresh', type of microbes and solvent type),'wild' is 0.52 times less likely than 'garden' to yield MIC values > 0.3 mg/ml (P = 0.003). On the other hand, when adjusting for 'wild or garden', solvents and microbes, 'fresh' is 4.202 times more likely than 'dry' to yield MIC values > 0.3 mg/ml (P < 0.001). These results only partially support farmers' claims that wild plant materials are more potent than cultivated ones. On the contrary, the results favour the drying of plant materials.

Do organic farming systems support higher bird densities?

Oral presentation

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Loss of biodiversity and degradation of ecosystem services in agricultural landscapes as a consequence of land-use change is a major global concern. In Europe and America, for example, significant declines in farmland bird species in recent decades have been linked to agricultural intensification, with similar

trends observed for plants and invertebrates. Growing concern about these adverse environmental impacts has led to increased public, government and market demands for more sustainable farming practices. Organic systems are often proposed as a potential solution, as they can benefit biodiversity and ecosystem services by increasing habitat heterogeneity and avoiding synthetic chemical pesticides and fertilisers. In New Zealand, large-scale changes in agricultural land-use have also occurred since the 1960s, with an ongoing and accelerating trend for intensification. However, no biodiversity monitoring system exists for New Zealand's agricultural landscape, so the nature of this threat and the extent of its impact on biodiversity is unknown. Elsewhere, birds are used as indicators of sustainable land management. As a first step towards developing similar indicators for New Zealand, we investigate how bird densities vary in relation to agricultural management systems. More specifically, we test whether organic systems support higher bird densities than conventional or integrated management systems.

Smoking hot spiders; effects of fire on tussock grassland spider communities

Oral presentation

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Fire has been used for the modification and improvement of tussock grassland pasture since the arrival of Europeans. However, there is limited information on the effects of controlled fire on invertebrate and, more specifically, spiders, which are potential indicators of ecological changes. Our study demonstrates the profound effects of fire in an ecosystem not adapted to regular burning. Samples were collected over a period of 7 years, before and after a controlled fire, in plots representing spring and summer burn treatments as well as unburnt control plots. Spider diversity declined drastically after the fire and remained significantly lower than in unburnt plots for 4 years. Spring and summer burn treatments did not differ in quantitative diversity measures immediately after the fire but spider assemblages became different over time. Changes in community composition may be explained by different transformations in the vegetation over time, which in turn affect habitat structure and conditions. Although the overall trend was for a decrease in the abundance of most spider families, the family Linyphiidae showed a large increase in the years following the fire, caused by their efficient dispersal and habitat colonisation. An increase in the number of exotic linyphiid species, and particularly the European species *Diplocephalus cristatus*, was a major component of this trend. Our results show the importance of addressing the question of the effects of disturbances like fire on the interactions between native and exotic species in New Zealand ecosystems and the dangers that invasive species may pose to native biodiversity.

Biodiversity in productive lands: market signals, responses and relative performance

Plenary presentation

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There are a range of drivers encouraging an increasing level of interest, awareness and scrutiny of the broad environmental and social impacts from agricultural production. A key strategy to respond to consumer and market concerns in relation to the management of negative impacts of farming and the encouragement of farm management practices that protect and enhance desired environmental and other values has been the establishment of farm assurance programmes. A large number of programmes have been established, including organic and integrated farming systems. The Agricultural Research Group on Sustainability (ARGOS) research programme has undertaken a 7-year research programme investigating the comparative performance and environmental and social impacts of organic, integrated and conventional farming systems in the sheep/beef, kiwifruit and dairy production sectors. This research has identified some differences between farming systems in their economic and environmental performance. These results provide insights into the comparative value of farm assurance programmes for fostering and encouraging higher standards of farm management. They also provide insights into how farm assurance programmes or alternative strategies could be enhanced to respond more effectively to emerging environmental issues. The potential for farm assurance programmes to encourage the protection and enhancement of often rare and threatened examples of biodiversity in productive landscapes is explored.

New Zealand rangeland protection: the catch-up challenge

Oral presentation

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The absence of formally protected areas of New Zealand rangeland, i.e. indigenous grasslands used for pastoral farming, was a major impediment to researching the ecological effects of the pastoral practices of burning combined with mammalian grazing. The history of correcting this deficiency will be outlined from its beginnings in the late 1960s to early 1970s, on the eastern Otago uplands, to the major debate over the nearby Nardoo (1000 ha) proposal, and the Clayton Report of the mid-

1980s, which resulted in limited acquisitions but were important scene-setting exercises. Since then, major acquisitions through five whole-property purchases and tenure review, now completed on 67 of the original 304 Crown leasehold properties, has resulted in >300,000 ha of indigenous tussock grasslands in the South Island rangeland region being formally protected. Relevant research on effects of pastoral farming practices on upland snow tussock rangelands will be discussed as well as their important ecosystem service of water production, while securing indigenous biodiversity and recreational opportunities. Threats and restoration problems will be briefly discussed. Mid- and low-altitude areas are seriously under-represented, as is the case globally, and needs to be urgently addressed.

Minimising decline and maximising protection: region-wide biodiversity assessment and prioritisation

Oral presentation

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Horizons Regional Council manages biodiversity at the regional scale (Manawatu-Whanganui) via regulatory (rules) and non-regulatory (assistance to landowners) methods, considering both to be essential for effective biodiversity protection. Assessment of areas considered to be ecologically significant and worthy of regulatory protection has been conducted at a regional scale by identifying habitat types (rather than sites) using national spatial datasets, predictive modelling, and expert knowledge. This habitat-based approach provides comprehensive protection without the need for extensive in-field survey and site-based significance assessments. As resources are limited, non-regulatory initiatives cannot extend to all sites worthy of enhancement. Therefore, rigorous prioritisation of sites is required to optimise outcomes. This step-wise process has been based on the underpinning principle whereby to be eligible for protection works a site *must be* ecologically important *and* able to be protected. Firstly, sites are classified by priority (A–D) by assigning scores against standard ecological variables. Secondly, high priority sites are run through a checklist that incorporates ecological considerations along with site history, current condition, landscape context, and practical and cultural considerations. Finally, an algorithm addressing the underlying principle is applied. The outcome of this last step determines whether or not a site should be prioritised for protection works. Although assessed using different methodology, the regulatory and non-regulatory methods implemented by Horizons are highly complementary. Combined, the two methods are enabling the protection of both biodiversity pattern and biodiversity processes at a regional scale.

Grazing preference of annual clover species naturalised in South Island hill and high country of New Zealand

Oral presentation (Student Day)

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Naturalised annual clover species such as cluster clover (*Trifolium glomeratum*), suckling clover (*T. dubium*), striated clover (*T. striatum*), and haresfoot trefoil (*T. arvense*) are widely distributed in dry South Island hill and high country areas. This study examined the relative grazing preference for these four naturalised species, including commonly sown clover species of subterranean clover (*T. subterraneum*) and white clover (*T. repens*). Merino sheep were allowed to graze stands of pure clover growing amongst a perennial grass background in spring and early summer. Pre- and post-graze measurements of clover stand heights and herbage mass were recorded, along with animal behaviour at 5-min intervals during the two temporally different grazing periods. Lowest preference was observed for suckling clover during first and second grazing periods. Striated and haresfoot clovers were similar while cluster clover was most favoured out of the naturalised species. Subterranean and white clovers were most preferred. Grazing preference as mechanisms of persistence and abundance of these naturalised species, compared with sown species in grazed, summer dry hill and high country environments, are discussed.

Role of bark beetles as vectors in the colonisation of windthrown timber by fungi

Poster presentation

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Recent wind and snow storm events affecting plantation forests of *Pinus radiata* in New Zealand have raised questions regarding the colonisation of fallen trees by sapstain fungi. These fungi are known to be spread by a multitude of factors including wind, rain splash, harvesting processes, and insect vectoring. Apart from the ecological interest in these interactions between fungi, plants and insects, sapstain fungi are also economically important because their hyphae discolour the sapwood and reduce the overall quality of the timber. Initially, a study was set up in sites affected by wind and snow storms in the Nelson region to measure sapstain accumulation over time and monitor the abundance of bark beetles (Coleoptera: Scolytinae), which are known vectors of some

sapstain fungi. We found that snapped trees accumulate sapstain and insect attack faster than trees that topple but remain rooted, and that the most common stain fungus affecting these trees was *Diplodia pinea*. Subsequently, manipulative experiments have been established to examine seasonal and regional variation in sapstain attack, and the importance of bark beetles as vectors. Trees are being felled at regular intervals to simulate windthrow at different times of the year, to assess seasonal effects. Also, experimental billet logs have been caged to exclude beetles and subsequently analyse fungal attack in comparison with identical logs left exposed to beetles. Finally, individual beetles are being analysed to determine what fungal species may be associated with them. An overview of the study, rationale, and preliminary results will be presented.

Impacts of the loss of biodiversity on the continuation of rongoā Māori (traditional Māori medicine)

Oral presentation

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One of the issues of growing concern to practitioners of rongoā Māori is the increasing difficulty in accessing the plants they need for their rongoā (medicine). This has a number of serious consequences; one of course is that rongoā are not available; another, not often considered, is that the mātauranga (traditional knowledge) concerning certain rākau (plants and trees) is gradually being lost; the plants are not available to keep that mātauranga alive. As a result more and more knowledge is being lost with the passing of each of the old healers. There has been a tremendous amount of work, particularly with the Treaty of Waitangi claim Wai 262, to protect the intellectual property issues surrounding rongoā. That is very important, but there has been much less attention to, let alone realisation of, the fading plant resource. This presentation will outline some of the reasons for the loss of species used for rongoā, and suggest ways in which the situation can be addressed. Robert McGowan is currently Amo Aratu (ecologist) for Ngā Whenua Rāhui, a contestable Ministerial fund established in 1991 to provide funding for the protection of indigenous ecosystems on Māori land. His role involves working with Māori land owners to restore the biodiversity of their lands, particularly in a way that incorporates traditional Māori understandings of the natural world and their part in it. Rob has had a long involvement with the traditional uses of New Zealand native plants, particularly for medicine, and is both a teacher and practitioner of traditional Māori medicine.

Can risk assessments predict invasion success of forestry trees in New Zealand?

Poster presentation

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Exotic conifers introduced for commercial forestry and horticulture have become invaders worldwide, threatening biodiversity and causing economic impacts. New Zealand's government is committed to a 250 000 ha expansion of planted forests by 2025 to mitigate the impacts of climate change, necessitating the introduction of new exotic species. Our understanding of why some species become invasive while others do not may be enhanced by looking at factors controlling the different stages of the invasion process: introduction, naturalisation and spread/distribution. We used the genus *Pinus* as a case study and classified each species as either not introduced, introduced, or naturalised using historical records of introductions and naturalisations. The number of regions that a species has naturalised in was used to measure spread/distribution. We quantified the 'weediness' of each species using a popular weed risk assessment (WRA). Model performance measures (AUC) indicate that the WRA score is an extremely effective tool for predicting which species naturalised from those that were introduced (AUC = 0.91), correctly identifying all naturalised species. Intriguingly, the WRA score was also accurate at identifying which species were selected for introduction in the first place (AUC = 0.88). However, WRA score had no ability to predict spread/distribution. Our results indicate that (1) foresters preferentially selected high-risk species for introduction in the first instance; (2) from those introduced, only the species with the highest WRA scores naturalise; (3) factors other than 'weediness' control the current distribution of pines in New Zealand.

Experimental introduction of the exotic plant *Hieracium lepidulum* reveals no significant impact on montane grassland and forest communities

Poster presentation

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There is debate over whether exotic plants necessarily alter the communities they invade or can coexist with native species without discernable impacts. We quantified changes in plant community composition and structure over 6 years in response

to the experimental sowing of the exotic weed *Hieracium lepidulum* in montane forest and grassland communities in Craigeburn, Canterbury. We used a replicated randomised block design, with 30 × 30 cm plots (n = 756) subdivided into 5 × 5 cm cells to examine the impact of *H. lepidulum* on native plant species richness evenness and diversity at 0.09-m^2 and 0.0025-m^2 scales. Plots were sown with 0–15 625 *H. lepidulum* seeds in 2003, forming gradients of invader density and cover. The relationships between the invader and local community attributes were modelled using hierarchical mixed-effect models. Plant communities differed in the extent to which they became invaded; *H. lepidulum* cover in the plots ranged from 0% to 52%, with a mean of 1.89%. Plot species richness increased from 2003 to 2009, with a component of this increase (+0.002 species per year) associated with increasing *H. lepidulum* density, the opposite to what we would expect if invasion by *H. lepidulum* led to competitive exclusion of native species. Other relationships between the plant community and *H. lepidulum* were generally non-significant. It appears *H. lepidulum* coexists in these communities with no measurable negative effects on native plant species richness, evenness or diversity, even where density and cover of the invader are highest. We suggest *H. lepidulum* has persisted preferentially at those sites with abiotic conditions sufficient to support a species-rich assemblage.

Grimean and gradient management frameworks for ecological restoration and conservation in cultural landscapes

Poster presentation

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Bush gardens of native trees were planted in New Zealand over a century ago. More deliberate mimicking of natural communities occurred post-WWII although these were generally unrestrained by concerns about eco-sourcing or fidelity to regional reference ecosystems. These early plantings resembled arboreta of New Zealand trees. Ecological restoration has been the *cause célèbre* in conservation since the nation's sesquicentennial year of 1990. It has focused on early structural species for bush, dune, riparian or eutrophic wetland habitats, or individual species recovery through surgical removal of weeds, pest animal control or translocation. The past decades have seen tentative steps towards incorporating a wider range of late successional or niche species (the biodiversity elements) but there is a long way to go for groups like fungi, weakly dispersed invertebrates or epiphytes. Cultural landscape dynamics have received some theoretical attention, but less is known about restoring herbaceous communities or seral states that characterise either highly stressed or disturbed environments, or the combination of both. A conceptual restoration and management framework, applicable to the diverse array of urban, rural and natural herbaceous habitats, is presented, fundamentally based on matching plant strategies to

a stress–disturbance–competition matrix(*sensu* J.P. Grime). An adaptation of this theory is the concept of gradient management, which regards multiple permutations and combinations of stress and imposed disturbance as providing the best chance for many lowland indigenous herbaceous plants to co-exist with the avalanche of exotic species that are here to stay.

Bryophyte – vascular plant interactions in New Zealand forest ecosystems

Oral presentation

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Bryophytes are widespread in terrestrial ecosystems but little is known about their interactions with the vascular flora. In this study, we explored (1) the general distribution pattern in mosses of New Zealand native forests and shrublands by modelling bryophyte species – environment relationships from a large-scale dataset and (2) the effect of bryophyte cover on the germination and seedling establishment of New Zealand native trees by testing allelopathic potential in numerous moss and liverwort species. Climate and above-ground vegetation biomass were critical factors in large-scale distribution patterns of bryophytes in general, most likely by influencing water relations. Habitat type (canopy tree species) also was important in the distribution patterns of several species, possibly through altering the physical environment and resource availability. At smaller scales dense mats of some moss and liverwort species influenced seedling growth of understorey and canopy vascular species, depending on the allelopathic profile of the resident bryophyte species and the tolerance of the vascular flora. Bryophytes are an integral part of forest dynamics in New Zealand and we encourage further investigations to establish (1) the relationships between vascular plant traits (e.g. canopy structure, leaf area, chemical compound and nutrient levels) and bryophyte species (occurrence and adaptive strategies) and (2) profiles of allelopathic interactions within the New Zealand flora.

Epidemiology of *Salmonella* in New Zealand island fauna

Poster presentation; oral presentation on Student Day

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Diseases can have profound detrimental effects on wildlife when populations first become exposed to an exotic pathogen or when stressors such as habitat change, climate change, predation or pollution promote endemic microorganisms to induce overt disease. To better understand the unique threats to our native wildlife, we are investigating the spatial and temporal distribution of a known pathogen (*Salmonella*) within native wildlife and targeting one species (tuatara *Sphenodon punctatus*) for in-depth immunological analyses. Cloacal swabs were collected from wildlife on Stephens Island (Takapourewa) during three time points over a year. These time points were selected as October, January and March. Species targeted for analysis include tuatara, native lizards, weta (*Hemideina crassidens* and *Deinacrida rugosa*) and fairy prion (*Pachyptila turtur*). Soil samples were collected from across the study site. Intestinal carriage of *Salmonella* has not been detected in more than 450 cloacal swabs collected from both wild and captive tuatara. In contrast, *Salmonella* has been isolated from soil samples collected from within tuatara habitat and also from 19% of native skinks caught in areas that tuatara inhabit. No *Salmonella* has been isolated from fairy prion or weta sampled. Isolation of *Salmonella* from native lizards and soil appears to have a seasonal component, with all positive samples collected in March 2010. Understanding the distribution of *Salmonella* within the environment and any effects seasonality may have on prevalence and distributions within species will help to inform decisions about translocations and disease screening.

Competitive exclusion and cold adaptation of two tree weta species

Oral presentation

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Mount Taranaki supports two species of tree weta, *Hemideina crassidens* (Wellington tree weta) and *H. thoracica* (Auckland tree weta) in parapatric populations with as little as 3 m of overlap between populations. *Hemideina crassidens* survives in the cooler, higher altitudes of the mountain, surrounded by populations of *H. thoracica*. Elsewhere (Tararua Ranges near Palmerston North) these two species form a mosaic, suggesting that although competitive exclusion may prevent an overlap of the species on the slopes of Mt Taranaki, the two species have very similar ecologies. High-altitude *H. crassidens* indicates that this species may have become metabolically adapted to the colder climate. In this study, we used closed-system respirometry to measure the resting metabolic rate of adult *H. crassidens* and *H. thoracica* from both Mt Taranaki and lowland populations and compared the results between species and collection site. We hypothesise that if metabolic cold adaptation is shown by the Mt Taranaki population of *H. crassidens*, then they will show a higher mean metabolic rate than Mt Taranaki *H. thoracica* and either of the lowland populations.

Conservation of biodiversity in the natural forests of central India: a case of critically endangered medicinal species *Curcuma caesia* (black turmeric) and *Tylophora indica* (dambel)

Poster presentation

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Medicinal and aromatic plants form the essential component of biodiversity. There has been gradual and recently rapid loss of medicinal plant genetic resources because of many factors. At present, 90% of collections of medicinal plants are from the wild and 70% of plant collection involves destructive harvesting. Due to over-exploitation of many medicinally important species, a few herbaceous species fall within the 'critically endangered' or 'vulnerable' categories. Currently medicinal plants are collected without paying attention to the stage of maturity. In a wider context, there is a growing demand for plant-based medicines, health products, pharmaceuticals, food supplements, cosmetics, etc., in national and international markets. Conservation and sustainable use of medicinal plants are issues on which immediate focus is required in the context of conserving biodiversity and promoting and maintaining the health of local communities, besides generating productive employment for the poor with the objective of poverty alleviation in tribal and rural areas. This study was conducted in the central part of Madhya Pradesh, which is rich in herbaceous medicinal plants. Five districts (Sagar, Hoshangabad, Seoni, Panna, Mandla) were selected for the study. The major causes for population decline and regeneration in the study area are habitat destruction, complete uprooting of plants, immature harvesting before flowering and fruiting, and increased market demand. The existing ecological status of species, causes of their population decline in central Indian tropical forests and the impact on biodiversity were assessed.

Should I stay or should I go? Attempts to anchor pelagic fairy prions to their release site on Mana Island

Oral presentation

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New Zealand conservation managers have a distinguished history in translocating forest birds and waterfowl to achieve conservation objectives. Although New Zealand is a centre of seabird diversity (including for penguins, albatrosses, petrels and cormorants), and many species are threatened and/or have

suffered human-induced range reductions, until recently there had been few attempts to translocate seabirds. Reluctance to attempt translocations was largely due to the perceived risk of dispersal, and the expectation that birds would return to their source colony. Translocations have now been attempted with 10 species of burrow-nesting seabirds in New Zealand, with pre-fledged chicks moved before they were likely to have developed awareness of their natal colony location, and hand-fed until they fledged. The translocation of 240 fairy prion chicks from Takapourewa/Stephens Island to Mana Island in 2002–2004 was one of the few studies where systematic searches of the source colony for returning translocated chicks was undertaken, and where a sample of marked control chicks allowed comparison of natural return rates with those of translocated chicks. Nineteen translocated chicks returned to Mana Island, and 25 were recovered at the source colony. Birds appeared to develop their homing ability at different ages, and there was no apparent maximum age after which chicks should not be translocated. Whether or not chicks had the opportunity to see the source colony in daylight when extracted from burrows for measuring, banding and placing in translocation boxes did not appear to affect return rates to either the source or transfer colony.

Song playback in mainland bird translocations: the answer to post-release dispersal?

Oral presentation

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The simulated sights and sounds of conspecifics have been used – with varying success – as a means of establishing or bolstering seabird colonies, and song playback has been shown to attract migratory songbirds to suitable but unoccupied breeding sites. In a 2005 translocation of North Island kōkako (*Callaeas cinerea wilsoni*), conspecific song playback was employed as a potential means of limiting post-release dispersal. While the release was not run as a properly controlled experiment, observations suggested that several released birds were attracted to playback speakers and that speakers might facilitate contact between individuals. Since 2005, song playback has been used in several translocations of kōkako and other songbird species in New Zealand with results that are, at best, equivocal. I will summarise the results of these translocations and discuss barriers to determining whether and when playback is a useful component of translocations.

Role of the Department of Conservation in biodiversity protection on private land in Nelson/Marlborough: what's changed in the last 10 years?

Oral presentation

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One of the roles of the Department of Conservation (DOC) is to engage with private landowners to promote biodiversity management and protection. Over the last 10 years, there has been a change in the emphasis of DOC's interactions with private landowners in the Nelson/Marlborough region. In 2000, natural area surveys on private land were led by DOC through the Protected Natural Areas Programme, whereas such surveys are now led by local authorities. The first generation of resource management plans was the catalyst for this change and led to a more collaborative approach in planning and implementing natural area initiatives. Regulatory backstops of plan rules relating to indigenous habitats evolved at the same time. There have been other significant changes in central government policy and guidance, biodiversity assessment tools, funding sources, covenanting and private land purchases, all of which affect the planning and implementation of biodiversity management and protection. In 2010, much of the collaborative work between DOC and private landowners is species-led, focusing either on threatened species or pest control. In this presentation, I discuss some of the key achievements and the lessons learned that serve as a basis for DOC's continued engagement in programmes involving private landowners in the Top of the South Island.

Understanding climate change: tree weta as model organisms

Oral presentation

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Global climate change is a thing of the past, as well as a reality of the present. Species respond to long-term temperature changes in two ways: range change and adaptation. Many sources of evidence suggest that changes in distributions of species is the dominant response, when opportunity exists. Patterns of genetic variation within species reveal past population size and history and provide an insight into both range changes and species interactions. By examining the current and past distributions of a pair of common tree weta species we can improve our understanding of the likely

consequences of current climate warming. Two tree weta species in the North Island appear to competitively exclude one another; the winning species is probably dependent on climatic factors. Thus the Auckland tree weta (*Hemideina thoracica*) has excluded the Wellington tree weta (*H. crassidens*) from all of the Taranaki area with the exception of forest on Mt Taranaki above ~800 m altitude. Using genetic data we illustrate the past fluctuations of the distribution of these two species, and using distribution data from two time points, 15 years apart, we infer ongoing distribution changes.

Biodiversity of a botanic garden

Oral presentation

Thomas E. Myers

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Botanic gardens are places that support biodiversity, a fact that generally goes unnoticed. In Dunedin Botanic Garden, diverse and long-established plant collections are managed by a local government authority as a city reserve. The site encompasses diverse terrain with a riparian floodplain at the junction of two streams, and a hill spur bordering one side of urban North Dunedin. The botanic garden provides both care of and access to biodiversity, and as a consequence, is widely used for research, teaching, and as a public amenity. While there is great value in accommodating these different interests, horticultural care and the management of resources for both teaching and research are not individually sufficient to manage the garden's biodiversity. This limitation is exacerbated by the lack of specific government legislation that provides guidance on the core duties of a New Zealand botanic garden. In context of the Dunedin Botanic Garden, there are several options for an integrated approach to manage the biodiversity.

Towards an understanding of the New Zealand 'beech gap': phylogeographic evidence from *Nothofagus menziesii* chloroplast DNA

Oral presentation

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New Zealand has a wealth of endemic tree species, but for the vast majority we have little idea about patterns of population connectivity and diversity within species. Many of the taxa exhibit striking biogeographic disjunctions, that have often been

explained by range fragmentation and/or long-distance dispersal events – but in the absence of molecular data these explanations remain difficult to substantiate. Here we investigate the phylogeography of the iconic 'beech-gap' species *Nothofagus menziesii* (silver beech) using 2405 base pairs of DNA from five chloroplast markers: *acc*D-*psa*I, *atp*B-*rbc*L, *trn*E-T, *trn*L-F, and *trn*L. Nine haplotypes were recovered from the 44 populations (63 individuals) sampled, and these exhibit strong biogeographic structure, with large regions often dominated by a single haplotype. Of particular interest is a phylogeographic split detected between northern and southern South Island haplotypes, consistent with glacial isolation across the 'beech gap'. Molecular dating and ancestral-area-analysis methods are employed to help elucidate species history. Broadly, from molecular clock analysis of the chloroplast markers – constrained by fossil data – we infer that the most recent common ancestor to the nine *N. menziesii* haplotypes dates back to the late Miocene. Despite a deep history of evolutionary diversification within the species, it seems that much of the South Island distribution can be explained by recent expansion from glacial refugia.

Advance, invading hordes! Population growth and detectability of mice on Saddle Island

Oral presentation

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The house mouse (*Mus musculus*) is an important mammalian pest species both in New Zealand and worldwide. Mice have proved difficult to eradicate and where they are able to invade a pest-free area, populations can quickly irrupt to unmanageable proportions. This study follows the invasion of a small pest-free island by mice. A founder pair of mice was released on Te Haupa (Saddle) Island in December 2009. A population was allowed to establish and persist until August 2010 and was intensively studied throughout this period. The investigations carried out consisted of three main elements. (1) The rate and magnitude of population growth from the initial two individuals was monitored using capture–mark–recapture methodology to estimate population size at regular intervals. (2) Mouse ranging behaviour at different population densities was investigated using a grid of tracking tunnels and toe-clipped individuals. (3) The effectiveness of Department of Conservation protocols for detecting incursions of pest-free islands was assessed by replicating the protocols at different population densities. Key findings were that the mouse population showed the sigmoidal pattern of growth characteristic of invasive species, ranging behaviour was modified by population density, and current detection methodologies were adequate. While there have been many studies investigating the population dynamics of existing populations of mice, those of a population in the initial stages of invasion have never been documented so far as we are aware.

As such this project represents an important advance in the study of the colonising behaviour of this prolific invader.

Urban ecology: taking it to the streets – linking science with design and development practice in the built environment

Oral presentation

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There is often significant overlap between the motivations and objectives of urban ecologists and urban design professionals – especially when dealing with multiple challenges of population dynamics, climate change, resource limitations, landscape degradation and biodiversity loss – in the context of proposing more sustainable built environments for humans and other species. Yet despite frequent intersection and alignment of fields of practice across a range of landscape scales, there appears to be little evidence of these sectors proactively working together to support common interests. This presentation aims to identify and examine some of the reasons why this is so, and to offer personal insights from the perspective of a non-scientist urban designer working on such issues within an Australian peak professional design organisation (AILA), as well as outline emerging policy, design and research initiatives to address the situation. The presentation will cover recent AILA experience in initiating, enhancing and supporting partnerships between design professions and urban ecologists to promote more sustainable urban design typologies for Australian cities and towns. Discussion will include constraints and opportunities emerging from 'designed experiment' approaches; green infrastructure and climate adaptation strategies; multidisciplinary collaboration; integrated urban sustainability assessment methodologies; and multi-sectoral advocacy and engagement initiatives aimed at enhancing social, environmental and economic outcomes for existing and future human settlements.

Pheromone evolution and speciation in New Zealand leafroller moths by differential gene regulation

Oral presentation

Jerome Albre[1,4], Marjorie Liénard[2], Tamara Sirey[1,3], Silvia Schmidt[1,4], Leah Tooman[1,4], Colm Carraher[1], David Greenwood[1,3], Christer Löfstedt[2], Richard Newcomb[1,3,4]

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If we are to conserve not only extant biota, but also the conditions that will enable the continued evolution of new biota, we will need to understand the mechanisms involved in speciation. While there are a multitude of theories at the population and ecological levels (e.g. allopatry, reinforcement) that often provide plausible scenarios for the generation of new species, there is little known of the processes involved at the molecular level. We have been studying speciation in a complex of endemic leafroller moths (genera *Ctenopseustis* and *Planotortrix*), where species boundaries are determined by differences in their mate recognition systems, encoded by the use of distinct sex pheromone blends. Many of the sibling species are morphologically cryptic and neutral molecular markers are often unable to distinguish between species, suggesting very recent speciation events. The pheromone blends are completely diagnostic for each species, with the distinct positions of double bonds in the pheromone molecules forming the important differences. We have isolated desaturase genes from a set of species within each genera and characterised where each desaturase enzyme introduces a double bond into the pheromone. Within the pheromone glands of females from the different species the desaturase genes are differentially expressed, providing evidence that gene regulation rather than coding sequence differences controls the production of the distinct pheromones. Our findings suggest that the underlying ability to produce mating system variants rapidly, via changes in the regulation of an existing array of genes, could be a contributing factor to the formation of highly speciose groups.

How above- and below-ground ecological linkages combine to influence plant population abundance and community organisation in thyme (*Thymus vulgaris*, Labitae) stands across Central Otago

Oral presentation (Student Day)

Jacqueline A. Nielsen[1], Katharine J. M. Dickinson[1], Peter A. Whigham[1], Russell D. Frew[1], Ragan M. Callaway[2]

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Common thyme (*Thymus vulgaris,* Labitae) is an aromatic perennial native to the western Mediterranean. It was probably introduced into Central Otago by European settlers who used it as a culinary herb. From just a few reported stands in the 1920s, it has now invaded several thousand hectares and is a significant component of the regional vegetation. The objective of my thesis is to examine how an invasive plant species alters below-ground ecosystem functions and how these changes ultimately transform above-ground community structure. I have a number of studies planned to increase our understanding of how above- and below-ground ecological linkages combine to influence plant population abundance and community organisation in thyme stands across Central Otago. Preliminary

findings from soil studies and vegetation sampling will be discussed.

Does kelp rafting drive dispersal among populations of intertidal invertebrates?

Oral presentation

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Holdfasts of the southern bull kelp (*Durvillaea antarctica*) are inhabited by numerous intertidal invertebrate species that either lack active long-distance dispersal means altogether or only have a short pelagic larval stage. The presence of obligate kelp epifauna in remote subantarctic islands and their large-scale phylogeographic patterns across the Southern Ocean suggest that macroalgal rafting is an efficient long-distance transportation mechanism for sedentary kelp epifauna. But do detached kelp plants make a vehicle for regular gene flow among established populations of kelp epifauna? Is there a systematic difference in genetic connectivity of populations of kelp-dwelling vs. rock-dwelling intertidal species? To find out, we are comparing multilocus genetic structures of kelp-dwelling and rock-dwelling intertidal molluscs that have a short pelagic larval stage. Results obtained with eight microsatellite markers from a trochid gastropod species pair (*Diloma durvillaea*, *D. arida*) showed a clear difference in relationship of genetic and geographic distance between the species, supporting a conclusion that rafting on detached kelp enhances dispersal in the kelp-dwelling species. Overall, the populations studied along the 400-km stretch of South Island coast were genetically highly connected in both species. Surprisingly, the long-term dispersal patterns inferred from genetic data do not seem to conform closely to the major Southland Current in either of the species.

Drivers of biodiversity change in agricultural ecosystems

Oral presentation

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In developing the most appropriate strategies for sustaining indigenous biodiversity in agricultural landscapes it is important to identify and understand the drivers that shape both biodiversity and land-use practice. In this presentation we outline a framework for considering the main drivers of biodiversity change. While some drivers have direct effects on biodiversity (e.g. land clearance or invasive species), others do

not directly impact biodiversity (e.g. global economic conditions); rather, they alter land management practices (e.g. the intensity of management inputs), which in turn has direct effects on biodiversity. We suggest that these different drivers of change can be summarised under five broad titles: (1) Global environmental change; (2) Historical legacies; (3) Markets; (4) Technology and knowledge; (5) Social values and awareness. While global environmental change and historical legacies directly affect indigenous biodiversity, all five indirectly affect biodiversity by influencing the decisions that land managers make about the way they use their land. It is these land management decisions that then have a range of critical flow-on effects for biodiversity.

Role of benchmarks of protected representative grasslands in maintaining biodiversity and assessing sustainability of different land uses

Poster presentation

Kevin O'Connor[1], Peter Espie[1], David Scott[1], Brian Molloy[1], Leo Condron[2], Alan Nordmeyer[1], et al.

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Among grassland areas recommended for protection in the Protected Natural Area Programme for the Mackenzie Ecological Region was an extensive area of glacial outwash and moraine on Balmoral run, principally occupied by red tussock grassland and induced fescue tussock grassland. The Simpson family seeks to conserve this natural area and to use it as a reference system for various land uses on related soils in the region. Completion of the soil survey of the Upper Waitaki Basin floor up to the boundaries of this area has allowed us over the past decade to evaluate its soil/ grassland systems as (1) a natural benchmark for assessing ecological sustainability of present and future land uses as well as (2) a natural area preserved for its own sake. The concepts and theory of benchmarks and of biosphere reserves and summary quantitative description of Balmoral soils and vegetation were reviewed for the NZ Soil Science Society Conference in Rotorua. At the subsequent AGM, Gregor Yeates, one of New Zealand's distinguished soil biologists, led the Society's support for the project. Zoning and protection fencing of the core and buffer areas have now been effected. Biological production and nutrient distribution in soil under controlled pasture and forestry conditions in related use areas are being collated. Protracted delays in the settlement of tenure review questions has inhibited formal seeking of funding and launching of ecological projects to assess soil biology linkages with biogeochemical processes and between above-ground management and soil biodiversity. Diversity in soil biota at any grassland site greatly exceeds that in all life forms above the soil. Such facts of soil life, largely ignored in New Zealand concerns with biodiversity, coupled with their persistence and potential adaptation to new, potentially stable or resilient ecosystems in productive use, call

for renewed attention to soil biology and related geochemistry. Benchmarks make such science relevant and durable.

Māori knowledge of naturally occurring toxins in New Zealand plants: potential for animal pest control

Oral presentation

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Representatives from Tūhoe, Lincoln University, Landcare Research, and Ngāi Tahu teamed up to investigate mātauranga Māori and scientific literature on toxic New Zealand plants, as the first step to determining the potential of the toxins these plants contain, to be used as alternatives to existing pest control tools, including 1080, for the control of animal pests such as possums. A surprising number of New Zealand plants with toxic properties were identified as candidates for pest control. Eleven native plant species showed potential. Some of the most promising native plants were tutu (*Coriaria* spp), karaka (*Corynocarpus laevigatus*), ngaio (*Myoporum laetum*), porokaiwhiri (*Hedycarya arborea*), poroporo (*Solanum aviculare* and *S. lacinatum*), and kōwhai (*Sophora* spp). The study also identified nine species of plants used traditionally for their anti-fertility properties. This could be a particularly important area of future research, allowing the development of baits that render pest populations infertile. The outcomes of this research will be discussed in the context of the next phase of the research, which has received funding for 6 years.

The Vital Sites model for conservation planning and reporting

Oral presentation

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We have developed the Vital Sites model and procedure for identifying priority sites and actions for conservation work, and reporting on conservation achievement. The Vital Sites model of biodiversity incorporates the current and natural distributions of biodiversity, pressures on biodiversity, and management effects that mitigate pressures, and implements ecological integrity as a high-level biodiversity goal. The effects of pressures on biodiversity are used to predict vulnerability and future biodiversity patterns. Management actions affect future

biodiversity patterns by reducing pressures, and all outputs are relative to a management scenario. Model procedures produce a range of outputs, including naturalness, significance and priority, as well as an ordered list of vital sites. Significant sites are those with a large contribution to national ecological integrity, and priority sites or actions are those where conservation action can avert the most expected loss of ecological integrity. We present results from analyses with input data that included 93 native terrestrial taxa (of which about one-third are snails), 53 animal and plant pests, grazing pressure, LENZ, LCDB2, and potential vegetation. Current management is predicted to avert only a small part of the expected loss of national ecological integrity, and greatly increased conservation effort would be required to halt the decline of biodiversity. This model has wide application to a range of conservation problems, and we provide examples of assessing the cost-effectiveness of possum control, and trade-offs in ecosystem services.

He turangawaewae mo ngā kiore: a refuge for the kiore

Oral presentation

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Former environmental antagonists met together on 25 May this year to celebrate the signing of an unusual agreement: to create an offshore island kiore (Pacific rat, *Rattus exulans*) refuge on Maui Taha, one of the smallest islands in the Hen and Chickens group. This surprising outcome was the culmination of 23 years of frequently acrimonious disagreement involving the Department of Conservation (DOC), the Ngātiwai Trust Board – who acted as kaitiaki for this species, scientists from The University of Auckland, public opposition (mainly the Forest and Bird Protection Society), and an Environment Court hearing. DOC had proposed in 1988 to eradicate all remaining kiore populations from 40 offshore islands. The cultural importance of kiore to Māori stems from their transport in ancestral waka, their utility in Aotearoa as a food source, their important place in whakapapa (genealogy), in waiata (songs), whakataukī (proverbs) and whakairo (carvings). The solution to create the kiore refuge came from two individuals in the DOC Northern Conservancy. Their relationship with Ngātiwai, developed over many years of controversy, persuaded them follow Section 4 of the Conservation Act which instructs the Department to 'give effect to the principles of the Treaty of Waitangi'. Under the agreement, tino rangitiratanga of Ngātiwai is recognised by the devolution of full management responsibilities for Maui Taha to the Ngātiwai Trust Board. We believe this to be a world first for the legal provision of a reserve for rats and an important national example of strong co-management by local iwi.

Regional council drivers and approach to monitoring biodiversity

Oral presentation

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Regional councils are developing a co-ordinated approach to monitoring biodiversity that will enable national reporting on the state of biodiversity on private land. Local authorities have responsibilities and powers for the management of terrestrial indigenous biodiversity (including wetlands). These responsibilities and powers are mandated in legislation and given effect to via policy documents such as regional policy statements, biodiversity and pest management strategies and district plans. In giving effect to their responsibilities and powers, local authorities need to monitor to understand the impacts of policy decisions. Local authorities have many competing demands, however: the provision of infrastructure for water and waste services, maintenance of water quantity, avoidance and mitigation of natural hazards, and the provision of public transport for example and ongoing pressure to reduce costs. Operating in a resource-constrained environment, the benefits of collaboration are multiple, but the challenge to identify an approach to monitoring biodiversity that can be universally implemented remains. Rather than develop different approaches to monitoring biodiversity, regional councils are working with Landcare Research to develop a framework that will link with Department of Conservation work to provide national reporting on biodiversity.

Role of plantation forests in biodiversity conservation in New Zealand: opportunities for threatened species

Oral presentation

Stephen Pawson[1], Eckehard Brockerhoff[1], Chris Ecroyd[1], Barbara Hock[1], Thomas Paul[1], Richard Seaton[2], William Shaw[3], Luc Barbaro[4], Marc Deconchat[4], Hervé Jactel[4]

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Most of New Zealand used to be covered in forest, but land clearing for agriculture and other development greatly reduced the forest cover. In many lowland regions, forest loss and fragmentation were extreme, causing significant decline of biodiversity. It is now widely accepted that biodiversity conservation cannot be achieved by the preservation of remnant native ecosystems, and the artificial separation of conservation from production. Ecosystems modified by humans for production purposes will play a major role in future conservation initiatives, if only because of their ubiquity. Exotic

plantation forests represent both a threat and an opportunity for biodiversity conservation. Currently ~1.8 million hectares of plantation account for nearly 25% of New Zealand's current forest area. This area may expand by one million hectares for bioenergy production, and could affect formerly disturbed land reverting to native shrubland and forest. However, research shows that plantations can provide habitat opportunities for many taxa, including some threatened species, that are not present in other production land uses. Plantations are most important in regions that have lost much of their natural forest cover, either providing important habitat in their own right, or creating conservation opportunities at the landscape scale by increasing connectivity between adjacent remnants of natural forest. Examples from several recent studies undertaken in New Zealand will be presented to highlight opportunities for biodiversity conservation and threatened species in plantation forestry. We will draw attention to the missed conservation opportunities that are generated by a lack of understanding and the somewhat 'puritanical' views of New Zealand's mainstream conservation paradigm.

Biotic indirect effects of plant invaders: small things matter!

Oral presentation

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Non-native invasive plants can greatly alter community and ecosystem properties, but efforts to predict which invasive species have the greatest impacts on these properties have been generally unsuccessful. An hypothesis that has considerable promise for predicting the effects of biological invaders is the mass ratio hypothesis (i.e. that dominant species exert the strongest effects). We tested this hypothesis using data from a removal experiment in which the presence of two dominant shrub species (one native and the other not), and subordinate weedy plant species, were manipulated in factorial combinations over 4 years. We measured the effects of these manipulations on the plant community, soil nutrients and soil biota. After 4 years, low-biomass non-native plant species exerted disproportionately large below-ground effects relative to their biomass, most notably by increasing soil C, soil microbial biomass, and by altering soil microbial community structure. Additional analyses of spatial diversity further revealed that weeds had important indirect biotic effects on diversity of native plant species by altering the effects of a dominant native shrub on plant community assembly. Our results demonstrate that: (1) high-biomass species do not necessarily exert the largest impacts on community or soil properties, (2) low-biomass, inconspicuous non-native species can influence community

composition and have important trophic consequences below ground through effects on soil nutrient status or resource availability to soil biota, and (3) the mass ratio hypothesis does not accurately predict the relative effects of different coexisting species on community- and ecosystem-level properties.

Spatial patterns in age and size structure in mixed *Nothofagus* forest, Nelson Lakes National Park

Oral presentation

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Red (*Nothofagus fusca*) and silver (*N. menziesii*) beech commonly occur in mixed stands, and their coexistence is believed to be facilitated by the so-called 'master trade-off' between shade tolerance and growth rate. Red beech grows quickly, but its establishment depends on the presence of canopy gaps and safe sites associated with woody debris; silver beech, on the other hand, is more shade tolerant, so may establish under the canopy, but is slower growing. These differences in life-history characteristics should leave a spatial signature via the species' different regeneration dynamics. This, in turn, suggests that it may be possible to infer the processes structuring these forest communities by characterising their spatial pattern. Such inferences are difficult to test, however, using spatial information alone. One way to strengthen links between spatial pattern and ecological process is to use appropriate null models of spatial pattern. We apply spatial point pattern analysis and point process models to spatial and dendroecological data collected from mixed red–silver beech forest to explore how differences in the regeneration niche of red and silver beech are revealed in their fine-scale pattern. We highlight the extent to which the use of 'biologically-informed' point process models can provide more useful descriptions of spatial patterns in plant communities than the widely adopted model of complete spatial randomness (CSR – the homogeneous Poisson process).

Reconstructing spatial vulnerability to forest loss by fire in pre-European New Zealand

Poster presentation

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Fire requires both an ignition source and biophysical conditions predisposing to combustion. At the time of Māori settlement of New Zealand fire frequencies dramatically increased. However, there is evidence for widespread fire activity in areas with little archaeological evidence for either prolonged or high density settlement. This implies that before human settlement large areas of New Zealand had biophysical conditions that made them vulnerable to fire, but that ignition was limiting. We use statistical approaches – a bootstrap extension of boosted regression trees – more commonly used to explore species distributions to (1) map the distribution of fire vulnerability and (2) isolate the best predictors of forest loss over the Māori, but pre-European, settlement period (c. AD 1280–1840). In the South Island the key predictors of forest loss are related to climate and topography, with proxies of human activity (density of archaeological sites, distance to major lakes and rivers) of minimal importance. In the North Island climatic variables are still important, but proxies of human activity are much more important than in the South Island. Although vegetation type is not directly included in the models, they plausibly reconstruct the inferred relative vulnerability to fire of broad vegetation assemblages. We conclude that biophysical conditions across large swathes of New Zealand – especially the drier, eastern side of both islands – rendered them highly susceptible to fire. The introduction of fire (i.e. an ignition source) to the New Zealand landscape by Māori made widespread forest loss a *fait accompli*.

Going with the flow: mammalian predator presence on islands in New Zealand's braided rivers

Oral presentation

Georgina Pickerell[1], Phil Seddon[1], Deb Wilson[2], Colin O'Donnell[3]

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The 'safe island' concept postulates that prey species are safer from mammalian predation on islands compared with mainland areas. Braided rivers contain a multitude of islands separated from the mainland by channels of varying size. In New Zealand, four endemic species of bird rely on braided rivers for breeding, often nesting on islands. Mammalian predation is thought to be

the single largest threat to these populations but nesting on islands may provide some protection. However, it is uncertain how decreases in river flow will affect predator access to the islands. We measured the variables most likely to explain mammalian predator presence on islands in the Rangitata River, South Canterbury. We reveal species-specific risk models for the presence of the most frequently detected predator species on islands at different levels of flow.

Preliminary results of modelling *Tradescantia fluminensis*

Poster presentation

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Tradescantia fluminensis Vell. (Commelinaceae) is a concerning invasive weed within Australasia. The aim of this work is to use branching process models – a stochastic method for simulating multiple cases of individual, independent growth – to examine the interactions and population dynamics of *T. fluminensis* and different types of biological control agents. The model will be used to explore possible management strategies, and ask the question 'What are the overall probabilities of survival given a range of branching rates and death rates?' In this talk, the branching process model will be described and preliminary results presented. Some conclusions about the model in relation to field data will be discussed.

Managing landscapes for their benefits using the ecosystem approach

Plenary presentation

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The United Kingdom, like many other parts of Europe, is a highly managed, production landscape. Managing this landscape to maintain its biodiversity in the face of emerging pressures of food security issues and an uncertain future climate is demanding new ways of thinking for managers, regional planners and conservation institutions. The Convention on Biological Diversity's Ecosystem Approach has resonated with institutions ranging from the highest levels of government to conservation and regulatory agencies and NGOs, and is fast becoming a framework within which regional development agencies and planners wish to operate. This presentation describes dimensions of the application of the Ecosystem

Approach with which the author has been actively engaged in partnership with NGOs, local stakeholders, regional authorities and regulatory agencies. It will illustrate the benefits of the approach and the barriers and methodological issues that remain unresolved. The studies include: managing the Yorkshire and Humber region for its ecosystem services; the largest upland catchment management experiment in Europe; the utility of Ecosystem Health as a framework for embedding wider social dimensions into ecosystem management. Within these examples, I will reflect on novel approaches to understanding the science–policy–publics discourse, issues of mismatches of scales of governance and ecosystem structures, the importance of stakeholder engagement, and the use of the analysis of language in understanding and resolving actual and potential conflicts in biodiversity management.

Heteroblasty in matai, a quantitative analysis

Poster presentation

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Matai *Prumnopitys taxifolia* is a native New Zealand tree species with separate juvenile and adult forms. The juvenile form is itself dimorphic, with distinct leafy and scaly shoots. I investigated the adaptive significance of leafy and scale juvenile shoots by characterising differences in their morphology, spatial distribution, chlorophyll concentrations, gas exchange and fluorescence. Scaly shoots were characterised by small, clasping leaves and elongate, intertwined stems that were distributed at the extremities of juvenile plants. Interestingly, the stems of scaly shoots contained chlorophyll and were active photosynthetically. Leafy shoots were characterised by larger, linear leaves that were attached to stems at the interior of plants. Photosynthetic productivity was higher in leafy shoots, and scaly shoots responded negatively to strong light. Overall results suggest that leafy shoots are adapted to maximise rates of carbon gain, and while scaly shoots are capable of fixing carbon, they may serve other important functions, such as minimising damage from large browsers.

Quantifying spatial ecology of mammals using GPS telemetry and high-resolution satellite imagery: the 'high-tech war' against pest predators in New Zealand

Oral presentation (Student Day)

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Predators such as feral cats and hedgehogs have become a significant threat to native terrestrial species in New Zealand. Control of predator populations has been based mainly on traditional trapping campaigns, where the trap placement is based on anecdotal data and individual trapper experience. Although this will continue to be the basis of trapping campaigns, a better understanding of the fine-scale movements, habitat use and activity patterns of pest predator species is needed. Improvements in GPS technology for wildlife telemetry offer the opportunity to track not only cat-sized predators, but also hedgehogs by using ultra-light GPS backpacks that can acquire positional data at different time-sampling intervals with little researcher input. Moreover, new-generation high-resolution commercial satellites such as Quickbird (0.6–2.4 m resolution), in combination with the latest advances on object-oriented image classification techniques make possible the production of fine-scale wildlife habitat maps. The combination of fine-scale animal movement data and habitat maps can be used to identify possible hot spots of animal activity and to prioritise the placement of traps and poison bait stations. We report here on research carried out in the braided river environment of Godley Valley in the Mackenzie Basin, South Island of New Zealand, This study explores the fine-scale spatial ecology of feral cats and hedgehogs using advanced GPS technology and remote sensing.

Catch per unit effort as a monitoring tool for community-led management of customary pāua (*Haliotis iris*) harvesting

Poster presentation

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Blackfoot pāua (*Haliotis iris*) is both a cultural and ecological keystone species in New Zealand's coastal ecosystems. Tangata tiaki (customary fisheries managers) and communities managing taiāpure and mātaitai (customary fisheries areas) seek a reliable, yet inexpensive, method for monitoring restoration of depleted pāua stocks. The success of adaptive co-management and community-led conservation initiatives depends on participation in all aspects of management, so the method must be usable by non-specialists. Catch Per Unit Effort (CPUE) is used by commercial harvesters and Ministry of Fisheries to monitor pāua stocks and could be measured by tangata tiaki when they authorise customary harvests. CPUE is usually assumed to be linearly related and directly proportional to density. We calibrated CPUE at 14 reefs at East Otago Taiāpure and Puna Wai o Tōriki Mātaitai against estimates of pāua abundance and size distributions determined by stratified random ecological survey methods. There was only a very weak relationship between CPUE and pāua abundance. Aggregation of pāua in specific high-density areas, local

knowledge of these aggregations, ability of the fisher to hone in on these 'hot spots' and not waste time searching low density areas, sea state, and the skill level of the harvester all disrupt the ability of CPUE to reliably indicate pāua population abundance. CPUE is therefore virtually useless for guiding sustainability of customary fishing, and its use by commercial harvesters and Ministry of Fisheries for stock assessments is also questionable. Stocks would have to be severely depleted before any fall in CPUE would be detected.

Influence of individual condition and transmitters on post-release dispersal of reintroduced hihi

Oral presentation

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Reintroductions frequently occur to areas that differ from the surrounding landscape, e.g. habitat can be of higher quality and/or managed to control invasive species. Dispersal of reintroduced individuals out of 'protected' areas can reduce the number of individuals founding the population, compromising the chances of a successful reintroduction. Natural dispersal patterns have been studied considerably more than post-release dispersal, with a range of influencing factors having been demonstrated, including the effect of individual quality. Dispersal is energetically expensive, hence individuals in better condition at the time of reintroduction may tend to disperse further. We examined whether several condition measures predicted variation in post-release dispersal of 21 juvenile hihi (*Notiomystis cincta*) that were fitted with radio-transmitters and reintroduced to the Waitakere Ranges. Carrying a transmitter can also have a potential energetic cost, hence we compared apparent survival (i.e. probability of surviving and remaining in the searched area) of transmitterised and non-transmitterised birds, correcting for the difference in detection probability. We found that individuals in better condition tended to disperse further. We also found that apparent survival was higher for transmittered birds, a result that is most easily attributable to reduced dispersal. We discuss the possible implications of these results.

Of birds, beasts, fire, and physiognomy: what do evolutionary insights tell us about managing today's grass guilds?

Oral presentation

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A cool temperate, oceanic climate, avian herbivory and infrequent fire were a globally unique selection triplet in open vegetation and species traits in Aotearoa. By examining structural traits of our grass flora and inferring their evolutionary origins, I speculate on the place of grasses in the different prehuman vegetation biomes. Next, I examine the fortunes of the different grass guilds within the two phases of human modification of open vegetation over the last 750 years. First, for 500 years, previously highly infrequent fire became the dominant open vegetation driver as avian herbivory vanished. Second, the greater consumption efficiency of introduced mammals and frequent pastoral fires transformed the preceding megafaunal-gap grasslands into rangelands. Managing today's open vegetation biomes for grass guild values can be informed by these evolutionary insights, especially the surrogacy of modern fire and herbivore disturbances in terms of their prehuman equivalents. We consider these themes as unsustainable pastoralism continues to degrade rangelands, or, alternatively, a no-herbivore paradigm is applied to Crown-managed grasslands.

Where do possums live in the drylands?

Oral presentation

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Little is known about the ecology of brushtail possums (*Trichosurus vulpecula*) in New Zealand's dryland ecosystems, despite their being common in such habitats and subject to population control over vast areas for mitigating bovine TB. Dryland ecosystems are also the subject of increasing conservation attention and research. It is therefore necessary to understand how possums behave in this ecosystem. We conducted a capture–mark–recapture study of possums in drylands at two sites in grassland–shrubland habitat near Alexandra in Central Otago. Density estimates were 0.50 (CI 0.42–0.59) and 0.72 (CI 0.6–0.84) possums/ha where shrub cover was 20% and 50%, respectively. While these densities are low compared with other habitat types in New Zealand, they indicate that possums are abundant in this ecosystem, especially in areas of greater shrub cover. Fourteen adult possums were radio-tracked at one of the sites over a 5-month period to investigate their denning behaviour. The maximum number of dens used by a possum was 24 (from 29 fixes) and the minimum number of dens was 7 (from 7 fixes). Shifts in den sites were therefore very frequent – possums changed their den site each day 83% (range 50–100%) of the time. Sixty-one percent of den sites were in rock cracks, 34% in shrubs, and 4% inside rabbit burrows. Home ranges derived from den site locations were larger for possums living in open areas compared with possums living in gullies. There were marked differences between individuals in both den range size and den type. These findings will increase the efficiency and effectiveness of ground control of possums in dryland habitats.

Ecology and Indigeneity: some thoughts from Mātauranga Māori

Plenary presentation

Te Ahukaramū Charles Royal

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At the heart of Indigeneity is a creative, kinship and dynamic participation in natural world environments. Where once 'mystical participation' was considered to be the primary problem of Indigenous (read 'primitive') cultures, more and more we see that the excessive abstraction of human consciousness away from natural world environments is causing the despoliation of our world. The new Indigenous movement has emerged out of a long period of response to colonisation to re-centre itself in this central principle of Indigeneity. Where our energies were understandably directed toward the mitigation of hardship faced by Indigenous peoples suffered through colonisation, our interest is to supplement this with the critical issue of the relationship of human consciousness with the natural world. Indigeneity, potentially, represents an important contribution to the worldwide issue of humankind's relationship with our planet. In this way of thinking about the world, our creativity finds its source in the natural world. The goal of knowledge is not so that we may impose our will upon the world but rather to find alignment with it. As philosopher Richard Tarnas envisages in a new knowledge to come:

> The human spirit does not merely prescribe nature's phenomenal order, the spirit of nature brings forth its *own* order through the human mind…Then the world speaks its meaning through human consciousness. (*The Passion of the Western Mind,* p. 435, Ballantine Books, New York, 1991)

The 'deep call' of Indigenous worldviews concerns the degree to which humankind is unified with the natural world. Indigeneity, in this new context, is not so concerned with the politics of ethnicity and culture but rather with this deep human question of our relationship with the natural world environments in which we dwell. The vital and perhaps disturbing challenge that Indigenous cultures present to all peoples asks what is the nature of our relationship with the natural environment? Is it possible to think of ourselves in a kinship relationship with the natural world?

Te Ahukaramū Charles Royal is a musician and researcher. His research interests lie with the 'creative potential' of mātauranga Māori and Indigenous knowledge. Charles's work is particularly focused upon the whare tapere (iwi-based 'houses' of storytelling, dance, games, music and more) and whare wānanga (iwi-based centres of higher learning) and how these institutions in their new form may give expression to the new Indigeneity. As a musician Charles has composed for Western orchestral instruments and smaller ensembles, as well as songs in the Māori language and utilising traditional chants. Charles is Professor of Indigenous Development and Director of Ngā Pae o te Māramatanga, a centre of research excellence hosted by

The University of Auckland. He is also Artistic Director of *Ōrotokare: Art, Story, Motion Trust,* a not-for-profit organisation established to advance Charles's research and to found the modern whare tapere (www.orotokare.org.nz).

Automatic track recognition of footprints for identifying cryptic species

Oral presentation

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The recognition of tracks (equivalently 'footprints') plays an important role in ecological research and monitoring, and tracking tunnels are a cost-effective method for indexing species over large areas. Traditionally, tracks are collected by a tracking system, and analysis is carried out in a manual identification procedure by experienced wildlife biologists. Unfortunately, this process is time-consuming and human experts are unable to reliably distinguish tracks of morphologically similar species. We propose a new method using image analysis, which aims at automatic species identification of tracks on cards. A reliable automated method would allow users to submit photos or scans of cards for track identification. Tracks would be identified on cards, and individually compared with a reference database to determine the number of tracks and species on each card. We demonstrate our progress towards developing such an automated method by identifying footprints of three invasive rat species with similar morphology that co-occur in New Zealand, including detection of a recent invasion of a rat-free island. Automatic footprint recognition successfully identified the species of rat for 70% of footprints, and 83% of tracking cards. Identification of tracks to species level gives better estimates of species presence and composition in communities.

Relationships between pigeon density and residents' environmental behaviour, attitudes and beliefs

Oral presentation

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Feral pigeons (*Columba livia*) are a source of human–wildlife conflict in cities worldwide. Regarded as pests by many, their populations are often managed but with varying degrees of success. There is a surprising lack of basic ecological knowledge about pigeon ecology in cities and their facilitative or antagonistic relationships with people are not well understood.

We estimated pigeon density by distance sampling and surveyed 1000 residents by mail along eight line-transects through Wellington City. We adopted an information-theoretic approach to test hypotheses for relationships between pigeon density and residents' behaviour, attitudes and beliefs about pigeons, and their environmental knowledge, action, and awareness. At the time of writing the household survey and density analysis is in progress. Results of the survey and analyses will be presented.

Assessment of the conservation status of estuarine ecosystems in the lower North Island

Oral presentation

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Since 2006 a field survey has been completed of 87 estuaries in the lower North Island (from the Manawatu River in the west to Wairoa on the East Coast). Estuaries are tidal reaches and mouths of coastal rivers, coastal lagoons and wet habitat of open, or temporarily closed, coasts where sea water is diluted by land drainage and where tidal effects are evident. The purpose of this survey was to document baseline information about the state of the these estuaries so that changes over time may be documented and to develop recommendations for community groups, landowners and other territorial local authorities about what needs to be done to protect and restore these sites. Five estuarine classes were documented in the study area. Criteria were developed and used to determine their relative priority for conservation management. This paper summarises the results of this programme of work and highlights the importance of increased work in estuaries to achieve biodiversity, recreation and economic goals.

Importance of kelp elasticity to South Island Māori (and all others): an unexpected relationship

Poster presentation

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A decrease in natural resources has assisted with a shift in awareness of the value of traditional practices and knowledge in the field of natural resource management. South Island Māori have used rimurapa, bullkelp (*Durvillaea antarctica*), for hundreds of years to preserve their food (pōhā tītī), mainly the seasonally harvested tītī bird (sooty shearwater). Local knowledge reports that coastal areas along South Island shores

where once healthy and dense stocks of bullkelp grew are fully decimated due to adverse environmental factors. Some stocks have lost those same qualities useful for traditional uses such as pōhā-making. These observations have been shown to correspond to the increase in untreated sewage discharge and changes in land use. In a preliminary experiment traditionally cured kelp from a site with low human impact (Brighton) was compared with samples from a sewage site (Tahuna) and sewage and industry site (Bluff). Additionally samples of freshly harvested kelp from a low-human-impact site (Kaka Point) were tested. Elasticity was used as an indicator of tissue health as local knowledge described a flexibility change in the tissue from highly stretchable (elastic) to powdery and easy to tear. Results indicate a difference in elasticity between samples from Bluff compared with those from Brighton or Tahuna. Trends also showed that the elasticity of traditionally cured kelp was 4–6 times higher compared with freshly harvested material. How this difference in blade elasticity correlates with environmental contamination and dislodgement, hence loss of resource and habitat, is to be investigated.

Biodiversity and function: a pasture example

Poster presentation

David Scott

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The base data for the series of papers were from shoot yields over four harvests in 2400 micro-plot (29 cm2) swards of 20 species at randomly assigned positions and subsequently amalgamated into adjacent group sizes. Species were defined by both taxa and rank position within samples. Vegetation composition changed from designed approximately equal composition to increasing dominance by chicory, prairie grass and lucerne. Within the highest frequency section of the data there was little relationship between productivity and stability (deviance) and either species number or dominance (% contribution of first-ranked species). However, considering all data, productivity increased with increasing dominance by a few species and unrelated to species diversity, while stability increased with diversity. Of single parameters combining diversity and dominance, the gradient of the log abundance – rank relationship was superior to Shannon H, with both showing productivity increasing with dominance rather than diversity.

Tussock rejuvenation or regeneration

Poster presentation

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Three drilled seeding trials in the Lake Tekapo area compared six native and six pasture grasses under different starter fertiliser levels and sowing methods with trends followed for 15 years. The most successful native species in order were *Poa colensoi, Elymus falcis*, *Festuca novae-zelandiae,* and *P. cita.* However, in two of the trials these were exceeded in performance by the introduced grasses *Arrhenatherum elatuis, Dactylis glomerata, Agrostis capillaris, Festuca rubra* and *Holcus lanatus.*

Utilisation of vegetation monitoring data

Poster presentation

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A comparison was made between analysis methods for estimating quantitative values or trends from stored monitoring data in either a ‘species from environment and management’ or ‘environment and management from species’ predictions. The data used were from two 19-year agricultural grazing trials in a tussock grassland environment under different controlled inputs but treated as if from a random ecological survey. Quantitative estimation of trends from such a reference dataset was best by a direct data search for closest matching observation, followed by response surface regression, simple multiple regression, multiple imputation, transformation regression, and least from principal component analysis.

The Ngāi Tahu Customary Fisheries Protection Areas Project: restoring rangatiratanga

Oral presentation

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This presentation will outline the project that is being conducted by Toitū Te Whenua to facilitate the establishment of a co-ordinated network of customary fisheries protection areas (‘CPA’), spread throughout the Ngāi Tahu Whānui Takiwā. This project will ensure Ngāi Tahu maximise the effectiveness of

CPA both individually and collectively, whilst minimising the impact on the commercial fishing sector. Ngāi Tahu Whānui are well aware that it is not possible to protect all traditional fishing grounds of significance using CPA and that each established area management tool will impact on the establishment of any other within a given quota management area. It was therefore essential that Ngāi Tahu Whānui acknowledged this cumulative effect and co-ordinated and planned the establishment of CPA in order to protect the most significant mahinga kai areas and to ensure a good spread of customary protection is achieved around the entire takiwā. Toitū Te Whenua has conducted extensive background research through a range of reference material as well as interviews with Ngāi Tahu Tangata Tiaki/Kaitiaki and key Ngāi Tahu individuals in order to identify the customary fisheries of significance that warrant CPA establishment. The outcome of the project so far has been the identification of a number of fishing grounds around the takiwā that require CPA. Mātaitai reserves are a common tool identified for enacting CPA, alongside special customary fisheries regulations and new taiāpure.

Should they stay or should they go now? Reintroductions and the challenge of post-release dispersal

Oral presentation

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Restoration of populations of critically endangered species can be achieved through the reintroduction of founders into suitable vacant habitat within the historical range. While a great deal of care can be taken over the selection and preparation of release sites, there is seldom any guarantee that animals will stay put after release. Large post-release movements may take animals away from suitable habitat or out of zones of intensive management, such as predator control, or the provision of supplementary food or veterinary care. Long-distance dispersal may make it hard or even impossible to monitor founders to assess post-release survival. In contrast, some degree of post-release dispersal may be advantageous, avoiding crowding at a release site and the associated problems of agonistic social interactions, resource depletion and disease transmission. In addition, long-distance dispersal may facilitate the colonisation of new areas and the establishment of new populations without the need for serial translocations. As the field of reintroduction biology has matured there has been increased focus on how best to manage post-release dispersal, principally to reduce the likelihood of the large movements immediately after release that may compromise the survival or productivity of founder animals. A future challenge will be how best to facilitate normal dispersal behaviours to enhance natural population recovery. This presentation will review the pros and cons of post-release dispersal in animal reintroductions, and look at the ways in which project managers have sought to increase release-site fidelity.

The role of patch connectivity in maintaining plant diversity in remnant taraire forest in the Manukau Ecological District south of Auckland: does connectivity influence plant diversity in forest remnants?

Oral presentation

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The Manukau Ecological District is a rural area located between the Waikato River and the Manukau Harbour south of Auckland. The area has been highly modified for agriculture and horticulture with only 1.6% (972 ha) remaining in indigenous vegetation cover. Remnant forest is highly fragmented with 85% of the 316 fragments less than 5 ha in area. The vast majority of these fragments are privately owned. Connectivity between areas of natural habitat has long been considered a key factor in the maintenance of biodiversity, but it is difficult to partition out its effect compared with other potential contributing factors such as patch area. I am examining the role of connectivity in maintaining plant biodiversity in remnant taraire-dominated (*Beilschmiedia tarairi*) forest in the Manukau Ecological District. Thirty-six patches of between 1 ha and 13 ha are being studied in a factorial design that includes three size classes and four levels of connectivity and ranging from small, isolated patches to large, well-connected patches. In each patch surveyed, all vascular plant species encountered are recorded in four abundance classes, with search effort standardised per unit area of forest. Evidence of regeneration of the canopy species is recorded, as is the presence of all bird species. In this ecosystem the physical separation of remnant forest patches appears to have less effect on plant biodiversity than other factors such as patch size and management history (e.g. fencing). The results of the study are discussed and the implications for management of highly fragmented forest within an intensive production environment are considered.

Using molecules to understand the evolution of New Zealand cicada biodiversity

Plenary presentation

Chris Simon

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Research in my laboratory over the past 18 years has used NZ cicadas to study the complete history of an island species radiation against the backdrop of a dramatically changing climate and landscape. Our molecular, morphological, and behavioural data suggest that more than 50 species/subspecies of NZ cicadas evolved from two colonising ancestors that arrived approximately 9–11 million years ago. Since that time they have come to occupy nearly every available ecosystem

from sandy beaches to high mountain tops. One lineage of NZ cicadas has its closest relatives in Australia and gave rise to only four species (placed in two genera), while the second lineage has its closest relatives in New Caledonia and gave rise to approximately 50 species/subspecies (placed in three genera). Focusing largely on the two most diverse genera in this second lineage, *Kikihia* and *Maoricicada*, our research has revealed interesting patterns of speciation and isolation heavily influenced by the climatic and geological changes of the last 10 million years. Major radiations of each genus took place in the Pliocene with continued speciation since that time. In the genus *Kikihia*, time to sympatry (or speciation) appears to have a 2-million-year threshold and thus any secondary contact that took place during the 1.8 million years of Pleistocene glacial–interglacial cycles had the potential to promote gene flow between species. While studies of Pleistocene phylogeography in general have tended to emphasise retreat into refugia during the last glacial maximum, and expansion after that time, the population dynamics of mountain-top species may have been influenced by climate change in exactly the opposite direction with current populations isolated in cold mountain-top refugia and past populations spread more broadly and likely coming in contact during glacial times. In both *Kikihia* and *Maoricicada* we see examples of ancient hybridisation events. In recent times, there has been significant gene flow between lowland species of both *Kikihia* and *Maoricicada* that have expanded their ranges (aided in part by human habitat modification). As in many other taxa that have been investigated using a variety of markers, gene flow between animal species seems to be more common than previously recognised.

Mixing farming and conservation: a high country farm model

Oral presentation

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Conservation of South Island high country ecosystems attracts considerable public interest. A common model, as implemented in tenure review of pastoral leases, divides properties into conservation and production land. A problem with this is that land often has both inherent and production values. At Balmoral Station in the Mackenzie Basin, regionally important indigenous biodiversity and landscape values have been identified in a productive fine-wool enterprise. A property management strategy has been developed to protect inherent values and to provide regional benchmarks, while maintaining economic viability. This multi-functional approach has the potential to deliver both public-good and sustainable-land-use outcomes.

Exploring patterns in saproxylic invertebrate communities by rearing insects from different timber resources

Oral presentation

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Saproxylic invertebrates are dependent on dead wood to complete their life cycle. This dependency is either direct, as a feeding resource, or indirect, as a source of habitat or food in the case of predators of wood feeders. We are assessing how landscape context, such as proportion of native habitat in the surrounding landscape and edge gradients, influences saproxylic beetle communities in native forest fragments and the surrounding plantation forest matrix. We combined two different sampling methodologies: (1) *Pinus radiata* log billets as passive traps for saproxylic invertebrates, and (2) flight intercept trapping across nine replicated habitat gradients that spanned 125 m into native forest fragments and the adjacent plantation forest matrix. A second component of the study was to assess host specificity and colonisation preferences of saproxylic invertebrates. At three of the edge gradients timber billets of three native tree species (*Schefflera digitata*, *Melicytus ramiflorus* and *Aristotelia serrata*) were placed alongside the *P. radiata* billets. The edge response associated with native timber resources will be compared to determine if there is any interaction between edge-gradient effects and colonisation preferences. For example, host specificity towards native timber may result in some species only being found living in, and close to, native fragments, not in pine forest. A third component of the study is to determine how saproxylic invertebrate communities change with the age of the timber resource. To do this we used a chronosequence approach and collected *P. radiata* timber of a known age in the forest and sampled invertebrate community composition using emergence chambers.

Resilience to fire of *Dracophyllum subulatum* (Ericaceae) frost flat heathland, a rare ecosystem in central North Island, New Zealand

Poster presentation

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We measured secondary succession in permanent plots for 15 years after a lightning-induced fire in a 90-year-old frost flat heathland dominated by *Dracophyllum subulatum* at Rangitaiki, North Island, New Zealand. We placed this succession in the longer-term context provided by earlier published data from the same site. Species re-establishment was rapid, with all of the consistently present species of mature heathland present by 15

years. The new *Dracophyllum* population has reached its pre-burn density, although cover is still minimal. Vascular plant cover began to decline 11 years after fire, but non-vascular cover continued to increase. *Poa cita* declined dramatically in abundance after 11 years. Earlier studies at the site demonstrate that nearly the entire species complement of mature heathland is present by 25 years, indicating a direct succession. With substantial resilience to fire, frost flat heathland is a fire-adapted ecosystem in a country where such ecosystems are rare.

Small-scale predator control does not benefit lizards: meso-predator release or scale issues?

Presentation: Oral presentation

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Large-scale predator trapping carried out over thousands of hectares has enhanced populations of threatened and common lizards at Macraes Flat. A smaller, nearby site (650 ha) was also trapped for 3 years but common lizards did not respond to predator removal compared with a similar-sized non-trapped site. Mice are present in this system and they also consume lizards. We tested whether the lack of lizard response was due to an increase in mouse numbers (meso-predator release), or whether the scale of predator control at the smaller site was insufficient to benefit lizards because of a continuing influx of predators (predator immigration hypothesis). Our evidence for a meso-predator release was equivocal. Although mice responded to a pulse of tussock seed production at the start of the study, their numbers declined shortly afterwards and remained low. We therefore discount the meso-predator release hypothesis. In contrast, consistent with the predator immigration hypothesis, the majority of predators were trapped towards the outer area of the smaller site. While it is possible that the lizard population may have benefited from predator control at the very core of this site, our four randomly located monitoring grids did not adequately sample the core. The lizards we measured were therefore effectively unprotected from predators. This experiment was repeated at a similar-sized, drier, inland site with similar results. We conclude that predator control in this system must be at a scale (e.g. greater than at least 650 ha) sufficient to provide a large enough buffer of predator traps to protect animals in a core area.

Home vs. away effects of litter decomposition in two New Zealand habitats: expect the unexpected

Oral presentation

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Global climate prediction models calculate litter decomposition using only two factors: climate and litter quality. However, litter tends to decompose faster in the habitat from which it was derived (i.e. home) than when placed in foreign habitats (i.e. away). This indicates that litter quality is in the eye of the beholder (the so-called home-field advantage of litter decomposition, HFA) and suggests importance of a third underappreciated factor in decomposition: soil organisms. To test if soil organisms are responsible for HFA of litter decomposition we reciprocally transplanted litter from two ends of a grassland-to-forest transition at two different sites: one a transition into native kānuka and another a transition into wilding pines. Unexpectedly, we found an overall HF *disadvantage* at our native kānuka site and no evidence of HFA at our wilding pine site. Patterns in the communities of decomposer organisms that colonised litterbags provided insight into these atypical results and support for the hypothesis that soil organisms are drivers of HFA where it does occur.

Do Argentine ants have impacts on ecosystems?

Oral presentation

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The Argentine ant, *Linepithema humile* (Mayr), is an invasive pest species that has been associated with various impacts in native ecosystems around the world. Research on the impacts of Argentine ants, as for other invasive ants, principally report reduced diversity and abundance of native ant species. However, New Zealand has a depauperate native ant fauna and little research has been carried out on Argentine ant impacts to date. We investigated the impact of Argentine ants on invertebrate diversity and composition, microbial biomass and subsequent impacts on below-ground processes such as decomposition. Differences in invertebrate composition were apparent between invaded and uninvaded sites, microbial biomass was reduced at invaded sites, fibre content of litter was higher and key nutrients (nitrogen, calcium, magnesium) lower at invaded sites, indicating lower breakdown of litter at invaded sites. We also examined the influence of Argentine ants on the health and fitness of an invasive weed, boneseed (*Chrysanthemoides monilifera monilifera*), via a mutualistic relationship with scale insects. Argentine-ant-infested plants

had significantly fewer invertebrate predators (mites, spiders and beetles), and also significantly less herbivore damage (excludes sap-sucking herbivore damage). In terms of plant reproductive success, significantly more fruits were produced on boneseed plants infested with Argentine ants, suggesting that Argentine ants may influence the invasion success of weeds. Conversely for native plants, our preliminary investigations suggest that Argentine ants may be having a negative effect on the fitness on flax (*Phormium tenax*). In terms of impacts in native ecosystems, we believe the most important aspects are the persistence and density of Argentine ant populations.

Cultural consequences of loss of abundance and biodiversity

Oral presentation

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Within their lifetimes, kaitiaki (Māori environmental guardians) from 14 North Island iwi/hapū and Ngāi Tahu in South Island have observed significant drops in the availability of species for kai (food) and other customary uses. In interviews, these kaitiaki told us how biodiversity loss from marine and freshwater environments has impacted on their communities. Decrease in the food resource leads to greater difficulty in accessing the resource, e.g. scuba gear is needed where pāua could once be picked in knee-deep water. Greater difficulty in providing foods that are a culturally and spiritually important gift to elders weakens kinship connections. Younger generations are no longer familiar with certain foods that were part of tribal tradition, nor with how to prepare them. Decreased availability also erodes traditional teaching to 'take just enough for a feed' each time food is gathered. Depletion means that knowledge and skills about harvesting or nurturing that species are no longer passed on, nor crucial knowledge about life cycles, niches and wider ecological linkages. Application of mātauranga (Māori knowledge) and tikanga (lore) are important parts of identity and connection to place that reinforce responsibility for kaitiakitanga. A further key loss relates to manaakitanga – losing the ability to generously offer locally distinctive foods to visitors, particularly at events such as hui (gatherings) and tangi (funerals). Wild food depletion impacts on health because people can no longer supplement their hunter gathering in supermarkets with fresh and healthy local foods. We briefly touch on some of the actions that kaitiaki are taking to try to reverse this loss.

Say what (you mean)? Nature and nativism in New Zealand

Oral presentation

Michael J. Stevens

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My paper will argue that researchers and policymakers charged with environmental management in post-colonial contexts need to complicate and refine terms like 'indigenous knowledge', 'traditional ecological knowledge', or, in the case of New Zealand, 'mātauranga Māori'. I will show why this is necessary, and how it may be achieved. In doing the latter, I will draw on the theoretical framework that I developed in my PhD thesis. My thesis, which used 'muttonbirding' as a way in to asking larger questions about 19th century changes in Māori culture and the production of colonial knowledge, rejected 'fatal impact' and 'cultural continuity' readings of Māori history. Inspired by recent scholarship from economic history, the history of science, and the new imperial history, my central argument was that there is much to be gained from being simultaneously attentive to both propositional knowledge (knowledge 'what') and prescriptive knowledge (knowledge 'how'), and their interplay. The upshot, I further argued, can be helpfully understood through reference to Eisenstadt's notion of multiple modernities. The benefit of my approach, premised on an admission of both continuity and change in Māori thought and practice, is, I think, made particularly clear in the context of environmental management. This is unsurprising when it is realised that my lifelong involvement in the tītī harvest has fundamentally shaped the academic space I am trying to open up.

Wild ecology in domesticated Canterbury: habitat use and phenology of birds, butterflies, and mammals in urban and rural Christchurch

Oral presentation

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To bring more native nature into our urban and rural areas, we need to better understand wild ecology in these habitats. With this in mind, I've added over 70 000 bird, butterfly, and mammal (road kill) observations to the New Zealand Biodiversity Recording Network, made along repeated routes in and between south-western Christchurch and Lincoln. Most have been made since 2003 while biking to work, a 17-km route through a mix of housing and pastures. These data reveal a strong seasonal ebb and flow of species and show the numerical dominance of naturalised species. Cars are a substantial source of mortality, killing more individuals of many

bird species in a year than I see on any ride. Suburban areas in south-western Christchurch, away from the Port Hills and restoration areas, have as few native forest birds as farmland. With surprisingly few exceptions, fantails and grey warblers are only where there is dense, tall, evergreen vegetation. Bellbirds are where there are trees with bird-flowers (especially eucalypts) and are largely absent when these trees are not flowering. This suggests that even our most adaptable native forest birds are strongly habitat-limited in these landscapes, highlighting the importance of retaining and growing areas of tall evergreen trees. Long-term quantitative data like these are essential for assessing the long-term effects of land development, invasions, and climate change on local biodiversity. I encourage everyone to pick a few taxa and standard routes and start recording.

How traditional ecological knowledge can survive under government policies in Inner Mongolia

Oral presentation (Student Day)

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The importance of Traditional Ecological Knowledge (TEK) and the need to conserve it have been internationally recognised in recent years. Despite an ongoing debate about which conservation mechanisms are most effective, governmental policy is one of the major means in TEK conservation. Chinese governmental policies, however, are often considered to be responsible for a loss of TEK in many minority areas. My paper examines the historical effects and recent change of Chinese governmental policies on indigenous communities and their TEK in Inner Mongolia. Two case studies are presented: The first one is from the Alashan region and reflects the failure of governmental policy on natural resource management by ignoring Mongolian TEK and excluding indigenous communities from conservation efforts. The second case study, from Wu Qi, explores the potential of utilising a newly enacted law, which encourages more economic independence for local organisations, to conserve and revitalise TEK, especially traditional institutions in Inner Mongolia.

How well can kinky fish swim? Trematode infections in a threatened species

Poster presentation

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Freshwater ecosystems are home to a multitude of parasites, which affect their hosts in a variety of ways. These alterations often directly or indirectly increase trophic transmission to the definitive host, e.g. skeletal malformations in amphibians in North America. More recently, malformations have been identified in juveniles of a threatened native galaxiid species, *Galaxias anomalus*, caused by the trematode parasite *Telogaster opisthorchis* in Otago. *Telogaster opisthorchis* infects the galaxiid (its intermediate host) at all stages of the fish's life, yet the effect of parasites in younger fish is likely to be greater as they have lower body reserves and a relatively high metabolism. Malformations are likely to amplify these effects as parasites have been found to decrease the condition of host individuals, leading to a greater chance of predation and transmission of the parasite. The discovery of malformations in amphibians has been linked to the rapid decline in population numbers of numerous species. It is possible a similar trend may occur in *G. anomalus* and therefore it is important to understand how parasites are causing malformations and their subsequent effects. By analysing the performance of young fish in a series of laboratory experiments, we assessed the swimming performance and condition of infected fish relative to control fish and their likelihood of survival. Our results shed new light on the impacts of parasitism and the resulting malformations on the survival of these fish, and could lead to the implementation of better conservation practices.

Spatial patterns in recruitment of large-fruited plants on northern New Zealand islands with or without the NZ pigeon *Hemiphaga novaeseelandiae*

Oral presentation

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Recruitment of many species of plant is dependent on dispersal of seed by animals. In some locations, the species responsible for plant dispersal are rare, and some are now extinct. This loss of dispersers has the potential to change the pattern of plant recruitment and plant community structure, which contributes to ecosystem change. We examine the differences in large-fruited plant recruitment patterns on three islands: one on which the NZ pigeon, the sole remaining disperser of these fruit, is extinct; one on which the NZ pigeon is common; and one on which the

NZ pigeon is rare. Marked differences in recruitment pattern were observed for plant species with a minimum seed diameter of ≥8 mm on the island without the NZ pigeon in comparison with the other two islands. These differences included: reduced maximum dispersal distance, increased clumping of offspring, reduced mixing of offspring of different species, and a reduced rate of recolonisation. Kernels fitted to the recruitment data from the different islands indicated considerable differences in the frequency of dispersal over distance. In particular the kernels for large-fruited, 'undispersed', species showed a rapid decrease in recruit density with increasing distance from source. The results for *Corynocarpus laevigatus* (karaka) consistently differed from other plant species, and it is possible this species is not native to New Zealand. The loss of dispersers of large fruit is likely to result in changes to forest communities and their inhabitants, though in New Zealand this process is likely to be slow.

Eat now or cache for later?

Poster presentation

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Caching or food hoarding is a behaviour in which an animal that obtains a food item does not immediately eat it, but instead stores it for consumption at a later time. Although a cache or series of caches can provide a future benefit in ensuring food at a later date, energy intake should outweigh the costs of caching, and a caching animal must also protect or hide its cache site(s) from thieves. I investigated three hypotheses on the caching strategies used by the South Island robin (*Petroica australis*): (1) does caching vary with prey size? (2) does caching behaviour vary with observer presence? and (3) does stealing affect caching behaviour? Previous research shows that male robins are dominant over females and protect caches from their mate via aggression and the use of scatter hoarding. I stimulated caching in male robins by feeding mealworms (*Tenebrio molitor*) of differing sizes and in differing social situations. Results show: (1) robins more often cache larger mealworms, whereas smaller mealworms are eaten immediately; (2) caching behaviour does not change with an observer's attentional state; and (3) robins cached with less visibility between them and a known thief. These results indicate that male robins adjust their caching behaviour depending on the value of the prey item and the risk it will be stolen.

A pastureland grand skink population: what can it tell us?

Oral presentation

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Mark–recapture methods were used to determine population abundance and life history of five grand skink (*Oligosoma grande* Scincidae) populations over 6 years at Macraes Flat, Otago. The population ecology of tussockland populations and a pastureland population were contrasted. All grand skink populations showed evidence of declines, with the exception of the pastureland population. The pastureland population excelled in all life-history traits measured: annual reproductive output was 1.66, 30% of newborns persisted 5+ years, adult survivorship averaged 0.84, and 36% of newborns were recruited to the adult population. In contrast, declining populations were seriously deficient in one or more traits. The influx of nutrients into the pastureland system may have supplied the skinks with a better food environment, allowing higher fecundity, recruitment and survival and therefore effectively offsetting, at least in the short term, the effects of predators. This theory is explored and illustrated with data examining the link between agricultural development, rabbits and skink predators.

Invertebrate biodiversity in organic and IPM kiwifruit orchards

Oral presentation

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In New Zealand, kiwifruit are grown under either organic or integrated pest management (IPM) systems. These systems aim to reduce environmental impacts by reducing the use of synthetic pesticides. To compare the effect of these different management systems on native biodiversity, this study assessed invertebrate biodiversity in 10 matched pairs of organic and IPM kiwifruit orchards. Three types of trap were used to collect as many different invertebrate taxa as possible in three trapping periods spread over the 2007/08 fruit-growing season. A total of 602 taxa were identified in the samples. Significantly more taxa were collected from the organic orchards than the IPM orchards in all three periods. The invertebrate assemblages in the two orchard types were also significantly different in the collections made in January and March 2008, but not in October 2007. There was no significant difference in the proportion of native or endemic species collected from the two orchard types, although the identified

species differed between the two management systems. This suggests that both management types are providing suitable habitat for a range of native and endemic invertebrates. However, the higher overall biodiversity in the organic orchards, and the correlation of several natural enemies and decomposers with the samples collected from the organic orchards, may indicate the presence of more-robust ecosystem services in these orchards and opportunities for further improvement of the orchards grown under the IPM system.

Effects of the native millipede (*Spirobolellus antipodarus,* Spirobolellidae) and the exotic species (*Oxidus gracilis*, Paradoxosomatidae) on decomposition processes in plant microcosms

Oral presentation

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Decomposition and nutrient cycling are key ecosystem functions in New Zealand native forests, but there is limited understanding of both the role of different groups of native soil fauna on decomposition processes and how these processes may have been affected by introduced species. The co-existence of native and introduced detritivores in native broadleaved forests raises the issue of whether native and exotic species differ in their effects on the rate and timing of decomposition and the implications for plant growth. Millipedes (Diplopoda) were the focus of this study, which examined their effect on decomposition processes in plant microcosms containing seedlings of pūriri (*Vitex lucens*). The millipede species included the native millipede *Spirobolellus antipodarus* and the cosmopolitan exotic species *Oxidus gracilis,* which co-exist in native broadleaved forests in the Auckland Region. Microcosm treatments included controls with no millipedes, single-species treatments with *O. gracilis* or *S. antipodarus* alone, and low and high density combinations of the two species. Litterbags were used to compare decomposition rates in microcosms under different treatment regimes. Plant growth rates were measured and nutrients in the soil and leaves were analysed to determine whether differences in the rates of litter breakdown affected plant growth and nutrient levels. The results showed significant differences in litter decomposition rates under the different millipede treatments, suggesting that the rate and timing of decomposition may be influenced by different species and species combinations of millipedes.

Synergistic effects of glyphosate formulation and parasite infection on fish malformations and survival

Oral presentation

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Anthropogenic pollution and disease can cause both lethal and sub-lethal effects in aquatic species but our understanding of how these stressors interact is often not known. Contaminants can reduce host resistance to disease, but whether hosts are impacted at environmentally relevant concentrations is poorly understood. Previous work has shown how the trematode *Telogaster opisthorchis* causes severe malformations leading to population effects in roundhead galaxias *Galaxias anomalus*. Here we investigated the independent and combined effects of exposure to the common herbicide glyphosate and *T. opisthorchis* on survival and the development of spinal malformations in juvenile *G. anomalus*. Survival of juvenile fish was unaffected by exposure to glyphosate alone (at an environmentally relevant concentration) or by *T. opisthorchis* infection alone. However, simultaneous exposure to infection and glyphosate significantly reduced fish survival. Juvenile fish developed spinal malformations when exposed either to infections alone or to infections and glyphosate, with a trend towards greater severity of spinal malformations after exposure to both stressors. This is the first study to show that parasites and glyphosate can act synergistically on aquatic vertebrates at environmentally relevant concentrations, and that glyphosate might increase the risk of disease in fish. Our results have important implications when identifying risks to aquatic communities and suggest that threshold levels of glyphosate currently set by regulatory authorities do not adequately protect freshwater systems.

The complex ecological impacts in streams of multiple anthropogenic stressors

Oral presentation

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Streams are affected worldwide by nutrient enrichment, inputs of sediment and pesticides, raised water temperatures, reduced discharge due to water abstraction for irrigation, and the introduction of invaders. Each of these stressors can be expected to exert individual effects on stream community composition and ecosystem functioning, but their combined impacts are poorly known. In a series of investigations in

streams and streamside channels we have studied key stressors in pairs and triplets, using factorial designs, to determine their individual and combined effects on community composition (invertebrates, fish and algae), algal biomass and leaf decomposition. Each stressor had strong individual effects, but in combination they often produced synergistic or antagonistic outcomes. For example, the presence of fine sediment can prolong the adverse effects of herbicide in streams. Moreover, the reduced flow associated with water abstraction often acts synergistically to increase the negative impact of sediment on the bed. In contrast, water abstraction acted antagonistically to decrease the adverse impact of invasive trout on native fish by providing refuges from trout predation. The ecological consequences of multiple stressors are often unpredictable on the basis of knowledge of single effects. Our findings imply that if river managers do not know how stressors interact with each other, their assessment of risk may be higher or lower than reality.

Inbreeding depression, multilocus heterozygosity and fitness in a small, inbred population of South Island robins

Oral presentation

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It is widely accepted that inbreeding depression poses a potential threat to the persistence of small or isolated populations. However, the fitness consequences of mating between related individuals in the wild are relatively poorly understood. Accurately estimating levels of inbreeding in free-ranging populations is difficult and gathering data to estimate fitness often requires intensive monitoring. While molecular estimates of inbreeding may be made using genetic markers such as microsatellites, the interpretation of resulting heterozygosity fitness correlations (HFCs) with respect to inbreeding depression is not always straightforward. In this study, we consider the cost of inbreeding in a small, isolated population of South Island robins (*Petroica australis*). This population has been closely monitored since its initial translocation to Ulva Island in 2000. As result, we are able to construct a highly accurate pedigree. This presents an ideal situation for investigating both HFCs and inbreeding. We examine the relationship between multilocus heterozygosity at microsatellite loci and fitness within sibling pairs across a range of inbreeding levels. Same-nest siblings are subject to similar conditions during nestling and fledgling periods and have similar levels of genome-wide heterozygosity. The implications of these results for interpreting HFCs in conservation scenarios where detailed pedigrees are unavailable will be discussed.

Functional biodiversity under land-use intensification: separating cause and consequence

Oral presentation

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Land-use change is the primary driver of biodiversity loss. Economic arguments for conservation, based on the provision of ecosystem services, suggest that biodiversity can provide direct benefits to farmers through increased yield and/or reduced pest damage. Yet, the global intensification of agriculture has resulted in dramatically increased yields, despite equally dramatic losses of biodiversity. This suggests that any positive effects of biodiversity on ecosystem functioning may be overwhelmed by the effects of the environmental drivers that drive biodiversity loss in the first place. Previous experimental studies have generally failed to take this into account. Indeed, the random assemblages of species primarily used in those studies bear little resemblance to communities generated by the non-random changes in biodiversity following environmental perturbation. Therefore, the most critical aspects of the diversity–function relationship in terms of ecosystem services are: (1) what aspects of biodiversity are most important for promoting functions that are of direct benefit to farmers? (2) Which species traits are selected for by environmental changes and how do they relate to functioning? (3) What are the relative strengths of the direct and indirect pathways involving land-use change, biodiversity and ecosystem functioning? Here we show that long-term (27-year), realistic manipulations of soil resource availability and grazing intensity in grasslands caused shifts in plant functional composition and diversity, with cascading effects on multiple ecosystem processes. Resource availability exerted dominant control over above-ground production and litter decomposition, both directly and indirectly via plant trait shifts. Importantly, increasing resource availability moderated the impacts of grazing intensity and plant functional diversity on these processes, shifting them both from negative to positive. These changes in turn altered soil respiration and soil carbon sequestration. Our study reveals that human changes to resource availability and grazing pressure directly, indirectly, and interactively control ecosystem functioning and carbon sequestration. Our results also show that the link between biodiversity and ecosystem functioning provides a poor argument for native biodiversity conservation, at least in these grasslands. On the other hand, they show that functional diversity can be important for ecosystem functioning, even against the background of other abiotic and biotic drivers, provided there are sufficient soil resources. This supports the idea that functionally diverse species mixtures offer a promising avenue for improving the efficiency of production systems, such as intensive pastures of biofuel crops on abandoned agricultural land.

Urban areas: integrating human dimensions with conservation biology

Oral presentation

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Biodiversity conservation in urban areas addresses the need to both provide the majority of the human population with opportunities to encounter nature and engage with wildlife on a day-to-day basis, which in turn can engender life-long interest in and support for nature, and to protect and enhance significant populations of native species. However, in contrast to less modified landscapes where spatial variations in biodiversity are the result of variations in resource availability and environmental factors, in cities variation is driven by a mix of socio-economic (e.g. income, education, age) and land-use factors as well as environmental factors. Individual city dwellers may be socialised by their cultural and social backgrounds to prefer different landscapes, placing different emphases on features such as canopy structure, and proportions of vegetative cover and native plants. Ecosystem function is heavily influenced by the integrated outcomes of householder choices, as well as city-level management strategies and decisions. Given the degree to which urban dwellers structure the environment, effective conservation in this human-shaped landscape is very much dependent on effective collaborations between conservation biologists and social scientists, as well as between city dwellers and scientists/managers (citizen science). There are numerous barriers to integrating social science and conservation, disciplines that differ in fundamental ways. Here we review the challenges in achieving this integration.

Conservation of New Zealand's coastal cresses: genetic influences on the response to the new threat of introduced plant viruses

Oral presentation

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Lepidium oleraceum agg. (Cooks scurvy grass) and *Lepidium banksii* make up two of the six native coastal cresses threatened with extinction. The reasons for their decline are numerous and include many that are synonymous with biodiversity loss worldwide such as habitat loss and the loss of associated animal mutualisms. Both of these species are now restricted to small isolated populations scattered around the New Zealand coastline and its associated offshore islands. The

genetic consequences of small populations have been well studied and processes such as inbreeding depression and genetic swamping can play large roles in the persistence of populations. Recently the discovery of *Turnip mosaic virus* (TuMV) in one of the Banks Peninsula *L. oleraceum* agg. populations has added to the threats already faced. Plant viruses can have large effects on fitness of individuals and populations, causing reduced growth and fecundity. There is anecdotal evidence that this may be the case for *L. oleraceum* agg. We surveyed seven small South Island populations for viruses finding widespread infection of TuMV and *Cauliflower mosaic virus* (CaMV), which was previously undescribed in this genus. Following these findings, a series of experiments have been conducted to examine how important genetic processes such as inbreeding and hybridisation will interact with the effects of these plant viruses. This may be some of the first direct evidence of introduced viruses affecting the conservation of threatened plant species. Results from this research may lead to changes in how we understand and manage endangered plant species. An overview of the study, rationale and preliminary results will be presented.

Marching up the mountain? Mechanisms of high altitude woodland expansion into the Australian alpine zone

Oral presentation

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The high altitude treeline is a transition zone between subalpine woodland and alpine tundra and is strongly temperature dependent. Warmer summers predicted for the Australian alpine zone in coming decades are expected to facilitate upslope movement of the treeline, as low temperature limits on trees are diminished. However, the treeline species in the Snowy Mountains, snowgum (*Eucalyptus pauciflora* subsp*. niphophila*), shows great tenacity; it cannot spread vegetatively, has limited seed dispersal mechanisms and very low seedling recruitment rates, is highly vulnerable to frost, does not readily germinate from the soil seed bank, and there are few examples of upslope regeneration after fire. Treeline movement appears limited. However, recent observations of recruitment processes operating at linear stripes of trees established above the contiguous woodland may reveal mechanisms by which the treeline can ‘move’ uphill. These landscape features are dominated by trees that are several hundred years old, but there appears to have been more recent tree regeneration downwind, which is also downslope of the stripes of mature trees, essentially backfilling to the existing treeline. We investigate the mechanisms that have maintained these features in the past and how snow, wind and fire may be interacting to promote expansion of the subalpine woodland.

The birds and the bees in the trees: the role of isolated specimen trees in supporting urban biodiversity

Oral presentation

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The rapid growth of towns and cities worldwide is a continuing trend, with dramatic implications for biodiversity at all scales. Sustaining urban biodiversity has been shown to have measurable benefits for nature conservation, and also for the maintenance of community health and well-being. Large, isolated trees are an unexamined part of the urban ecological landscape and offer a novel avenue of research, despite their status as keystone structures in other modified landscapes. Observational data have been collected over a 12-month period on bird use of 40 individual trees representing four tree species around urban Dunedin. Preliminary findings indicate that (1) the majority of bird visits to these trees are for dispersal purposes; (2) the landscape context in which the tree is situated may be a more important factor in determining patterns of usage than the species of the tree; (3) 'corridor effects' of bird movements through the landscape are evident. Future directions for this research will also be discussed.

Linking biodiversity reporting, resource allocation and data gathering in New Zealand with a common framework

Oral presentation

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New Zealand needs better methods of prioritising biodiversity work, reporting on net achievement and the difference that work has made, and cost-effectively gathering biodiversity data. There is also growing demand for understanding trade-offs, collateral effects on biodiversity (e.g. from carbon storage), and the adequacy of biodiversity compensation. These different needs are often approached in a fragmented fashion. In this talk we will propose that the three needs are linked, and could be efficiently approached in New Zealand using a common basic model of how biodiversity works. We will set out what we see as the basic requirements (the framework) for such a model, that would serve the need to prioritise across and report on the difference made by very different actions such as pest control and reserve acquisition, by a range of different agencies. In doing so, we will describe some of the key international and home-grown ideas that need to be incorporated. Using the VSA (Vital Sites and Actions) model of Overton et al. for terrestrial biodiversity as an example, we will argue that such a model clarifies New Zealand's biodiversity inventory and monitoring

requirements, and also many research requirements; priority new information to collect is that which will add most value to how we allocate scarce biodiversity management resources and report on achievement and net progress. We will discuss the potential benefit of populating and improving a central, cross-agency New Zealand biodiversity information repository to inform diverse biodiversity prioritisation and reporting needs.

The importance of history: molecular data reveal dynamic responses to environmental change

Oral presentation

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In New Zealand, seven centuries of human occupation have decimated an indigenous vertebrate fauna that evolved in the absence of terrestrial mammalian predators. Although the prevailing paradigm interprets surviving taxa as declining remnants of previously abundant populations, recent genetic data provide a warning against such simplistic narratives. As a case in point, ancient DNA analyses of *Megadyptes* penguin sub-fossils suggest a dynamic extinction–recolonisation scenario. Specifically, our data indicate that the yellow-eyed penguin (*M. antipodes*) may be a new (AD 1500–1800) arrival from the subantarctic following the recent extinction of its previously unrecognised New Zealand sister species, the Waitaha penguin (*M. waitaha*). Indeed, Bayesian analyses of genotypic data imply that this northward expansion of *M. antipodes* occurred as recently as 500 years ago, approximately two centuries after the arrival of Polynesians. In another possible case of extinction and replacement, recent mtDNA analyses of little blue penguins (*Eudyptula*) suggest a parallel expansion event into southern New Zealand. Are extinction–recolonisation events such as the one inferred for *Megadyptes* the exception, or are they the rule? Certainly, it is becoming clear that environmental change and extinction can facilitate rapid colonisation across enormous geographic scales (e.g. *Durvillaea antarctica*). Additionally, there can be little doubt that New Zealand represents one of the world's most informative systems for studying the consequences of recent human impacts.

Monitoring giant weta using footprint tracking tunnels

Oral presentation

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Giant weta (Orthoptera: Anostostomatidae) are iconic endemic New Zealand species, and are often of high conservation value. Despite this no method for surveying or monitoring them exists that does not involve laboriously searching habitat. Here we detail the development of a novel monitoring technique for detecting giant weta using footprint tracking tunnels. The method, which is efficient and produces unambiguous results, was originally investigated with the nationally endangered Little Barrier Island giant weta, or wetapunga (*Deinacrida heteracantha*), New Zealand's largest terrestrial invertebrate. Our results showed that adult wetapunga produced significantly longer tarsal pad footprint lengths than subadult wetapunga and Auckland tree weta, but tarsal pad length could not be used to distinguish subadult wetapunga from adult Auckland tree weta. Setting tunnels on the ground detected greater numbers of wetapunga than setting them on tree branches, and peanut butter placed inside the tunnels as an attractant bait increased the detection rate of adult wetapunga. This monitoring technique has now been used to monitor translocated populations of other giant weta including Mahoenui giant weta (*D. mahoenui*), Cook Strait giant weta (*D. rugosa*) and Mercury Islands tusked weta (*Motuweta isolata*). Recently, tracking tunnels have also been used to monitor other species of weta including Auckland tree weta after mammal eradication. Future research is required to determine how tracking rates of giant weta relate to the population density.

Intensive development of New Zealand's indigenous grasslands: rates of change, assessment of vulnerability and protection priorities

Oral presentation (Student Day)

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Though most of New Zealand's indigenous grasslands have been modified to varying degrees, they have continued to support a rich flora characterised by high species diversity. However, recent changes in land-use activities have led to further fragmentation and likely extinction of some rare and threatened species. An increasing number of indigenous grasslands (in the South Island), formerly used for extensive grazing, are being converted for intensive agricultural activities. Areas once covered by indigenous grassland species have been replaced with exotic pasture, forestry plantations, and perennial crops. While the loss of grasslands to arable cultivation is found throughout the South Island, most of the change was found in three major river basins: the Waitaki, Taieri, and Clutha. In particular, there was a noticeable increase in the rate of change in the Waitaki, where cultivated land has doubled in the past 10 years, and irrigated land has quadrupled over the same time period. There are a suite of environmental, social and economic 'predictors' of this change, including regional council, ownership status, distance to previous change

and slope. These predictors are used to indicate areas vulnerable to future land-use change. If land-use change continues at the current rate, in combination with the other changes (such as climate change, and invasive species), New Zealand's indigenous grasslands will have some of the largest changes in terms of altered biodiversity.

Sex- and season-dependent behaviour in the Auckland tree weta

Oral presentation

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We set up artificial cavities to investigate movement and occupancy patterns in the Auckland tree weta in an urban forest fragment in Hamilton. Weta made use of the artificial refuges rapidly and rates of use were higher than in any previous study of tree weta. Single weta were the most common 'household type' in cavities, and females outnumbered males all year. During initial colonisation, single females were less likely to depart from refuges than cohabiting females. Both male and female weta moved into refuges occupied by a weta of the opposite sex more often than expected by chance alone, but females avoided cavities with another female present, except during the summer. For the first time we observed seasonal change in the pattern of male–female aggregations, with most harems formed in summer, due to a change in female behaviour. Departure rates provide evidence that males are more mobile than females but only in winter and spring. We therefore propose that both sexes actively seek mating partners during the summer.

Habitat and seasonal influences on New Zealand farmland bird populations

Poster presentation

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The influence of farm-level habitat parameters on the population density of four species of common farmland birds (skylark *Alauda arvensis*, common blackbird *Turdus merula*, song thrush *Turdus philomelos*, Australian magpie *Gymnorhina tibicen*) was investigated on South Island sheep and beef farms. Bird populations were monitored on 12 pastoral farms located between Banks Peninsula (Canterbury) and Owaka

(South Otago), using line transect distance sampling. Each farm was visited 9–10 times between November 2005 and August 2007. Percentage of woody vegetation on farms was found to have the largest effect on population density, being positively correlated with thrush and blackbird densities and negatively with skylark densities. Thrushes and blackbirds also showed strong seasonal population dynamics, part of which could be traced to seasonal changes in availability for detection. In contrast, the abundance of magpies did not vary seasonally or with percentage of woody vegetation. There was limited indication that bird densities differed between farms under organic, integrated, or conventional management regimes, suggesting that studies with higher replication or focusing on less generalist species are needed to address this question in New Zealand farmlands.

Effect of colour on bait consumption of kea (*Nestor notabilis*): implications for deterring birds from toxic baits

Poster presentation

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The kea (*Nestor notabilis*), an endemic New Zealand parrot, is at risk of primary poisoning during 1080 possum control operations. This project aimed at providing information on bait attractiveness and hence increasing the safety of toxic baits. To achieve this a feeding trial with captive kea was conducted, which investigated their colour preferences by offering dyed cake in six different colours over six consecutive days. On average, the order of preference was yellow>red>brown>mid-blue>dark-blue>green with some variation between individual birds. Nevertheless, all birds encountered and consumed less green-dyed cake throughout the trial. These results are similar to previous studies on other bird species, including two natives, which suggests that there might be general colour preferences. However, due to kea's opportunistic feeding behaviour and inquisitive nature an additional deterrent to colour may be necessary to deter free-ranging birds from consuming any toxic bait.

Kei ngaro i te moa: whakataukī and the relationships between biological, linguistic and cultural diversity

Oral presentation

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Whakataukī have been described as a blueprint for living. As such, they encapsulate many of the principles of te ao Māori. We investigate how these messages are conveyed, through an analysis of native and exotic fauna represented in them. We ask what animal groups and species appear most frequently, discuss the ecological context around them, and the vocabulary and ideas used in these references. We then investigate a sample of whakataukī and pepeha from two tribal areas, to determine whether these patterns are similar or generic in nature. We consider these whakataukī within a conservation framework, and also discuss the links between biological, linguistic and cultural diversity.

Exploring *Phytophthora* taxon *Agathis* associated kauri dieback in the Waitakere Range using dendrochronology and spatial analysis

Oral presentation

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The dieback of *Agathis australis*, kauri, across large parts of its range can be attributed to a soil-borne pathogen discovered in the 1970s. While the evidence is often clear that the phytopathogen *Phytophthora* taxon *Agathis* (PTA) is resulting in kauri mortality, there is considerable uncertainty as to how PTA interacts with and affects its host and environment. Here we evaluate the growth response of kauri to the disease and spatial ecology of the disease. The dynamics of affected stands of regenerating kauri forest were explored at three field sites, two at Huia and one at Piha, in the Waitakere Ranges, west of Auckland. A total of 100 tree cores were collected from symptomatic and asymptomatic kauri and analysed using dendrochronological techniques to determine whether symptoms are expressed in the tree-ring pattern during illness and prior to death. The dieback dynamics are examined in detail at a Huia site permanent vegetation plot, established in 2006, using dendrochronological analysis and spatial studies. All individual kauri were mapped within an area of approximately 1 km^2 at Huia; these data are used to examine

fine-scale patterns in symptomatic and asymptomatic individuals and the role of landscape effects such as topography and water movement in promoting the local (i.e. within-stand) spread of the disease. Understanding how the phytopathogen *Phytophthora* taxon *Agathis* is affecting *A. australis* is essential to making appropriate decisions so that its effects on kauri and associated ecosystems can be mitigated.

Building a population of the critically endangered skink *Oligosoma grande* from scratch: simulation, trial, estimation and reassessment

Oral presentation

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The in situ management of the critically endangered skink *Oligosoma grande* currently hinges on the ongoing health of a single large ridge-top population at Macraes Flat. Given the skink's vulnerability it is desirable to have additional populations for management purposes. Our spatial meta-population simulation suggested that the establishment of additional populations could be facilitated by the translocation of grand skinks into vacant areas of predator-protected habitat. Areas identified by modelling as judicious translocation sites were ground-truthed by an experienced survey team in 2008. In October 2009 we began a translocation trial. We moved 19 grand skinks from four locations into what was identified as viable habitat. The founder population was made up of 10 young-of-the-year and nine sexually mature grand skinks. In order to assess immediate survival and fidelity differences over the first two months five periodic photo-resight surveys were conducted and examined using a Cormark–Jolly–Seber analysis. High apparent survival rates over this period suggested immediate homing is not a factor of concern. Subsequent estimation in summer of survival and abundance using a robust design methodology also allowed the testing and validation of our standard abundance estimation technique. Autumnal surveys revealed that gravid females had given birth to healthy offspring and that while some adults were absent from the translocation site all translocated juveniles had survived. The final post-winter monitoring and analysis is scheduled for early October 2010 and a reassessment of the trial translocation will be presented.

Wetland communities

Oral presentation

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Wetlands were important sources of kai in the pre-contact Māori world but most have been drained for farming. In the few that remain some species are extinct, locally at least, or seriously depleted. For example, giant kōkopu, which once frequently grew to two feet (60 cm) are now rare at half that size, largely due to the ravages of introduced trout, and raupō, an important habitat plant, has been eradicated from many waterways. There are only a few places where these trends are being reversed, largely due to a refocus on Māori cultural values, which has been made possible by mechanisms introduced as a result of Treaty settlements.

Abundance of small skinks in predator management treatments at Macraes Flat

Oral presentation

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Predator control regimes were established in 2005–2006 at Macraes Flat, to protect endangered grand skinks and Otago skinks. We sampled three other species of small, relatively abundant skinks (common skinks, McCann's skinks, and cryptic skinks) inside a mammal-proof fence, at two sites in an intensive mammal-removal area, and at an experimental control site with no mammal removal. In 2007 and 2009 we estimated skink population density based on capture–mark–recapture in pitfall traps over five consecutive days. In 2009 we also counted skinks found under artificial cover objects (ACOs) at dawn on one day and at noon 4 days later. Our results provide an estimate and two indices of the abundance of the small skink species, 1–3 years after implementation of predator management. The estimated density of skinks was higher in the mammal removal treatments than at the experimental control site, but the pattern of between-treatment differences varied by species. Treatment effects on single-day counts of skinks in ACOs were less marked. The differences between treatments were consistent with our earlier population estimates based on capture–mark–recapture in ACOs in 2006, and it is important to recognise that we have no data before predator removal began. We outline a new sampling programme to study the abundance of small lizards along a gradient of distance from the core of the Macraes Flat predator control area.

Using boosted regression trees and fuzzy clustering to map and validate a national-scale quantitative classification of New Zealand forests

Oral presentation

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Maps of vegetation classifications provide critical information to meet management and policy needs. Past national-scale maps relied on expert concepts of vegetation types to optimise mapping from aerial imagery. In 2007, the New Zealand Carbon Monitoring System completed the collection of vegetation data from 1177 permanent plots established on an 8-km^2 grid across the mapped area of native woody vegetation. We classified these data using beta-flexible clustering with Sorenson's distance measure to define 24 woody vegetation classes, each comprising 19–105 plots. We use four classes of mapped variables (climate, topography, landcover, and disturbance) to derive spatial predictions of the occurrence of each class using boosted regression trees. Across the 24 classes, mean annual temperature was the most important predictor with landcover, climate variables and earthquake frequency of secondary importance. Goodness of fit of predictions (AUC) varied from 0.81 to 0.97. We used the spatial predictions to produce two types of composite maps, one with discrete boundaries between classes, as are displayed in traditional vegetation maps, and one with fuzzy boundaries to depict ecotones. We validated the resultant maps in two ways. First we compared them with existing maps for specific locations. Second, we assigned plots from a new dataset to one of the 24 classes using fuzzy clustering and compared this assignment to that of the maps, based on spatial location. We demonstrate this process with examples from Stewart Island and Mangatu Forest.

Inter-population variation and sociality of the North Island rifleman (*Acanthisitta chloris granti*): implications for conservation management

Poster presentation

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Species management strategies are often formulated and carried out after a species has become endangered or threatened. This inevitably leads to strategies that are limited in their scope to collect explorative information related to the ecology and variation present within the species' distribution.

Unfortunately this often results in a lack of fundamental knowledge related to that species, particularly in relation to aspects of their biology that may influence the success or failure of particular management strategies. Translocation is a management strategy that is being increasingly utilised as a tool for expanding the range of a declining or fragmented species. However, individuals from threatened species are often translocated between populations or into new areas with little knowledge of the variation inherent between meta-populations. So how do we define appropriate objectives and priorities without this fundamental information? Using mitochondrial DNA analysis, bio-acoustic techniques and morphological comparisons, my research focuses on collecting both ecological and genetic data to identify variation between separated populations of the North Island rifleman (*Acanthisitta chloris granti*), a subspecies that is not yet endangered, but which is declining and becoming increasingly fragmented. I will discuss the findings of the project to date and the implications of the work for the definition of appropriate management strategies for the subspecies, particularly with regard to the use of translocation as a tool for future management.

Seasonal variation in habitat use by South Island giant moa (*Dinornis robustus*) and upland moa (*Megalapteryx didinus*)

Poster presentation

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Coprolites (preserved dung), deposited between AD 975 and 1408, were recovered from a rockshelter in the Dart River valley, Otago. Ancient DNA identified coprolites from three moa species: South Island giant moa (*Dinornis robustus*), upland moa (*Megalapteryx didinus*), and heavy-footed moa (*Pachyornis elephantopus*). Although there was significant overlap between seed assemblages in coprolites from the three moa species, 40% contained no seeds, masking potential variability in diets and habitat use. To provide greater resolution of habitat use, we analysed pollen from the coprolites. Each coprolite was assigned a likely season based on the following criteria: low pollen abundance, low seed abundance = winter; abundant pollen, low seed abundance = spring to early summer; moderate–low pollen abundance, high seed abundance = late summer to autumn. For *D. robustus* and *M. didinus*, winter coprolite pollen assemblages were dominated by forest taxa (*Nothofagus* spp. and ferns). Pollen assemblages from warmer season coprolites were dominated by grassland herbs and small shrubs, and in the case of *D. robustus*, several were dominated by *Coprosma* spp.. Whether this spring–early summer dichotomy in *D. robustus* potentially reflects sex-related habitat segregation during the breeding season remains to be tested. The assignment of seasons and habitats to the

moa coprolites was supported by baseline data obtained from pollen analysis of mammalian herbivore (deer, goat, and hare) dung collected near the coprolite site. The pattern of seasonal habitat use observed in these two moa species reflects that of red deer (*Cervus elaphus*), and of another endemic avian herbivore, the takahē (*Porphyrio hochstetteri*).

Farmland biodiversity: evaluating and enhancing it

Oral presentation

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The biodiversity – ecosystem function debate is active and of high relevance to the future of farming. Many governments are analysing farming's prospects for the coming decades –see www.foresight.gov.uk. Key questions include which aspects of functional diversity are most important, what are their values and where, when and how they should be deployed in the farming landscape? This presentation will illustrate these questions with data from current experimental work in New Zealand and Denmark to show how theoretical and experimental ecology can lead to the creation of Service Providing Units (SPUs).

Mutualism or opportunism? Tree fuchsia (*Fuchsia excorticata*) and tree weta (*Hemideina*) interactions

Oral presentation

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Mutualisms or interspecific interactions involving net mutual benefits are an important component of ecological theory, although effectively demonstrating mutualism is notoriously difficult. Among two New Zealand endemics, a slightly elevated germination rate of *Fuchsia excorticata* (Onagraceae) seeds after passage through tree weta (Orthoptera: Anostostomatidae) compared with seeds manually extracted from fruit led to the proposal that a mutualistic relationship exists between this plant and animal. An improved germination rate, or any other single trait, however, does not alone constitute evidence for mutualism; the relative costs and benefits of numerous components of the interaction need to be accounted for. We considered the costs and benefits to *F. excorticata* of the putative seed dispersal mutualism with tree weta. Tree weta provided with *F. excorticata* fruits destroyed

78% of the seeds they consumed, did not move fruit, and faeces containing seeds were deposited near their roost holes (which are naturally in trees). The seeds remaining after fruit consumption and those that are ingested but survive gut passage are unlikely to be deposited in suitable habitat for seedling survival. Plant food preferences of captive tree weta assessed using pairwise leaf choice tests showed that the leaves of *F. excorticata* were the least preferred of six commonly encountered plants. In addition, we found that tree weta did not show a preference for *F. excorticata* fruit over a standard leafy diet, indicating they are unlikely to be actively seeking fruit in preference to other sources of food. These observations indicate that any interaction between tree weta and *F. excorticata* is likely to be opportunistic rather than mutualistic, and highlight the difficulty of characterising such interactions.

Alternative stable state theory in kauri forest: kauri as an ecosystem engineer and its effects on its associated plant communities

Poster presentation

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New Zealand kauri (*Agathis australis*) is the largest and longest lived tree species in New Zealand forests, dominating its ecosystems and known to exert a substantial influence on soil properties and nutrient cycling. Although considerable research has investigated the effects of kauri on its soils, less is known about the potential importance of the species in shaping habitats, or its influence on its associated plant communities. These communities are often highly distinctive since species that may be rare in adjacent forest types are common in kauri-dominated forest and vice versa, causing marked changes in species composition between sites where kauri is present or absent. The alternative stable state theory proposes the existence of ecosystems in which two or more ‘states’ can occur for a given set of environmental conditions, with various feedback processes acting to maintain the system in one or another state. The present research aims to determine whether the characteristics of the vegetation in kauri and adjacent forest ecosystems can be explained by this theory with kauri creating its ecosystem state through feedback mechanisms that enhance its persistence. The research will allow assessment of the ecological importance of kauri within its communities, thus determining how potential risk factors that threaten kauri may also threaten the wider plant community. Preliminary results indicate that kauri may significantly influence its neighbouring plants, controlling the suites of species that coexist with it and creating habitat for a range of species that otherwise may not occur in the region.

Dispersal of seeds of fleshy-fruited alpine plants: the roles of kea, introduced mammals and other frugivores

Oral presentation

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Fleshy-fruitedness is prevalent in New Zealand's alpine plants, thus requiring seed dispersal services from animals. Alpine ecosystems are depauperate in indigenous frugivorous birds and lizards due to extinctions and the decline in abundance and distribution of extant fauna. This, in addition to the relatively recent introduction of mammals, could lead to potentially devastating consequences for plant regeneration if faced by dispersal failure. I investigated whether a range of plant species were experiencing adequate fruit removal, and the relative contributions to seed dispersal (and/or predation) by the current suite of resident alpine fauna, both native (kea in particular) and exotic. Fixed-area plots (totalling 300 m2) representing a range of montane to alpine vegetation types (shrub, open grassland, mat, herbfield and rocky scree) were monitored regularly by clearing all animal pellets over two fruiting seasons to determine the relative contributions of all animal dispersers at a community scale. Using spatial and temporal faecal deposition analysis, I examined the relative densities of animals and preferred faecal deposition sites in relation to vegetation and ground cover (and subsequent seed germination sites). Faecal analyses revealed large quantities of fruit eaten and the effects of gut passage/mastication on seed quality (predated or whole). Additionally, day and night footage was obtained to detect frugivorous activity pre-dispersal. Overall there have been large shifts in the disperser fauna in the New Zealand alpine zone, mostly with introduced mammals replacing native birds and lizards but with kea remaining important in long-range movement of seed (as well as seed predators).

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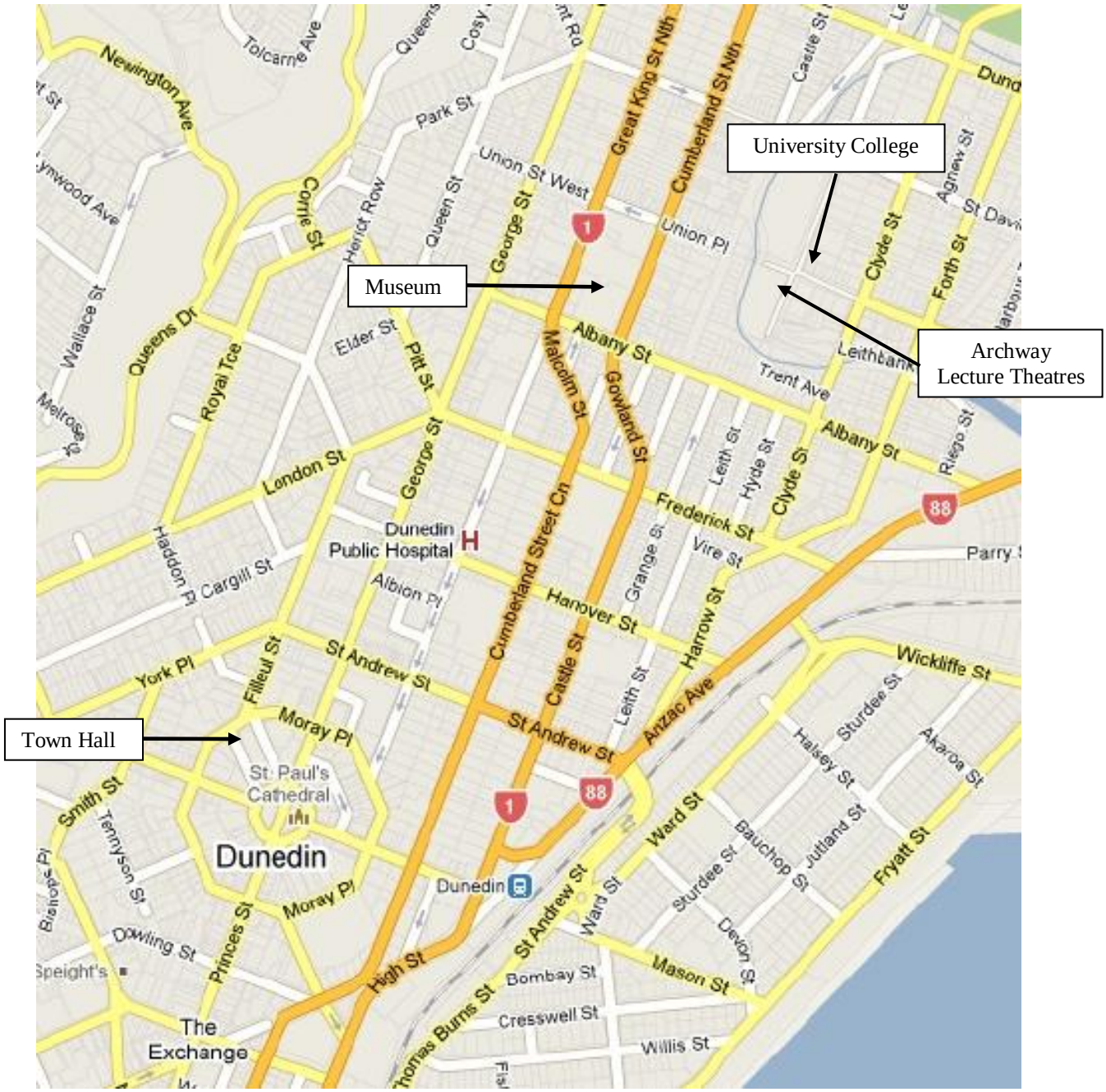
University of Otago campus map. Key buildings are circled. Dashed lines show walking routes between University College (UniCol), Archway Lecture Theatres (1-4), Te Tumu, and Castle Lecture Theatres. The main Te Tumu entrance is on the west (left) side of the building. **Walking from UniCol to Castle 2 takes about 3 minutes.**



Central Dunedin Map. The walk from the University to the Octagon and Town Hall takes roughly 20 minutes.