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Organising committee

- **CHAIR: Bruce Burns**
The University of Auckland
- **Jacqueline Beggs**
The University of Auckland
- **Jonathan Boow**
Auckland Council
- **Kerry Bridle**
University of Tasmania
- **Ewen Cameron**
Auckland War Memorial Museum
- **Weihong Ji**
Massey University
- **Sebastian Leuzinger**
Auckland University of Technology
- **Mahajabeen Padamsee**
Landcare Research
- **George Perry**
The University of Auckland
- **Steve Pointing**
Auckland University of Technology
- **Gail Spina**
Ecological Society of Australia
- **Alicia Warren**
Department of Conservation

Presidents' Welcome



NEW ZEALAND
ECOLOGICAL
SOCIETY



ESA

Nga mihi niu ki a koutou katoa.

On behalf of the New Zealand Ecological Society, it is my pleasure to welcome delegates to EcoTas13, the 5th joint conference of the New Zealand Ecological Society and the Ecological Society of Australia. The theme, Celebrating ecology on both sides of the Tasman: diversity and opportunity, acknowledges the commonalities, differences and challenges of our respective ecologies. Our joint conference is a forum where existing cross-Tasman partnerships are strengthened and new collaborations develop. Such networking is essential to ensure that ecology within our Pacific region develops the necessary strengths to meet future ecological challenges in an ever-changing world.

I trust that your participation in this conference will provide you with both personal and professional benefits through new information, research outcomes, and shared best practices. A very special greeting is extended to those who have been recognised through the awards, grants and scholarships offered by both societies. These acknowledge valuable contributions to our discipline, and also reward and encourage emerging ecologists. I invite everyone to share in the celebration of these awards by engaging with the recipients during networking opportunities.

We are indebted to the organizing committee for assembling a comprehensive programme of symposia, contributed talks, workshops, field trips and social events that make up the conference. Equally important are the sponsors, industry partners and exhibitors who, collectively, make events like this a possibility. I thank these organisations for their contribution to the conference.

I look forward to sharing the experience of the ecology of Australasia with you at this exciting forum. Welcome to Auckland, welcome to New Zealand!

Mel Galbraith (*President NZES*)

Welcome to all delegates of the EcoTas13 conference.

While both being part of Gondwana initially and being only separated by a small sea, it is interesting that both Australia and New Zealand have experienced such different histories over the last few millions of years. Developing in isolation from each other, the ecology of the two countries diverged. Such differences between two land masses creates great opportunities for researchers to easily 'step outside' their paradigms associated with their own country. Sharing our research results from two separate countries is likely to allow us to think 'outside the box' in our own work. That makes for an exciting conference full of new ideas.

While there are differences in our soils, our climate, our vegetation, and our fauna, we both face very similar anthropogenic disturbances; invasive weeds, habitat loss, introduced predators, changes in climate. Discussing our research with each other may open our eyes to new possible solutions and build new collaborations.

The Ecological Society of Australia would like to welcome you to this conference and thank the NZES for hosting this opportunity. I hope new ideas, new networks, new techniques and new possibilities are the outputs of our 5 days together.

Prof. Kris French (*President ESA*)

EcoTas13 

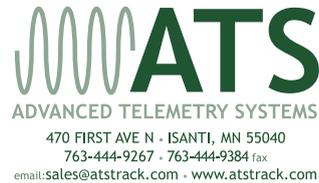
Sponsors

Special thanks to our sponsors for their support.



Exhibitors

Special thanks to our exhibitors for their support.



Advanced Telemetry Systems (ATS) offers innovative and reliable wildlife tracking products designed for researchers world-wide.

We manufacture over 400 models of custom VHF transmitters, VHF receivers/data-loggers, acoustic systems, and GPS collars with Iridium technology.

Visit www.atstrack.com today to get personalized project consultations.

WILEY

Wiley Blackwell is the world's leading publisher in Ecology, Conservation and Evolution, and is proud to publish *Austral Ecology* and *Ecological Management & Restoration* on behalf of the Ecological Society of Australia. Our cutting-edge research is aimed at researchers, students and professionals working in a range of sub-disciplines. Visit the Wiley stand to find out about our extensive range of resources.



Wild Supply specialises in the design and development of innovative tracking and monitoring solutions for the wildlife professional. Our growing product suite includes unique technologies such as Wireless Identification Devices (WIDs), and lightweight avian GPS devices with drop-off capability. We also offer cost-effective and robust remote acoustic recording systems.



AS1 Ltd distributes leading edge technologies to Australian and New Zealand researchers. "Presens" is well known globally for its fibre optic technology for Oxygen, Carbon Dioxide and pH monitoring. Try the new Visisens 2D system combining optical foils with imaging technology. Use "Biolog" for phenotypic microarray characterisation of microorganisms.



The Terrestrial Ecosystem Research Network (TERN) connects ecosystem scientists and enables them to collect, contribute, store, share and integrate data across disciplines. Collectively this increases the capacity of the Australian ecosystem science community to advance science and contribute to effective management and sustainable use of our ecosystems.

E: tern.comms@uq.edu.au
W: www.tern.org.au



Sirtrack specialise in design and manufacture of wildlife tracking systems using state-of-the-art technologies.

With 25 years experience, our talented team of professionals are experts in animal monitoring and tracking technology.

Our wildlife telemetry consultants offer you a wealth of telemetry and biological knowledge from many years spent in the field.

General Information

Registration Desk Hours

For any questions, please visit the registration desk located in the Owens Foyer of the Aotea Centre during the conference.

Sunday 24 November*	5.00pm – 7.00pm
Monday 25 November	7.30am – 4.30pm
Tuesday 26 November	8.00am – 4.30pm
Wednesday 27 November	8.00am – 4.30pm
Thursday 28 November	8.30am – 4.30pm

*On Sunday the registration desk will be located on level 1 of the Owen G Glenn Building at the University of Auckland from 5pm – 7pm.

Name Tags

Please wear your name tag at all times during the conference and social events. You will be asked to present your name tag to enter the conference dinner.

Mobile Phones

During all presentations please switch off or turn your mobile phones to silent.

Conference Mobile App

Stay informed with all that's happening during EcoTAS13 by downloading our smartphone app, ShowGizmo.

Simply download the free ShowGizmo app to your smartphone, available from the Apple App Store (for iPhone) or Google Play (for Android), enter your email and the password you set when we invited you to the app and you're good to go! If you haven't received our email, use the temporary password ecotas13 instead.

If you don't have an iPhone or Android phone, open your smartphone browser and type showgizmo.mobi to use the mobile web app instead.

The app includes agenda details, speaker profiles, a live event feed, an interactive map and much more!

Cameras and Electronic Recording

No electronic recording of presentations is permitted in any form without the express permission of conference organisers and speakers.

Car Parking

Parking is available at the Civic Car Park with entry at Greys Ave and Mayoral Drive. Early bird parking is available for \$13 a day (must arrive before 8.30am and leave before 7.00pm). For more information on the car park please refer to www.aucklandtransport.govt.nz

Internet Access

Aotea Centre:

Wireless Network: RFA Events

Passphrase: eventswifi

Once you open a web browser enter the credentials below:

Username: ecotas

Password: Lxmm93

Conference Catering

Vegetarian morning and afternoon teas are included in the registration fee and will be served in the Owens foyer at the Aotea Centre. Please use your keep-cup for hot beverages. If you ordered a lunch-box online these can be collected from the Owens foyer at lunchtime.

Dietary Requirements

Care is taken to ensure all dietary requirements are catered to. If you specified your dietary requirements when registering, please make yourself known to the catering staff at each meal break and advise them of your name and requests.

No Smoking Policy

Delegates should be aware that smoking is banned from all public buildings in New Zealand, including the University of Auckland and the Aotea Centre. This policy is strictly enforced.

Urgent messages and lost property

Urgent messages for delegates and lost property can be directed to the registration desk.

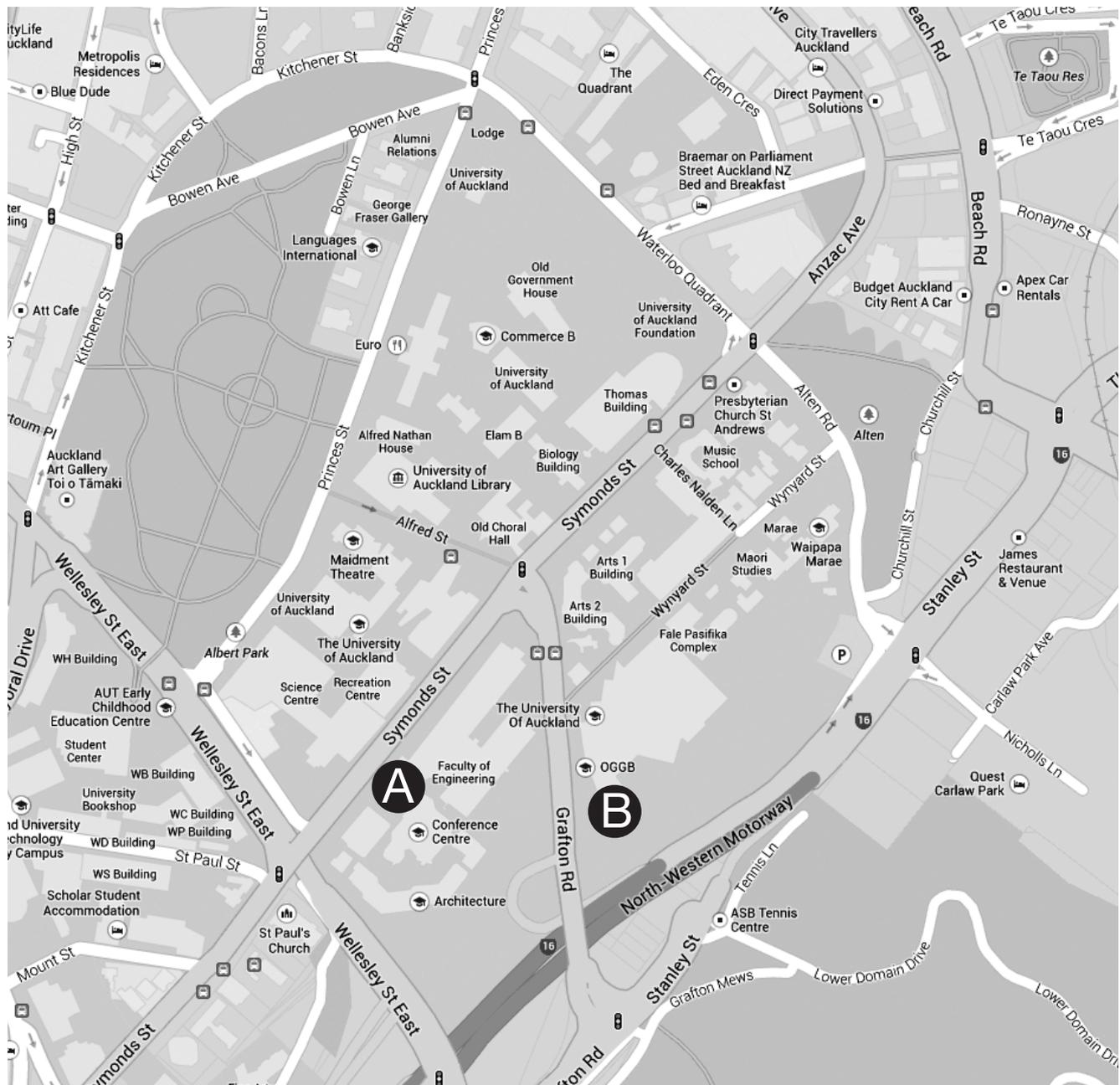
Messages and lost property will be held there for collection until the conclusion of the conference.

Emergencies, medical needs and illnesses

If you have an emergency you can contact the police, paramedics and fire department by calling 111 from any landline or mobile phone.

If you require non-emergency medical attention during the conference, please inform the registration desk.

University of Auckland

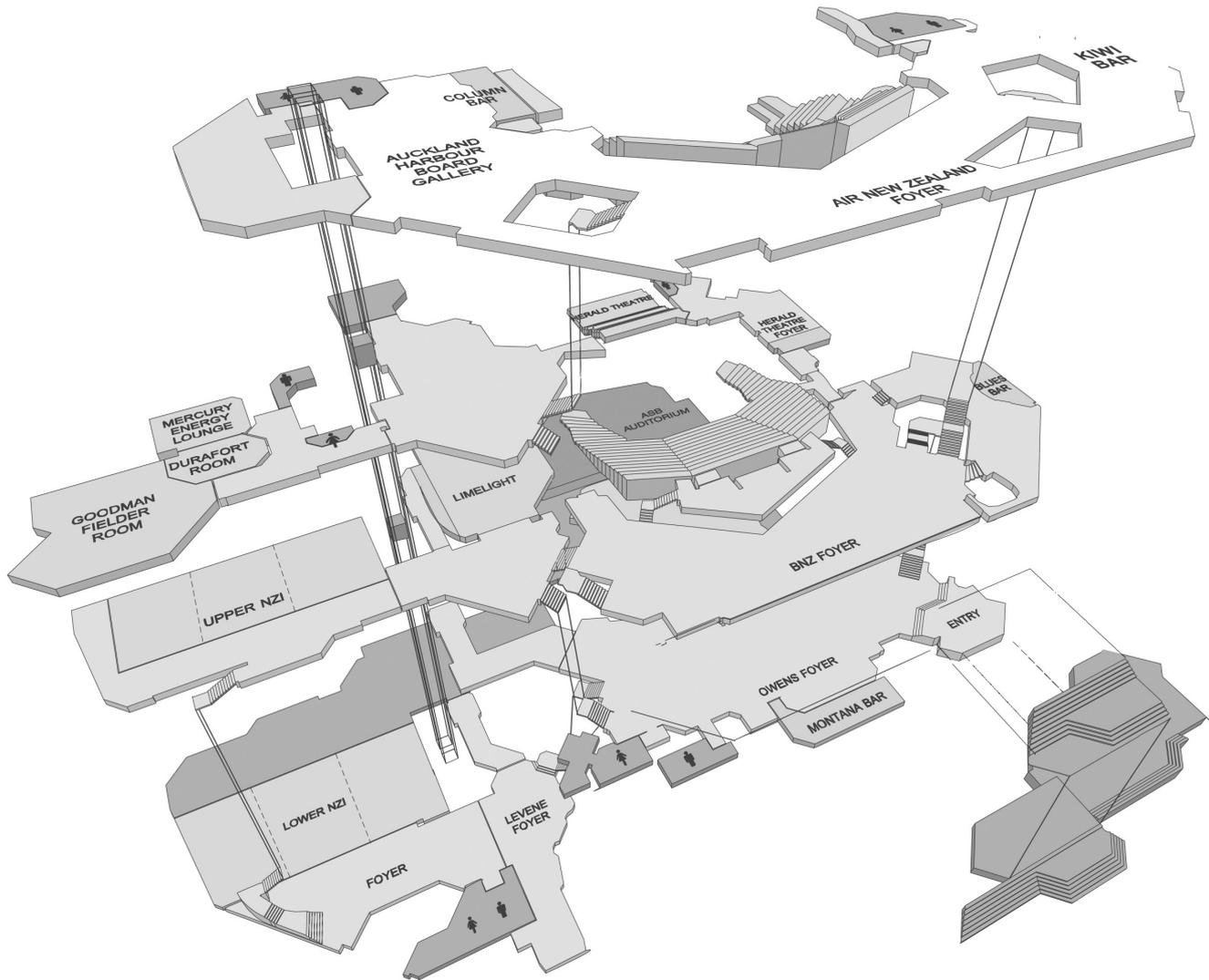


A Faculty of Engineering
20 Symonds Street

B OGGB Building
Grafton Road

Map data ©2013 Google, MapData Sciences Pty Ltd, PSMA

Aotea Centre



Key:

Owens Foyer: Registration, Exhibition, Catering, Entrance to Plenary room

BNZ Foyer: Poster and Photo exhibition

Upper and Lower NZI: Break-out rooms for presentation sessions

Limelight Room: Speaker room

Presenter Information

Please familiarise yourself with the following information before your scheduled presentation time.

The room allocations and session chair names will be available on the programme poster next to the registration desk.

Oral presentations and speed talks

Your Presentation

- Please ensure your presentation filename follows these conventions: Lastname_Initial_ Stream. Session#.ppt eg.Davis_S_A.3.ppt
- Upload your presentation PowerPoint from a USB drive to the computer in the speaker room well in advance of your allocated session, preferably a half day prior to the start of each day. A technician will be available to assist with this.
- If you have videos or animations in your presentation, please ensure you have embedded the files in your presentation and copied and transferred the video file together with your PowerPoint presentation. Without doing this, your video will not function. WMV or AVI file types are recommended.
- Those of you presenting in session 1, please go to the speaker room from 7.45am on Monday 25 November.

Time

- Oral presentations are allocated 15 minutes (12 minute talk + 3 minute Q&A) to complete. This is important to adhere to as it will ensure the conferences keeps to schedule.
- Speed Talk presentations are allocated 5 minutes (4 minute talk + 1 minute changeover) to complete. This is important to adhere to as it will ensure the conference keeps to schedule. Please note; maximum of three slides permitted for Speed Talks.
- Each session chair will be keeping strictly to the programme.

Session Information

- Please introduce yourself to your session chair in the allocated room 15 minutes before your session is due to begin.
- The room allocations and session chair names will be available on the programme poster next to the registration desk.

Presentation Equipment

- Each presentation room features standard audio-visual equipment, including projection screens, data projector, Windows 7 lectern computer and lectern microphone. Remote PowerPoint controllers and laser pointers are not available.
- Apple Mac users, please ensure your presentation is capable of running on Windows 7.

Poster presentations

Set-up – Monday 25th November, 7.30am – 10am.

The poster display is located at the BNZ Foyer of the Aotea Centre.

We will provide you with: a designated poster display board, please bring your own Velcro dots to adhere your poster onto the display panel.

Posters should be left in place until the end of the conference. They may be removed on Thursday 28th November, between 3.30pm – 6.00pm.



Student Awards

The following awards will be presented by the 2012 award winners on Monday 25 November.

- **Jill Landsberg Trust Fund Scholarships (x2)**
Presented by Amanda Edworthy and Kate Stevens
- **The Nature Conservancy Applied Conservation Award**
Presented by Matthew Rees
- **Wiley Fundamental Ecology Award**
Presented by Rhiannon Dalrymple

Student Conference Awards

The following Student Awards will be presented on the final day of the conference.

NZ Ecological Society

- **Three prizes for 'best talk'**
(1st, 2nd, highly commended)
- **Three prizes for 'best poster'**
(1st, 2nd, highly commended)

Ecological Society of Australia

- **ESA Marilyn Fox Award** for best inaugural presentation at a conference
- **Blackwell/EMR prize** for a spoken presentation on management or restoration
- **Blackwell/EMR prize for** a poster presentation on management or restoration
- **Society for Conservation Biology Prize for a** spoken paper on conservation
- **Australian Flora Foundation prize for** a spoken paper on the biology or cultivation of an Australian plant
- **Australian Flora Foundation prize for** a poster paper on the biology or cultivation of an Australian plant

Social Functions

Make the most of the opportunities to network and socialise at EcoTas13.

Welcome Reception

**Sunday 24 November 2013,
5.30pm – 7.30pm, The University of Auckland**

Mix and mingle with your fellow delegates over refreshments. Take advantage of pre-registration in the Owen G Glenn Building, University of Auckland, Grafton Road.

Barbara Rice Memorial Poster Session

**Monday 25 November 2013,
5.30pm-7.30pm, Aotea Centre**

Sponsored by the estate of the late Barbara Rice. Enjoy the submitted posters and talk with authors over refreshments. Please see flyer in delegate satchel.

Community Event

**Tuesday 26 November 2013,
6.00pm - 8.00pm, Aotea Centre**

This community event is generously sponsored by the Department of Conservation, allowing community members to enjoy the evening free of charge.

The event is an opportunity for interaction between ecological scientists and the conservation community. There will be a mini-seminar at 6.00pm; followed by light refreshments and networking

Conference Dinner

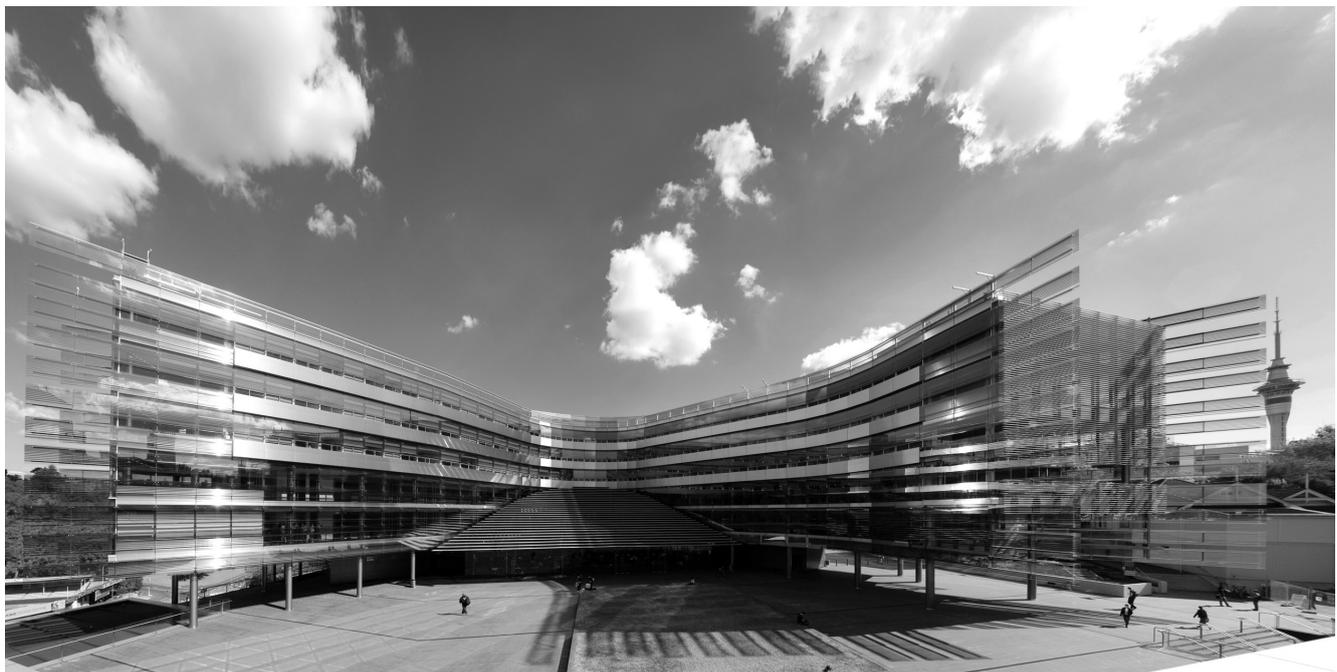
**Wednesday 27 November 2013, 6.30pm
Viaduct Events Centre, Wynyard Quarter,
Auckland Central.**

Enjoy a delicious meal and entertainment with your fellow delegates in the stunning Viaduct Events Centre.

Urban Ecology Research Chapter of the Ecological Society of Australia meeting

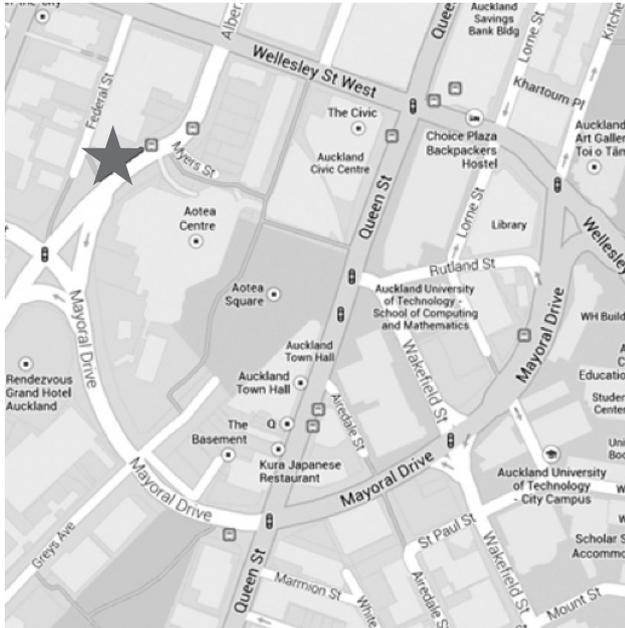
Wednesday 27 November, 5.30pm-6.30pm

This meeting follows straight on from the Urban Landscapes Symposium and is an opportunity for those delegates with an interest in Urban Ecology to meet, discuss and have input into the activities and directions for this Research Chapter in 2014. For those members who are also attending the Conference Dinner, there will be a “walking bus” departing from the meeting that will arrive in time for the start of the dinner. Please see the flyer on the EcoTas13 Notice Board for more information, or contact Amy Hahs at hahsa@unimelb.edu.au or Gary Luck at galuck@csu.edu.au



Field Trips

All field trip buses depart from the coach parking strip ★ (on the west side Mayoral Drive opposite the Aotea Centre).



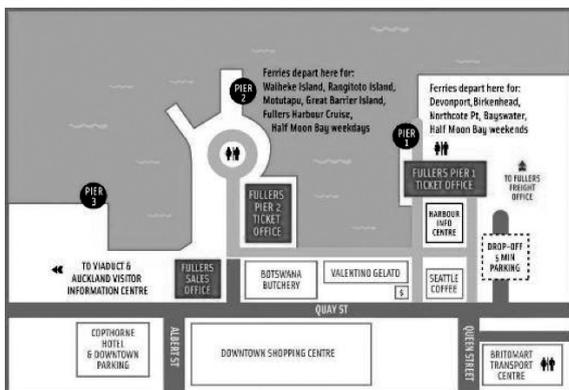
Map data ©2013 Google, MapData Sciences Pty Ltd, PSMA

Rangitoto Island

Friday 29 November, 9.00am – 4.00pm

Allow 20 minutes to walk from the Aotea Centre down Queen Street to the Downtown Ferry Terminal. Meet your field trip leader Mike Wilcox at the Downtown Ferry Terminal at 9:00am for a 9:15am ferry departure. Lunch, snacks and water bottles will be provided.

Wear strong walking shoes or boots. Bring a backpack, raincoat, warm jacket/jersey, sun block and hat. There are no shops on Rangitoto, but additional snacks and drinks can be purchased on the ferry.



Please meet your host Mike Wilcox near the Fullers Ticket Office on Pier 2.



Auckland's Wild West Coast – restoring diverse ecosystems at Te-Henga/Bethells Beach

Friday 29 November, 8.30am – 5.30pm

Departing at 8.30am from Mayoral Drive. Lunch, water & snacks are provided. Wear strong walking shoes or boots. Bring a backpack, raincoat, warm jacket/jersey, sun block and hat. Togs and towel optional if you wish to swim in the lake at lunchtime.

Tawharanui Open Sanctuary – a mainland fenced sanctuary on a peninsula

Friday 29 November, 8.00am – 4.00pm

Departing at 8.00am from Mayoral Drive. Lunch, water & snacks are provided. Wear strong walking shoes or boots. Bring a backpack, raincoat, warm jacket/jersey, sun block and hat. Check bags and personal belongings for stowaway pests before departure.

Te Hauturu o Toi (Little Barrier Island)

Friday 29 November, 7.00am – 6.00pm

Departing at 7.00am from Mayoral Drive. A packed lunch, snacks, bottled water are provided. Tea and coffee are also available on the island. Wear strong footwear for walking. Bring a raincoat and warm jacket as well as a sunhat. Footwear, clothing and field gear must be scrupulously clean, and free of all dirt, seeds, insects, pocket fluff. You will be given a biosecurity checklist to fill in, and undergo a biosecurity briefing and check at the Department of Conservation Office in Warkworth before catching a boat at Sandspit.

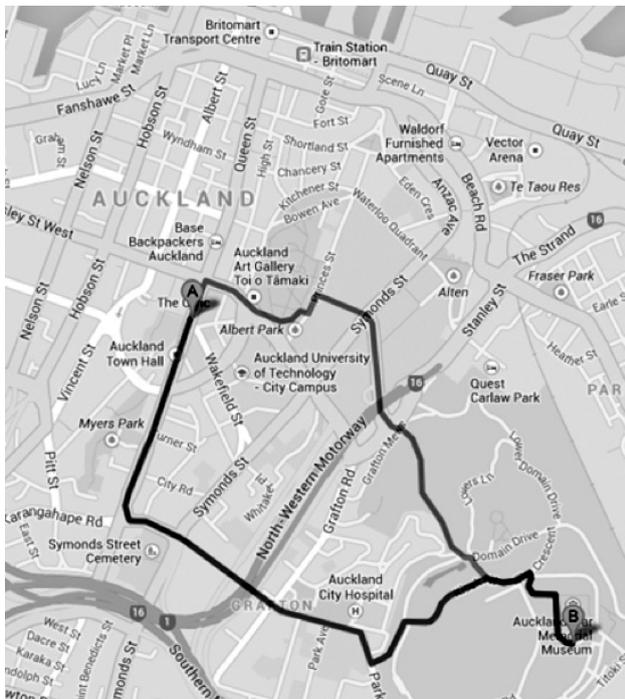
No personal packs or bags can go to the island. Your gear will go through strict quarantine procedures and be repacked into fish bins for travel to the island. On the island you will be lent a day pack.

Due to the possibility of cancellations if sea conditions are not suitable, the backup plan is to join the Tawharanui field trip.

Auckland War Memorial Museum with the Curators

Friday 29 November, 9.00am – 12.30pm

Transport is not provided. The Behind the Scenes at the Museum tour starts at 9.00am. Enter the Museum by the South entrance. You'll need to allow 35 minutes (2.6km) to walk between Aotea Centre and the Museum. The map below shows 2 possible routes, or you can catch the clockwise Outer Link bus (the orange bus) from Wellesley St to Parnell Rd (Museum bus stop). Morning tea is provided by your Museum hosts. Lunch can be purchased from the café at the Museum.



Map data ©2013 Google, MapData Sciences Pty Ltd, PSMA

Behind the scenes at Auckland Zoo and the NZ Centre for Conservation Medicine

Friday 29 November, 1.00pm – 5.00pm

The bus departs at 1.00pm from the coach park on the west wall of the Museum for those people wanting to go to both the Museum and Zoo. The bus will then collect additional passengers at 1.10pm from Mayoral Drive (western side – other side of the road from the Aotea Centre), before proceeding to the Zoo.

The bus will depart from the Zoo at 4:30 pm and return you to Mayoral Drive.

Waikato Wonders weekend

**Saturday 30 November – Sunday 1 December
8.00am Saturday – 5.00pm Sunday**

Your bus or minivan departs at 8:00am from Mayoral Drive (western side – other side of the road from the Aotea Centre). Food and water bottles for the first day will be on board.

Your guide to Waikato wetlands, Keith Thompson, will join you at Meremere. After you drop Keith off in the afternoon, you will continue to Out in the Styx Guest House aiming to get there around 6pm. Accommodation is twin share, and shared bathroom. Your evening will include an excellent dinner and an introduction to Maungatautari from your guides for the following day. Out in the Styx will provide breakfast and lunch for the second day. Tea and coffee are also available from the Maungatautari Visitor Centre.

Departure from Maungatautari on Sunday will be at 2.00pm. Drop-offs at the airport will be possible for Sunday evening check-ins after 6.00pm.

Wear hiking clothing and boots, bring a back pack for day walking. Include a hat and raincoat, warm jacket. Leave space in your pack for your packed lunch. Use a separate bag for your overnight gear.

Seabirds and Islands of the Outer Hauraki Gulf with Pterodroma Pelagics (www.nzseabirds.com)

Saturday 30 November

This tour is independent of the conference. For information and bookings contact Pterodroma Pelagics (email info@nzseabirds.com or phone 09 422 6868)

Auckland General Information

The following information is provided as a guide to Auckland. If you have any queries, please visit the registration desk.



Banks and ATM machines

The University of Auckland: The nearest bank (ASB Bank) and ATM machine is situated on Level 1 of the Owen G Glenn Business School, Grafton Road. Additional bank branches are available in the Kate Edger Information Commons across from the Engineering School on Symonds Street.

The Aotea Centre: ATM machines of most major banks can be found along Queen Street.

Getting around

The LINK Bus

The city LINK bus is an easy way to get around town.
www.maxx.co.nz/link

Lunchtime food options

There is a large selection of cafés in the surrounding area, here are a couple of suggestions.

Box Café & Bar

Located on the Terrace of the Aotea centre

Hours

Mon to Wed 7.30am - 7.00pm
Thurs and Fri 7.30am - 9.30pm

Great coffee, delicious sweet and savoury cabinet food and a selection of local and international wines. EcoTas13 delegates will receive 10% off food and beverage when they show their conference name badge.

Elliot Stables

39 Elliot Street

Open from breakfast – late night, a variety of vibrant, international restaurants under one roof.

Revive Cafe

33 Lorne Street

Auckland's healthy food haven – excellent lunch option.

Taxis and shuttles

There are a host of taxi companies to choose from. Some recommended companies are:

Auckland Co-op Taxi: 09 300 3000 or 09 300 3100

Discount Taxi: 09 529 1000

Green Cabs: 0508 447 336

Corporate Cabs: 09 377 07730

Airbus Shuttle: 09 366 6400

Shopping, bars & restaurants

As a guide, shopping hours in central Auckland are 9.00am – 5.30pm each day, with most shops open until later in the evening on Fridays.

Shopping malls located in suburban areas may stay open until 9.00pm on Thursdays and Fridays. Visit www.westfield.co.nz for information.

Night on the town

Want to go out for a night on the town but unsure where to start? Here are a few options:

Britomart

Britomart is a vibrant shopping, entertainment and business precinct in the heart of downtown Auckland, just minutes from the University of Auckland's city campus. Surrounded by beautiful heritage buildings, it's a neighbourhood of buzzing restaurants and cool bars, designer boutiques and quirky art space.

www.britomart.org

Viaduct Harbour

Hobson Wharf, Corner of Quay and Hobson Street.

With over 20 bars and restaurants to choose from in one waterfront destination, Viaduct Harbour is a superb place to dine or relax and watch the world go by. www.viaduct.co.nz

SkyCity

Corner of Victoria and Federal Streets.

Restaurants, bars, clubs, casinos; and no trip to Auckland is complete without a visit to Sky Tower! www.skycityauckland.co.nz

Ponsonby Road

Ponsonby road, Auckland's hippest strip, is easily accessible by the Inner Link bus and home to over 100 of Auckland's top cafes, bars and restaurants. Take a stroll down the strip to check out the boutique shops, local fashion scene and some of the best coffee in Auckland. www.iloveponsonby.co.nz



Restaurant guide

Central Auckland has many excellent restaurants; the following are just a few recommendations:

Depot Eatery and Oyster Bar

86 Federal Street

Chef Al Brown's place reflects his attitude towards food: in season, beautifully cooked, to be enjoyed with friends.

Ebisu

116 - 118 Quay Street, Britomart

A sophisticated twist on the traditional Japanese izakaya style of informal drinking and dining.

Euro Restaurant and Bar

147 Quay Street, Princes Wharf

Euro offer superb contemporary New Zealand cuisine and exceptional service.

Kermadec Bar and Bistro

Level 1, Viaduct Harbour.

Surrounded by the upbeat theme of contemporary Pacific art, enjoy the casual atmosphere and excellent seafood-based menu.

Soul Bar and Bistro

Viaduct Basin, Viaduct Harbour Avenue.

Soul Bar & Bistro prides itself on its use of the finest and freshest local ingredients, with seafood taking centre stage.

For a greater selection of restaurants, including pubs, bars and clubs, get the Metro Eats app or visit www.dineout.co.nz



NEW ZEALAND ECOLOGICAL SOCIETY

The New Zealand Ecological Society was formed in 1951 to promote the study of ecology and the application of ecological knowledge in all its aspects. Through its activities, the society attempts to encourage ecological research, increase awareness and understanding of ecological principles, promote sound ecological planning and management of the natural and human environment and promote high standards both within the profession of ecology by those practicing it, and by those bodies employing ecologists.

Membership Benefits include:

- Networking opportunities and contacts with professional ecologists within New Zealand and internationally.
- Subscription to the New Zealand Journal of Ecology, the premier New Zealand ecological journal.
- Cost savings on registration for the New Zealand Ecological Society Annual Conference.
- Subscription to a regular e-newsletter on New Zealand ecology and ecologists.
- Eligibility to receive grants, awards and prizes for New Zealand ecologists and students.
- Opportunities to contribute to society submissions on government policies relating to the New Zealand natural environment.
- Discounted subscription rates to the Ecological Society of Australia and its journals (Austral Ecology and Ecological Management and Restoration)
- Access to other special-purpose publications.

Join the New Zealand Ecological Society



www.newzealandecology.org

Programme Overview

How to search for abstracts

Plenary abstracts

Plenary abstracts are listed on pages 26-29 alongside the plenary speaker biographies.

Symposia abstracts

Symposia abstracts are listed in Symposia theme blocks in the handbook from pages 30-96

Oral presentations

Oral presentation abstracts are listed alphabetically by the presenting author's last name (not session blocks) and can be found on pages 97-172.

Speed talks

Speed talk abstracts are listed alphabetically by the presenting author's last name (not session blocks) and can be found on page 173-184

Poster presentations

Poster abstracts are listed alphabetically by the presenting author's last name (not session blocks) and can be found on pages 185-204

Programme – Session timetable

Sunday 24 November

WORKSHOPS					
Start time	End time	Workshop Title	Venue	Room	Organiser
9am	12pm	A gentle introduction to the beauty of R for ecologists	Owen G Glenn Building, University of Auckland, Grafton Road	Comp Lab 1/260-004	Sebastian Leuzinger / Martin Bader / Thomas Etherington / Sarah Wyse
1pm	3pm	knitr - the best of Latex and R combined		Comp Lab 1/260-004	Martin Bader
12.30pm	3.30pm	Are New Zealand plants prepared for drought? Establishing a network for drought research in NZ		260-005	Cate Macinnis-Ng and Tim Curran
12.30pm	5pm	Developing a Biodiversity Conservation Act		260-325	Sue Eber
12.30pm	5pm	Guidance for Biological Data Management		260-223	James Lambie
STUDENT DAY					
9am	5.30pm	Student Day	Engineering Building, University of Auckland 22 Symonds Street	401-439	Weihong Ji
ESA PLANNING DAY					
8.30am	5.00pm	ESA Planning day	Owen G Glenn Building, the University of Auckland, Grafton Rd.	260-317	Gail Spina
WELCOME FUNCTION					
5.30pm	7.30pm	Welcome function (Registration open)	Owen G Glenn Building, (Registrations) the University of Auckland		

MONDAY 25 NOVEMBER

Start Time	Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title	
8:45		Opening								
9:15		Keynote Speaker: Angela M. Gurnell (Plants as River System Engineers)								
10:00		Morning tea								
		STREAM A			STREAM B			STREAM C		
		Session 1: S14 - Insects and climate change			Session 1: S-12 Impact of Phytophthora			Session 1: Ecological genetics		
10:30	532	Sgro, C	Range shifts under climate change	667	Burns, B	Ecology and epidemiology of <i>Phytophthora</i> 'taxon Agathis' in kauri forest	52	Drummond, A	Metabarcoding soil biodiversity on a forested offshore island	
10:45	628	Kitching, R	Insects & Altitude: transcending taxonomic patterns	372	Ngakuru, W	From the mountain to the sea, I am the tree and the tree is me	407	Sweeney, O	Genetic analyses reveal distinct structuring between populations of the endangered Glenelg Spiny Crayfish, <i>Euastacus bispinosus</i> , and a lack of genetic diversity in a disjunct South Australian population.	
11:00	302	Cook, J	Predatory green ants mediate trophic cascades in Australasian fig wasp communities	467	Scott, P	Rehabilitation of <i>Agathis australis</i> (Kauri) ecosystems impacted by <i>Phytophthora</i> taxon <i>Agathis</i> (PTA), an international context	578	Liggins, L	Testing the core-periphery hypothesis: genetic signatures across the latitudinal range of a coral reef fish	
11:15	60	McKenzie, S	Climate change and above-belowground herbivore interactions: phloem feeders vs root chewers.	289	Hardy, G	Impact and management of <i>Phytophthora</i> diseases in natural ecosystems in Australia	335	Mather, A	Contrasting phylogeographic patterns of two co-distributed Australian freshwater rainbowfish	
11:30	409	Andrew, N	How is dung beetle biology, resource competition and responses to environmental change currently being assessed?				275	Rafat, A	Roles of genetic specificity and geographic location in photobiont-mycobiont associations in New Zealand <i>Usnea</i> spp.	
11:45	619	Gerard, P	Some like it hot: comparison of climate change predictions for four pasture pests				59	Birnbaum, C	Specialists or generalists? Nitrogen fixing bacterial communities of invasive acacias in Australia	
12:00		Lunch (+ Austra Ecology editorial board meeting)								
13:00		ESA Student awards presentation			2012 Student award winners highlighted in programme					
13:15		Keynote Speaker: Chris Thomas (Climate change, invasions and Anthropocene conservation)								
		Session 2: S7 - New horizons on CO2 impacts			Session 2: S5- Ecosystem scale modelling			Session 2: S8 - Microbial ecology		
14:00	120	Hovenden, M	I can predict the impact of elevated CO2 but not of warming on temperate grassland productivity	185	Dr Pollino, C	Advancing Ecological Modelling Tools for Application in Water Resource Planning	625	Pointing, S	Microbial colonization and functionality in dryland systems	
14:15	326	Newton, P	The carbon dioxide fertilisation effect in grasslands	232	Hauser, C	Modelling kangaroo-vegetation dynamics in semi-arid Australia	209	Morales, S	Uncovering novel regulatory pathways and sinks of greenhouse gases through bioinformatics.	
14:30	364	Gimeno, T	Elevated CO2 in an Australian woodland (EucFACE): impact of contrasting water availability on carbon uptake and water use in a nutrient-limited ecosystem	254	Baldwin, D	Advances in modelling hypoxic blackwater	244	Drigo, B	Will the forest soil microbiome stop doing us a favor?	
14:45	277	Power, S	Elevated CO2 enhances phosphorus availability in a P-limited eucalypt woodland	290	Dr Rumpff, L	Overcoming (some of the) frailties of experts using structured decision making	689	Borges, H	Toxic in Crowds' & " Mapping cyanotoxin production across a eutrophic lake	
15:00	362	Macdonald, C	Impact of elevated carbon dioxide on soil respiration and microbial activity in a nutrient poor forest	337	Khanal, S	Quantifying post-fire recovery of forest canopy structure and carbon uptake using satellite image time-series	305	Beck, S	Spatial patterns in soil fungal beta diversity across an Australian alpine/subalpine gradient	
15:15	271	De Kauwe, M	Testing ecosystem model hypotheses against observations from contrasting free-air CO2 forest enrichment sites.	354	Greenville, A	Spatial and temporal synchrony in small mammal populations: the role of intrinsic and extrinsic factors	419	Lear, G	Decoupling of fine scale spatial pattern in bacterial community structure and function within a highly connected freshwater landscape	
15:30		Afternoon tea								
		Session 3: S14 -Insects and climate change			Session 3: Various			Session 3: S8 - Microbial ecology		
16:00	212	Johnson, S	Climate change in the underworld: root herbivore responses to C3 and C4 grasses under elevated CO2	267	Lester, R	Validating an ecosystem response model: assessing model performance under wet and dry conditions	575	Dhami, M	Happily ever after: coevolution of scale insects and their symbionts.	
16:15	248	Ryalls, J	How does climate change mediate below-ground effects on aboveground aphids in lucerne?	682	Moore, B	Do koalas prefer hot dinners? Eucalyptus leaf quality in a warmer world	687	Goddard, M	Ecosystem engineering drives mutualistic coevolution between yeasts and flies	
16:30	226	Gherlanda, A	Will elevated CO2 and temperature facilitate host switches in eucalypt leaf beetles?	239	Griffiths, J	Do reproductive strategies in clonal plants change along a stress gradient?	192	Knight, S	Advancing analyses of microbial population structure: Quantifying gene-flow and connectivity in New Zealand's <i>Saccharomyces cerevisiae</i>	
16:45	64	Hentley, W	Trophic cascades in a changing environment: the impact of elevated CO2 on multi-trophic interactions	263	Spencer, R	Adaptive Significance of Genotypic Sex-Determination (GSD) in Turtles	376	Morrison-Whittle, P	Biogeography of fungal communities associated with New Zealand winemaking.	
17:00	141	Harris, R	Projecting changes in phenology using temperature based growing degree days	513	Cieraad, E	The slow and the fast: native versus exotic conifers in extreme New Zealand environments	322	Klop-Toker, K	A pathogen's impact on the reintroduction of a threatened frog species	
17:15				599	Forrest, C	The role of sexual and asexual reproduction in threatened native semi arid <i>Acacia</i> populations in far western NSW				
17:30		Social Function: Rice Memorial Poster Session								

Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title
STREAM D			STREAM E			STREAM F		
Session 1: Ecosystem dynamics			Session 1: Animal behaviour			Session 1: Seabirds		
246	Orwin, K	Effects of species evenness and dominant species identity on multiple ecosystem functions in grassland communities	525	Garvey, P	Behavioural responses of stoats to the presence of a dominant competitor	58	Taylor, G	Death on a seabird colony - causes, effect on seabird population growth and ecosystem benefits
303	Holdaway, R	A forest dynamics model to predict carbon sequestration during secondary succession	390	McEvoy, J	Spoilt for choice - spatial ecology of waterfowl in arid and agricultural landscapes is shaped by individual movement decisions	388	Friesen, M	Studying sensory adaptations of petrels for use in conservation
156	Kenny, S	Facilitation and decline - the story of leguminous woody weeds post-fire	482	Veltheim, I	Influence of thermodynamic costs on daily movement decisions and habitat use of the brogla (<i>Grus rubicunda</i>)	227	Corkery, I	A hot bird is a desirable burrow-mate
498	West, C	Different trajectories of primary succession after eruption events on Raoul Island, New Zealand?	137	Galindez Silva, C	Planned fire, gullies and refugia. Where do bush rats go?	341	Buxton, P	Spatio-temporal changes in density and distribution of burrow-nesting petrels following predator removal
500	Monks, A	Cue-less correlation: differential-temperature model fits simulated mast seeding without being a flowering cue	65	Bull, M	Grazing changes behaviour of grassland lizards	590	Murray, N	Flyway-wide effects of climate and threats on the non-breeding abundance of a migratory shorebird
147	Fowler, W	Evaluating the restoration potential of transferred topsoil	380	Coughlin, C	Weighed down by science: do collar-mounted tags affect cat behaviour?	225	Roberts, C	Challenges in providing habitat for forest birds on a regenerating seabird island
Session 2: Predator prey			Session 2: Sampling					
264	van Bommel, L	Movements and behaviour of free-ranging livestock guardian dogs	621	Rees, M	Comparison of sight, sound and scent attractants for pelagic fishes to remote mid-water video stations			
601	Hunter, D	Guard dog: the dingo protects small native mammals from invasive predators in eastern Australia	124	Tucker, D	Linking bioacoustics and ecological condition in a fragmented landscape			
344	Feit, B	Can excluding cane toads from water provide biodiversity benefits for arid Australia?	413	Paull, D	A practical approach to monitoring ground-dwelling mammals across landscapes			
544	Wilder, S	Quantifying food limitation of redback spiders (<i>Latrodectus hasselti</i>) in the field	585	Sinclair, S	Geckos uncovered: monitoring arboreal geckos in the Auckland region			
561	Waterhouse, B	Pyrosequencing of prey DNA in predatory mollusc faeces reveals seasonality and unexpected levels of earthworm diversity	539	Wysong, M	Evaluating camera trap designs to measure feral cat and dingo abundances, Lorna Glen, WA			
422	Lentini, P	Making use of old biased estimates: A trait-based model of microbat survival	435	Sparrow, B	Basal area from photos. Is it possible?			
Session 3: Various			Session 3: SPEED TALKS					
262	Rayner, L	What we need to know about temperate woodland bird decline.	See Speed-talk page					
584	Arnst, E	Ecological importance and long-term viability of shrubs on New Zealand gravel beaches						
62	Llewelyn, J	Change with the climes: widespread variation of climate sensitivity in a rainforest specialist						
214	White, R	Drought intensity alters allometric survival relationships in an extremophile forest-dwelling fish.						
543	Zhou, S	Evidence-based modelling of diverse plant water use strategies on stomatal and non-stomatal components under drought						
423	Nguyen, V	Modelling time series data with missing values						

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TUESDAY 26 NOVEMBER

Start Time	Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title	
08:45		ESA Presidents Address - Kristine French								
08:50		Don Driscoll - Introduction of new ESA website								
09:05		Keynote Speaker: Ian Jamieson (Is managing species with minimum viable populations of <5,000 a waste of time? Revisiting the 50/500 rule in conservation biology.)								
09:50		Morning tea								
		STREAM A			STREAM B			STREAM C		
		Session 4: S2 - Invasive species in a changing world			Session 4: SPEED TALKS			Session 4: Herbivory		
10:15	88	Hoffmann, B	Invasive ants, climate change and consequences for island conservation			See Speed-talk page	63	Arman, S	Classifying the diets of the extant Macropodidae demonstrates local and universal factors in dietary adaptation	
10:30	384	Stanley, M	Are climate change and invasive species research outcomes being used to future-proof pest management?				338	Morley, J	What are the nutritional drivers of foraging strategies in common brushtail possums in New Zealand?	
10:45	78	Buckley, Y	Maximising translocation success: insights from invasions and biological control				358	Mills, C	Macropod herbivory on vegetation regrowth after fire: trophic cascades in the Great Lakes area NSW	
11:00	84	Moles, A	Rapid evolution in introduced species: will weeds in New Zealand and Australia eventually be accepted as unique native taxa?				360	Meredith, T	A quantification of anti-herbivore defences on land and in the ocean	
11:15	336	Stockwell, C	Evolution alters ecological dynamics for an invasive species				393	Windley, H	Does foliar nutrition explain the success of possums in New Zealand?	
11:30	278	Lester, P	Social insect population dynamics, pathogens & climate change				403	Ferguson, A	Luderick, Girella tricuspidata, exhibit strong site fidelity and higher abundance within marine sanctuaries	
11:45		Lunch + Ecological Society of Australia and New Zealand Ecological Society AGM's								
13:15		Keynote Speaker: John Ogden (Science and Common Sense: Assessing a decade of Conservation Action on Great Barrier Island)								
		Session 5: S2 - Invasive species in a changing world			Session 5: S4 - Community engagement			Session 5: S13 - Functional community ecology		
14:00	150	Hulme, P	Greater focus needed on plant invasion impacts in protected areas	87	Gordon, A	Transboundary systematic conservation planning: when does increasing collaboration payoff?	176	Laughlin, D	Environmental filtering and limiting similarity in functional community ecology	
14:15	77	Chapple, D	Assessing the impact of introduction history and pathways on the potential distribution of an invasive lizard	119	Tulloch, A	Spatially strategic conservation actions can achieve high levels of biodiversity and human well-being by accounting for leakage	295	Price, J	Micro-environmental filtering drives functional convergence in species-rich grasslands	
14:30	76	Byrom, A	Responses of invasive mammal communities to global change in New Zealand forest and dryland ecosystems	397	Jarvis, R	Social network analysis: How do social and institutional characteristics affect conservation outcomes?	346	Kunster, G	How are competitive interactions influenced by traits? A global analysis based on tree radial growth	
14:45	394	Hartley, S	Challenges, and some solutions, for building predictive species distribution models of invasive species	107	Raymond, C	Public participation GIS and inclusive conservation planning: Insights from 8 years of empirical research	151	Letten, A	Is phylogenetic and functional community structure temporally labile? Yeah, but no, but yeah!	
15:00	383	Abbott, K	Generalisations and their influence on communicating complex ecology from the Pacific.	160	Gent, M	Comparing Community and Natural Values for Effective Coastal Management	440	Mason, N	Moving from demonstrating effects to predicting outcomes - the next step for functional ecology.	
15:15	284	Catterall, C	The role of novel ecosystems in active and passive restoration				276	Lusk, C	Growth vs shade tolerance trade-offs and the dynamics of New Zealand's podocarp/broadleaved forests	
15:30		Afternoon tea								
		Session 6: S2 - Invasive species in a changing world			Session 6: S4 - Community engagement			Session 6: S13 - Functional community ecology		
16:00	294	Gardener, M	Vegetation patterns in Galapagos during eradication of feral goats: Driven by rainfall or herbivory?	558	Jakob-Hoff, R	Using mass collaboration tools to develop a global conservation resource	503	Curran, T	Trait-environment relationships explain community assembly of dry rainforests in northern New South Wales	
16:15	210	Sheppard, C	Potential distribution and invasiveness of new weeds under climate change	167	Veltman, C	Going from talking to doing in adaptive management of New Zealand forests affected by deer	377	Thomas, F	Incorporating functional traits into a multi-species model of plant growth	
16:30	576	Cremona, T	Enduring the toad invasion: A successful re-introduction of 'toad-smart' northern quolls.	57	Hawthorn-Jackson, D	The environmental, cultural and social values of Pygmy Bluetongue Conservation	317	Moran-Ordóñez, A	Aquatic metacommunities in an arid landscape: novel approaches to understand spatially structured communities	
16:45	161	Cooling, M	The role of pathogens in the decline of the invasive yellow crazy ant (Anoplolepis gracilipes) in Arnhem Land, Australia	195	Corbett, F	Project Island Song - A Unique Partnership	142	Westoby, M	Machinery of competition and assembly of strategy mixtures	
17:00	75	Bassett, I	Changes in invertebrate fungivore communities: a predictable consequence of ground-cover weed invasion?	660	Lyer, P	Ecological restoration of islands: pivotal roles of value judgements and cultural understanding	207	Groote-maat, S	Burn or rot: the role of leaf traits in fire and decomposition	
17:15	690	Rapson, J	Urban areas give insights into the floristic invasibility of New Zealand		Towns, D	Symposia Overview	437	Nano, C	Landscape-scale patterns of plant vulnerability to fire and Browsing in arid Australia	
17:30		Social Function: Community Engagement								

Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title
STREAM D			STREAM E			STREAM F			STREAM G		
Session 4: S3 - Agricultural ecosystems			Session 4: Soil/plant			Session 4: Environmental stressors			Session 4: Biogeography & macroecology		
588	Meurk, C	Maximising Biodiversity and Ecosystem Services in Cultural Landscapes by Gradient Management	370	Nielsen, U	Response of belowground communities to short-term phosphorus addition in a Cumberland Plain Woodland	260	Gooden, B	Does alien grass invasion affect recruitment dynamics and reproduction of resident native plants?	159	Dairymple, R	Is life in the tropics really more colourful? A cross-taxa test for a latitudinal gradient in colour
308	Bridle, K	How much biodiversity is enough in agricultural landscapes?	408	Franklin, H	The potential of New Zealand native plants to mitigate nutrient transport from agricultural land	373	Batson, W	Effects of temporary captivity used as a soft-release method for translocating eastern bet-tongs (<i>Bettongia gaimardi</i>).	348	Hitchcock, T	The latitudinal gradient in plant longevity
157	Brown, S	Lessons from Forty Years of Native Revegetation on the Northern Tablelands of NSW	211	Wyse, S	New Zealand kauri under threat: consequences for the wider forest ecosystem	597	Leuzinger, S	A broad view on forest response to CO2: experiments, models, concepts	103	Burns, KC	Plant defense against megaherbivores: biogeography, heteroblasty and trait matching
662	Newell, G	An approach for Identifying Habitat Connectivity at Regional Scales	371	Wotton, D	Why are some plants rare? Seed supply, safe sites, or soil feedbacks	93	Manea, A	Woody plant seedling establishment success is reduced in a model grassland system under elevated CO2.	251	Meredith, E	Testing assumptions about herbivory and plant defence on islands
396	Collard, S	Monitoring restoration success of key ecological assets in the 'WildEyre' region of South Australia	309	Wood, J	Facilitation of invasive pines and their ectomycorrhizal fungi through novel mammal associations	243	Wan, J	Is there a cost of adaptation for species as they invade new and increasingly stressful habitats?	71	Moncrieff, G	An intercontinental comparison of savanna tree architecture
158	Ikin, K	How is bird, marsupial and reptile habitat influenced by interacting abiotic features and land management?				250	Campany, C	Effects of belowground space limitation on performance of Eucalyptus seedlings: barrier sensing or nutrient limitation?	357	Ohiemuller, R	Quantifying the spatial distinctiveness of alpine climate niches
Session 5: S3 - Agricultural ecosystems			Session 5: Distribution patterns			Session 5: Various					
113	Radar, R	Pollination ecosystem services provided by wild insects are greatest in human-modified habitats	153	Morgan, J	Upslope establishment after wildfire of the obligate-seeding montane tree <i>Eucalyptus delegatensis</i> fails to keep pace with 20th century warming	144	Martin, J	Flying-fox management; the Sydney relocation is working (thus far) but there is no 'silver bullet' for all nuisance colonies			
479	Jones, C	To thin, or not to thin? Examining the understorey condition of dense woody vegetation stands	236	McGregor, K	Quantifying uncertainty in species distributions under climate change: a case study in South-Eastern Australia	197	Deng, Y	Biodiversity Management for Terrestrial Ecosystems in the Waikato Region			
449	Hansen, B	Does riparian condition influence breeding success in woodland birds in highly modified landscapes?	252	Boddy, N	Interacting global change drivers limit the distribution of a thermally-sensitive freshwater fish	230	Prahalad, V	Is there a future for coastal salt-marshes in southern Tasmania?			
128	Morales, N	Are fencing and pest controls enough? Perspectives on long term forest management	279	Higgins, S	A physiologically based model for projecting the potential distribution of invasive plants	74	Bowden, W	Objectively measuring the ecological biodiversity of green space.			
670	Dodd, M	Early recovery of indigenous forest fragments after livestock grazing exclusion	526	Beaumont, L	Eeny, meeny, miny, moe: is the choice of species distribution model algorithm important?	324	Longson, C	Rapid recovery of Hochstetter's frog in a predator-free environment			
			596	Cornwell, W	A geographic mosaic of climate change impacts: which areas are most at risk?	553	MacLeod, C	How will ocean acidification affect the free-living stages of marine parasites?			
Session 6: S3 - Agricultural ecosystems			Session 6: Plant-pollinator-seedling			Session 6: Disturbance					
255	Wright, A	Ecological Restoration Using Stag Trees in Former Agricultural Landscapes and Post Mining Rehabilitation	273	Wardle, G	Rainfall drives the structure of flower-visitor networks across space and time	265	Vivian, L	Challenges in reinstating disturbance regimes for restoration and conservation: an example from a degraded floodplain			
306	McKinnon, L	A Conservation Corridor and Biodiversity Monitoring program within fragmented Grassy Woodland of Former Agricultural Landscape	121	Bodley, E	Ecology and pollination of deceptive New Zealand greenhood and spider orchids (<i>Diplodium</i> and <i>Nematoceras</i> spp.)	281	Burge, O	Native forest regeneration under <i>Leptospermum scoparium</i> in Awarua-Waituna wetland, Southland: constraints, trajectories, and predictive ability.			
665	Lockie, S	Monitoring and reporting biodiversity change in rural habitat fragments across the Auckland Region	351	Popic, T	Species richness, traits, and flowering: how they influence species role and the structure of flower-visitor networks	343	Lang, M	Propagation of Austral bracken fern (<i>Pteridium esculentum</i>) for revegetation.			
592	Bowie, M	Impact of dairy farming on soils, earthworms and plants of an adjacent Canterbury dryland reserve	692	Anderson, S	To bee or not to bee?: interrogating the role of introduced honeybees (<i>Apis mellifera</i>) in native ecosystems	366	Johns, C	Plant functional groups: an effective indicator for detecting hydrological disturbance in groundwater-dependent wetlands?			
127	Mortelliti, A	Effects of the agricultural matrix on the spatial synchrony of highly fragmented bird populations	311	Maciunas, E	Seedling ecology of <i>Cassytha pubescens</i> , a native hemiparasitic vine	455	Gehrig, S	Use of drip irrigation to improve floodplain black box (<i>Eucalyptus largiflorens</i>) woodlands.			
656	Todd, J	Kiwifruit orchard management and beneficial invertebrate biodiversity				257	Wainwright, Q	Positive interactions in a novel annual plant community			

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WEDNESDAY 27 NOVEMBER

Start Time	Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title
08:45			Photo competition awards						
09:00			Keynote Speaker: Jason Tilyanakis (Global change and ecosystem functioning: the interplay of biodiversity, environmental context, and species interactions)						
09:45			Morning tea						
	STREAM A			STREAM B			STREAM C		
	Session 7: Invasive species			Session 7: S15 - Ecosystems and Economics			Session 7: S9 - Urban landscapes		
10:15	447	Wijet-hunga, U	Facing the acid test: pH influences the viability of eggs and larvae of the invasive cane toad (<i>Rhinella marina</i>)	134	Livesey, C	Why ecologists and economists should have plenty of common ground	183	Hahs, A	The importance of interdisciplinary collaboration in creating sustainable and resilient urban landscapes
10:30	339	Aires, F	Alteration of fuel load, structure and fire hazard due to African Olive invasion in eucalyptus Woodland	332	Greenhalgh, S	Ecosystem services: providing a link between natural and human ecosystems	509	Stewart, G	Building urban resilience with biodiversity to cope with increasing probability of catastrophic events
10:45	231	Lamou-reaux, S	Native plant recovery following control of ground cover weeds in New Zealand lowland forests	653	Weaver, S	The Rarakau Program: Practical challenges on the supply side of ecosystem service markets.	486	Fuller, R	Managing the growth of urban landscapes for people and biodiversity
11:00	400	Bray, J	Didymosphenia geminata impacts on benthic algal and invertebrate diversity and community composition in New Zealand rivers	115	Luck, G	Extending the ecosystem services concept to include the net return from animal activity	350	van Heezik, Y	Managing humans and other wildlife to enhance biodiversity in urban landscapes in NZ
11:15	405	Lebel, T	Impacts of an invasive mycorrhizal fungus on native fungal diversity	126	Maron, M	Do biodiversity offset policies risk entrenching a baseline of biodiversity decline?	200	Standish, R	Improving city life: options for ecological restoration in urban landscapes
11:30	528	Kilbey, D	Geospatial Smartphone Apps and the use of Crowd Sourcing for the Recording of Invasive Species	122	Brown, M	Systematic evaluation of ecological compensation in New Zealand	633	Simcock, R	Urban motorways as ecological assets
11:45	658	Green-away, A	Killing possums collaboratively: the invasion of public knowledge into pest control decision making.	253	Eber, S	The SWAEI Strategic Framework for Biodiversity Conservation in Western Australia	368	Galbraith, J	Guess who's coming to dinner: Changes to local bird communities as a result of supplementary feeding
12:00			Lunch						
13:00			Keynote Speaker: Don Cowan (Shifting paradigms in Antarctic Dry Valley microbial ecology)						
	Session 8: S11 - Antarctic Ecology			Session 8: S15 - Ecosystems, Economics and Policy			Session 8: S9 - Urban landscapes		
13:45	618	Morgan, F	Terrestrial bioregionalisation for the Ross Sea region	190	Steven, R	Valuing Australian Avitourism: Assessing preferences for bird assemblages using a choice experiment.	208	Kruger, D	Frogs about Town: Micro- and macro habitat determinants as observed in a South African city.
14:00	680	Pinkerton, M	Change in Ross Sea regional ecosystems: trophic relationships and climate-ecosystem linkages	95	Vas, K	The Economic Value of Bird-watching in New Zealand	283	Davis, A	Energetics of the suburbs: does nectar availability explain nectarivore abundance in an urban environment.
14:15	375	Terauds, A	Habitat heterogeneity and biodiversity in terrestrial Antarctica	472	Creagh, K	Value and price: how systems-thinking narratives can assist communities in reconstructing ecological identities	552	Hand, K	Finding nature in the city: biodiversity and children's habitat-use in the urban environment
14:30	657	Sewell, M	Ecological insights from the Antarctic mero-plankton	474	Roberts, L	How do we communicate the value of ecosystem services to human wellbeing?	581	Amiot, C	Impact of nest site selection on reproductive success of a New Zealand passerine in urban woodlands
14:45	659	Lohrer, D	Biodiversity and ecosystem function in coastal ecosystems of the Ross Sea	452	Bau, S	Technical information and judgement for conservation decisions	465	Tomlinson, A	Distribution and community composition of millipedes and isopods in forest fragments along a suburban-rural gradient
15:00	676	Hogg, I	High biodiversity revealed for the Central and Southern Transantarctic Mountains (83-87oS)	574	Gilfedder, L	Can we secure climate-adapted sanctuaries for the future as a key adaptation strategy?	182	Paris, B	Bat awareness movement - advocacy for long-tailed bats in Auckland
15:15	470	Kolb, J	Short circuit co-evolution by the perfect parasite? Antifreeze glycoproteins of fish leeches in Antarctica	679	Boow, J	Application of IUCN threatened ecosystem criteria to terrestrial ecosystems in Auckland, New Zealand	681	Clarkson, B	Bringing nature back into New Zealand cities: key factors in reaching Hamilton City's "tūi tipping point".
15:30			Afternoon tea						
	Session 9: Foodweb			Session 9: Population dynamics			Session 9: S9 - Urban landscapes		
16:00	369	Klemmer, A	Quantifying the connectedness of terrestrial/freshwater meta-ecosystems.	450	Edworthy, A	Pardalotes, lerps, and parasites: causes of decline in forty-spotted pardalotes	329	White-head, A	Avoiding extinction by a thousand cuts: Evaluating strategic approaches to mitigating impacts of urban expansion on biodiversity
16:15	395	Leo, V	Evaluating the role of the dingo (<i>Canis lupus dingo</i>) as a trophic regulator in differing Australian ecosystems.	359	Hall, A	Eucalypt psyllid population dynamics and psyllid-induced tree decline - a case study from Western Sydney	518	Baranyovits, A	Movements of a native fruit pigeon within a fragmented urbanised landscape
16:30	591	Varennas, Y	Un-nesting DNA Russian dolls - The potential for rapid construction of food webs using residual DNA in empty aphid mummies.	386	Galato-witsch, M	Trade-offs and dispersal in unpredictable environments: generalist invertebrate persistence in ponds	387	Connelly, C	Identifying landscape connections for a small woodland bird in an urbanising ecosystem in Melbourne, Australia
16:45	145	Walker, M	Tailoring hedgerow plants in agroecosystems to maximise beneficial insects	433	Aguirre, D	Genetic diversity influences productivity in marine invertebrate populations	492	Sullivan, J	How many birds are killed by cars on New Zealand roads, and does it matter?
17:00	287	Vesk, P	Predicting species grazing responses from lists	125	Painting, C	Trade-offs between body and weapon size in the New Zealand giraffe weevil: A new approach to Bergmann's rule	398	Blaschke	Catchment-based ecological restoration in urban settings: examples and conclusions from Wellington, New Zealand
17:15	499	Ball, O	A dung fight at Te Paki?	224	Bowman, A	Patchiness of resources determines heterogeneity of density dependent effects in arid lands of southern Australia	392	Parris, K	Larger frogs experience greater acoustic interference in urban noise
18:30			Conference Dinner						

Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title
STREAM D			STREAM E			STREAM F		
Session 7: SPEED TALKS			Session 7: Dispersal & connectivity			Session 7: S10 - e-Research		
See Speed-talk page			512	Kelly, D	Are smaller seeds less fit? A 7-year test in <i>Beilschmiedia tawa</i> , and implications for frugivore loss	291	VanDer Wal, J	The Biodiversity and Climate Change Virtual Lab: enabling research on climate change impacts on biodiversity
			249	Warren, C	Promoting succession in retired pastures: can artificial bird perches increase native seed rain?	637	Evans, B	Towards a framework for sharing an open set of data and tools for ecosystem modellers
			519	Wyman, T	What can we tell about fruit dispersal quantity by looking under the parent canopy?	497	Dwyer, R	OzTrack: new online software for the analysis & visualisation of animal tracking data
			557	Babale, A	The interplay of habitat and seed type on conditional mutualism in fragmented Afrotropical forest landscape	508	Parsons, S	Acou-informatics: searching for biologically relevant signals amongst the background noise of the world
			325	Driscoll, D	Dispersal research in conservation biology. Do we need to get better at it?	548	Turner, D	ÆKOS: A new paradigm to enable discovery, access and re-purposing of complex ecological data
			476	van der Burgh, C	Assessing landscape connectivity values using an expert opinion approach: Slopes to Summit case study	91	Bastin, L	Easy access to reproducible computing and uncertainty propagation - the Tzar framework
			96	Chen, S	A mammoth mouthful? A test of the idea that big animals disperse big seeds.	353	McCreedy, E	Empowering Indigenous land and sea managers to undertake natural and cultural resource management - I-Tracker initiative
Session 8: Disturbance - fire			Session 8: Ecophysiology			Session 8: Spatial processes		
456	Aponte, C	Long-term effects of repeated prescribed fires on coarse woody debris in an Australian temperate forest	117	Macinnis-Ng, C	Growth of kauri (<i>Agathis australis</i>) trees: source or sink limited?	114	Stirne-mann, J	Bird community responses to vegetation cover and structural heterogeneity
460	Tasker, E	Fire regimes of the Blue Mountains World Heritage Area, Australia: patterns and ecological impacts	399	Scaloni, M	Parasitic mistletoes show curiously similar photosynthetic adaptations to aridity as their hosts	196	Fraser, J	The curious case of the non-flammable grassland
490	Ruiz-Taloni, L	Germination in <i>Eucalyptus</i> : initial implications for restoration	402	Ellsworth, D	Elevated CO ₂ in an Australian woodland (<i>EucFACE</i>): Are phosphorus limitations to trees truth or myth?	216	Sato, C	Drivers of reptile distributions in disturbed alpine and sub-alpine environments
242	Foster, C	Are wallabies bad for spiders? Indirect interactions between large herbivores and arthropods in a post-fire environment.	463	Jakob, S	Drought stress in <i>Eucalyptus marginata</i> - water relations and carbohydrates	327	Nathan, E	Determining the spatial extent of pest management outcomes
194	York, A	Regime change: The response of beetle assemblages to altered seasonality and frequency of fire	686	Hunt, J	Drought and temperature effects on carbon transport and allocation: results from 13CO ₂ pulse labeling experiments	487	Lisovski, S	The Same but Different: Avian Influenza Infection Dynamics on Both Sides of the Equator
256	Mackenzie, B	Germination syndromes in <i>Boronia</i> (Rutaceae): complex interactions between heat shock, smoke and season	296	Shelby, T	New Zealand-naturalized <i>Trifolium</i> lack root flavonoid diversity	600	Murphy, B	Fire extent and small mammal declines in northern Australia
589	Ooi, M	Post-fire soil seed bank resilience of obligate seeders: bet-hedging capacity and increased fire frequency	269	Uddin, M	Assessment of root and litter mediated allelopathic interference of <i>Phragmites australis</i> using density-dependent approach	285	Voinopoulou-Sassu, A	Functional habitat connectivity for the rifleman on Banks Peninsula, New Zealand
Session 9: Fire			Session 9: Various			Session 9: Various		
247	Collins, L	Impacts of long term frequent burning and post-harvest regeneration on live tree biomass and demography	698	Clearwater	Tree fern hydraulic functioning	345	Perry, G	A time to die: a high-precision extinction chronology for moa (Aves: Dinornithiformes)
172	Zeeman, B	Re-introducing fire into a long-unburned coastal woodland: changes in stand structure and composition	131	Hayes, R,A	Attractiveness of volatiles from natural honeybee hive products to the small hive beetle <i>Aethina tumida</i> (Coleoptera: Nitidulidae)	517	Metherell, ZI	Integrating ecological concepts into urban park design
374	Cadenhead, N	Spatio-temporal Trade-offs In Fire Management For Threatened Species Persistence	580	Hill, S	You changed your tune: diurnal variation in avian song complexity	672	Thurgate, N	Missing pages: filling the gaps in Australia's ecological story
411	Densmore, V	Phos-fire-us'- Can fire intensity and P availability predict population densities of woody legumes after bushfire?	175	Morris, W	Value of information analysis for Box-Ironbark forest and woodland management	391	Harrop-Archibald, H	Prime time: do fungi prime litter for invertebrates?
547	Williams, R	Fire futures for a flammable continent	630	Bonser, S	High reproductive efficiency as an adaptive strategy for plants in competitive environments	671	Khin, J	Monitoring and reporting biodiversity change within Auckland's urban landscape
						219	Flores-Moreno, H	In the beginning: Phenotypic change of three species through their first 200 years since introduction.

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THURSDAY 28 NOVEMBER

	Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title
	STREAM A			STREAM B			STREAM C		
Start Time	Session 10: S6 Landscape Genetics			Session 10: S16 - Indigenous ecology			Session 10: Community assembly		
09:15	468	Adamack, A	Examining the spatial structure of Foxes in Australia using landscape genetics approaches	178	Ens, E	Caring for Aboriginal-owned Country in South Eastern Arnhem Land using innovative two-way learning and management approaches	516	Lee, W	Community assembly and historical contingency over evolutionary timescales
09:30	89	Fuller, S	Landscape genetics of the threatened water mouse (<i>Xeromys myoides</i>) and implications for management	202	Chetham, J	A Framework for Māori Cultural Health Indicators for Kauri Ecosystems	330	McIntosh, A	Experimental evidence that habitat size influences multiple aspects of river community stability
09:45	448	Gruber, B	LandPopGenReport - a landscape genetic tool to analyse the effect of landscape feature on population structure using genetic data	610	Smith, H	Manaaki Taha Moana	378	Facelli, J	Aggregated distribution modifies competitive effects in an annual plant guild in arid lands of Australia.
10:00	631	Sarre, S	Landscape level microsatellite DNA analysis reveals substantial cryptic genetic structure in feral possums in New Zealand	315	Davies, S	Emancipatory Resource Management: A Hapu Story	286	Clements, C	Interactions between assembly order and environmental change can alter both short and long-term community composition
10:15	181	Etherington, T	Quantifying the direct transfer costs of dispersal using least-cost modelling	356	Turpin, G	Bridging Indigenous Knowledge and Western Science in Innovative Ways for a Sustainable Future - The Tropical Indigenous Ethnobotany Centre	135	Thomsen, M	Cascading habitat formation increase biodiversity in New Zealand estuaries
10:30	622	Stevens, K	Effects of group isolation and population size on mating systems and relatedness of the Grey-crowned Babbler (<i>Pomatostomus temporalis</i>)	414	Standley, P	The angel in the detail: Diverse burning for cultural and environmental outcomes in Australia	507	Wiser, S	Using species complementarity to set conservation priorities: which species are most important?
10:45	Morning tea								
	Session 11: Invasive species			Session 11: S16 - Indigenous ecology			Session 11 - Policy & Mgmt		
11:15	685	Clout, M	Vertebrate extinctions: the relative impacts of humans and other invasive mammals	416	Johnson, M	Transforming Agriculture with Native plants and Indigenous Knowledge	282	Tierney, D	Genetic and recruitment patterns predict biodiversity loss from biodiversity offsetting schemes
11:30	100	King, C	Swimming capabilities of stoats and the threat to inshore sanctuaries	443	Costello, O	Cultural Burning - Diversity of Fire	420	Anderson, B	Climate change and conservation prioritization
11:45	206	Griffiths, J	Can airborne laser scanning enhance ecological outcomes of large scale <i>Salix cinerea</i> control?	461	Phillips, R	Grassroots in Urban Landscapes - Aboriginal Leadership in Environmental Management within Government structures	428	Giljohann, K	Optimal fire management strategies are sensitive to conservation objectives and taxonomic focus
12:00	234	McAlpine, K	Facilitating native seedling recruitment in the presence of ground cover weeds and seed/seedling predators	556	Richards, A	Savanna burning, greenhouse gas emissions and Indigenous livelihoods: Introducing the Tiwi Carbon Study	155	Namazi, A	Impact of stress and grazing on the importance of facilitation by <i>Acacia gerrardii</i> in arid environments in Saudi Arabia
12:15	504	Rouco, C	Effects of population reduction on possum movements and habitat use in a New Zealand dryland ecosystem				700	Brockhoff	Effects of forest loss and fragmentation on New Zealand passerines
12:30	Lunch								
13:30	Keynote Speaker: David Keith - Australian award winner (I See Red, I See Red, I See Red (List): assessing risks of ecosystem collapse)								
14:15	Keynote Speaker: Richard Duncan (Understanding the past: ecological insights into prehistorical ecology)								
15:00	Conference closing + Student Conference awards								

Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title	Abst No.	Speaker	Talk title
STREAM D			STREAM E			STREAM F		
Session 10: Monitoring			Session 10: S1 - Ecosystem Development			Session 10: Disturbance - recovery		
310	Brownstein, G	Ecotones as indicators: do they have potential as a monitoring tool for wetland plant communities?	641	Jones, A	Shades of Grey: soil carbon, nitrogen and phosphorus dynamics along the Cooloola soil chronosequence	123	Freestone, F	The effect of natural flooding on floodplain understorey vegetation, following extended drought in Northwestern Victoria
677	McMurtry, M	Breaking the paper mold: electronic data capture for biodiversity monitoring at Auckland Council	515	Laliberté, É	Long-term soil chronosequences from south-western Australia: recent findings and future research plans	168	O'Donnell, J	Can riparian seed banks facilitate the geomorphic and ecological recovery of degraded streams?
418	Bishop	Monitoring changes in the state of indigenous biodiversity within the Waitakere Ranges Heritage Area, 2006 - 2013	501	Teste, F	Arbuscular mycorrhizal fungal communities along an soil age and fertility gradient on an arid sand dune chronosequence	567	Haby, N	Small mammal and reptile response to a 15-year old integrated management program in a semi-arid environment
169	Monks, J	Predator impacts and potential monitoring techniques for New Zealand's alpine birds	545	Peltzer, D	Soil community composition changes along two ecosystem chronosequences	562	Roschak, C	Regeneration success in Central North Island mixed podocarp-broadleaved forest - the positive impact of large disturbance
191	Buckley, H	Phylogenetic patterns of algal selectivity in epiphytic lichens	674	Condron, L	Ecosystem development in temperate rainforests on the west coast of the South Island of New Zealand: pedogenesis, phosphorus depletion, and the composition of plant and microbial communities	598	Coggan, N	Restoration of ecosystem engineers affects habitat use by a key detritivore.
340	Gruber, M	Context-dependence complicates the prediction of invasion outcomes: a case study with the invasive yellow crazy ant	593	Tylianakis, J	The assembly and disassembly of ecological networks	288	Krauss, L	Feed the birds: propagation of female Buloke (<i>Allocasuarina luehmannii</i>) for revegetation.
Session 11: Workshop			Session 11: Biogeography & macroecology					
Workshop 9: Ecological Principals for NZ Resource Management Act Proceedings Organised by: Jonathan Boow			301	Buitenwerf, R	Biome predictions based on leaf phenology			
			90	Tucker, M	Carnivorous Mammals: the Big, the Small and the Giants.			
			318	Bernays, S	Chasing the dragon: A species resilience to climate change in the Wet Tropics, Queensland			
			429	Caddy-Retali, S	TERN: Building new ecological plot infrastructure to enable Australian science			
			454	Maire, V	Joint modulation of leaf economic trait relationships by soil and climate, at global scale			
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Speed Talks

12 talks per speed session + 30 mins discussion

Speed talk Monday AFTERNOON

Time	Abstract No.	Speaker	Title
TBC	99	Reid, T	Some Simple Reasons Why Monitoring and Adaptive Management Often Fail in Practice
	205	Canessa, S	Dealing with trade-offs in destructive sampling designs for occupancy surveys
	694	Landers, T	Satellite-based tracking of kaka in the Auckland region
	445	D'Agui, H	Keeping pace with a changing climate: Can Australian plants count on rapid evolution?
	72	Hurry, C	Using shared phylogeographic patterns to infer the shared threats to an ecto-commensal flatworm and its critically endangered crayfish host
	143	Knight, A	Gene flow and population structure in the Endangered Nigerian Cameroon chimpanzee in Taraba State, Nigeria
	328	Knafker, G	Is the MHC class II B gene a single locus in parrots?
	367	Ramon-Laca, A	Identification multiplex assay of 19 terrestrial mammal species present in New Zealand.
Discussion			

Speed talk Tuesday MORNING

Time	Abstract No.	Speaker	Title
TBC	83	Fazlioglu, F	A test of the Specialization Hypothesis using plant populations on an altitudinal gradient
	451	Yearsley, E	Germination and seedling fitness response to smoke treatment of serotinous species
	577	Hudson, A	Patterns of Physical Dormancy Breakdown Along Two Climatic Gradients
	232	Hauser, C	Modelling kangaroo-vegetation dynamics in semi-arid Australia
	431	Fedrigo, M	Carbon Stock Variation with Transition Between Wet Sclerophyll Forest and Cool Temperate Rainforest in South-Eastern Australia
	471	Lambert, M	Significant Species and Complex Communities of the University of Canterbury's Cass Mountain Research Area
	258	Belbin, L	Data integration and data quality
	533	Barmuta, L	Joining the dots: connecting downscaled climate projections, hydrology, ecosystem values, and management frameworks to conserve biodiversity in freshwaters
	193	Zhang, J	A Spatially-explicit Individual-based Approach to Assess the Optimal Perception Range of Foraging Animals
	683	Ochoa-Hueso, R	Impacts of altered precipitation and root herbivory on nutrient cycling in Australian grassland - DRI-Grass experiment
Discussion			

Speed talk Wednesday MORNING

Time	Abstract No.	Speaker	Title
TBC	333	Schroeder, T	Spatial and temporal interactions between Dingoes, Cats and Foxes in South Australia's arid zone
	636	Stavert, J	We know what you ate last summer: dung beetles, isotopes and the ocean
	110	Venn, S	Dispersal opportunity among Australian alpine plant species
	642	DeGabriel, J	The effects of local climatic variation on the fig/pollinator mutualism and its associated parasites
	649	Iwasaki, J	The Varroa Invasion of Australasia
	605	Valdez, J	Comparison of habitat selection by an endangered amphibian in a natural and created landscape
	624	Ruykys, L	Straddling the divide: den use by brushtail possums (<i>Trichosurus vulpecula</i>) in urban parklands.
	97	Harun, M	Allelopathy of Boneseed (<i>Chrysanthemoides monilifera</i> subsp. <i>monilifera</i>): a Biochemical Weapon of Invasion
	668	O'Loughlin	Invasive Giant African Landsnails in rainforest on Christmas Island, Indian Ocean: little no evidence of impact
	688	Dale, E	A sticky situation: seed dispersal of Cook's scurvy grass
	696	Hughes, C	Assessing the impact of fox baiting on Tasmanian devils
Discussion			

Friday 29 November

FRIDAY WORKSHOPS					
Start time	End time	Workshop Title	Venue	Room	Organiser
9.00am	12.30pm	Invasive species in a changing world: are we asking the right questions?	Owen G Glenn Building, University of Auckland, Grafton Road	260-009	Monica Gruber and Ben Gooden
9.00am	12.30pm	Long-term planning for sustaining and building Australian ecosystem science		260-215	Rebekah Christensen
9.00am	5.00pm	NVS Express Training Workshop		260-012	Susan Wiser
WRITER'S RETREAT					
Start time	End time	Workshop Title	Venue	Room	Organiser
9.00am	11.00am	Writer's Retreat Seminar	Old Government House, University of Auckland	102-G36	Cate Macinnis-Ng
FRIDAY FIELD TRIPS					
Start time	End time		Departing point	Organiser name	
7.00am	6.00pm	Te Hauturu o Toi (Little Barrier Island)	48-52 Mayoral Drive (western side)	Lyn Wade	
8.00am	4.00pm	Tawharanui Open Sanctuary	48-52 Mayoral Drive (western side)	Matt Maitland	
8.30am	5.30pm	Auckland's wild west coast	48-52 Mayoral Drive (western side)	TBC	
9.00am	4.00pm	Rangitoto Island	Downtown Ferry Terminal	Mike Wilcox	
9.00am	12.30pm	Behind the scenes at Auckland War Memorial Museum	Auckland War Memorial Museum (South entrance)	Ewen Cameron	
1.00pm	5.00pm	Behind the scenes at Auckland Zoo and the NZ centre for conservation medicine	Auckland War Memorial Museum (West wall) at 1.00pm and 48-52 Mayoral Drive (western side) at 1.10pm	TBC	
SATURDAY / SUNDAY FIELD TRIPS					
Start time	End time				
Saturday 8am	Sunday 5pm	Waikato Wonders weekend			
Saturday		Seabirds and Islands of the Outer Hauraki Gulf with Pterodroma Pelagics		info@nzseabirds.com	

Plenary Abstracts



Shifting paradigms in Antarctic desert soil microbial ecology

Cowan, Don¹

¹*Centre for Microbial Ecology and Genomics, University of Pretoria*

Through the first decade of this century, renewed interest in the microbial ecology of the east Antarctic Dry Valley deserts, coupled with increasingly ready access to Next Generation DNA sequencing technologies, has revolutionized our understanding of the structure and function of these unique ecosystems. Early perceptions that the desiccated oligotrophic Dry Valley soils were either sterile or harboured very low levels of microbial biomass were rapidly reversed. Phylogenetic surveys clearly demonstrated that bacterial species diversity (and, by implication, physiological capacity) is unexpectedly high, leading to the growing realisation that these apparently depauperate soils and their associated lithic biotopes harbour complex and structured microbial, lower eukaryote and viral communities. There is also recent evidence that these communities are remarkably responsive to changing environmental conditions. Recent transect studies and landscape-scale biocomplexity surveys in the Dry Valleys show highly inhomogeneous distribution patterns, and have revealed some of the macro- and micro-environmental drivers of small- and large-scale community structure. These studies are highly relevant to the development of future conservation policies for the unique Antarctic Dry Valleys, under increasing threat from natural (climate change) and anthropogenic (tourist and scientific) impacts.

Biography

Professor Don Cowan, Director of the GENOMICS RESEARCH INSTITUTE, and the CENTRE FOR MICROBIAL ECOLOGY AND GENOMICS, University of Pretoria, South Africa. Research interests include microbial ecology of hot and cold desert soils, functional metagenomics and applied microbiology.



Plants as River System Engineers

Gurnell, Angela M¹

¹*Queen Mary, University of London*

Research undertaken over the last decade has demonstrated that certain plant species can have a significant influence on the form of river systems across space scales from individual plants to entire forested river corridors. Small plant-scale phenomena structure patch-scale landforms and processes, and interactions between patches are almost certainly crucial to the larger-scale and longer-term behaviour of rivers and their riparian margins.

The influence of plants on river environments also varies continuously through time as above and below ground plant structures change within the annual growth cycle, over longer-term growth trajectories, and in response to external drivers of change such as climatic, hydrological and fluvial fluctuations and extremes. These interactions between plants and physical forms and processes are fundamental to the plant biodiversity as well as morphodynamics of river environments and, as a consequence, are also crucial to the sustainable management and restoration of river systems.

Biography

Angela Gurnell is Professor of Physical Geography at Queen Mary, University of London. Her research focuses upon the biogeomorphology and sustainable management of river systems.



Climate change, invasions and Anthropocene conservation

Thomas, Chris D¹

¹*University of York*

Changes to the geographic distributions of species are becoming the norm as a result of human activities: climate change, habitat change, and the deliberate and accidental translocation of species between regions. I will describe some of the recent evidence surrounding species' range shifts, making credible forecasts of substantial future extinction. Changing distributions and communities during a period of rapid environmental change undermine some of the traditional assumptions of conservation thinking. For example, as species change their distributions in response to multiple Anthropocene drivers of change, we increasingly find them in the "wrong places". It is no longer possible, and often not desirable, to put the species back where they came from. So conservation strategies have to be selective about choosing which battles to fight. I will illustrate some of the challenges by discussing the potential for translocations of species outside their historical ranges to save species from extinction (especially from climate change), yet risking new invasions in so doing.

Biography

Chris Thomas is Professor of Conservation Biology at the University of York, in the UK. His research considers the combined effects of habitat fragmentation and climate change on the distributions, ecology and evolution of species.



Global change and ecosystem functioning: the interplay of biodiversity, environmental context, and species interactions

Tylianakis, Jason M. ^{1,2,3}

¹*University of Canterbury, New Zealand*

²*Imperial College London, Silwood Park, UK*

³*Allan Wilson Centre*

Global environmental changes are driving widespread extinctions of species, which have generated concerns over disruption of ecosystem functioning. Historically, the importance of diversity for maintaining ecosystem functioning and services has been debated, due to often contrasting results. However, environmental changes not only affect biodiversity, but they also alter the conditions under which species carry out their roles, and this can determine the functional importance of biodiversity. Using primary productivity, predator-prey interactions and pollination as examples, I will outline the environmental context under which biodiversity is most important for promoting ecosystem services, and the mechanisms through which this occurs.

Despite the importance of biodiversity, many ecosystem services involve interactions among many different species within a community, and interactions may be disrupted long before the species involved go extinct. These interactions can be viewed as a network, and the architecture of such interaction networks is known to affect ecosystem stability and resistance to extinctions. Resource partitioning is implicit in this architecture, which provides a link between ecological networks and ecosystem functioning. Unfortunately, recent work has shown that human changes to the environment can alter this architecture, yet evidence from plant-pollinator networks suggests that it may be possible to foresee the disruption of individual interactions within networks and thus to predict extinctions. Finally, given the importance of this interaction network structure, I will discuss how it originates during ecosystem development.

Biography

JMT is a professor of ecology and Rutherford Discovery Fellow, with primary interests in how biotic and abiotic forces shape species interactions and the conditions under which ecosystem functioning and services are affected by biodiversity.



Understanding the past: ecological insights into prehistorical ecology

Duncan, Richard¹

¹*Institute for Applied Ecology, University of Canberra, ACT 2601, Australia*

Ecologists frequently strive to understand phenomena that are difficult to observe directly – we often aim to infer underlying patterns and processes from incomplete observations that are confounded by issues such as detection uncertainty. As a consequence ecology has become adept at developing or adopting quite sophisticated tools to infer patterns and to interpret these in terms of underlying processes. Similar problems confront other fields. In particular the present-day ecology of Australia and New Zealand has been strongly shaped by the impacts of the first human settlers. Understanding these impacts is important but difficult because data from the past are also strongly confounded by issues such as detection uncertainty. My aim in this talk is to illustrate, using examples, how concepts and methods developed to deal with present-day ecological problems can be applied to data from the past to better understand the ecology of prehistoric human impacts.

Biography

Richard Duncan is Professor of Conservation Ecology at the Institute for Applied Ecology, University of Canberra, and is particularly interested in the ecology of invasions and extinctions.



Is managing species with minimum viable populations of <5,000 a waste of time? Revisiting the 50/500 rule in conservation biology

Jamieson, Ian¹

¹*Allan Wilson Centre for Molecular Ecology and Evolution, Department of Zoology, University of Otago*

It has been argued recently (by a group of Australian scientists) that minimum viable population size (MVP) should be at least 5,000 individuals to maintain long-term evolutionary potential. This stems in part from the 50/500 rule, which is used as a guiding principle in conservation for assessing minimum viable effective population size (N_e). There is no doubt that genetic diversity is eroded by genetic drift in small populations, but there is little evidence that relatively large populations (>1,000) are at risk of extinction due to genetic drift alone. I advocate strategies that emphasize maintaining genetic diversity during the recovery stage of conservation programs, rather than one that focuses exclusively on the requirement of a population size of thousands of individuals in order to maintain evolutionary potential. I illustrate this approach with several New Zealand examples.

Biography

Ilan Jamieson is a Professor of Zoology, University of Otago, and a PI with the Allan Wilson Centre and has research interests on the impact of inbreeding and loss of genetic diversity in bottlenecked populations.



I See Red, I See Red, I See Red (List): assessing risks of ecosystem collapse

AERA Lecture

Keith, David^{1,2}

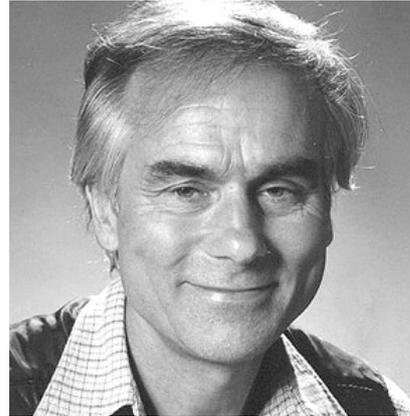
¹*Australian Wetlands, Rivers & Landscapes Centre,
University of New South Wales., Australia*

²*Ecosystem Processes Group, NSW Office of
Environment & Heritage, Australia.*

IUCN's Red List of Threatened Species is one of the sharpest tools in the shed for communicating the status of biodiversity and planning action for its conservation. The listing criteria are elegant shorthand that translates principles from population theory into relatively simple proxies for assigning species to ordinal categories of extinction risk. The global uptake of the method and its language over half a century of use and development speaks volumes about its success in communicating simple and powerful messages about the status of biodiversity. The need for an equivalent system for assessing higher levels of biodiversity such as ecosystems has long been recognised. However, the design of a simple protocol that represents principles from ecosystem theory accurately and consistently across terrestrial, freshwater, marine and subterranean environments, is challenging to say the least. In this paper, I will describe new IUCN criteria for Red Listing ecosystems, outline some key concepts underpinning the protocol and report on some early performance evaluations. Among the most challenging issues are defining an endpoint of ecosystem decline, dealing with multiple dimensions of scale and quantifying ecosystem degradation in a consistent generic manner. I conclude by outlining an agenda to get the band back together for a new album of promising research tunes.

Biography

David Keith is Professor of Botany (UNSW) and Senior Principal Research Scientist (OEH). His research interests include ecosystem dynamics, conservation biology, fire ecology and plant demography. John Ogden.



Science and Common Sense: Assessing a decade of Conservation Action on Great Barrier Island.

Ogden, John¹

¹*Great Barrier Island Charitable Trust. www.gbict.co.nz*

Communities undertaking local conservation often require professional input to ensure their efforts are based on good science. They recognise that this will produce both better outcomes, and a data base and track record to assist with on-going funding. The scientist involved is often working in an uncontrolled environment, where conclusions rely on judgements from multiple lines of evidence rather than neat statistical experiments. Communicating methods, explaining results and suggesting new approaches are key roles, and vitally important to sustained input by participants. "Bird monitoring" as a measure of conservation success usually take precedence over vegetation (except in "restoration"). Rodent control/eradication has been undertaken by several organisations at sites on Great Barrier Island with varied success. Bird counts have been used as indicators of success, although other biota, and tracking tunnels are now being monitored also. A decade of results from Windy Hill (620 ha.) and Glenfern Sanctuaries (230 ha.) suggest that large reductions in ship rat numbers have benefitted some large frugivorous birds. Smaller (insectivorous) species may have declined. Changes in vegetation structure/ composition are also implicated. However the on-going cost and human effort required to keep rats at low numbers in such sanctuaries suggests that total island eradication of rats and feral cats is the only way to prevent long-term biodiversity losses. This is the mission of the Great Barrier Island Charitable Trust, which continues to work with the local community (through the Local Board) to this end.

Biography

John Ogden is a former associate professor of forest ecology at Auckland University. Publications include forest dynamics, dendrochronology, vegetation history in NZ, (and birds!) He is currently engaged in community-led conservation initiatives on Great Barrier Island.

Symposia

1. Patterns in ecosystem development

Thursday 28 November

Stream E, Session 10

Shades of Grey: soil carbon, nitrogen and phosphorus dynamics along the Cooloola soil chronosequence

Jones, Andrew^{1,3}; Schmidt, Susanne¹; Sanderman, Jonathan²; Dalal, Ram³; Allen, Diane³

¹School of Agriculture and Food Sciences, The University of Queensland, St Lucia 4072, Queensland, Australia

²CSIRO Land and Water, Waite Campus 5064, South Australia.

³Department of Science, Information Technology, Innovation and the Arts, Eco Sciences Precinct, Dutton Park 4102, Queensland, Australia.

The subtropical Cooloola Podosols chronosequence comprises sand dunes that form a successional gradient from young to ancient (≈ 500 to $\approx 700,000$ years) and represents an ideal system to study long-term ecosystem feedbacks on soil organic carbon (SOC) dynamics with minimal variation in clay minerals. We measured C and nutrient stocks as well as C turnover rates using D14C measurements on samples collected in 1974 and 2012. As predicted, soil P stocks declined progressively with age, but litter P yield (kg P/ha) peaked in forest soils 120,000 years old with highest biomass and associated productivity. Increasing C:N ratios of soil and litter with dune age indicated increasing N limitation. The SOC stocks (upper 0.5 m) were 70, 40, 36, 73, 55, and 56 t C/ha from youngest to oldest stages, not conforming to aboveground biomass build-up and decline and therefore not correlated to current annual C input from vegetation. A possible reason is that organic matter leaches into deeper soil rather than accumulate in upper horizons. A second finding was that SOC turnover was comparatively fast at all stages as D14C-calculated turnover times were ≈ 40 years. Thus changing N and P relations across the chronosequence may not impact on immediate SOC turnover rate, although it is unknown if this is also true for SOC in the deeper B horizon. Together, the variation in SOC stocks in the upper soil and similar SOC turnover rates indicate that SOC stabilisation is not a function of dune age, associated productivity, or N and P relations. This somewhat contrasts current chronosequence concepts and suggests SOC stabilisation mechanisms in sandy soils are poorly understood.

AJ is a recent graduate from the University of Queensland, who completed his Honours project evaluating soil dynamics along the Cooloola chronosequence. He now works for the Queensland Government Department of Science; assisting research in soil carbon.

Thursday 28 November

Stream E, Session 10

Long-term soil chronosequences from south-western Australia: recent findings and future research plans

Laliberté, Etienne¹; Turner, Benjamin L.²; Hayes, Patrick¹; Zemunik, Graham¹; Teste, François P.¹; Lambers, Hans¹

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²Smithsonian Tropical Research Institute, Apartado 0843-03092, Balboa, Ancon, Republic of Panama

Some of the best-studied, long-term soil chronosequences in the world are found along the Tasman Sea coast in New Zealand (e.g. Franz Josef) and Australia (e.g. Cooloola). Recently, we initiated ecological research on Australian long-term dune chronosequences in south-western Australia. These coastal dune chronosequences are of particular interest for three reasons. First, they are located in a global biodiversity hotspot, with high plant species and functional diversity. Second, similar dune chronosequences can be found across a broad climate gradient from Jurien Bay (~ 500 mm rainfall) to Pemberton (~ 1300 mm rainfall), providing opportunities to explore climate effects on ecosystem development. Third, they include some of the most phosphorus (P)-poor soils on the planet, with surface soils on the oldest dunes commonly containing < 10 mg P kg⁻¹. This talk will give a general overview of ongoing and future research along these chronosequences. The focus will be on the Jurien Bay chronosequence, where most work has been done so far. Data will be presented on soil nutrient availability, nutrient limitation, vegetation composition and diversity, as well as plant nutrient acquisition and use. The work conducted so far shows that these south-western Australian dune chronosequences contain both progressive and retrogressive phases, with extreme phosphorus (P) limitation on old soils. The exceptionally broad range in nutrient availability found across these chronosequences, coupled with the species-rich flora, make them valuable model systems to determine belowground controls over plant diversity.

Etienne Laliberté is Assistant Professor in the School of Plant Biology at The University of Western Australia (UWA). He holds an ARC Discovery Early-Career Researcher Award that supports his research on belowground controls on plant diversity along soil fertility gradients.

Thursday 28 November

Stream E, Session 10

Arbuscular mycorrhizal fungal communities along an soil age and fertility gradient on an arid sand dune chronosequence

Teste, François¹; Krüger, Manuela²; Laliberté, Etienne¹; Lambers, Hans¹; Bunce, Michael³¹School of Plant Biology, The University of Western Australia, 35 Stirling Highway, Crawley (Perth), WA 6009, Australia²Academy of Sciences of the Czech Republic, Praha, Hlavni mesto Praha, Czech Republic³Murdoch University, School of Biological Sciences and Biotechnology, South Street, Murdoch (Perth), WA 6150, Australia

Arbuscular mycorrhizal fungi (AMF) are known to enhance phosphorus (P) acquisition by plants, but it has been suggested that AM strategy becomes ineffective in strongly weathered soils, where P availability is extremely low. Using high-throughput DNA sequencing, we determined changes in the diversity and composition of AMF communities along a 2 M year old sand dune chronosequence in the south-western Australia global biodiversity hotspot. AMF have thus far been largely ignored in biodiversity hotspots, and it is unknown how these communities vary during long-term ecosystem development. We show that AMF spore density decreased from 90,000 spores m⁻³ in the young dunes to 55,000 spores m⁻³ in the old dunes. Mycorrhizal colonisation was dominated by *Rhizophagus* species where it peaked to 24% in 120,000 year old dunes and then dropped again to 9% in 2 M year old dunes. This reduction in colonisation was perhaps due to antagonistic effects of non-mycorrhizal, cluster-rooted Proteaceae plants that dominate on the oldest soils, or to the very low P levels in the soil (<10 ppm total P). Multivariate analyses of the operational taxonomic units (OTUs) show that richness and diversity of the AMF communities are the greatest in the 120,000 year old dunes. A sharp 50% loss of OTUs richness was found in the oldest dunes. The AMF community structure in the mid-aged dunes also differ from the younger and older dunes. Our results are consistent with the view that the AM strategy becomes less effective when P availability declines to very low levels.

Dr François Teste integrate's functional ecology with fungal community biology to better understand plant coexistence, maintenance of biodiversity and ecosystem functioning under a changing climate. His research is mostly field- or microcosm-based assisted by cutting-edge nutrient tracer and molecular techniques.

Thursday 28 November

Stream E, Session 10

Soil community composition changes along two ecosystem chronosequences

Peltzer, Duane³; Bokhorst, Stef^{1,2}; Kardol, Paul²; Bellingham, Peter³; Kooyman, Robert⁴; Schmidt, Suzanne⁵; Wardle, David¹¹ Department of Forest Ecology and Management, Swedish University of Agricultural Sciences, SE 90183 Umeå, Sweden.² Norwegian Institute for Nature Research, Arctic Ecology, Tromsø, Norway³ Landcare Research, Lincoln 7640, New Zealand⁴ Royal Botanic Gardens, Sydney 2000, New South Wales, Australia⁵ School of Agricultural and Food Science, University of Queensland, St Lucia 4072, Queensland, Australia

Co-ordinated changes in plant and soil nutrient status throughout ecosystem development result in predictable shifts in nutrient availability and stoichiometry. Soil chronosequences document long-term ecosystem development and retrogression along which foliar nutrients and resorption from leaf litter can shift several-fold. These strong shifts should exert bottom-up control of soil food webs through promotion of different energy channels dominated by either fungal or bacterial components of the soil microbial community. Thus, bottom-up control should drive consistent patterns of soil invertebrate community structure and composition throughout ecosystem development. We determined the abundance, diversity and community structure of soil and litter-dwelling invertebrates in forests along two contrasting long-term chronosequences characterised by strong shifts from N- to P-limitation: newly exposed dune surfaces in subtropical Australia (Cooloolool) and newly deglaciated surfaces in temperate New Zealand (Franz Josef). Collembola (springtail) abundance was strongly unimodal with ecosystem age at Cooloolool but no clear pattern was observed along the Franz Josef chronosequence. In contrast, Acari (mite) abundance and diversity both decreased along the chronosequence at Cooloolool, but increased at Franz Josef. Fungal:bacterial ratios of the soil microbial biomass were bimodal at both sites because fungi dominated very early and late in ecosystem development whereas bacteria dominated intermediate stages. These results support the view that fungal-based energy channels dominate when nutrient availability is lowest, and this occurs both early and late in ecosystem development. Our results demonstrate that resource availability is a major driver of changes in soil biota abundance and diversity during long-term ecosystem change.

Duane Peltzer is a plant ecologist with research interests in linking above- and belowground ecosystem processes during ecosystem development and biological invasions. He is a Science Portfolio Leader for research in ecosystem ecology and services at Landcare Research.

Thursday 28 November

Stream E, Session 10

Ecosystem development in temperate rainforests on the west coast of the South Island of New Zealand: pedogenesis, phosphorus depletion, and the composition of plant and microbial communities

Condrón, Leo M¹; Turner, Benjamin L.²; Wells, Andrew¹; Andersen, Kelly M.²

¹ Agriculture and Life Sciences, PO Box 84, Lincoln University, Lincoln 7647, Canterbury, New Zealand

² Smithsonian Tropical Research Institute, Apartado 0843-03092, Balboa, Ancon, Republic of Panama

The dynamic nature of the west coast of the South Island of New Zealand provides a wealth of opportunities for studying interactions between soil development and biological communities. We will present recent findings on ecosystem development along west coast chronosequences developed on glacial deposits, coastal dunes, and uplifted river terraces. Pedogenesis is relatively rapid under the wet and warm climate in the region, but we find marked differences in rates of soil development and phosphorus transformations among the sequences. These edaphic contrasts reflect differences in the physical nature of the parent material, which in turn promote variation in the patterns of forest biomass and community composition. In addition, evidence from two of the chronosequences suggests that pedogenesis also influences soil bacterial communities, which undergo marked shifts in composition during long-term ecosystem development.

Benjamin L. Turner is a staff scientist at the Smithsonian Tropical Research Institute in the Republic of Panama. He uses natural and experimental gradients to understand how soils shape the diversity and distribution of plant species in the environment.

Thursday 28 November

Stream E, Session 10

The assembly and disassembly of ecological networks

Tylianakis, Jason M.^{1,2}; Martínez, Laura³; Richardson, Sarah³; Peltzer, Duane³; Coux, Camille¹; Dickie, Ian³

¹ School of Biological Sciences, University of Canterbury, NZ

² Department of Life Sciences, Imperial College London, UK

³ Landcare Research, Lincoln, NZ

All species are embedded in networks of interactions with other species. The architecture of these networks is known to confer emergent properties to the system as a whole, and recent studies have demonstrated that this structure can be affected by environmental changes. In particular, the loss of interactions from networks is known to be non-random, with traits of species or interactions predicting their likelihood of local extinction. However, it remains unclear how the structure of interaction networks emerges, and whether the process of network assembly mirrors its disassembly. We studied mutualist networks involving plants and arbuscular mycorrhizal fungi along the Franz Josef chronosequence. We then compare the early points in time with the retrogressive phase to understand how network structure emerges and decays along the sequence, and how it relates to soil nutrient availability.

JMT is a professor of ecology and Rutherford Discovery Fellow, with primary interests in how biotic and abiotic forces shape species interactions and the conditions under which ecosystem functioning and services are affected by biodiversity.

2. Invasive species in a changing world

Tuesday 26 November

Stream A, Session 4

Invasive ants, climate change and consequences for island conservation

Hoffmann, Ben¹; Bertelsmeier, Cleo²; Courchamp, Franck²; Donlan, Josh^{3,4}; Russell, James⁵; Bellard, Céline²; Leclerc, Camille²; Luque, Gloria².

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There is general consensus that climate change and biological invasions will act synergistically, with the distributions, and thus impacts, of invasive species predominantly expanding with climate change. However this dogma remains poorly tested. Here we model suitable area globally for 15 of the worst invasive ant species, both currently and with predicted climate change (in 2080), globally, regionally and within the world's 34 biodiversity hotspots. Surprisingly, the potential distribution of only five species was predicted to increase (up to 35.8%) with climate change, with most declining by up to 63.3%. The ant invasion hotspots are predominantly in tropical and subtropical regions of South America, Africa, Asia and Oceanic islands, and particularly correspond with biodiversity hotspots. Contrary to general expectations, climate change and invasive ant species will not systematically interact synergistically. However, ant invasions will likely remain as a major global problem, especially where invasion hotspots coincide with biodiversity hotspots. Additional modelling shows that management of such invasive species on islands needs to urgently consider climate change in the prioritisation process, with many of the world's islands already subject to eradication programs predicted to be submerged with only a 1m sea-level rise.

Ben Hoffmann is an Australian based ecologist, specialising in ants. He has a particular interest in invasive ants and their management.

Tuesday 26 November

Stream A, Session 4

Are climate change and invasive species research outcomes being used to future-proof pest management?

Stanley, Margaret C.¹; Sheppard, Christine S.¹

¹Centre for Biodiversity and Biosecurity, School of Biological Sciences, University of Auckland, Private Bag 92019, Auckland, New Zealand

Increasingly, invasion ecologists are investigating the potentially synergistic interaction between climate change and invasive species. Predictive models are often used to identify which introduced species are more likely to establish and spread as a result of climate change. Case studies from New Zealand, with a more temperate environment, show that introduced species from tropical and subtropical climates are more likely to establish and spread under climate change. While improving predictive models and validating them in the field is critical to ensuring robust decision-making, there is an urgency to undertake preventative management of invasive species. Large numbers of potential invaders (pre- and post-border) prohibit extensive empirical research on individual species. Uncertainty aside, enough evidence exists that introduced organisms, such as weeds and invertebrates, will benefit from climate change, and that mitigation or adaptation is required. However, no weed risk assessments, cost-benefit analyses, or regional pest management strategies in New Zealand currently address climate change. It appears that, for the most part, the science being produced on climate change and invasive species is not being translated into management actions. We discuss the implications, and indicate how invasion ecology can aid climate change mitigation and adaptation.

Margaret Stanley is the Director of the MSc in Biosecurity & Conservation at the University of Auckland. She is a terrestrial ecologist with diverse interests in community ecology, particularly where it intersects with invasion ecology.

Tuesday 26 November

Stream A, Session 4

Translocating co-threatened dependent species under climate change: insights from invasions

Buckley, Yvonne M.¹; Plein, Michaela²

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Conservation translocations are intentional movements of individuals of threatened species from one site to another with the purpose of ensuring the species survival within its indigenous range (i.e. relocations) or outside its indigenous range (i.e. conservation introduction). Little guidance currently exists on the risks and benefits of translocating co-threatened dependent species. If translocation of dependent species is to be employed as a conservation strategy we need a framework supported by data and case-studies that give insights into how translocation of dependents can be carried out safely and effectively. Biological invasions, studied in most biomes of the world, can provide useful analogs for some of the ecological consequences of intentional species distribution shifts. In particular the use of biological control programs to manage the impact of invasions provides a wealth of research which can inform on the effectiveness of translocation of dependent species. Invasions and biological control programs illustrate the adaptive and interactive responses that can occur when species are confronted with new environmental conditions. In particular we will discuss how research on biological control systems can inform translocation strategies for dependent plants and insects. Biological control research has contributed insights into which species traits determine establishment success, optimal introduction strategies, integration into food webs and impact on host species.

Yvonne Buckley is an ARC Australian Research Fellow in population dynamics and environmental decision making. She is currently at the University of Queensland but has been appointed Chair of Zoology at Trinity College Dublin, Ireland in 2014.

Tuesday 26 November

Stream A, Session 4

Rapid evolution in introduced species: will weeds in New Zealand and Australia eventually be accepted as unique native taxa?

Moles, Angela¹; Buswell, Joanna²; Brandenburger, Claire¹; Rollins, Lee Ann³

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Introducing species to a new environment creates excellent conditions for evolution. The species is released from its native enemies. It is also exposed to a new suite of biotic pressures from herbivores, pollinators, pathogens and competitors, and a new suite of abiotic pressures such as different rainfall, temperature, disturbance regime, soil fertility. Our work with herbarium specimens collected over the last 150 years has shown that 65% of the short-lived, sexually reproducing plant species introduced to Australia and 33% of the species introduced to New Zealand have undergone significant morphological change in at least one trait since their introduction. Glasshouse experiments suggest that differences between source and introduced populations are retained when they are grown in common

conditions. As gene flow between introduced populations and their source populations is extremely limited, it seems inevitable that introduced species will eventually evolve to become unique new taxa. At this point, we will have to decide whether to accept them as new native species, or try to exterminate them. While most ecologists don't like the idea yet, I think acceptance of introduced species is just a matter of time.

Angela Moles is an Associate Professor at the University of New South Wales. She has a range of research interests, including quantifying global patterns in plant traits, and invasion biology.

Tuesday 26 November

Stream A, Session 4

Evolution alters ecological dynamics for an invasive species

Stockwell, Craig¹; Henkanaththegedara, Sujan^{1,2,3}

¹*Department of Biological Sciences, North Dakota State University, Fargo, ND USA*

²*Environmental & Conservation Sciences Program, NDSU, Fargo, ND, USA*

³*Department of Biological & Environmental Sciences, Longwood University, USA*

Recent work has shown that evolution can occur on contemporary time scales and thus may alter ecological dynamics. We explored how contemporary evolution could change the dynamics of intra-guild predation between the endangered Mohave tui chub (*Siphateles bicolor mohavensis*) and invasive western mosquitofish (*Gambusia affinis*). In experimental mesocosms, mosquitofish adults consumed tui chub larvae while tui chub adults consumed mosquitofish adults. In both cases predation was limited by gape-size. To evaluate how contemporary evolution might change these ecological dynamics, we developed predator vulnerability curves using two mosquitofish populations (Wabuska and Garrett) that shared common ancestry in 1937, but evolutionarily diverged for size at maturity. Garrett females are approximately 32% larger than Wabuska females for body depth ($F_{1,398} = 499.2$, $P \ll 0.001$) and 26% larger for gape size ($F_{1,398} = 356.3$, $P \ll 0.001$). Thus, compared to Garrett, the smaller Wabuska females have higher predation risk, and their diet is limited to smaller prey items. Using Mohave tui chub as potential predators, we find none of the Garrett females have 50% predation risk, while approximately one-third of Wabuska females have 50% predation risk. The differences in gape sizes between Garrett females ($3.19 \pm 0.02\text{mm}$; mean \pm standard error) and Wabuska females ($2.54 \pm 0.02\text{mm}$) limit prey size. Prey items with a body depth of 3mm have 19% vulnerability to predation by Wabuska mosquitofish females, but 71% vulnerability to predation by Garrett mosquitofish females. These findings suggest that ecological processes associated with invasive species can be altered by contemporary evolution.

Craig Stockwell, Professor in the Biological Sciences Department at North Dakota State University, evolutionary ecology of native and non-native fishes and amphibians.

Tuesday 26 November

Stream A, Session 4

Social insect population dynamics, pathogens & climate change

Lester, Phil¹

¹*Victoria University of Wellington*

Population densities and distributions of invasive social insects can fluctuate wildly. Why? I will discuss how we have observed dramatic fluctuations in the population dynamics of NZ social insects, including ants, bees and wasps. While such fluctuations may be associated with a range of ecological factors, variation in parasite and pathogen diversity are increasingly recognized as having strong effects on social insect population dynamics. We have now observed a variety of candidate pathogens that may be responsible for such fluctuations, including microsporidian pathogens and viruses. These pathogens may have synergistic effects with both insect competitors and environmental change. Climate and climate change are known to influence pathogen population dynamics, including an exacerbation of parasite and pathogen effects. For some pathogens increasing temperatures may enhance attempts to control ants and wasps, but may in turn impose negative effects on bees and pollination services.

Phil's research focus is on invasive species, particularly with exotic social insects. He is based in Wellington but has research programmes throughout New Zealand and the Pacific.

Tuesday 26 November

Stream A, Session 5

Greater focus needed on plant invasion impacts in protected areas

Hulme, Philip¹; Pyšek, Petr²; Pergl, Jan²; Jarošík, Vojtěch²; Schaffner, Urs³; Vilà, Montserrat⁴

¹*The Bio-Protection Research Centre, Lincoln University, New Zealand.*

²*Institute of Botany, Academy of Sciences of the Czech Republic, Czech Republic.*

³*CABI, Switzerland.*

⁴*Estación Biológica de Doñana, Spain.*

Invasive plant species are significant threats to protected areas worldwide yet many studies only describe the degree to which these

areas have become invaded. Research must move towards a better understanding of alien plant impacts since managers urgently require an appropriate evidence-base to prioritise control or eradication targets. We exploit a comprehensive global database of quantitative studies of alien plant impacts to summarise existing knowledge of alien plant impacts within and outside protected areas. Protected areas are a significant focus for quantitative impact studies but research intensity does not map onto the global distribution of protected areas nor on the plant life-forms recognised to have greatest impacts on biodiversity and ecosystem function. While impacts were often as significant within protected areas as outside, only a minority of studies provide any subsequent management recommendations. There is therefore considerable scope to improve the evidence base on invasive plant management in protected areas.

Philip Hulme holds the Chair in Plant Biosecurity at Lincoln University, New Zealand. His research covers all aspects of biosecurity but especially the causes and consequences of alien plant invasions with the aim of developing policy/management tools to mitigate impacts.

Tuesday 26 November

Stream A, Session 5

Assessing the impact of introduction history and pathways on the potential distribution of an invasive lizard

Chapple, David G¹; Thompson, Michael B²; Hartley, Stephen³; Tingley, Reid⁴

¹*School of Biological Sciences, Monash University, VIC, Australia*

²*School of Biological Sciences, University of Sydney, NSW, Australia*

³*School of Biological Sciences, Victoria University of Wellington, New Zealand*

⁴*ARC Centre of Excellence for Environmental Decisions, School of Botany, University of Melbourne, VIC, Australia*

Globalisation is increasing the volume of freight and cargo being transported around the Earth, and enhancing the unintentional movement of animals to regions beyond their native range via long-distance human-mediated dispersal. The development of effective conservation and biosecurity protocols requires accurate information on both the transport hubs and routes of invaders and an understanding of their potential niche and distribution. Yet, studies predicting the potential distribution of invasive species often neglect the introduction history and human-assisted dispersal pathways of the species. We incorporate our detailed knowledge of the native-range source populations, introduction history, and human-assisted dispersal pathways of the invasive delicate skink (*Lampropholis delicata*) into an integrated predictive distributional modelling approach. The delicate skink is native to eastern Australia, but has established invasive populations in the Hawaiian Islands, New Zealand and Lord Howe Island. We use MaxEnt to develop distributional models based on i) the known native-range source regions, ii) the entire native distribution, iii) the invasive distribution, and iv) the native and invasive distribution. We demonstrate that the delicate skink has the potential to spread further throughout New Zealand, the Pacific region and the rest of the world. However, the predicted distribution differs depending on the dataset used. Additional introductions from transport hubs in eastern Australia and climate change both have the potential to enhance the species potential distribution in New Zealand. Our study highlights the importance of considering introduction history and pathways when predicting the potential niche and distribution of invasive species.

David Chapple is a Senior Lecturer at Monash University whose research group uses invasive species as model systems in which to examine ecological and evolutionary processes.

Tuesday 26 November

Stream A, Session 5

Responses of invasive mammal communities to global change in New Zealand forest and dryland ecosystems

Byrom, Andrea E¹; Tompkins, Daniel M²; Norbury, Grant L³ & Pech, Roger P^{1,4}

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Managing the impacts of multiple invasive species is complex because ecological relationships are often incompletely understood. These knowledge gaps also undermine our ability to predict global change effects on invaded ecosystems when potential changes in extrinsic environmental factors are uncertain. We investigated the consequences of interactions among invasive species, land use change and predicted climate change in forest and dryland ecosystems in New Zealand.

For a beech forest, we modelled the probability of episodic high seed production (masts) and trophic interactions among rodents, mustelids and possums. Parameters were altered to simulate contemporary conditions, or conditions of more or less frequent masting as a consequence of climate change. The model predicted that increased mast frequency would lead to less irruptive but chronically high populations of one invasive mesopredator (rats) and an invasive top predator (stoats). For the dryland system, we investigated how invasive mammals and habitat modification operate synergistically to alter impacts on indigenous fauna. A combination of interactions among invasive mammals (feral cats, mustelids, rabbits and mice), seral transitions to a shrub-dominated plant community, and proximity to expanding intensive pastoralism sometimes blocked recovery of indigenous fauna.

Ecological release of mesopredators and landscape supplementation of top predators are key processes to consider when managing

invaded ecosystems. Because invasive mammals are key drivers of the extinction of native species in New Zealand, with the additional loss of associated functions such as pollination and seed dispersal, our results imply serious adverse impacts of global change for the conservation of biodiversity and ecosystem function.

Andrea Byrom leads a Portfolio of research on invasive species at Landcare Research. She juggles research on the ecology of pest animals such as ferrets, stoats and rodents with her management role, and the management usually wins.

Tuesday 26 November

Stream A, Session 5

Challenges, and some solutions, for building predictive species distribution models of invasive species

Hartley, Stephen¹; Beaudrais, Josef²; de Roiste, Mairead¹

¹Victoria University of Wellington

²AgResearch, Palmerston North

The use of species distribution models (SDM) for predicting the potential future distribution of invasive species is widespread. Perhaps this is because SDM methods are relatively cheap and easy to apply. However, their use is not without its challenges: in terms of (1) data quality and (2) at a conceptual level the assumptions of equilibrium distributions, stable climate space and spatial independence, are rarely met. Here, we use examples from a well-recorded invasive insect, the Argentine ant (*Linepithema humile*), and a less well-studied pest plant (*Senecio glastifolius*), to demonstrate how a more judicious use of SDMs can be used to provide insights into the role of dispersal-limitation vs climate-limitation, and to provide a better understanding of the (un)-certainty associated with predictions of future distributions of invasive species.

Stephen Hartley is a senior lecturer and acting director of the Centre for Biodiversity and Restoration Ecology at Victoria University of Wellington. He is interested in all aspects of ecology and conservation, especially in a spatial context.

Tuesday 26 November

Stream A, Session 5

Generalisations and their influence on communicating complex ecology from the Pacific.

Abbott, Kirsti¹

¹Monash University, Melbourne

Invasive ants are established on the majority of inhabited Pacific islands, and these islands are under threat from climate change. This statement is vague and over generalised, and that is the point; so is much of the communication that aims to improve the understanding of complex ecological issues on Pacific Island Countries and Territories (PICTs). Our ecological knowledge of invasive ants on Pacific islands, where they threaten biodiversity, livelihoods, lifestyle and culture, is improving, and is at a stage where control of damaging species is possible with commitment and funding. However, communication of the problem by scientists, government agencies and external consultants to those affected by invasive ants has resulted in an incomplete understanding of the ongoing issues and complexities, and reluctance to resource research and management of pests. Furthermore, policy and legislative frameworks can suffer from lack of specific directives for managing invasive species. Using invasive ants as a case study I'll look at how effective and specific science communication strategies embedded into research programs can bring hope, pathways and agency to people who not only strive to conserve the natural world, but who are responsible for making laws to do so.

Kirsti Abbott is an invasion ecologist and science educator/communicator. Having just left the role of co-coordinating the core undergraduate science unit at Monash University, she splits her time between teaching, writing, and thinking about ants and conservation in the Pacific.

Tuesday 26 November

Stream A, Session 6

The role of novel ecosystems in active and passive restoration

Catterall, Carla¹; Freebody, Kylie¹; Kanowski, John¹; Neilan, Wendy¹; and Shoo, Luke²

¹ School of Environment & Environmental Futures Centre, Griffith University, Australia

² School of Biological Sciences, The University of Queensland, Australia

Growing recognition of the need for reforestation in over-cleared landscapes has led to widespread recent investment in ecological restoration projects. Forest recovery can be promoted through either intensive restoration intervention (typically replanting) or by passive regrowth after reduction or retirement of agricultural land use. Typically, restoration ecologists advocate goal-setting with reference to pre-clearing species composition, and therefore the removal of non-native invasive species becomes a logical priority intervention. However, novel forest ecosystems, comprising new combinations of species and functional relationships which incorporate both native and non-native species, are becoming increasingly prevalent. In this talk we consider the role of such new combinations in

rainforest restoration. We use data on vegetation structure and floristic composition from case studies of both active replanting and passive regrowth in the Australian wet tropics uplands, to address the following questions. 1. Are ecological restoration plantings novel ecosystems? 2. How prevalent are novel ecosystems in passive regeneration? 3. What ecological processes are involved? 4. What are the implications for conservation? The data indicate that new species combinations, incorporating both native and invasive species, are an inevitable component of the developmental trajectories of sites undergoing both active and passive restoration. Cost-effective management of these trajectories requires the development of approaches which harness the functional roles of some invasive species, and which do not equate suppression of all invasives with restoration. This may create complex dilemmas for land managers, whose resolution requires dispassionate observation and experimentation to provide evidence regarding the risks, costs and benefits of alternative approaches.

Carla Catterall is a Professor in the School of Environment at Griffith University's Nathan campus in Brisbane, Australia. Her research interests include habitat use, ecological interactions and ecosystem change, in particular those associated with deforestation and restoration.

Tuesday 26 November

Stream A, Session 6

Vegetation patterns in Galapagos during eradication of feral goats: Driven by rainfall or herbivory?

Gardener, Mark^{1,2,3}; Mauchamp, André¹; Aldaz, Iván¹; Atkinson, Rachel¹

¹Charles Darwin Foundation, Galapagos, Ecuador

²Astron Environmental Services, Perth, Australia

³University of Western Australia, Perth, Australia

The Galapagos Islands hosted one of the biggest feral goat eradication programs ever to be implemented in the world with successful goat removal from several islands by 2006. Goats were introduced on Alcedo Volcano in the 1970s and increased in numbers until impacts on the unique flora and fauna became apparent in the 1990s. We present results from a long term vegetation monitoring program on Alcedo from 1996 to 2007, spanning periods of sustained high goat populations, followed by a period of lower goat numbers and then final eradication and recovery. We subsequently explain changes in plant species richness, cover and structure in relation to goat density and seasonal and decadal rainfall. Species richness was negatively correlated with goat density but had a strong positive interaction with an extreme rainfall event in 1997-1998 (El Niño). Many species persisted after the event despite heavy goat numbers. Herbivory modified vegetation composition and structure according to the palatability and life form of individual species. Over the monitoring period one previously abundant endemic species became extinct within the study plots. Conversely, eleven new species arrived and became abundant (two introduced, nine native and one endemic). Vegetation cover reflected an interaction between rainfall and goat density from 1996 to 2004, whereas from 2004 to 2007 it strongly tracked seasonal rainfall. We also show that a remotely sensed greenness index from an independent study was a good proxy for vegetation cover. In conclusion, vegetation patterns were strongly influenced by both rainfall and herbivory.

Mark Gardener currently works as a Principal Scientist at Astron Environmental Services. He is a plant ecologist with interests in invasive species, fire ecology, community ecology and restoration. Mark previously worked for the Charles Darwin Foundation based in Galapagos.

Tuesday 26 November

Stream A, Session 6

Potential distribution and invasiveness of new weeds under climate change

Sheppard, Christine S.¹; Burns, Bruce R.¹; Stanley, Margaret C.¹

¹Centre for Biodiversity and Biosecurity, School of Biological Sciences, The University of Auckland

Climate change and plant invasions have been studied extensively as individual factors, but few studies have considered their combined and potentially synergistic impacts. This study aims to test if climate change may provide opportunities for alien plants to expand into regions where they previously could not survive and reproduce. For three new weeds from warmer native ranges (*Archontophoenix cunninghamiana*, *Schefflera actinophylla* and *Psidium guajava*), we modelled potential distributions using a range of climate change scenarios. To validate the models, we conducted field trials to test whether these alien plants perform as expected in suitable, potentially suitable and unsuitable habitats (as identified by the models). Furthermore, we investigated effects of competition on closely related native species. The distribution models indicated that the alien plants are likely to expand their range (by 2090) on average by 101% (*A. cunninghamiana*), 112% (*S. actinophylla*) and 70% (*P. guajava*). The field trials showed high performance of the alien plants in the sites identified as suitable, and growth and survival was high even during the drought of summer 2013. Effects of competition from the alien species under high densities were strong compared to intraspecific competition. The combined results from the models, field trials and competition experiments provide strong evidence of the potential invasiveness of these plants. By having higher confidence in the potential risk of new weeds, cost-effective management actions can be taken to control alien plants at an earlier stage of their naturalisation.

Christine S. Sheppard is in the final stage of her PhD in the field of plant ecology. Her main research focus is on the effects of climate change on plant invasions.

Tuesday 26 November

Stream A, Session 6

Enduring the toad invasion: A successful re-introduction of 'toad-smart' northern quolls.

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Cane toads have had devastating impacts on many vertebrate species as their invasion progresses across northern Australia. Monitoring of northern quoll populations has indicated severe declines and even local extinctions due to ingestion of the lethal cane toad toxins. Cane toads cannot be eradicated in the near future, so we need new methods to reduce cane toad impacts on predators. In order to minimise the impacts of cane toads on the endangered northern quoll, we trained captive-bred quolls to avoid consuming cane toads and reintroduced these toad-smart quolls to a site in Kakadu National Park.

Three years after the initial reintroduction, quolls are surviving in Kakadu. A number of females have survived to reproduce in multiple years and genetic analysis has shown at least half of the population is descended from captive bred females. We are now seeing second and third generation females surviving to reproductive maturity.

Our results demonstrate the potential for reintroduction to facilitate population recovery when threat removal is not possible. Because cane toads cover several million square kilometres, it is unlikely that we can eradicate this threat in the near future. Nonetheless, teaching captive-reared animals to avoid a threatening process may help to enhance the success of reintroduction programs.

Teigan Cremona (ESA student) is a PhD Candidate at the University of Technology, Sydney. Teigan's research interest lies in conservation ecology and her PhD is focused on monitoring a population of Northern quolls that have been trained to avoid eating cane toads.

Tuesday 26 November

Stream A, Session 6

The role of pathogens in the decline of the invasive yellow crazy ant (*Anoplolepis gracilipes*) in Arnhem Land, Australia

Cooling, Meghan¹; Gruber, Monica¹; Hoffmann, Ben²; Lester, Phil¹

¹*School of Biological Sciences, Victoria University of Wellington*

²*CSIRO Sustainable Ecosystems*

The yellow crazy ant (*Anoplolepis gracilipes*) is a widespread invasive species which can have severe ecological impacts on native ant and invertebrate communities. In some areas of their invaded range, yellow crazy ant populations have been observed to fluctuate strongly. In Arnhem Land, Australia, populations of these ants fluctuate spatially and temporally and sometimes disappear altogether. The mechanisms responsible for such declines have yet to be investigated. Yellow crazy ant populations in Arnhem Land represent a unique opportunity to investigate mechanisms by which a globally significant invader declines. It is my hypothesis that microorganisms affect fitness of yellow crazy ants. In order to test this hypothesis I will treat colonies from expanding and declining populations with antibiotics and a pathogen, I will also evaluate the effects of these microorganisms on colony fitness. Initial findings suggest pathogens affect egg production in queens. By identifying the mechanisms behind such population collapses, we may improve the management and control of invasive species.

Meghan Cooling is a PhD student at the Victoria University of Wellington. She is interested in invasive ant ecology.

Tuesday 26 November

Stream A, Session 6

Changes in invertebrate fungivore communities: a predictable consequence of ground-cover weed invasion?

Bassett, Imogen¹

¹*University of Auckland*

Empirical impact data exists for very few of New Zealand's environmental weeds. Given financial and logistical constraints, it will never be possible to research impacts of all environmental weeds in all receiving environments. Therefore, it is useful to look for common themes, to improve our ability to predict impact and prioritise control. Ground-cover weeds have been shown to alter patterns of biomass cycling, decomposition rates, and microclimate. These changes potentially affect fungivorous invertebrates via altered fungal communities. I used pitfall trapping to sample ground invertebrate communities beneath three weed species in urban Auckland forest fragments; *Asparagus scandens* (climbing asparagus); *Tradescantia fluminensis* (tradescantia); *Hedychium gardnerianum* (ginger). All Coleoptera taxa to show significant changes in abundance with weed presence were fungivores, with the exception of one saprophage

(Cholviniae). Furthermore, at least one species of fungivorous Coleoptera responded to the presence of each of the three weed species. Acari (mainly Oribatids, many of which are fungivores), Amphipoda and Isopoda (decomposers) were the only other taxa to vary in abundance with the presence of all three weed species. These results provide some support for the idea that fungivores (or at least decomposition-associated taxa) are particularly responsive to ground-cover weed invasion. However, the direction of effect differed among weeds and invertebrate taxa. Therefore, while changes in fungivore abundance may be predicted as one of the more likely consequences of ground-cover weed invasion in New Zealand lowland forest, site- and taxa-specific effects make it difficult to predict the direction of this effect in any given situation.

Dr Imogen Bassett (Research Associate, University of Auckland) is interested in the complex community and ecosystem changes associated with invasive weeds and introduced biological control agents, and common impact themes which emerge across weed species.

Tuesday 26 November

Stream A, Session 6

Urban areas as insights into the floristic invasibility of New Zealand

Rapson, Jill¹

¹*Ecology Group, Institute of Agriculture and Environment, Massey University, Palmerston North, New Zealand*

Urban areas across the temperate world offer habitats which are largely similar, though with some novel features, which are available for invading plants to occupy. Occurring in natural biodiversity hotspots, urban areas then provide an important dispersal hub into the hinterland for naturalising species. Experience overseas suggests that urban floras are largely influenced by the size and history of the urban area, but with some evidence of on-going homogenisation. New Zealand was colonised by Europeans over a relatively limited period, when the suite of available vectors was the most extensive ever. Thus it represents an opportunity to start to disentangle the history of human settlement from the environmental constraints on invasion. A floristic study was made of the spontaneously occurring plant species of 11 towns in the lower North Island, finding 483 species, with only *Poa annua* occurred in >50% of plots. Nearly half of our urban species were apparently introduced accidentally, the majority of species originating from Eurasia and the Mediterranean, having arrived accidentally. Influential environmental factors include distance to the coast and size of the central business district, overlying a basic homogeneity, probably due to our recent and relatively uniform history of colonisation and urbanisation. Comparison with similar-sized urban areas in England supports this interpretation, but with overseas' urban areas more tightly linked in terms of the exotic component of their floras. New Zealand urban areas appear unable to sustain a viable mix of native and exotic plant species. This suggests inherent invasibility to New Zealand.

Jill is a plant ecologist working on native ecosystems which are being anthropogenically degraded or lost, and on the invaders causing or responding to those losses. Additionally she works with conservation organisations to protect and restore native remnants.

3. Remnants in agricultural ecosystems

Tuesday 26 November

Stream D, Session 4

Maximising Biodiversity and Ecosystem Services in Cultural Landscapes by Gradient Management

Meurk, Colin D¹

¹*Landcare Research*

Management and restoration of biodiversity in cultural landscapes is complex and in colonial New Zealand conservation and production became polarised. This dichotomy between 'pristine' wilderness, to be tamed, and an increasingly imported cultural landscape became entrenched through private property rights, the fact that virtually all conventional production species were alien, and the comparative vigour of these introductions. This resulted in decimation of indigenous natural values in arable lands. A contemporary response has been a surge in community-led habitat restoration in and around urban and rural environments. But there are many more opportunities for indigenous nature, in recombinant ecosystems, to play a larger role in the lived-in environment. These opportunities can contribute to rebuilding ecological integrity, natural character and landscape legibility in areas with under-represented nature. They will also help to redefine indigenous niches in the NZ lowlands. A framework for restoring and managing these areas back to health on a large scale is informed by Grime's stress-disturbance matrix. It is referred to here as Gradient Management – where every permutation and combination of management disturbance is applied across every class of land (stress gradient) with the expectation that each species will find its optimum role to play sustainably, whether in sanctuaries, patches, corridors or the matrix. In particular the full temporal sequence of species is preserved - the sere as Clements called it - not just his 'climax' species. The vision is for indigenous biota to be ubiquitous, visible and providing ecosystem services – inevitably in cultural landscapes associated with exotic species.

Colin D Meurk, Scientist at Landcare Research and consultant: research interests ecological restoration, subantarctic islands, integration of biodiversity in cultural landscapes, citizen science.

Tuesday 26 November

Stream D, Session 4

How much biodiversity is enough in agricultural landscapes?

Bridle, Kerry¹; Fitzgerald, Nick²

¹*Tasmanian Institute of Agriculture, Private Bag 98, Hobart 7001, Tasmania, Australia*

Agricultural intensification is known to reduce biodiversity values at landscape scales. The geography of the land (slope, aspect, altitude) and land capability (geography plus soil type and availability of water) have determined where investment in agriculture has been directed, i.e. flat sites on fertile soils. Many researchers have proposed targets for the retention of native vegetation to maintain a functioning landscape. In a topographically variable State like Tasmania, with over 40% of its land area in reserves, it is understandable that public perception is that we have 'enough' biodiversity. As ecologists we know that communities and species are over- or under-represented in the reserve system and in the landscape as a whole. The development of irrigation infrastructure will change land capability assessments as limitations relating to water availability are addressed, allowing conversion of pastoral land and remnant native vegetation to cropping and horticulture. High cost irrigation infrastructure demands high value crops to be grown under irrigation. Wine grapes and cherries are two such crops which are likely to impact on traditional dryland native grazing areas such as hillslopes. This paper discusses how native plant communities may be further reduced and fragmented in the future in the context of investment in irrigation development, and what the potential impacts on ecosystem service provision may be.

Kerry Bridle is a research fellow (Ecologist, Agricultural Landscapes) at the Tasmanian Institute of Agriculture. Her research interests are directed at improving natural resource management on Australian farms, particularly the management of native pastures for production and conservation outcomes.

Tuesday 26 November

Stream D, Session 4

Lessons from Forty Years of Native Revegetation on the Northern Tablelands of NSW

Brown, Sharon¹; Carr, David²; Wilson, Brian¹; Smith, Rhiannon¹; Reid, Nick¹.

¹*School of Environmental and Rural Science, University of New England, Armidale, NSW 2351.*

²*Stringybark Ecological, Armidale, NSW 2350.*

Broad-scale land clearing since European settlement poses the greatest threat to Australia's biodiversity through habitat destruction, degradation and fragmentation. Great efforts are currently being made to preserve and restore native remnant vegetation in the agricultural regions of Australia with the aim of enhancing ecosystem services and biodiversity, and increasing functional connectivity. On the Northern Tablelands of New South Wales there is still much to learn about the technologies employed to revegetate degraded rural landscapes. This study reviews the effectiveness of revegetation trials (mostly shelterbelts) carried out by Greening Australia, The University of New England, Southern New England Landcare and landholders at various locations across the Northern Tablelands since 1979. Together the trials represent a combination of species, provenance, weed control and ground preparation trials, planting techniques and natural regeneration at different aspects and elevations in the New England landscape. Measuring the successes and failures of early revegetation endeavours on the tablelands provide important opportunities to evaluate, modify and advance previously tried technologies. The results of this study will inform planting design and composition, with a focus for improving the success of revegetation outcomes for the future.

Sharon Brown is currently enrolled in her first year of post graduate study (Doctor of Philosophy) at the University of New England. Her research is aimed at investigating cost effective revegetation technology in the Border Rivers Gwydir Catchment of New South Wales, Australia.

Tuesday 26 November

Stream D, Session 4

An approach for Identifying Habitat Connectivity at Regional Scales

Newell, G.¹; Liu, C.¹; Bennett, A.²; Holland, G.²; White, M.¹; Nimmo, D.²,

¹*Arthur Rylah Institute for Environmental Research, Department of Environment & Primary Industries, Heidelberg, Vic.*

²*Deakin University, Burwood Campus, 221 Burwood Hwy, Burwood, Vic.*

Small populations are encumbered with a suite of genetic and stochastic vulnerabilities that can ultimately lead to extinction. Identifying locations in landscapes that support connectivity to potentially ameliorate these outcomes is of interest to government and conservation agencies, as well as local interest groups. There are many software tools that have been developed over several decades to support analyses of landscapes for connectivity. We reviewed a range of these tools / packages and evaluated more closely five of the more common methods in the context of their application to regional conservation planning across central Victoria. Methods examined include (1) Connectivity Analysis Toolkit (CAT), (2) Circuitscape (CCS), (3) Linkage Mapper (LM), (4) Universal Corridor (UNICOR), and (5) Conefor Sensinode 2.2 (CS22). We used tested these methods on 12 targeted taxa including mammals, birds, and reptiles that display a variety of ecological characteristics and dispersal capabilities.

In the subsequent part of this study we developed an approach that integrates several nested views of connectivity at species-specific scales over the whole landscape for each taxon. Our intent was to use available software tools with a structured logic to forming views of multi-scale species-specific connectivity. These analyses used several processing options within ArcGIS, as well as the systematic

conservation planning tool *Zonation*. For each species we considered i) the home range, ii) a conservative and iii) broader estimate of the species' gap crossing ability, iv) an estimate of the broader dispersal capabilities of the species, and v) the longer-distance pathways identified from CCS analyses undertaken above. We then used *Zonation* as a tool for spatially aggregating integrated connectivity models for all 12 species into a regional analysis.

Graeme Newell, Principal Research Scientist at the Arthur Rylah Institute, Victorian Department of Environment and Primary Industries. Current work includes the development of innovative spatial data for Government investment and regulation of conservation management.

Tuesday 26 November

Stream D, Session 4

Monitoring restoration success of key ecological assets in the 'WildEyre' region of South Australia

Collard, Stuart¹

¹*Nature Conservation Society of South Australia*

The 'WildEyre' project is a partnership between state government, a regional NRM Board and three non-government organisations that aims to conserve and restore the unique and diverse ecosystems of the central western Eyre Peninsula of South Australia. The project is a successful example of community-based restoration at the landscape scale. Future large-scale restoration is being planned for the region, with significant support from the Australian Government's 'Biodiversity Fund'. A strong focus for the current project is the monitoring of ecological assets identified through the 'Conservation Action Planning' process. These assets form the basis of a performance monitoring plan that identifies objectives and states clear hypotheses used to test progress towards restoration objectives. The plan specifies future monitoring requirements for the region and the monitoring responsibilities of project partners. Core monitoring indicators include vegetation condition, bird community diversity and abundance and pest animal and plant distribution and density. Ongoing monitoring will build on an existing network of resource condition monitoring sites in the region and establish ecological monitoring sites in future restoration/revegetation areas. Randomly selected bird monitoring sites, surveyed in Spring 2012, have been used to identify key bird species associated with ecological assets and resampling techniques have been used to optimise future bird survey effort. These data will be presented along with vegetation condition from a subset of Red Gum (*Eucalyptus camaldulensis*) sites. The multiple benefits of a coordinated approach to monitoring for large-scale restoration projects will be discussed within a broader ecosystem services context.

Stuart is Conservation Programs Manager at the Nature Conservation Society of South Australia and is a member of the WildEyre Working Group. His main research interests include bird ecology, vegetation condition and landscape conservation and restoration.

Tuesday 26 November

Stream D, Session 4

How is bird, marsupial and reptile habitat influenced by interacting abiotic features and land management?

Ikin, Karen^{1,2,3}; Mortelliti, Alessio^{1,2,3}; Stein, John¹; Lindenmayer, David^{1,2,3}

¹*Fenner School of Environment and Society, The Australian National University*

²*Australian Research Council Centre of Excellence for Environmental Decisions*

³*National Environmental Research Program Environmental Decisions Hub*

A major focus of conservation research in fragmented agricultural landscapes is the identification of habitat structures important for the persistence of native wildlife. However, we still do not have a good understanding of where (and why) these habitat structures occur in the landscape. This limits our ability to implement effective conservation, restoration and management strategies. In our study, we aimed to address this knowledge gap using a large-scale natural experiment in south eastern Australia. We asked: (1) what abiotic features affect the occurrence and abundance of vegetation structures that provide critical habitat for birds, arboreal marsupials and reptiles in eucalypt woodland remnants? And: (2) how do these abiotic features interact with land management practices? We investigated several vegetation structures, including leaf litter, moss and lichen, native grasses, mistletoe, logs, hollow-bearing trees and rock cover. We found that a range of abiotic features, including climate, topography, landscape position and lithology fertility, were significant predictors of the occurrence and abundance of these different vegetation structures. We also found that several management features, including grazing, land use intensity and native vegetation fragmentation, were important and that these interacted with the abiotic features to affect occurrence and abundance. In some cases, we found that the positive effect of a specific management practice (for example, grazing exclusion) outweighed or equalled favourable abiotic conditions. Our findings can be used to target particular management strategies to particular locations in the landscape to improve the availability of habitat resources for native wildlife in fragmented agricultural landscapes.

Karen Ikin is a post-doctoral fellow with the Conservation and Landscape Ecology Group at the Australian National University. Her research focuses on wildlife and habitat conservation in human-modified environments, such as those that occur in urban and agricultural landscapes.

Tuesday 26 November

Stream D, Session 5

Pollination ecosystem services provided by wild insects are greatest in human-modified habitats

Rader, Romina¹

¹ School of Environmental and Rural Science, University of New England, Armidale

Fragmented landscapes comprise a range of different land use types that provide resources for insect pollinators. It is still unclear, however, to what extent pollination services vary among different land uses. This study investigated differences in pollinator community composition and contribution to seed set among four different land use types in northern Australia; dairy, rotational cropping, avocado orchards and remnant forest. We recorded 46 pollinator taxa from four insect orders whereby flies were the most diverse order. Potted experimental crop plants (*Brassica rapa*) received significantly greater pollinator visits on dairy farms than all other land use types. The proportion of fertilized seed pods was significantly greater in the three modified land uses (avocado, dairy and potato) than in the remnant forest sites. The results of this study suggest that open, modified habitats provide resources for generalist insect pollinators across several orders, which in turn, impacts the provision of crop pollination services. Understanding how pollination services vary with land use via changes in pollinator community abundance and composition is a critical step in evaluating ecosystem services in human-modified habitats.

Romina Rader has recently joined the University of New England as a Lecturer in Environmental Management. Current research interests include: the impacts of land use change, intensification and climate change upon species, functional and phylogenetic diversity; the role of biodiversity in providing ecosystem services.

Tuesday 26 November

Stream D, Session 5

To thin, or not to thin? Examining the understorey condition of dense stands of woody vegetation

Jones, Christopher^{1,2}; Vesk, Peter^{1,2,3}; Duncan, David^{1,3}; Rumpff, Libby^{1,2}

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Woody regeneration into previously cleared landscapes is occurring in many parts of the world. Significant ecological benefits can be gained through large-scale natural regeneration, but the process by which this regeneration occurs will influence the ecological 'condition' of the resulting vegetation. In many cases woody regeneration occurs following a mass recruitment event as a result of favourable growth conditions, or removed disturbance, such as livestock grazing. These events develop dense stands of woody individuals, which are for many purposes considered floristically depauperate. Competition for resources reduces stem growth rates, alters growth form, and suppresses understorey vegetation. Ecosystem function can subsequently be dramatically altered in these systems.

Over time, self-thinning is expected to occur in these stands, potentially improving their condition and function. The rate and vegetation outcomes of self-thinning are slow and uncertain. In order to expedite and maximise any ecological gains from dense natural regeneration, management may be required. Ecological thinning is increasingly being considered a viable option for management of excessively dense stands; with aims of improved overstorey and understorey vegetation attributes, and ecosystem function. However, we have little understanding of how and when it might be effective. To this end, we examined effects of dense stands on understorey vegetation attributes and their response to stem thinning within Box-Ironbark woodlands and forests in central Victoria. We propose a conceptual model of stem regeneration and understorey condition in these systems, with an aim to help managers make informed decisions about when thinning might be a viable and cost effective option.

Christopher Jones, Plant Ecologist. Research interests include: riparian vegetation condition, assessment of vegetation change, livestock grazing impacts, woody regeneration, ecological thinning, and restoration ecology.

Tuesday 26 November

Stream D, Session 5

Does riparian condition influence breeding success in woodland birds in highly modified landscapes?

Hansen, Birgita¹

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Riparian zones are typically areas of higher avian diversity and abundance compared to surrounding landscapes. Where riparian zones and their hinterland vegetation are relatively intact, the full suite of resources necessary to support populations of woodland birds should be available. However, when riparian zones are degraded, successful breeding is expected to be restricted to a suite of predominantly generalist species capable of exploiting limited resources. Woodland bird breeding success might be predicted to be

higher in riparian zones where livestock grazing is absent, the tree layer includes multi aged stems, shrubs are present and understory is intact. This research project investigated the influence of riparian condition, in terms of vegetation cover and other structural attributes, on woodland bird breeding success in riparian zones within agricultural landscapes of northern Victoria. Nine riparian sites, representing a gradient of impact from highly modified through to relatively intact, were surveyed throughout spring 2012. Abundance, richness and breeding activity data were collected. In all sites, woodland and generalist species were observed attempting to breed, but the proportion of woodland species successfully breeding (as evidenced by the presence of young) was generally higher at more intact sites. Preliminary data analysis indicates a positive relationship between breeding activity and shrub, tussock grass and litter cover, density of eucalypt saplings, and riparian extent (patch width and length). This shows that structural elements of riparian zones that represent purported indicators of condition do appear to have a positive influence on desirable ecological functions like woodland bird population productivity.

Birgita Hansen is a Collaborative Research Network research fellow at the University of Ballarat. She has strong research interests in the management of streamside zones, woodland bird communities and the conservation of biodiversity in agricultural landscapes.

Tuesday 26 November

Stream D, Session 5

Are fencing and pest controls enough? Perspectives on long term forest management

Morales, Narkis¹; Perry, George^{1,2}; Burns, Bruce².

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The negative impacts of unsustainable human activities have reduced many natural ecosystems to patches surrounded by productive land threatening their long-term survival. In New Zealand, approximately three-quarters of the original forests have been destroyed.

Beilschmiedia tawa is an endemic evergreen canopy tree, one of the two members of *Beilschmiedia* in New Zealand, and one of the main species of the podocarp-tawa type forest. The main threats to these forests are the pressure by exotic mammalian herbivores and the reduction of seed dispersal by keystone dispersers such as the native pigeon (*Hemiphaga novaeseelandiae*). The podocarp-tawa type forest in New Zealand, especially *B. tawa* (tawa) dominated fragments, have suffered from recruitment problems that are affecting its long term survival.

The aim of this study is to determine if the combination of fences and exotic herbivore control has an impact on forest fragment species composition, abundance, number and survivorship of natural seedlings. We compared areas with long term management (fencing and pest control) with smaller fragments under less rigorous controls to determine which type of management could lead to higher survivorship and abundance of natural seedlings over time. Also, we are developing an ecological model to assess the factors that affect recruitment of *B. tawa* forest fragments and the fragments potential for self-sustainability. Preliminary results from Nonmetric Multidimensional Scaling and modelling indicate that fencing and herbivore control would not be enough to restore the forest fragments to a previously undisturbed condition.

Narkis Morales is a Forestry Engineer and M.Sc in Natural Resources from the Pontificia Universidad Católica de Chile. Currently pursuing a PhD in Environmental Sciences at the University of Auckland, New Zealand. His research interests include restoration of degraded landscapes.

Tuesday 26 November

Stream D, Session 5

Early recovery of indigenous forest fragments after livestock grazing exclusion

Dodd, Mike¹, Smale, Mark², Burns, Bruce³

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³ University of Auckland, School of Biological Sciences, Private Bag, Auckland, New Zealand

Indigenous forest fragment restoration was included as part of an integrated catchment management project initiated in 1996 on a 300 ha hill country pastoral farm "Whatawhata Research Centre" in the Waikato region of New Zealand. Three small forest remnants and three sites in larger local forest areas were monitored before (2000) and after (2002, 2004, 2008, 2012) stock exclusion from two of the fragments in 2001. Measurements on 10 x 5 m permanent vegetation plots included species composition, canopy cover in 5 tiers, ground cover, stem numbers and tree diameters. Initial comparison of grazed fragments and larger forest areas in 2000 indicated that the grazed fragments had lower overall canopy cover, lower species richness per unit area, greater adventive species richness, few palatable shrubs, few regenerating saplings and higher exposed mineral soil ground cover. In the last 10 years, the fenced fragments have increased in species richness from 24 to 28 spp./50m² plot, increased tree basal area from 55 to 63 m²/ha, decreased bare ground cover from 15 to 6%, increased tree seedling densities 2 to 6 per m², increased shrub cover in the stock browse layer from 10 to 25% and massively increased sapling densities from <100 to >10000 stems/ha. Recovery appears to be following an expected pattern involving release of browsing pressure on seedlings and development of cover in the 0-2m tier. By contrast, characteristics of the larger forested sites and the fragment still grazed have remained largely unchanged or deteriorated.

Mike Dodd is a plant ecologist and science team leader with AgResearch, working on plant-soil interactions in pastoral systems.

Tuesday 26 November

Stream D, Session 6

Ecological Restoration Using Stag Trees in Former Agricultural Landscapes and Post Mining Rehabilitation

Wright, Andrew^{1,2}; Vernes, Karl¹; Reid, Nick¹; Smith, Rhiannon¹

¹University of New England

²Whitehaven Coal

Since European settlement, Grassy White Box Woodlands have been extensively cleared and remnants continue to face threats from agricultural and extraction industry activities. Arboreal fauna over-represent the number of threatened species found within woodland communities, particularly due to the lag time after clearing (up to and greater than 100 years) to when woodland vegetation reaches maturity with similar structural and habitat complexity to the pre-clearing landscape. This project will measure the habitat value of existing stag trees in former agricultural landscapes, and augmented (reconstructed) stag trees in post mining rehabilitation near Werris Creek, North West Slopes and Plains of New South Wales. The project aims to answer the following question: can restoration of arboreal habitat in Grassy White Box Woodlands improve ecological restoration of degraded woodlands, and become another management strategy for land managers to improve biodiversity and reinstate lost ecosystem services?

Monitoring will examine the presence and use of stag trees by woodland birds and microbats. Woodland birds and microbats have been selected as indicator groups because of their mobility to recolonise woodland communities following disturbance. Methods used on stag trees include Song Meters (SM2BAT+) to record ultrasonic microbat calls and camera traps recording bird and other species that trigger the motion sensor. Preliminary results indicate that woodland birds (principally generalist and raptor bird guilds) and microbats (above canopy guilds) use existing stag trees within former agricultural areas and are also present within augmented stag trees on post mining rehabilitation after only four years since the restoration process commenced.

Andrew Wright has been an environmental professional for 12 years in the NSW coal industry. This Masters of Resource Science research project commenced in 2012 and expands on Andrew's previous work in post mining rehabilitation, habitat augmentation and reconstruction.

Tuesday 26 November

Stream D, Session 6

Establishing a Conservation Corridor and Biodiversity Monitoring program within fragmented Grassy White Box Woodland of a Former Agricultural Landscape

McKinnon, Lucas¹; Wright, Andrew²; Von Chrismar, Antony¹

¹Eco Logical Australia Pty Ltd

²Whitehaven Coal Pty Ltd

The sheep and wheat belt of NSW is a highly cleared agricultural landscape, with predominant landuses including sheep and cattle grazing and varying degrees of cropping. The loss of biodiversity in this landscape is well documented, in particular with woodland dependant bird species and some fauna guilds such as microbats being listed as threatened under both State and Commonwealth legislation. Werris Creek, in the central western slopes of NSW, is an area typical of these landuses. Remnant native vegetation is restricted to the lower productivity ridgelines or smaller degraded patches on the richer soils of the lowlands, within the agricultural matrix. It is these degraded remnants that retain potential islands of biodiversity and ecosystem services, but their long term viability remains unsecured.

With limited public funding to secure restoration of these fragmented landscapes, requirements of development approvals to offset impacts are providing opportunities, increasingly from mining. Here we outline how the development of a coalmine in the agricultural landscape of Werris Creek, will achieve an in-perpetuity conservation landuse outcome. Resources are allocated for the restoration and monitoring of a >1,500ha conservation corridor, linking the rarely conserved rich black earth soils of the Liverpool Plains, with two sub-regional corridors in the Gunnedah Basin. Discussion will focus on the biodiversity value and ecosystem services recognised within this corridor, the proposed actions to enhance these values, with discussion of the monitoring program underpinning the restoration works and trends in the short term.

Lucas McKinnon is a Senior Ecologist and Accredited Biobanking Assessor in NSW. Lucas' work focusses on terrestrial flora and fauna survey, and quantifying impacts from development under the NSW Biobanking Scheme, and associated offsets arrangements under NSW and Commonwealth legislation.

Tuesday 26 November

Stream D, Session 6

Monitoring and reporting biodiversity change in rural habitat fragments across the Auckland Region

Lockie Stacey¹; Bishop Craig¹; Khin Jade¹¹Research Investigations and Monitoring Unit (RIMU), Auckland Council

The Auckland Region encompasses almost 500,000 ha of land area, the large majority (c.85%) of which lies outside metropolitan areas. The region includes c. 305,000 ha of rural production landscapes, largely in the Hunua, Manukau, Rodney, Kaipara and Inner Gulf Islands ecological districts. The Auckland Council's Terrestrial Biodiversity Programme is a comprehensive monitoring programme designed to measure landscape scale changes in biodiversity. The programme encompasses both forest and wetland monitoring and is used to quantify the status and trends of biodiversity within the Auckland Region. Over 500 plots have been established across the region, approximately half of which are in fragments of forest and wetland habitat in rural areas. The data collected from these sites is used to inform policy development and biodiversity management, as well as assessing policy effectiveness and the effectiveness of the activities of Landcare groups. Baseline measures for the plot network have revealed some differences in rural forest and wetland habitat - in comparison with similar ecosystems in less modified landscapes. Rural fragments have a greater number of exotic and weedy plant species across all structural classes (seedlings, saplings and stems), a higher biomass of exotic and weedy plants, and a lower average species diversity of indigenous plants; although total indigenous plant diversity is comparable to back-country plots. This paper will summarise and discuss these differences and the consequences for the management of biodiversity in rural habitat fragments.

Stacey Lockie is an Environmental Specialist with the Research, Investigations and Monitoring Unit (RIMU) at the Auckland Council. She coordinates the operations of the streams and lakes water quality monitoring programmes, as well as providing organisational and technical assistance for the terrestrial biodiversity forest and wetland monitoring programmes.

Tuesday 26 November

Stream D, Session 6

Impact of dairy farming on the soils, earthworms and plants of an adjacent Canterbury dryland reserve

Bowie, Mike¹; Black, Lesley²; Boyer, Stephane¹; Dickinson, Nick¹¹Lincoln University²Merrin Primary School

Less than 60 hectares of protected native dryland habitat remain in the Canterbury Plains of New Zealand. These few remaining dryland areas are surrounded by farms that dominate the landscape. Due to their small size, their isolation and the increasing presence of dairy farming around them, these dryland remnants and the native communities they contain are likely to be affected by irrigation, nutrient inputs and the colonisation by exotic plant and animal species.

We surveyed soil nitrate and phosphate, earthworms and vegetation in the 2.6 ha Bankside Reserve using a series of nine transects from the adjacent dairy farm into the reserve. We also compared plant species found in the reserve with a survey 40 years earlier. We found that the adjacent dairy farm had significant edge effects on soils biochemistry, earthworm communities and plant diversity within Bankside Reserve. Mean phosphate values in the reserve were significantly higher ($P=0.018$) closer to the paddock boundary. Mean phosphate and nitrate values on the boundary were two-fold higher than in the paddock. Four species of endemic earthworms were found and at least six species of exotic earthworms. Endemics mainly occur in high areas and away from the fence (and adjacent dairy pasture). Drainage from the dairy farm through the reserve also has a significant detrimental effect on the reserve with lower lying areas with significantly higher mean phosphate levels, higher exotic plants and exotic earthworms. Protective and remedial action for management of this reserve and implications for other dryland reserves are discussed.

Mike Bowie, Senior Technical Officer, ecological restoration and conservation ecology.

Tuesday 26 November

Stream D, Session 6

Effects of the agricultural matrix on the spatial synchrony of highly fragmented bird populations

Mortelliti, Alessio¹; Westgate, Martin. J¹; Stein, John¹; Lindenmayer, David B.¹¹Fenner School of Environment and Society, Australian Research Council Centre for Environmental Decisions, National Environmental Research Program, The Australian National University

Population connectivity is vital for the persistence of spatially structured populations in highly fragmented landscapes. However, population connectivity is difficult to quantify, because the permeability of the agricultural matrix varies strongly between species with differing dispersal capabilities. A novel solution is to quantify the synchrony between populations, i.e. to identify coincident changes of population density over time. Using this approach, more connected populations are expected to display synchronous dynamics whereas disconnected populations are expected to fluctuate asynchronously. In this study, our aim was to evaluate the effects of the matrix type on the population synchrony of a suite of forest dependent birds in two highly fragmented landscapes of south-east

Australia. Our dataset encompassed more than 10 years of data collected over a large area (>100 km²) and included a variety of species, with life history strategies ranging from insectivorous to granivorous birds. Further, the landscapes that we studied were characterised by varying matrix characteristics ranging from grazed paddocks to pine plantations. After controlling for the effects of weather (cumulative rainfall) on population dynamics, we found strongly varying effects of matrix type on population synchrony across species. Overall, though, the strength of the spatial synchrony between local populations was relatively weak, which strongly suggests that local factors (e.g. habitat quality) prevail over synchronising agents (e.g. climate/dispersal) in shaping the trajectory of populations.

Alessio Mortelliti is a Research Fellow at the Australian National University. His main research interest is the impact of habitat loss and fragmentation on animal populations.

Tuesday 26 November

Stream D, Session 6

Kiwifruit orchard management and beneficial invertebrate biodiversity

Todd, Jacqui¹; Malone, Louise¹; Bengé, Jayson²; Barraclough, Emma¹; Wohlers, Mark¹; Thorpe, Stephen³; Poulton, Joanne¹; Beggs, Jacqueline³

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The composition of invertebrate communities in New Zealand kiwifruit orchards has been shown to differ between orchards managed using organic practices and those using integrated pest management (IPM). Higher numbers of invertebrate species were found in the organic orchards than the IPM orchards that were studied. This difference was consistent for parasitoids, predators, omnivores, herbivores and fungivores, but there was no difference in the number of detritivore species sampled from the orchards. An analysis was performed to determine whether these functional group differences were correlated with particular management practices. Potential correlations between orchard 'outputs', such as the diversity of invertebrates representing different functional groups and the yield and quality of fruit produced, and various 'inputs', such as the diversity of plants in shelterbelts and understoreys and the application of various agrichemicals, were examined for 19 orchards using distance-based linear models and redundancy analysis. Results suggest the use of the budbreak enhancer, hydrogen cyanamide (HC), by IPM growers explains the most variation in both the fruit and functional group data: more fruit with higher dry matter were positively correlated with the use of HC, and greater numbers of predatory invertebrate species were negatively correlated with the use of this chemical. This analysis may be used to generate testable hypotheses for examining the impacts of particular practices on beneficial biodiversity in commercial orchards, potentially leading to recommendations for growers wishing to increase biodiversity on their orchards (without loss of production) while reducing costs and use of sprays. This may be particularly useful as HC may become unavailable for growers in future.

Jacqui Todd is a scientist in the insect science team at Plant & Food Research, currently investigating invertebrate biodiversity in kiwifruit orchards and the contribution of natural enemies to the control of insect pests in these orchards.

4. Community engagement

Tuesday 26 November

Stream B, Session 5

Transboundary systematic conservation planning: When does increasing collaboration payoff?

Gordon, Ascelin¹; Coutts, Shaun R²; Kark, Salit²

¹RMIT University

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Increasing collaboration is often considered important for more efficient conservation outcomes, particularly when considering transboundary conservation features. Although this is often true, it may not always be a cost-efficient use of scarce resources due to the transaction costs of collaboration (negotiations, meetings, delays etc) diverting scarce resources from on-ground actions. This issue has received scant attention in the conservation literature to date. We examined this issue in the context of conservation planning for multiple biodiversity features using 17 South American countries under multiple scenarios of collaboration. Using IUCN Red List data on the range of 790 terrestrial mammals, we undertook spatial prioritisations with the Zonation conservation planning software. We show that when countries design their conservation plans independently, conserving 10% of each species' range results in a 70% decrease in efficiency (in terms of area required) compared to when those same countries plan collaboratively. We then examine how the conservation efficiency changes under a range of coalition structures, where we assumed collaboration within, but not between coalitions. The 17 countries were divided into between 2 and 11 coalitions of approximately equal size, where each coalition used Zonation to select conservation areas collaboratively. We show how the conservation efficiency decreases with the number of coalitions. We also show how the most efficient coalition size is driven strongly by assumption of how collaboration transaction costs scale with the coalition size. We thus demonstrate the importance of considering collaboration transaction costs when undertaking transboundary conservation planning.

Dr Ascelin Gordon is a Postdoctoral Research Fellow in the Interdisciplinary Conservation Science Research Group in RMIT University, Melbourne. His research interests include the application of modelling and simulation approaches to assist decision-making for conservation issues.

Tuesday 26 November

Stream B, Session 5

Spatially strategic conservation actions can achieve high levels of biodiversity and human well-being by accounting for leakage

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By gazettement protected areas, conservation planners seek to mitigate anthropogenic pressures to areas of particularly high biodiversity. Responding to these restrictions, resource users will seek to replace some or all of those resources from elsewhere in the landscape. Protected areas thereby change the pattern of human pressures in the broader landscape. This displacement of human pressures outside of protected areas is known as leakage. Whilst the negative effects of leakage on conservation outcomes have been empirically documented, the process has not been incorporated into regional-scale conservation planning that accounts for multiple objectives for biodiversity and society. In this paper we combine models of household utility, adaptive foraging and biodiversity conservation to provide an integrated framework that considers the dynamic effects of leakage. We demonstrate that the process of leakage has strong and divergent impacts on conservation outcomes, undermining biodiversity conservation objectives, but mitigating the impacts of conservation on community welfare. Leakage therefore complicates conservation planning by creating win-lose trade-offs between important objectives. However, we use our model to show that if decision-makers consider leakage explicitly in their conservation plans, the worst of these trade-offs can be avoided. Further, we show how non-standard conservation interventions aimed at community resource demand can create win-win outcomes for biodiversity and welfare.

Ayesha Tulloch is a postdoctoral research fellow with the National Environmental Research Program Environmental Decisions Hub. She is a conservation biologist interested in monitoring and management of threats to biodiversity. She integrates multi-disciplinary perspectives (economic, social, and environmental) to prioritise conservation investments.

Tuesday 26 November

Stream B, Session 5

Social network analysis: How do social and institutional characteristics affect conservation outcomes?

Jarvis, Rebecca¹; Bollard-Breen, Barbara¹; Krägeloh, Chris²; Billington, Rex²

¹*Institute for Applied Ecology New Zealand, Auckland University of Technology*

²*School of Health and Psychosocial Studies, Auckland University of Technology*

One of the main challenges in conservation is in translating management objectives into effective action on the ground. The difficulty arises from inadequate consideration of the social and institutional dynamics that influence conservation decision-making, and the support for conservation actions. Stakeholders have different priorities and to be able to manage the system, we need to understand how well they collaborate and communicate, and how their priorities overlap and diverge. Social Network Analysis (SNA) is a systematic information tool used to measure how individuals and organisations communicate, learn, and share knowledge across complex conservation systems. In identifying and understanding these interactions, SNA allows us to explore the dynamic nature of policy, governance and management. This holistic insight is especially useful in determining how conservation decision-making takes place across complex multi-organisation, multi-stakeholder networks that would otherwise be difficult to understand. In accounting for the social and institutional characteristics of these systems, planners and decision-makers will have a greater insight into the potential feasibility of different conservation actions. Appreciating how human-environment and human-human interactions influence conservation outcomes, we can make better conservation decisions for both the environment and society.

Rebecca Jarvis is a PhD Commonwealth Scholar at Auckland University of Technology. Her interests include decision-making and collaboration across complex multi-stakeholder networks, and the human elements of conservation from a socio-ecological perspective.

Tuesday 26 November

Stream B, Session 5

Public participation GIS and inclusive conservation planning: Insights from 8 years of empirical research

Raymond, Christopher¹

¹*Enviroconnect and Institute for Land, Water and Society, Charles Sturt University*

Public participation GIS (PPGIS) is increasingly been used as a tool to engage local communities in conservation planning and as a way of understanding how social, cultural and political systems are related to the environment. A variety of web and mail-based PPGIS techniques now exist for understanding the distribution, intensity and type of values and preferences which local communities

assign to places on the landscape. This presentation will provide an overview of the evolution of PPGIS techniques as applied to four conservation planning studies in Australia over the past eight years and key findings with respect to each technique. Early studies used mail-based PPPGIS techniques to identify the spatial overlap between social values and areas of biological importance in order to understand the social acceptability of conservation plans. More recent studies have expanded these techniques to understand the costs and benefits associated with integrating social values and development preferences within a spatial prioritization, the perceived risks of conservation efforts and the potential for development and conservation conflicts. The presentation will conclude with a discussion of the limitations of PPGIS, followed by future research directions for using PPGIS to engage local communities in conservation planning to ensure conservation is inclusive and effective in Australia, New Zealand and the Pacific Islands.

Dr Raymond is the Director of Enviroconnect and Research Fellow at the Institute for Land, Water and Society, Charles Sturt University and is interested in tools and techniques for engaging local communities in conservation planning.

Tuesday 26 November

Stream B, Session 5

Mapping Community and Natural Values: Implications for Coastal Management

Gent, Martha¹; Wallis, Anne¹; Kilpatrick, Sue²

¹Deakin University, Warrnambool, Australia

²University of Tasmania, Launceston, Australia

Consideration of the social value and use of coastal areas by community is essential in developing effective coastal management plans. We investigate the relationship between natural values and perceived community values with the coastal management zone of a rural city in, South West Victoria, Australia. We used a questionnaire (n=226) to identify and map areas of perceived community value within the coastal management zone. A number of social "hot spots" are identified and compared with the strategic natural values identified for the sites using an existing GIS model. The model used integrates existing statewide information about biodiversity values, threatening processes and ecosystem function at the landscape scale. There is a great deal of overlapping between areas of high natural and high social value. In fact, all of the social "hot spots" identified by the community are also considered to be of relatively high natural value. The most common reason given by community participants, for selecting an area was for the view or scenic value of an area, closely followed by recreational opportunities. As such, we can conclude that for this coastal region, areas identified as having high strategic natural value, also appeal to community for aesthetic and recreational reasons. The relationship between community and natural values provides valuable information in identifying different coastal management approaches. In this particular case it also emphasises the need for site specific community engagement programs and identifies potential for the development of future community based conservation programs.

Marty Gent is a PhD Student at Deakin University, and works in the area of climate change planning, coastal management and community development. Her particular area of interest is in the resilience of social-ecological systems under climate change.

Tuesday 26 November

Stream B, Session 6

Using mass collaboration tools to develop a global conservation resource

Jakob-Hoff, Richard¹, Lees, Caroline²

¹Auckland Zoo

²IUCN-SSC Conservation Breeding Specialist Group-Australasia

To date the role of wildlife as reservoirs and vectors of disease transmission to human and domestic animal populations has been incorporated into disease risk analysis (DRA) models but far less attention has focused on the risk of disease to biodiversity. In the early 1990s the IUCN-Species Survival Commission's (IUCN-SSC) Conservation Breeding Specialist Group (CBSG) facilitated face to face workshops that culminated in the 2001 publication of a workbook focussed on disease risk associated with wildlife translocations. Since then considerable evidence has been published demonstrating the significant role disease can play in the decline of wildlife populations. This, and the parallel identification of wildlife as reservoirs of emerging and re-emerging diseases of people and domestic animals, has led to a dramatic expansion of interest in wildlife-associated disease risks. In 2010, CBSG initiated a collaborative project to develop *Guidelines* and a *Manual of Procedures for Wildlife Disease Risk Analysis* with three other IUCN-SSC Specialist Groups and the World Organisation for Animal Health (OIE). Effective use of available internet-based mass collaboration tools enabled input from 290 individuals based in 40 countries and representing 26 occupation categories. The use of dedicated websites, e-mail, computer-screen sharing programs and other remote communication tools reduced the need for face to face encounters to one workshop and enabled 22 authors to pool their specialised expertise in the creation of two documents (currently in press) that we anticipate will make a significant contribution to evidence-based decision making for biodiversity conservation.

Richard Jakob-Hoff, a wildlife veterinarian, in his roles of Co-convenor of CBSG Australasia (with co-author, Caroline Lees) and Manager of Conservation Science and Research at Auckland Zoo, has led the production of the wildlife DRA resources described in this presentation.

Tuesday 26 November

Stream B, Session 6

Going from talking to doing in adaptive management of New Zealand forests affected by deer

Veltman, Clare¹; Allen, Rob²; Allen, Will³; Barker, Richard⁴; Bellingham, Peter²; Forsyth, David⁵; Jacobson, Christine⁶; Nicol, Simon⁵; Ramsey, David⁵; Richardson, Sarah²; Todd, Charles⁵

¹Department of Conservation, New Zealand

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⁶University of the Sunshine Coast, Queensland, Australia

To resolve uncertainty about the costs and effects of suppressing populations of invasive deer in New Zealand forests, we designed an adaptive management programme to support four groups of interested local people and conservation managers during a deer control experiment that ran from 2006 to 2011 or 2012 at three of four study sites on public conservation lands. Brushtail possum control was ongoing at all sites. The social process we adopted in the lead-up to deer control weighted contributions from all group members equally and was designed for collaborative learning. The predictive models we developed explicitly considered how interactions between non-palatable and palatable forest plants may suppress a growth response by the latter when deer densities are reduced. We indexed deer abundance yearly or two-yearly by counting faecal pellets in plots on 50 lines in each 3,600ha area where we killed deer (by shooting, from the ground or helicopters) and in the matched 3,600ha non-treatment areas. Although deer abundance was negatively related to helicopter hunting effort, only one of the study sites reached convincingly lower deer abundances compared with its non-treatment. We evaluated support for models using data on growth of individually tagged seedlings and measures of biomass accumulation by palatable plants at 50 sampling locations within each area, where we also measured or estimated light, water and nutrients. We reflect on problems and compromises we encountered as we worked towards our goal of learning about the deer-forest systems we worked in, in partnership with sceptical non-experts.

Clare Veltman is employed as a Principal Science Advisor with the Department of Conservation and researches effects and control of invasive mammals.

Tuesday 26 November

Stream B, Session 6

The environmental, cultural and social values of Pygmy Bluetongue Conservation

Hawthorn-Jackson, Dawn¹; Mark N Hutchinson²; C. Michael Bull³

¹Emu Consulting

²South Australian Museum

³Flinders University

Protecting a small endangered species which lives within a small geographic range, and commonly survives on agricultural land can be fraught with conservation, cultural and social challenges. To enhance the sustainability of the endangered Pygmy Bluetongue Lizard, a community based conservation program has been implemented in Burra, South Australia. This program is based on scientific research, local community ownership, and traditional Aboriginal knowledge and input. It is aimed at permanently establishing community ownership of the lizard and its conservation management. The combinations of ecological and social collaboration, with positivity, planning, social learning and respect are proving highly effective in the initial phases of this program. Importantly the knowledge and values of the local community are being recognised as essential for successful conservation. Early success can be clearly linked to the development of carefully planned management strategies, policies and procedures, and effective communication, all integrated with socialisation, goodwill, empathy, passion and commitment. We have focussed this effort on one region within the species' range at this stage. Outcomes and feedback obtained from this program provide important insights into other community based conservation programs.

Dawn Hawthorn-Jackson is the owner and Director of Emu Consulting; a business which specialises in environmental management, Aboriginal Cultural Awareness, communications and community engagement. Dawn is an alumni of Flinders and Adelaide Universities and is committed to conservation collaborative management.

Tuesday 26 November

Stream B, Session 6

Project Island Song – A Unique Partnership

Corbett, Fleur¹; Willoughby, Robert²

¹Guardians of the Bay of Islands Inc

²Project Island Song

Project Island Song is an island restoration project in the eastern Bay of Islands which in 2009 saw to the eradication of stoats and three species of rat from seven main islands and approximately 150 rock stacks. Unique features of this project include close proximity of the

archipelago to the mainland (670 metres at the closest point); four of the main islands occupied by permanent or holidaying residents; and open visitation by >200,000 people annually. The project is a partnership between Tangata whenua (first people), the Department of Conservation (DOC), island landowners and a community group: the Guardians of the Bay of Islands. Any incursions of stoats and rodents are monitored and managed by traps and tracking stations on the islands plus regular checks by handlers with rodent and stoat dogs. A pest control buffer on the adjacent mainland, together with strong messages around ensuring visiting vessels are free of vermin, have been effective, with no new reports on the islands for more than 12 months. An education and advocacy programme has effectively encouraged broad community ownership of the project including tourism companies, agencies and other conservation groups. The project is supported by strong partnerships including a Memorandum of Understanding with DOC and a relationship with Tangata whenua based on traditional principles and values of *Wairuatanga* – spiritual connections; *Tikanga* – protocol; *Kaitiakitanga* – guardianship; *Whangaungatanga* – relationships; *Kotahitanga* – togetherness, ; *Manaakitanga* – respect. This acknowledgement of customary lore alongside contemporary restoration science has resulted in a relationship of reciprocity, trust and progress.

Fleur Corbett is Chair of the Guardians of the Bay of Islands, an Incorporated Society that coordinates Project Island Song. Her strength and interest lies in bringing diverse groups together with common conservation goals that provide social, cultural, environmental and economic benefits to the community.

Tuesday 26 November

Stream B, Session 6

Ecological restoration of islands: pivotal roles of value judgements and cultural understanding

Lyver, Phil¹; Heteraka, TeWarahi²; Towns, David³; Parata, Hori²; Jones, Chris¹; Moller, Henrik⁴.

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³Department of Conservation, Auckland; AUT, Auckland, NZ

⁴University of Otago, Dunedin, NZ

Island restoration projects require high public involvement in planning and implementation alongside a transparent system for dealing with value-judgments. Plans for four islands administered by the Department of Conservation (DOC) as restoration sites required value judgements at eight stages in the management process. Some judgements were controversial and lacked a system for unequivocal resolution. Decision pathways can be clarified through adaptive guidelines to island management. However, developing guidelines can become especially challenging when accounting for different values and worldview between Māori and non-Māori. Some Māori would prefer restoration projects to develop at a higher spiritual level rather than just at a level of intellectuality. Initiatives need to be conceived, grown and born from within a 'cultural womb' in order to acknowledge human relationships with the environment. Translocations from offshore islands also perturb values. Elements such as whakapapa (genealogy) and kaitiaki (sentinels) are fundamental as an iwi (Māori group) perceives their responsibility for a species in perpetuity, even when they are transferred out of an iwi's rohe (tribal area). Iwi are often sceptical about lack of information relating to source populations, the amount of effort and cost required for translocations and the uncertainty around success. Reciprocity between actors and adaptive management are also important. The restoration of Taranga (Hen Island) on the north-east coast of NZ began only after creative action to resolve an impasse between a local iwi, for which kiore (*Rattus exulans*, Pacific rat) had high cultural significance, and DOC which viewed the rats as a threat.

Phil Lyver is a scientist whose studies include seabird biology, the effects of harvest on seabird populations, and Māori perspectives on biodiversity.

5. Ecosystem-scale modelling

Monday 25 November

Stream B, Session 2

Advancing Ecological Modelling Tools for Application in Water Resource Planning

Pollino, Carmel A.¹; Brown, Alice¹; Merrin, Linda¹; Murray, Justine²; Stratford, Danial¹

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Evaluating ecological outcomes as a consequence of alternative hydrologic regimes has been limited to a set of modelling approaches that typically describe hydrologic habitat quality. To enhance our ability to predict change spatially and temporally, there is a pressing need to advance ecological modelling methods to fulfil water resource planning needs. The most pressing of limitations of existing ecological modelling tools used in water resource planning include the poor representation of spatial and dynamic processes in predicting ecological outcomes. This limits the exploration of likely ecological consequences in systems when hydrologic watering requirements are 'not met', fails to represent the connectivity between assets, and lacks representations of hierarchies within ecological systems (such as links between vegetation condition and productivity). In this paper I will overview ecological modelling methods for environmental flows and demonstrate advances in spatial and dynamic modelling methods. I will also discuss the application of ecological models within water resource planning model frameworks, and in particular, hydrologic optimisation and scenario evaluation frameworks.

Carmel Pollino has an interest in ecology, risk and decision-frameworks and integrated assessment and modelling. At CSIRO Carmel is the leader of the Ecosystem Responses to Flow stream project portfolio within the Water for a Healthy Country Flagship.

Monday 25 November**Stream B, Session 2****Modelling kangaroo-vegetation dynamics in semi-arid Australia**Hauser, Cindy E.¹; Lahoz-Monfort, José J.¹¹*School of Botany, University of Melbourne, Parkville Vic 3010 Australia*

In Victoria's Wyperfeld National Park, the kangaroo population is controlled to reduce grazing pressure and enhance the regeneration of pine-buloke woodland vegetation. Over the last 15 years a kangaroo population model has been used to determine cull quotas. Evaluation of the program is hampered because the model does not currently connect kangaroo population control to vegetation regeneration.

We are developing an adaptive management plan for kangaroo control, which will explicitly link kangaroo dynamics to vegetation objectives and condition. In a workshop attended by relevant experts, we elicited objectives and measures of vegetation condition suitable for ongoing monitoring at Wyperfeld. We have gathered expert opinion and research literature to propose a transition model for pine-buloke woodland vegetation under grazing pressure. This model will help identify the likely effectiveness of the control program, current knowledge gaps and future experiments and research directions that have the capacity to improve management of the woodland.

Cindy Hauser is a research fellow at the University of Melbourne. She's a mathematical modeller who develops survey, monitoring and adaptive management plans in collaboration with environmental managers.

Monday 25 November**Stream B, Session 2****Advances in modelling hypoxic blackwater**Baldwin, Darren¹; Whitworth, Kerry²; Keogh, Andrew³¹*CSIRO Land and Water & Murray-Darling Freshwater Research Centre*²*La Trobe University & Murray-Darling Freshwater Research Centre*³*Murray-Darling Basin Authority*

In 2010/2011 extensive flooding in the southern Murray-Darling Basin, south-eastern Australia mobilised several hundred thousand tonnes of dissolved carbon from floodplains. Microbial metabolism of this carbon resulted in prolonged river hypoxia, lasting several months and affecting over 2000 km of river channel. To inform better management of floodplain carbon export (an important part of lowland river functioning) while minimising the likelihood of hypoxia we have developed a series of algorithms that can be used to underpin predictive, process-based models. In this presentation we will detail the development of these equations and introduce two applications based on these equations. The first is a generic, desktop risk assessment tool that can be used to predict the likelihood of hypoxic blackwater generation during inundation of an idealised floodplain. The second application links the predictive blackwater module to a detailed hydrologic model of the southern Murray-Darling Basin. This model allows estimation of floodplain carbon export and subsequent microbial respiration at a sub-basin scale under variable flow scenarios. This application also allows hind-casting of carbon dynamics in the absence of the extensive river regulation that now occurs in the southern Murray-Darling Basin.

Darren Baldwin is a biogeochemist based in Wodonga. He is interested in how natural and human-induced perturbations change the way energy and nutrients are processed in the environment.

Monday 25 November**Stream B, Session 2****Overcoming (some of the) frailties of experts using structured decision making**Rumpff, Libby¹; Walshe, Terry²¹*Centre of Excellence for Environmental Decisions, School of Botany, University of Melbourne.*²*NERP Environmental Decisions Hub, School of Botany, University of Melbourne.*

Natural resource managers are routinely faced with making decisions about complex ecosystems, often with poor information. Process models are often employed to represent the cause-and-effect relationship between management actions and objectives. There are many types of suitable models available, but there remains a lack of guidance on how to construct them. If available, models can be parameterised using raw data, but having the 'right data' to satisfy the purposes of any given model is rare. Consequently, models are commonly constructed using expert opinion. However, experts can differ in their opinions about the efficacy of alternative management options because they hold different understandings of cause-and-effect, have different priorities, and different attitudes to risk. Independently derived models of cause-and effect may illuminate controversy among scientists about how to best describe biophysical (or other) systems, and identification and consideration of plausible models can avert the risk of implementing a suboptimal decision.

In this paper we demonstrate a method for eliciting plausible models of ecological cause-and-effect from a group of experts within a structured decision making framework. The models presented are structured as Bayesian Networks, allowing for prior beliefs about the outcomes of management to be updated as new data arises. We use a case study involving management decisions about water allocation in a freshwater system in Australia.

Libby is a postdoctoral research fellow with the ARC Centre of Excellence for Environmental Decisions at the University of Melbourne. Her research interests revolve around adaptive management and structured decision making for natural resource management.

Monday 25 November

Stream B, Session 2

Quantifying post-fire recovery of forest canopy structure and carbon uptake using satellite image time-series

Khanal, Shiva¹; Boer, Matthias¹; Duursma, Remko¹

¹*Hawkesbury Institute for the Environment, University of Western Sydney, NSW*

Fire is a recurring disturbance in most of Australia's forests. Depending on fire severity, impacts on forest canopies vary from light scorching to complete defoliation, with related variation in the magnitude and duration of post-fire gas exchange by that canopy. Estimates of fire impacts on forest canopy structure and carbon uptake for south-eastern Australia's forests do not exist. Here, we use 8-day composite measurements of the fraction of Absorbed Photosynthetically Active radiation (FPAR) as recorded by the Moderate-resolution Imaging Spectroradiometer (MODIS) to characterise forest canopies before and after fire and to compare burnt and unburnt sites. FPAR is a key biophysical canopy variable and primary input for estimating Gross Primary Productivity (GPP). Post-fire FPAR loss was quantified for all forest areas burnt between 2001 and 2010, showing good agreement with independent assessments of fire severity patterns of 2009 Black Saturday fires. A new method was developed to determine the duration of post-fire recovery from MODIS-FPAR time-series. The method involves a spatial-mode principal component analysis on full FPAR time series followed by a K-means clustering to group pixels based on similarity in temporal patterns. Using fire history data, time series of FPAR for burnt and unburnt pixels in each cluster were then compared to quantify the duration of the post-fire recovery period, which ranged from less than 1 to 8 years. Next, this result will be used to estimate post-fire GPP. Our approach can be readily applied to other forest environments and/or other disturbances affecting forest canopy structure and carbon uptake.

Shiva Khanal is a Masters by Research student at the Hawkesbury Institute for the Environment, University of Western Sydney, NSW. His current research involves application of remote sensing based approach for understanding post-fire primary production dynamics in forest ecosystem.

Monday 25 November

Stream B, Session 2

Spatial and temporal synchrony in small mammal populations: the role of intrinsic and extrinsic factors

Greenville, Aaron^{1,2}; Wardle, Glenda^{1,2}; Dickman, Chris^{1,2}

¹*Desert Ecology Research Group*

²*School of Biological Sciences, University of Sydney.*

Intrinsic and extrinsic forces can influence the population dynamics of species across space such that sub-populations either fluctuate synchronously or exhibit distinct sub-population structures. Here we use multivariate state-space models to investigate five potential spatial population structures of small mammals using 17–22 years of live-trapping data from nine spatially distinct sites in central Australia. We investigated whether sub-populations are asynchronous (independent hypothesis), form two sub-populations at either ephemeral water sources versus open desert sites (oasis hypothesis) or at burnt versus unburnt sites (wildfire hypothesis), form three sub-populations organised by shared rainfall gradients (productivity hypothesis), or if all sub-populations are synchronous (single population hypothesis). All these models were run with and without density dependency. We also used the best fitting model to incorporate potential drivers such as local rainfall, dominant plant cover and other species interactions that may regulate our study populations. Sub-populations were shown to be synchronous or to have two structures (single population and wildfire hypotheses) if driven by a large-scale driver (e.g. rainfall or wildfire), or asynchronous (independent hypothesis) if driven by local events, with both extrinsic and intrinsic drivers contributing at different levels. Density dependence was detected in all species, but was weak for small insectivorous dasyurids, suggesting that environmental stochasticity and interactions with other species on a local scale are more important in driving their population dynamics than intrinsic factors. In contrast, rodents and the carnivorous dasyurids were driven by both extrinsic and intrinsic factors that operate at the landscape scale.

Aaron Greenville is a PhD student and Research Assistant with the Desert Ecology Research Group. His research interests involve investigating ecological interactions in arid Australia, both within and between trophic groups, and how external environmental factors influence these interactions.

6. Landscape genetics

Thursday 28 November

Stream A, Session 10

Examining the spatial structure of Foxes in Australia using landscape genetics approaches

Adamack, Aaron T.¹; Berry, Oliver^{2,3}; Gruber, Bernd¹; Sarre, Stephen¹

¹*Institute for Applied Ecology, University of Canberra, Bruce, ACT, Australia*

²*Invasive Animals CRC, School of Animal Biology, University of Western Australia, Australia*

³*CSIRO Marine and Atmospheric Research, Floreat Western Australia, Australia*

Invasive species provide excellent opportunities to evaluate DNA-based estimators of demographic and spatial dynamics because their histories of spread and population growth are often well-documented. We are applying this principle to a continent-wide genotypic dataset (3192 individuals; 36 microsatellite loci) for the red fox (*Vulpes vulpes*) in Australia. As the rate of spread, abundance and other life history traits of foxes in Australia are well described it provides a unique opportunity to test the predictions of recently developed approaches for determining demographic and spatial details of foxes such as dispersal distances, migration rates, and population sub-structuring. As an initial step, we investigated the spatial structure of foxes in Australia using a both STRUCTURE and TESS, two Bayesian population clustering models. Preliminary results suggest a major east-west division separated by the Nullarbor Plain and the deserts of Western Australia. Future work will determine inter-population dispersal rates, relative male and female dispersal distances, and identify the relationships between landscape and dispersal behaviour. These results will identify the optimal spatial scales for management of this significant environmental and economic pest.

Aaron Adamack is a Postdoctoral Research Fellow at the University of Canberra and is working on topics related to landscape genetics, ABC modeling, and fisheries oceanography.

Thursday 28 November

Stream A, Session 10

Landscape genetics of the threatened water mouse (*Xeromys myoides*) and implications for management

Fuller, Susan¹; Benfer, David¹

¹*Queensland University of Technology*

The water mouse (*Xeromys myoides*, Thomas 1889) is a small, native rodent found in mangrove and salt marsh communities, sedge coastal lakes and coastal freshwater swamp habitats. Its Australian distribution consists of three distinct and isolated regions and it is also known from a single record in New Guinea. The phylogeography and population genetics of this threatened species was examined to infer contemporary influences on gene flow and evolutionary history. Genetic diversity was assessed at two mitochondrial DNA fragments (Cytochrome b and D-loop) for individuals spanning the Australian range of the water mouse. In addition, eight polymorphic microsatellite markers were developed and used to characterise genetic variation within and across populations. Both mitochondrial and microsatellite data indicated that the water mouse has arrived in Australia very recently and despite its disjunct distribution, is a single species that constitutes a single evolutionarily significant unit. This has significant implications for the way the species is managed in the future, particularly in terms of augmenting populations through translocations or re-introducing water mice in areas where they have gone extinct. Highest genetic diversity was found in the Mackay area (central Queensland) and sub-structure was identified suggesting local populations may be isolated. Conversely, the Coomera region (south-east Queensland) revealed very low genetic diversity and the population in this region has experienced a significant genetic bottleneck. As only a single evolutionary lineage is present across the species range, translocation programs may be required in future to limit potential inbreeding effects in small, isolated populations.

Dr Susan Fuller is a Lecturer in Ecology at QUT. My research integrates field-based population studies with molecular techniques to deliver ecological management outcomes. I also have research interests in biodiversity monitoring, offsets and restoration.

Thursday 28 November

Stream A, Session 10

LandPopGenReport – a landscape genetic tool to analyse the effect of landscape feature on population structure using genetic data

Gruber, Bernd¹; Adamack, T. Aaron¹

¹*Institute for Applied Ecology*

²*University of Canberra*

The ever fastening development of genetic techniques such as second generation sequencing offers unique opportunities for ecological researchers to study the spatial structure of populations and how they are influenced by landscape features. The creation of such kind of data namely samples of genotyped individuals with known spatial locations, is not paralleled by the application of landscape genetic methods to analyse them. Though a standard approach to study the effect of landscape features using resistance matrices and compare these with genetic distances using partial mantel tests is developed, we see a lack of publications applying this approach.

A literature search revealed only around 56 papers, roughly about 10-15 a year since 2009 using this approach, which offers highly valuable insights how to manage populations within a landscape context. Our explanation for such a lack of publications is partly due to the required expertise which encompasses the integration and data exchange between three specialised type of software packages (population genetic, geographic information systems and statistical) to analyse the data. We present a newly developed R package that incorporates all necessary steps into a single framework and demonstrate its application using population genetic data on endangered reptile species within the ACT.

Bernd's research interest focus around landscape genetics. Specifically he is interested on how we can use individual genetic data to study spatial population dynamics to inform conservation and management of threatened and invasive species.

Thursday 28 November

Stream A, Session 10

Landscape level microsatellite DNA analysis reveals substantial cryptic genetic structure in feral possums in New Zealand

Sarre, Stephen D.¹; Aitken, N.^{1,2}; MacDonald, A.J.¹; Adamack, A.¹; Gruber, B.¹ and Cowan, Phil³.

¹ Institute for Applied Ecology, University of Canberra, Canberra, ACT 2601, Australia

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³ Landcare Research New Zealand, Lincoln, North, New Zealand.

Population genetic studies of single species can reveal much about population structure, providing inferred information about dispersal and gene flow among sub-populations. Increasingly, such studies are being linked spatially through geographic information systems to provide a finer scale resolution of population interactions. Here we report on a large microsatellite DNA analysis of common brushtail possums from 31 sites in Hawkes Bay, New Zealand. When viewed spatially, the data reveal substantial and unexpected complexity in possum population structure and behaviour, including dispersal patterns that appear to favour movement around river head waters in preference to crossing local bridges. More importantly, our analysis shows two distinct genetic groups of possums that appear to abut each other with minimal overlap. These two groups conform to our knowledge of the history of introductions, which involved possums from Tasmania introduced to the north of Hawkes Bay and possums from mainland Australia introduced to the south. This greater complexity of genetic exchange changes markedly our understanding of the dispersal characteristics of possums in the region and more broadly in New Zealand. We discuss the results in the context of incorporating spatial components in population genetic studies and species concepts.

Stephen Sarre is Professor in Wildlife Genetics at the University of Canberra. He is interested in the genetics, genomics, evolutionary biology, and ecology of wildlife.

Thursday 28 November

Stream A, Session 10

Quantifying the direct transfer costs of dispersal using least-cost modelling

Etherington, Thomas¹; Perry, George^{1,2}; Cowan, Phil³; Clout, Mick²

¹School of Environment, The University of Auckland, Auckland, New Zealand

²School of Biological Sciences, The University of Auckland, Auckland, New Zealand

³Landcare Research, Lincoln, New Zealand

The brushtail possum (*Trichosurus vulpecula*) is a notorious invasive species within New Zealand. Management of the species needs to consider dispersal, however the current dispersal model represents the transfer component of dispersal between geographic locations using a kernel that is purely a function of distance. This approach ignores any landscape obstacles to dispersal that impose transfer costs through factors such as energetic expenditure, behavioural aversion, or mortality risk. We estimated the transfer costs associated with brushtail possum dispersal by quantifying the transfer costs associated with landscape obstacles, and by describing the likely transfer costs accumulated by dispersing brushtail possums. Assuming that landscape connectedness between pairs of locations can be represented by the genetic relatedness in possums at those locations, a landscape genetics approach based upon least-cost modelling was used to create a geographic information system cost-surface for the North Island of New Zealand that quantified the transfer costs associated with various landscape obstacles. Least-cost paths between the start and end points of dispersal movements from radio-collared brushtail possums from several studies were then used to define a dispersal kernel in terms of accumulated-cost units. By using the cost-surface in combination with the accumulated-cost dispersal kernel, existing dispersal models could be refined to include transfer costs as part of the dispersal process in order to better represent dispersal for management of brushtail possums.

Thomas Etherington is a Research Fellow at The University of Auckland who is interested in the application of geographic information science to answer research questions in landscape ecology and biogeography.

Thursday 28 November

Stream A, Session 10

Effects of group isolation and population size on mating systems and relatedness of the Grey-crowned Babbler (*Pomatostomus temporalis*)

Stevens, Kate¹; Harrison, Katherine²; Cooke, Raylene¹; Clarke, Rohan²; Bennett, Andrew¹; Hogan, Fiona²¹Deakin University, Australia²Monash University, Australia

Agricultural systems have radically modified almost one third of the world's terrestrial habitats, resulting in landscapes of remnant habitat patches within fragmented ecosystems. The Grey-crowned Babbler is a cooperatively-breeding woodland-dependent bird that requires close proximity to other groups for their breeding ecology. Restricted suitable habitat availability has increased negative pressures on Grey-crowned Babbler genetic variability, breeding integrity, and dispersal opportunities. This project aimed to identify the effects of population size and group isolation on the genetic structure of the Grey-crowned Babbler, in a fragmented landscape. A stratified field design stipulated two population sizes (large and small), and two group isolation levels (near and far). We tested the hypotheses that (1) relatedness is higher amongst more closely located groups than isolated groups, and (2) individuals in smaller populations will display higher levels of relatedness than larger populations. DNA extraction provided genotypic data used to determine differences in genetic structure relating to population size and isolation. A total of 65% of groups sampled ($n = 40$) were assigned at least one offspring from all sampled offspring ($n = 117$). Parentage assignments were made to 63% of the dominant within-group female and 61% to the dominant within-group male. Extra-group fertilisation (EGF) was evident in both sexes (female: 6%; male: 4%), while one male from a small population recorded the only extra-pair fertilisation. Females were found to disperse 10 times further than males within both small and large populations. Four separate populations were identified, showing possible linkage through historic and contemporary habitat corridors across a large fragmented landscape.

Kate Stevens is a PhD candidate. Areas of research interest include conservation biology, landscape genetics, and ornithology.

7. New horizons on CO₂ impacts

Monday 25 November

Stream A, Session 2

I can predict the impact of elevated CO₂ but not of warming on temperate grassland productivity.

Hovenden, Mark¹¹School of Plant Science, University of Tasmania

The future productivity of this world depends upon how ecosystems respond to the changing globe. One aspect of global change that has received much attention is the increasing concentration of CO₂ in the atmosphere but the responses to accompanying warming are seldom studied in a field setting. The TasFACE experiment exposed species-rich native Tasmanian grassland to both elevated CO₂ and warming, solely and in combination, for 10 years. In this ecosystem, biomass production is linearly dependent upon rainfall. The productivity responses to CO₂ and warming always appeared to be a mess but using the full 10 year dataset demonstrates that the response to elevated CO₂ in any year can be very accurately predicted using seasonal rainfall totals. What's more this works both in the absence or presence of warming. The impact of warming on productivity, however, cannot be inferred from climatic data and, unfortunately, remains a mess. Thus, the productivity response to elevated CO₂ seems to be more reliable and easily modelled than the response to warming. Clearly warming effects require more concerted future research effort if we are to improve our ability to predict and model future land-atmosphere feedbacks.

Mark Hovenden is an Associate Professor in the School of Plant Science at the University of Tasmania. He is interested in all aspects of plant ecology, is a passionate cyclist and marimba zealot.

Monday 25 November

Stream A, Session 2

The CO₂ fertilisation effect in grasslands

Newton, Paul¹; Parsons, Tony²; Lieffering, Mark¹¹AgResearch, Palmerston North, New Zealand²Massey University, Palmerston North, New Zealand

The carbon dioxide (CO₂) fertilisation effect (CFE) is important as it is often the most influential (and most uncertain) term in impact studies and has implications for carbon sink activity and thus potentially influences future trajectories of atmospheric CO₂ concentration. Here we consider the CFE for grasslands – the most extensive land use globally. Using experimental data from a range of long-term experiments we show that the CFE changes rather little over a wide range of CO₂ enrichment. We then explore some of the possible explanations for this response including plant physiological acclimation and feedbacks through soil processes. We will focus particularly on data collected from a New Zealand Free Air Carbon Dioxide Enrichment experiment on pasture and an historical analysis where the CFE was derived from a long-term dataset. It is important to understand the mechanisms constraining the CFE if simulation modelling is to provide reliable projections of grassland function under climate change.

Paul Newton is a Principal Scientist with AgResearch. His research interests are climate change impacts and adaptation and he has been involved for many years in a FACE experiment on grassland. He is a lead author for the AR5 assessment.

Monday 25 November

Stream A, Session 2

Elevated CO₂ in an Australian woodland (EucFACE): impact of contrasting water availability on carbon uptake and water use in a nutrient-limited ecosystem

Gimeno, Teresa E.¹; Crous, Kristine Y.¹; Cooke, Julia^{1,2}; O'Grady, Anthony P.³; Ellsworth, David S.¹

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³Water for a Healthy Country National Research Flagship, CSIRO Ecosystem Sciences Private Bag 12, Hobart, Tasmania 7001, Australia

Australia is the driest inhabited continent with some of the oldest weathered soils. Thus, Australian ecosystems are nutrient impoverished and whilst also experiencing sustained periods of low water availability. Rising atmospheric [CO₂] (C_a) is expected to enhance plant C-uptake and reduce water use, but these effects may be mitigated by low resource availability. We expected these elevated C_a effects to increase with decreasing water availability and to decrease with low nutrient (N and P) availability. Our study site is a free air CO₂ enriched native woodland (EucFACE). Within each experimental plot, vegetation is exposed to a C_a of 150 ppm above ambient, increased gradually at a rate of 30 ppm CO₂ month⁻¹ from September 2012. From April 2012, we performed quarterly campaigns to measure leaf gas exchange, morphology and nutrient content. Whole tree water use was monitored continuously with sapflow probes, used to calculate tree canopy conductance. Preliminary results show that an increase of 60 ppm in C_a significantly enhanced photosynthesis by 17% during a low water availability period. A larger increase of 150 ppm in C_a during a high water availability period increased photosynthesis less, by 16%, and reduced water loss via stomata by 25%. Measurements under low-intermediate water availability and suboptimal temperature suggest a smaller photosynthetic enhancement and reduced water use. Leaves grown under stepping C_a were thicker and had higher leaf mass per area (LMA). Overall, we suggest that water availability has a strong impact on the physiological response of this nutrient limited ecosystem to rising C_a.

Teresa Gimeno is a postdoctoral fellow at the HIE-UWS. She is a plant ecophysiologicalist, supported by a CSIRO-UWS flagship collaboration. Her research project addresses the impact of elevated CO₂ on whole ecosystem water use in a nutrient limited mature Australian woodland.

Monday 25 November

Stream A, Session 2

Elevated CO₂ enhances phosphorus availability in a P-limited eucalypt woodland

Power, Sally A., Hasegawa, Shun, Macdonald, Catriona

Hawkesbury Institute for the Environment, University of Western Sydney

The response of forest ecosystems to elevated CO₂ has been the subject of much recent debate. However, to date, field-scale CO₂ experiments in forests have been confined to Europe and North America where climate and soil conditions differ considerably from those in the southern hemisphere. In particular, the low P availability of Australian soils may constrain ecosystem responses to rising CO₂ concentrations, reducing the future C sink capacity of forest systems. A recently initiated Free Air CO₂ Enrichment experiment in a native *Eucalyptus* woodland in western Sydney provides a unique opportunity to quantify the response of a woodland ecosystem to increasing CO₂. The experiment, which began in September 2012, exposes a mature woodland to two CO₂ treatments - ambient (390 ppm) and elevated (540 ppm) - in replicate 25 m diameter FACE rings. CO₂ concentrations were initially ramped up gradually, with increments of 30 ppm over the first 6 months. Here, we describe the effects of elevated CO₂ on nutrient dynamics in a Cumberland Plain woodland. Preliminary results indicate that even small increases in atmospheric CO₂ drive a rapid increase in P availability and P turnover. This suggests that some of the CO₂ fertilisation response observed in N-limited, northern hemisphere woodlands may be realised in P-limited Australian ecosystems, at least in the short term.

Sally Power joined the Hawkesbury Institute for the Environment at UWS in 2012. Her research is aimed at investigating the impacts of global change on terrestrial ecosystems, with a particular focus on plant community and biogeochemical responses.

Monday 25 November

Stream A, Session 2

Impact of elevated carbon dioxide on soil respiration and microbial activity in a nutrient poor forest

Macdonald, Catriona¹; Drake, John¹; Anderson, Ian¹; Singh, Brajesh¹

¹Hawkesbury Institute for the Environment, University of Western Sydney, Australia.

Rising atmospheric carbon dioxide (eCO₂) concentrations are of global concern. Forest ecosystems could contribute to mitigation of

increased atmospheric CO₂ through sequestration in above and below ground components resulting from increased photosynthesis, growth and carbon (C) inputs into soils. However, there is no data from mature forest systems to support this. Additionally, because of the tight coupling between C, nitrogen and other biogeochemical cycles, the potential and sustainability of forest soils with low nutrient status to act as C-sinks is unknown. Here we report preliminary results from a Free Air CO₂ enrichment study in a nutrient poor *Eucalyptus* forest. Soil respiration rates responded rapidly to even relatively small (30ppm) CO₂ increases and were consistently higher over time (9%, $P < 0.05$) under eCO₂ treatment. Microbial biomass C and N showed little initial response to eCO₂ over time ($P > 0.05$) but differences in nutrient turnover rates suggest enhancement of physiological activity of the microbial community. We draw on data from a complimentary growth room study to discuss the underlying mechanisms for such responses and consequences for ecosystem feedbacks.

Catriona Macdonald is a research fellow at the Hawkesbury Institute for the Environment. Her research focuses on understanding interactions between above and below ground communities with particular interest in microbial driven soil processes and interactions between biogeochemical cycles.

Monday 25 November

Stream A, Session 2

Testing ecosystem model hypotheses against observations from contrasting free-air CO₂ forest enrichment sites

De Kauwe, Martin¹; Medlyn, Belinda¹; Zaehle, Soenke²; Walker, Anthony³

¹Macquarie University

²Max Planck Institute for Biogeochemistry

³Oak Ridge National Laboratory

The atmospheric concentration of carbon dioxide (CO₂) continues to rise as a result of fossil fuel burning. Free-air CO₂ enrichment (FACE) experiments allow us to probe the effects of this rise on terrestrial ecosystems. The findings from FACE experiments need to be incorporated into ecosystem models to project likely impacts of rising CO₂ in future. We applied a series of ecosystem models to two nitrogen-limited Northern hemisphere forest FACE sites, evaluating model hypotheses that underlie predictions of carbon, nitrogen and water responses to elevated CO₂. We present findings from this model-experiment comparison exercise related to the links between nitrogen availability, net primary productivity, carbon allocation and transpiration. We use these insights to examine the likely consequences for forest productivity and water balance in response to elevated CO₂ at the phosphorous-limited Australian Eucalyptus FACE site.

Martin De Kauwe is a Research Fellow at Macquarie University. His research focuses on improving our understanding of land-atmosphere interactions in forest ecosystems. Specifically, by applying ecosystem models to the Free Air CO₂ enrichment experiments and examining how models predict the observed responses of carbon, nitrogen and water fluxes.

8. Microbial ecology

Monday 25 November

Stream C, Session 2

Microbial colonization and functionality in dryland systems

Pointing, Stephen B.¹

¹Institute for Applied Ecology New Zealand (AENZ), Auckland University of Technology, Auckland, New Zealand.

Drylands constitute the most extensive terrestrial biome, covering more than one-third of the Earth's continental surface. Edaphic niches (soils and rocks) in these systems provide a tractable model system for elucidating global patterns in microbial biogeography. Here, I describe how temporal phylogenies and high-throughput amplicon sequencing have revealed striking climate-related trends in colonization. Further work using metagenomic enquiry is revealing how functional traits impact community assembly. I will present data to illustrate how primary metabolism and stress response pathways are linked to niche specialization in various edaphic desert communities. I will review how these communities mediate inputs and outputs of gases, nutrients and water from desert surfaces, as well as regulating weathering, soil stability, and hydrological and nutrient cycles. The presentation will also consider how microbial feedbacks impact regional desert-related environmental problems.

Steve has worked on dryland systems for many years, previously with the US space agency NASA, and more recently with Kiwi partners in Antarctica's Dry Valleys. His research interests are the evolutionary history and functional ecology of these microbial systems.

Monday 25 November

Stream C, Session 2

Uncovering novel regulatory pathways and sinks of greenhouse gases through bioinformatics.

Morales, Sergio E.¹; Anderson, Jack¹

¹University of Otago, Dunedin, New Zealand

Advances in sequencing technology and declining sequencing costs have resulted in vast databases replete with genomic information. Here we present an example of how analysis of available information can yield new hypotheses with promising applications in the management of greenhouse gases (GHG). We analyzed databases for available genomes from organisms encoding the nitrous oxide reductase gene (*nosZ*) responsible for the enzyme that catalyzes the last step in the denitrification pathway ($N_2O \rightarrow N_2$). This enzyme represents the only known sink of N_2O , a powerful GHG >300x stronger than CO_2 . To date, our understanding of N_2O reduction is primarily based on pure culture studies and molecular microbial ecology work focusing on a portion of organisms harboring *nosZ*. More importantly most in depth studies have been carried out on denitrifying organisms capable of carrying out all or most of the prior steps in the denitrification pathway. These studies are the foundation of our current regulatory paradigm and the focus of research in managing N_2O emissions. Here we show that an unhitherto unexplored population of organisms is putatively capable of reducing N_2O despite lack of denitrification related genes. Genomic organization of these atypical *nos* operons suggests that new regulatory pathways likely control these non-denitrifying populations and could represent a novel sink of N_2O not being accounted for.

Dr Morales is a lecturer in the Microbiology and Immunology Department at the University of Otago. His research focuses on understanding regulatory pathways in bacteria, and their effect on ecosystem processes.

Monday 25 November

Stream C, Session 2

Will the forest soil microbiome stop doing us a favor?

Drigo, Barbara¹; Anderson, Ian C.¹

¹Hawkesbury Institute for the Environment, the University of Western Sydney, Sydney, Australia.

Atmospheric carbon dioxide (CO_2) levels recently reached 400 ppm demonstrating the disturbing ability of humanity's power to alter the chemistry of the atmosphere and by extension, the climate of the planet. If managed appropriately, forests could serve as a large net sink of carbon (C) and contribute to offset human emissions. However, forest survival and adaptation to future climate change conditions are dependent on soil microbial communities, which are the main agents responsible for litter decomposition and nutrient cycling. Here we describe how climate change will affect belowground forest microbial communities and their capacity to store C. Rhizosphere and bulk soil was collected from *Eucalyptus spp.* trees grown under ambient (ca. 350 ppm) or elevated (ca. 700 ppm) CO_2 conditions, different watering and temperature regimes. Lipid fatty acids and real-time PCR approaches revealed that elevated CO_2 intensified the effect of warming and drought by significantly altering the bacterial and fungal community composition associated with the *Eucalyptus spp.* rhizosphere. As opposed to simply increasing the biomass of soil-borne microbes at elevated CO_2 under changes in rainfall patterns and temperature, elevated atmospheric CO_2 strongly selected for opportunistic plant-associated microbial communities and effected shifts in microbial community composition. Bacterial metagenomic analysis revealed the dominance of beneficial rhizobacteria however it also revealed the presence of several opportunistic and true human pathogenic bacteria in the rhizosphere microbiome, including *Staphylococcus*, *Salmonella*, *Clostridium* and *Vibrio* species. The potential mechanisms involved in the interplay between the good, the bad and the ugly in the rhizosphere microbiome will be discussed.

Dr. Barbara Drigo is a Postdoctoral Research Fellow at the Hawkesbury Institute for the Environment. Her research involves the development of novel experimental systems to test microbial dynamics and functioning in response to environmental change using high-throughput approaches, biostatistics and bioinformatics.

Monday 25 November

Stream C, Session 2

'Toxic in Crowds' – Mapping cyanotoxin production across a eutrophic lake

Borges, Hugo¹; Wood, Susie^{1,2}; Puddick, Jonathan¹; Prinsep Michèle²; Rodgers Shelly²; Dietrich, Dan³; Cary, S.Craig²; Hamilton, David²

¹Cawthron Institute, Nelson

²University of Waikato

³University of Konstanz

Toxic cyanobacterial blooms are increasing in prevalence globally. Of the known cyanobacterial toxins the hepatotoxic microcystins are the most notorious. Laboratory studies have shown correlations between the amount of microcystin produced per cell and a multitude of physiochemical variables including nutrients, temperature and pH. Whilst these laboratory-based experiments allow environmental conditions to be stringently controlled, studying cyanobacteria in these 'artificial' environments may alter or remove variables that regulate microcystin production. Over the past three years, our group has been performing experimental manipulations using mesocosms (55-L polythene chambers suspended in a lake) to study toxin production in a more natural environment. During these studies we mimicked the formation of a cyanobacterial bloom or scum by adding concentrated suspensions of cyanobacteria to the mesocosms. These experiments demonstrated a strong correlation between microcystin production and cell density in the mesocosms.

This year we profiled a small eutrophic lake (Lake Rotorua, Kaikoura) to explore whether this same phenomenon occurred naturally with spatial variation in cell density around the lake. Cyanobacterial density was assessed fluorometrically and spatial/depth samples were collected to determine cell and microcystin concentrations, examine the expression of genes involved in toxin production and to ascertain nutrient levels. This whole lake profile is being used to elucidate how interactions between abiotic and biotic variables influence microcystin synthesis and may ultimately help to predict parts of a lake or periods of greatest health risk.

Hugo is a PhD student within the Freshwater and Coastal group at the Cawthron Institute and at the University of Waikato. His research uses molecular, biochemical and chemical techniques to monitor and understand why cyanobacteria produce toxins.

Monday 25 November

Stream C, Session 2

Spatial patterns in soil fungal beta diversity across an Australian alpine/subalpine gradient

Beck, Sarah¹; Powell, Jeff¹; Drigo, Barbara¹; Anderson, Ian¹

¹Hawkesbury Institute for the Environment, University of Western Sydney, Australia

Studying the spatial patterns that exist in ecological communities is fundamental to understanding how communities function and the mechanisms that drive and maintain their biodiversity. Below-ground fungal communities perform fundamental roles in ecosystem functioning through nutrient cycling, and their community structure is known to directly influence individual plant growth and plant community structure. Therefore, it is important to understand the spatial dynamics of these fungal communities, especially in environments that are unique and endangered. We investigated the spatial structure of below-ground fungal communities along a strong climatic gradient driven by elevation, across an Australian alpine/subalpine ecotone. Soil fungal communities were sampled using a spatially explicit sampling design at three sites (above, at and below the treeline) near Thredbo in the Kosciusko National Park. The communities were characterised using 454 pyrosequencing and the relative importance of spatial and environmental factors in shaping fungal community structure among and within the three sites was determined. A degree of large scale structure in the fungal communities was evident, with differences in the communities above, at and below the treeline, and spatial autocorrelation was evident at the smaller spatial scales within each of the three sampling locations. A small but significant proportion of the overall variation in community structure could be separately attributed to abiotic factors, vegetation community structure and purely spatial factors. The community structure among individual sites also showed a high degree of variability, indicating the additional role of stochasticity in shaping these communities.

Sarah Beck is a PhD candidate at the Hawkesbury Institute for the Environment, University of Western Sydney, Australia. Her research interests include the spatial ecology of communities, in particular microbial communities, and the mechanisms driving community structure in various environments.

Monday 25 November

Stream C, Session 2

Decoupling of fine-scale spatial pattern in bacterial community structure and function within a highly connected freshwater landscape

Lear, Gavin¹; Bellamy, Julia²; Case, Bradley³; Lee, Jack³; Buckley, Hannah³

¹School of Biological Science, University of Auckland, NZ

²Dept. Soil and Phys. Sci., Lincoln University, NZ

³Department of Ecology, Lincoln University, NZ

The extent to which bacterial communities exhibit small-scale biogeographic patterns in their distribution remains unclear. In this study, we investigate variability in bacterial community composition and function within a patchwork of shallow alpine tarns. Using a grid-based sampling design, we collected 100+ water samples located between 4 and 60m apart. For every sample, variability in bacterial community composition was monitored using a DNA-fingerprinting methodology (ARISA) whereas differences in bacterial community function (i.e. carbon substrate utilisation patterns) were recorded from Biolog Ecoplates. The exact spatial location and dominant physico-chemical conditions (e.g., pH, temperature, depth) were simultaneously recorded from every sample location.

On average, bacterial community structure and function became significantly different comparing samples located ≥ 20 m apart. Variance partitioning revealed that purely spatial variation accounted for the more of the observed variability in both bacterial community structure and function (Range: 24-38% and 17-39%) than the combination of purely environmental variation and spatially structured environmental variation (Range: 17-32% and 15-20%). Contour plots of bacterial community similarity revealed greater spatial structuring in bacterial community composition than function suggesting that some of the changes in bacterial community composition are functionally 'redundant'.

Our investigation, which is one of the smallest scale studies of bacterial biogeography conducted within lentic freshwater, reveals the presence of distinct bacterial communities across unexpectedly small spatial scales. We suggest that even within relatively mixed ponds, bacterial communities separated by distances of < 20 m may be dispersal limited, differentiating at a rate which is faster than they are mixed together by ecological drift.

Gavin Lear is a senior lecturer in microbiology at the University of Auckland where his research interests include themes related to environmental microbiology, microbial biogeography and bioremediation.

Monday 25 November

Stream C, Session 3

Happily ever after: coevolution of scale insects and their symbionts.

Dhami, Manpreet Kaur¹; Taylor, Mike²; Beggs, Jacqueline²

¹Plant Health and Environment Laboratory, Ministry for Primary Industries, New Zealand

²School of Biological Sciences, The University of Auckland, New Zealand

Symbiosis is ubiquitous, from the deep fissures in the sea floor, to the great diversity of plants and animals, and in fact within each one of us. Mutualistic symbiosis often leads to innovation in the survival strategy of two or more organisms. Scale insects (family: Coelostomidiidae) feed on phloem sap that is poor in key nutrients such as amino acids. We applied the 16S rRNA gene approach to discover bacterial symbionts that may supplement these insects nutritionally. We found a range of bacteria, one of which was subsequently confirmed, by *in situ* hybridisation, to be embedded in specialised insect tissue called “bacteriome”. We mapped the 28S rRNA + COI gene-based phylogeny of the scale insect family against that of the symbiont 16S rRNA phylogeny. We found strong support for co-phylogeny between the two. The main symbiont was further characterised using electron microscopy and was discovered to be a typical “primary symbiont”. Primary symbionts of sap-sucking insects are often involved in the metabolic pathways of their hosts. Using highly sensitive GCMS, we traced the chemical composition of honeydew produced by scale insect species with different bacterial communities. We found species-specific chemical signatures from these honeydews. This effect was further traceable downstream in the fungal consumers of the honeydew that were analysed using ITS-based pyrosequencing. This study provides a rare example of a bacterial symbiosis extending its influence across trophic levels. We describe for the first time the microbial building blocks that are the foundation of the honeydew-fuelled ecosystem of New Zealand.

Manpreet is a scientist at the Plant Health and Environment Laboratory, Ministry for Primary Industries. She is working on the detection of high priority invasive pests crossing New Zealand borders. Her all-time interest lies in interspecies interactions, especially symbiosis.

Monday 25 November

Stream C, Session 3

Ecosystem engineering drives mutualistic coevolution between yeast and flies

Goddard, Matthew, R.¹; Buser, Claudia C.¹; Newcomb, Richard D.²; Gaskett, Anne C.¹; Guenther, Catrin¹;

¹ The School of Biological Sciences, University of Auckland, Auckland, New Zealand.

² The New Zealand Institute for Plant & Food Research Limited, Auckland, New Zealand.

All organisms change their environment to some degree, ranging from the simple consumption of nutrients and production of waste to more sophisticated modifications such as dam building. The yeast *Saccharomyces cerevisiae* engineers its ecosystem by fermenting sugars in fruit to produce a toxic cocktail of alcohol, heat, and carbon dioxide that sabotages microbial competitors. Fermentation by yeast also produces volatile compounds that impart flavour to ferment products such as wine, but the biological function of these compounds is unclear. We are investigating whether ecosystem engineering is a new and previously unstudied mechanism for the evolution of mutually beneficial relationships between species: Yeasts benefit from volatile production because attracting vectors allows them to ‘hitch a ride’ with flies and escape ephemeral fruits, and flies benefit from following yeast volatiles because they reproduce better in fermenting fruits. With lab and field experiments we show that an interaction between yeast and flies is instigated by yeast ecosystem engineering and this appears to have driven an association where both partners enjoy fitness benefits. These data demonstrate that ecosystem engineering provides a general potential platform for the evolution of mutualisms.

Matthew completed a PhD and then post-doctoral work at Imperial College, Silwood Park (UK) on evolutionary and ecological genetics and experimental evolution using yeasts as a model. From there Matthew moved to NZ where he has continued his experimental evolution and population genetics work, but he has become increasingly interested in ecological aspects: particularly patterns and processes of community structure and composition.

Monday 25 November

Stream C, Session 3

Advancing analyses of microbial population structure: Quantifying gene-flow and connectivity in New Zealand’s *Saccharomyces cerevisiae*

Knight, Sarah¹; Goddard, Mat¹

¹School of Biological Sciences, The University of Auckland

Currently eukaryotic microbial populations are evaluated as either being structured or homogeneous. Just as for macro-organisms, this is unlikely to be biologically accurate. A better approach is to quantify the degree to which microbial populations are differentiated as well as connected by gene flow, but this is largely unexplored. Here we focus on the model research eukaryote *Saccharomyces cerevisiae* which, along with its commercial applications in the production of wine, beer, bread and other alcoholic beverages, has long been used to investigate aspects of cell biology, molecular biology, genetics and evolutionary theory; however, little is known about its ecology and population biology. Previous research by our group has shown that New Zealand harbours a genetically distinct population of this species. Using a microsatellite genotyping system, here we quantify the degree of both population structure and connectivity of this sexual yeast throughout New Zealand by analysing samples of vineyard soil, spontaneous ferments and native plants collected from Hawkes Bay, Martinborough, Nelson, the Wairau and Awatere Valley’s and Central Otago.

Between the different samples within each region no differentiation was detected suggesting these populations are ubiquitous within regions. Between regions a complex pattern of population differentiation overshadowed by human mediated gene flow emerges. Directional migration into large wine producing regions is uncovered which is consistent with the movement of grapes around the country by the wine industry. This study is the first to quantify gene flow in a model eukaryote and demonstrates the impact human activities can have on microbial distributions.

Sarah Knight is a PhD student under the supervision of Dr Mat Goddard at the University of Auckland. Her current research interests are in the fields of population genetics, genomics, bioinformatics, ecology, evolution and wine science.

Monday 25 November

Stream C, Session 3

Biogeography of fungal species associated with New Zealand winemaking

Morrison-Whittle, Peter¹; Goddard, Mat¹

¹*School of Biological Science, University of Auckland*

Biogeography is the study of the distribution of organisms through space and time. Historically, it is assumed that natural selection to environmental conditions drives the structure of microbial communities. However, it has been shown that microbial communities can vary significantly within niches, apparently independent of measured environmental gradients. This variation can culminate in differences within niche community structure over regional scales.

To what degree can microbial communities vary within the same niche across regions? Are these differences greater or lesser than between-niche differences within regions? Is microbial community structure driven primarily by natural selection or by spatial variation across regions?

To test whether selection, geographic distance (i.e. dispersal limitations) or some interaction between the two primarily drives microbial eukaryotic community structure, we compared the differences in microbial community structure and composition between three comparable niches: bark, soil and fruit across six distinct regions in NZ using next generation sequencing (454 pyrosequencing) approaches.

We show that the greatest source of variation lies between niches and thus selection is dominant in defining community structure. However, regional differences were also significant, as well as an interaction between niche and region, showing that neutral process, such as lack of dispersal also have a hand in defining community composition in space and these interact with natural selection differentially between niches in regions. This experimental design allows us to analyse and present a more realistic picture of the forces driving microbial community structure rather than a black and white selection or dispersal limitation conclusion.

Peter Morrison-Whittle, PhD student. Microbial ecology and biogeography.

Monday 25 November

Stream C, Session 3

A pathogen's impact on the reintroduction of a threatened frog species

Klop-Toker, Kaya¹; Stockwell, Michelle¹; Valdez, Jose¹; Bainbridge, Loren¹; Clulow, Simon¹; Clulow, John¹; Mahony, Michael¹

¹Conservation biology group, University of Newcastle

Many anuran species across the globe are declining due to the fungal pathogen, *Batrachochytrium dendrobatidis* (Bd). One management method used in the conservation of threatened frog species is captive breeding and release. However, Bd is detrimental to such programs because released frogs can succumb to the pathogen. Mortality from Bd is highest in cooler months when temperatures are optimal for the disease's growth and reproduction. Although in winter, most frog species reduce their activity, making it difficult to find specimens and obtain Bd infection levels. Our study investigates the year-round impact of Bd on a released population of green and golden bell frogs, *Litoria aurea*, in created habitat. Infection data for released *L. aurea* were gathered weekly between April 2011 to June 2013. Bd infection loads and prevalence peaked in June with 100% of individuals infected and zoospore counts reaching over 1000 GE. In order to manage the threat of Bd, the salinity of two created ponds were increased, as salinities over 3ppt reduce Bd growth and motility. A small percentage of released animals survived winter, however reproduction, which has not yet occurred, is essential to sustain the population. This is one of the first studies to collect winter Bd infection loads and highlights the need for adaptive management that promotes the survival of released frogs through winter to enable sufficient breeding in subsequent seasons.

Kaya Klop-Toker, PhD candidate, amphibian conservation biology, and ecology.

9. Urban landscapes

Wednesday 27 November

Stream C, Session 7

The importance of interdisciplinary collaboration in creating sustainable and resilient urban landscapes

Hahs, Amy K.¹; Luck, Gary W.²

¹ Australian Research Centre for Urban Ecology (ARCUE), Royal Botanic Gardens Melbourne, c/o School of Botany, The University of Melbourne, Australia

² Institute for Land, Water and Society, Charles Sturt University, Australia

The growth of urban landscapes is one of the most serious ecological problems currently facing Australia, New Zealand and the world, resulting in significant impacts to local, regional and global environments. This raises substantial challenges for conservation of local species and maintaining connections between urban residents and natural environments. In this presentation, we synthesize urban studies from across south-eastern Australia to identify the most critical socio-ecological links, and then discuss how interdisciplinary research can also contribute to the implementation of this knowledge into the realm of landscape architecture and other built environment professions. Our synthesis shows that the socio-economic characteristics of urban residents can strongly influence the dynamics of urban ecosystems in concert with underlying biophysical factors. In some locations, the natural characteristics of residential neighbourhoods are only weakly related to human well-being and feelings of connection to nature, while access to and types of urban green space appear to be critical to the health and well-being of urban park users. Yet, little is known about the specific characteristics of urban green space that are most important for improving user's well-being, and the associated implications for biodiversity and ecosystem processes. Interdisciplinary research is therefore critical for shaping resilient urban landscapes at two levels; 1) by increasing our understanding of the social-ecological dynamics of urban ecosystems, and 2) to inform actions that will support rich experiences of nature and a high quality of life for the people who live there.

Dr Amy Hahs is GIS Ecologist at the Australian Research Centre for Urban Ecology. Her interests are: spatio-temporal dynamics of urbanisation, understanding their impact on the ecology of urban areas, and applying this knowledge to create resilient cities and towns.

Wednesday 27 November

Stream C, Session 7

Building urban resilience with biodiversity to cope with increasing probability of catastrophic events

Stewart, Glenn H.^{1,2}, Meurk; Colin D.²

¹Faculty of Environment, Society & Design, Lincoln University, New Zealand

²Landcare Research, PO Box 61040, Lincoln, New Zealand

The state of green space in the urban environment is regarded as a predictor of human health, happiness, equity, and biodiversity, but functional attributes of the urban ecosystem are also key indicators of whole-city health, adaptability, sustainability and resilience to catastrophic events such as earthquakes, fires, floods, tsunamis, sea level rise, dust storms and hurricanes. Yet the use of such indicators to inform planning and management is often ignored or is an afterthought. With the projected increase in catastrophic climatic events and ever larger human populations crammed into marginal environments more attention needs to be given to building resilience into urban ecosystems to ensure they are sustainable. In addition to conventional engineering solutions and more energy efficient building codes, constructive management of vegetation and biodiversity will be critical to urban resilience and in the long run cheaper. The opportunities include first avoiding or progressive retreat from hazardous areas like coastlines, floodplains, liquefaction-prone substrates, fire-prone forests and unstable areas prone to land or mud slips, ensuring robust vegetation buffers within and along the edges of such vulnerable areas. Second, managing stormwater with vegetated roofs, walls, rain gardens, swales, and pervious paving. Third greening for cooling, carbon and fire-resistance; and fourthly, bee and bird friendly plantings. In this presentation we explore urban indicators of resilience to catastrophe and adaptive approaches to managing the environment and incorporation of green space and biodiversity in order to meet these new challenges.

Glenn Stewart is an urban ecologist at Lincoln University, Christchurch, New Zealand. His research focusses on the structure and function of vegetation in cities and towns and its susceptibility to invasive species and responses to natural and man-made catastrophes.

Wednesday 27 November

Stream C, Session 7

Managing the growth of urban landscapes for people and biodiversity

Fuller, Richard A.¹; Sushinsky, Jessica R.¹; Rhodes, Jonathan R.¹; Possingham, Hugh P.¹

¹University of Queensland, Brisbane, Australia

Experiences of nature are important for human health and well being and as the world's population continues to become concentrated

in towns and cities, there is mounting concern that our experiences of nature are diminishing. Despite this, little is known about how we should design cities to maintain people's access to nature. Here, we quantify the impact of future urban growth on access by people to nature using spatially explicit, statistical models to predict local extinctions of bird species across the city of Brisbane, Australia. We simulated the addition of 84,642 houses to the city under urban growth strategies representing compact and sprawling growth forms. We then modelled access to nature by estimating changing green space provision and patterns of bird species richness close to households. We discovered that impacts of urban growth on people's access to nature depended crucially on the form of urban growth. Under a sprawling pattern of development, with lower residential densities and few green spaces, there were severe declines in bird species richness and access to green space around the home. Moreover, these declines were concentrated in socio-economically disadvantaged neighbourhoods. Our results suggest a trade-off, in that the residential infill required to retain large green spaces will almost inevitably require a reduction in backyard sizes, potentially impacting nature experience in these private spaces. Careful planning is needed to balance public and private urban green spaces to ensure that we maximise the opportunities for people to interact and connect with nature in our increasingly urbanized world.

Richard Fuller studies how people have affected the natural world, and how their destructive effects can be reversed. On the flip side, he wants to understand whether and how people can benefit positively from experiences of biodiversity.

Wednesday 27 November

Stream C, Session 7

Managing humans and other wildlife to enhance biodiversity in urban landscapes in NZ

van Heezik, Yolanda¹

¹*Department of Zoology, University of Otago*

Twenty-four years ago Oliver Gilbert (1989, *The Ecology of Urban Habitats*) wrote “The fostering of wildlife areas in cities is too complex an operation to be left in the hands of the ecologists” and this is still the case. Humans are an integral part of urban ecosystems. A particularly challenging aspect of urban ecology is incorporating human influences into research. For conservation biologists and wildlife managers who aim to protect and enhance biodiversity in urban areas, city dwellers are a huge resource with enormous potential to effect change, if they are appropriately inspired, informed and engaged. Most ecologists lack the skills to address the questions involving human dimensions, which lie in the realms of the social scientists and psychologists, necessitating multi-disciplinary partnerships between social scientists, psychologists, geographers and ecologists. I will review research in urban NZ that incorporates a social element (cats, invertebrates, gardens, children's connection with nature; bird feeding) and discuss the social dimensions of these studies and the value added by adopting a multi-disciplinary approach.

Yolanda van Heezik (Senior Lecturer) undertakes predominantly urban-focussed research investigating distributions and abundances of urban wildlife, impacts of urban predators, and the social and environmental drivers of biodiversity in private gardens. A current collaboration explores city children's connection with nature.

Wednesday 27 November

Stream C, Session 7

Improving city life: options for ecological restoration in urban landscapes

Standish, Rachel J.¹; Hobbs, Richard J.¹; Miller, James R.²;

¹*School of Plant Biology, The University of Western Australia, Australia*

² *Natural Resources & Environmental Sciences, University of Illinois, USA*

The role of humans in the restoration of ecosystems has been emphasised since its inception. The human dimension of restoration is particularly well established in urban ecosystems because this is where people and nature co-exist. At the same time, the altered biophysical conditions that characterise cities place constraints on restoration in its strictest sense—assisting the recovery of historic ecosystems. Rather than viewing this as a shortcoming, in this talk, I present the ways in which such constraints can be viewed as opportunities. There is the chance to broaden traditional conservation and restoration goals for urban settings reflecting peoples' preferences for nature in their backyards, and in doing so, offer people multiple ways in which to engage with nature. I consider four main restoration options—conserve and restore nature at the fringes, restore remnant patches of urban nature, manage novel ecosystems and garden with iconic species—in terms of their potential to contribute to promoting human-nature interactions in urban landscapes. I explore these options using the coastal city of Perth, Western Australia, as a case study. Perth is one of the fastest growing cities in Australia; home to ~1.6 million people and a smattering of green spaces and wild places. Ecological restoration can contribute to the sustainability of urban landscapes in Perth and elsewhere, not just in terms of nature conservation, but also by providing opportunities for people to interact with nature and so increase our understanding of how people perceive and value landscapes.

Rachel Standish is currently exploring the utility of the resilience concept for environmental management as part of her research role with the Centre of Excellence for Environmental Decisions (CEED) which is funded by the Australian Research Council.

Wednesday 27 November

Stream C, Session 7

Urban motorways as ecological assets

Simcock, Robyn¹; Bannock, Carol²; Meurk, Colin D.¹; Gardener, Rick²

¹Landcare Research NZ Ltd, Auckland, New Zealand

²Auckland Motorways, Auckland, New Zealand

Roads are primarily constructed as efficient, safe conduits for vehicles; however they are increasingly valued for landscape benefits, native plant and animal conservation and connectivity, and for provision of ecological services such as visual buffers, calming, and amelioration of storm water surges and temperature extremes. Motorways provide unique ecological opportunities: people are deliberately excluded (CIPTED applied in reverse) and increasingly high mowing costs are making the establishment of dense, minimally-managed vegetation away from sight-lines increasingly cost-effective. This reduced disturbance has allowed remnant wildlife animals and ecosystems to survive in the midst of increasingly intensive cities. The paper presents case studies of managing motorways for enhanced biodiversity values, the key constraints and considerations. We also explain some ways of communicating biodiversity values and potentials within transport agencies, and building on established Key Performance Indicators and agreed 'levels of service'. Case studies include: 1) managing predation, nesting and foraging areas for variable oyster-catchers and dotterels; 2) reducing mowing frequency and timing of mowing to enhance invertebrates and save money; 3) manipulating stress and disturbance through growth media, slope and maintenance regimes to encourage flora of infertile clay banks (orchids and insectivorous plants) and gravel batters (dryland forbs), and 4) conserving small remnants, small individuals and animals as miniature whole worlds, seed sources and stepping stones.

Robyn Simcock is an ecologist researching and consulting on rehabilitation of grossly-disturbed and de-novo ecosystems in cities, roads and mines, often with a focus on achieving ecological and stormwater mitigation benefits.

Wednesday 27 November

Stream C, Session 7

Guess who's coming to dinner: Changes to local bird communities as a result of supplementary feeding

Galbraith, Josie A.¹; Beggs, Jacqueline R.¹; Jones, Darryl N.²; Stanley, Margaret C.¹

¹Centre for Biodiversity and Biosecurity, School of Biological Sciences, University of Auckland, Private Bag 92019, Auckland.

²Environmental Futures Centre and Griffith School of Environment, Griffith University, Nathan, Qld 4111, Australia.

Supplementary feeding of birds is a global phenomenon, involving millions of people and vast quantities of food annually. While it is an important socio—ecological link in an increasingly urbanised world, many people engage in the practice of feeding believing the birds gain some benefit from the food they provide. There are, however, a number of potential negative ecological effects that may arise as a result, including dependence, increased aggression, and disease outbreaks. In the New Zealand context, an important concern is the potential for feeding to enhance populations of introduced species, yet the practice has received virtually no attention from the scientific community here. We have carried out an experimental feeding study in urban Auckland to investigate the effects of common New Zealand feeding practices. A key aim was to examine whether feeding causes changes in local avian community structure. In addition, baseline information on seasonal variation in feeder use was collected, both at the individual and species levels. Dramatic increases in local abundance of some species, house sparrow (*Passer domesticus*) and spotted dove (*Streptopelia chinensis*) in particular, were observed at experimental feeding sites. All species observed visiting feeding stations during the study were introduced, with the exception of the silvereye (*Zosterops lateralis*), which was a seasonal visitor in winter months only. The findings from this study indicate that bird feeding contributes to the patterns of avian community structure observed in urban New Zealand, with the potential to inflate numbers of invasive birds.

Josie Galbraith is part way through a PhD in urban avian ecology at the University of Auckland, covering a range of aspects related to bird feeding including community ecology, invasion biology, behavioural ecology, and epidemiology.

Wednesday 27 November

Stream C, Session 8

Frogs about Town: Micro- and macro habitat determinants as observed in a South African city.

Kruger, Donnavan¹; Du Preez, Louis¹

¹School for Biological Sciences, Zoology, North-West University, Potchefstroom, South Africa

Amphibians utilize a wide variety of habitats around the globe. Most species have unique life history characteristics adapted to specific climates, habitats and local conditions providing suitable environments for reproduction, development and connectivity to other populations. Most ponds or wetlands in urban areas are prone to a degree of isolation, modification, fragmentation and chemical pollution. Despite these challenges, some frogs prosper in an urban environment, some are barely surviving and others do not survive at all. Few studies have focused on how amphibian communities are affected by urbanization. We evaluated the breeding distribution of pond-living frogs along an urban—rural gradient in the city of Potchefstroom, South Africa. In this study we examined anuran communities at micro- and macro habitat scale in a wide range of habitats that were classified in nine different wetland types. Using

three different sampling methods, we collected frog larvae from 62 sites. Preliminary results show a decrease in species richness in ponds close to highly altered areas with high road and human resident densities. Green open space and aquatic vegetation play a huge role in increasing species richness. We observed that invasive predatory fish does not play a key role in pond choice for some species, but still have far-reaching effects on population densities and might lead to local extinctions of some frog species. Within the city of Potchefstroom we observed that *Xenopus laevis*, *Amietia queckettii*, *Amietophrynus gutturalis* and *A. rangeri* thrive. Although common in the area, three species were not collected in the city.

Donnavan Kruger is a Ph.D. candidate in the field of bioacoustics and urban ecology in South Africa. He investigates frog population dynamics in urbanized settings as well as the effects that anthropogenic noise have on anuran communication systems.

Wednesday 27 November

Stream C, Session 8

Energetics of the suburbs: does nectar availability explain nectarivore abundance in an urban environment.

Davis, Adrian¹; Major, Richard²; Taylor, Charlotte¹

¹*School of Biological Sciences, University of Sydney*

²*Australian Museum*

In some Australian cities, nectarivores have become a conspicuous component of the avifaunal community. One mechanism that has been proposed to explain their success is an increased availability of nectar that is provided by suburban gardens and other ornamental plantings. To determine whether the amount of nectar within the suburban landscape is comparable to that of the non-urban landscape we measured floral abundance and nectar concentrations in 24 sites in Sydney. We also measured the abundance of four species of nectarivores and available nectar energy over a period of 18 months within streetscapes, remnant vegetation, forest and heathland, to determine whether nectar availability explains nectarivore abundance. Two species of nectarivorous parrot, the rainbow lorikeet and musk lorikeets were more abundant within the suburban landscape compared to the non-urban landscape and streetscapes provided significantly more nectar than the natural environment during spring and winter. Both rainbow lorikeets and musk lorikeets were associated with flowering of *Eucalyptus* spp and red wattlebirds with the flowering of *Grevillea* and *Callistemon* spp. within streets. Streets appear to provide a constant supply of nectar for large-bodied nectarivores and provide for more efficient foraging, explaining the success of these species in urban environments.

Adrian has just submitted his PhD thesis, investigating the ecology of Sydney's parrot community. His research focused on parrots and how they utilise urban habitat, competition for tree hollows throughout the urban landscape and availability of nectar in urban environments.

Wednesday 27 November

Stream C, Session 8

Finding nature in the city: biodiversity and children's habitat-use in the urban environment

Hand, Kathryn¹; Seddon, Philip¹; Freeman, Claire²; Van Heezik, Yolanda¹

¹*Department of Zoology, University of Otago, Dunedin, New Zealand*

²*Department of Geography, University of Otago, Dunedin, New Zealand*

Today nearly half of the world's children will grow up in the highly modified and artificial urban landscape. For these children urban green spaces provide a residual link to the natural world, preserving opportunities to experience and connect to biodiversity. However, the distribution and quality of urban green space across cities is patchy and increasing parental safety concerns may restrict access to even nearby natural areas. As such many urban children may be in danger of growing up in isolation from nature and the developmental and well-being benefits it affords. Here we seek to answer whether this is occurring in New Zealand's cities by combining methods from social and ecological fields to describe children's home ranges and habitat selection preferences. Children's most visited places will be identified by children themselves during interviews on their time spent outdoors. This information will be used to estimate home range areas and available biodiversity will be estimated within these areas using data collected on flora and fauna richness across urban habitats. We will then test whether children seek out the more biodiverse areas that are available to them using resource selection functions. This presentation will report on the results of these analyses from over 100 children living in New Zealand's two major urban centres, Auckland and Wellington. This novel approach combining wildlife methodology to children's geography will provide insights for urban planning and management of urban green spaces, as well as answering whether children are still able to experience nature in the city.

Kathryn Hand is currently a Master's candidate at the University of Otago. Current research interests include urban ecology and conservation, wildlife habitat-use and environmental psychology.

Wednesday 27 November

Stream C, Session 8

Impact of nest site selection on reproductive success of a New Zealand passerine in urban woodlands.

Amiot, Christophe¹; Dale, James²; Brunton, Dianne³ and Ji, Weihong¹

¹Human-Wildlife Interactions Research Group, Institute of Natural and Mathematical Sciences, Massey University, Auckland, New Zealand

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³Ecology, Behaviour and Conservation Group, Institute of Natural and Mathematical Sciences, Massey University, Auckland, New Zealand

Urbanisation alters several ecological factors that shape the composition and the structure of animal communities. Changes in predation pressure and human disturbances are among the important factors that affect native bird survival in urban habitats. Nesting period, especially for open-cup nests, represents the most sensitive stage of life to predation and disturbances. Previous study has found an important significant variation in horizontal placement of nests on the trees along an urban gradient. In this study, we compare reproductive performance of New Zealand Fantail in relation to nest site selection. The height of nest, tree height, exposure, vertical and horizontal index of NZ Fantail nest placement was measured to determine the effect of nest and nest-site characteristics on reproductive success. There is no evidence of differential in nest success in relation to site selection and site-characteristics. The significance of nest site selection is discussed.

Christophe Amiot is a PhD Student from Massey University, Albany, New Zealand, originally from France. Christophe's research contribution focuses to understand the change of behavioural and life history traits of natives bird in response to urbanisation in New Zealand, using NZ Fantail as a model.

Wednesday 27 November

Stream C, Session 8

Distribution and community composition of millipedes and isopods in forest fragments along a suburban-rural gradient

Tomlinson, Anne¹; Wardle, David²; Beggs, Jacqueline¹

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²Dept of Forest Ecology and Management, Swedish Univ. of Agricultural Sciences, Umeå, Sweden

Habitat fragmentation may facilitate exotic species establishment and change native species assemblages towards disturbance tolerant species. Naturalised exotic millipedes (Diplopoda) and slaters (Isopoda) are distributed throughout New Zealand, but there is limited understanding of the factors influencing their establishment in native ecosystems; and the impacts of exotic species and forest fragmentation on native millipede and isopod communities are unknown. Millipedes and slaters were sampled in forest fragments across a suburban-rural gradient in Auckland to determine: (1) whether exotic species were present; and (2) the significance of a range of environmental and anthropogenic factors in explaining native and exotic species abundance. Three exotic millipedes, *Cylindroiulus britannicus*, *Ophiulus pilosus* and *Oxidus gracilis*, dominated the millipede fauna in small suburban fragments. Decreasing fragment size, however, was not associated with a decline in the native millipede fauna, nor was there a negative correlation between native and exotic millipede abundance and species richness. Exotic millipede abundance was influenced by fragment size and litter nutrient quality, while fragment age and litter quantity affected native species abundance. Three native isopod species were collected with litter nutrient quality a consistent influence on species abundance. The absence of exotic isopods was surprising as cosmopolitan, synanthropic species including *Porcellio scaber* and *Armadillidium vulgare* are common in the Auckland region. The results highlight the conservation value of forest fragments in preserving native litter fauna in anthropogenic landscapes. However the creation of novel communities comprising native and exotic species assemblages may alter decomposition dynamics in small forest fragments.

Anne Tomlinson is a PhD. student in the Centre of Biodiversity and Biosecurity, University of Auckland, studying invertebrate decomposers, including native and exotic species interactions, environmental and anthropogenic factors influencing species distributions, and exotic species impacts on decomposition dynamics.

Wednesday 27 November

Stream C, Session 8

Bat awareness movement - advocacy for long-tailed bats in Auckland

Paris, Ben

Auckland Council

The threatened long-tailed bat (*Chalinolobus tuberculatus*) is one of two endemic bat species in New Zealand and are the only native terrestrial mammals in the country. This species is classed as being nationally vulnerable but it is only recently that bats have been discovered to use human-dominated ecosystems, including peri-urban environments in cities like Hamilton and Auckland. The main threat facing cryptic local populations is ongoing destruction and fragmentation of habitats used by foraging and roosting bats. Auckland Council has been supporting bat advocacy and research over the past two years. Educational talks to schools, community and interest groups, and a number of positive media articles have grown the awareness of these widely unknown bats. New records

of long-tailed bats have also been discovered by monitoring in likely habitat types across Auckland. The accumulation of this work was celebrated with hundreds of local Aucklanders in a bat awareness event with attitudes being assessed via survey. Survey results have shown 82 per cent of respondents would actively check trees for bat occupation before felling. This has illustrated how a successful bat awareness movement can be implemented to the public urban community.

Ben Paris is a Senior Biodiversity Advisor at Auckland Council. Areas of research interest include native fauna community advocacy, and science education through social media.

Wednesday 27 November

Stream C, Session 8

Bringing nature back into New Zealand cities: key factors in reaching Hamilton City's "tūi tipping point".

Clarkson, Bruce D.¹; Kirby, Catherine L.¹; Alston, Andrew E.¹

¹*Environmental Research Institute*

²*The University of Waikato*

New Zealand's 20 largest urban centres vary considerably in their indigenous biodiversity resource (e.g. <1% to 9% native vegetation cover), and their approach to protecting and enhancing it. Focussing restoration efforts on well-known, charismatic species can gather support and build momentum that benefits both the target species and many interconnected aspects of biodiversity. In Hamilton City, the focal species has been tūi (*Prosthemadera novaeseelandiae*). In an uncontrolled and uncoordinated experiment, different Waikato agencies, institutions and community groups have been working directly, or indirectly to restore urban tūi populations. The vision to return tūi was formalised in 1989 with the establishment of the community group Tui 2000 Inc. Gully habitat enhancement had begun as early as the 1960s with the pioneering work of Dr A.J. Seeley and was followed by the Gully Restoration Programme (established 2000) and pest animal control by Hamilton City Council. These efforts were complemented by many small-scale private restoration projects and as habitat expanded and improved, and pest numbers reduced, the scene was set for Hamilton City to reach the "tūi tipping point". This milestone was achieved around 2010 after the Hamilton Halo programme (established 2007) undertook intensive pest control in 2,000 hectares of forest patches within a 20 km radius of the City. A dramatic increase in Hamilton tūi sightings has since been reported in 5-minute bird counts (mean abundance increased 16 fold from 2004 - 2012) and very widely throughout social and traditional media. These are significant achievements but questions remain as to the relative importance of different initiatives and whether tūi could have been brought back sooner. Coordinated approaches which span urban and periurban zones are likely to give the best results for bringing nature back into New Zealand cities similar to Hamilton.

Professor Bruce Clarkson is the director of the Environmental Research Institute at the University of Waikato. His research focuses on the opportunities and challenges of ecological restoration of urban environments and has led to many on-the-ground solutions.

Wednesday 27 November

Stream C, Session 9

Avoiding extinction by a thousand cuts: Evaluating strategic approaches to mitigating impacts of urban expansion on biodiversity

Whitehead, Amy¹; Kujala, Heini¹; Wintle, Brendan¹

¹*Quantitative and Applied Ecology Group, School of Botany, University of Melbourne, Parkville, VIC 3010, Australia*

Expanding urban populations are placing increasing pressure on biodiversity globally. Such pressure often makes it difficult to retain biodiversity values in the face of development, leading to biodiversity losses. Spatial conservation prioritisation tools identify areas of high conservation value, usually with the goal of conserving habitat or prioritising management actions across a landscape. However, they have rarely been applied to problems of regional development in which attempts to mitigate multiple different types of impacts are likely to take place. We developed a strategy for determining the optimal choice of mitigation which maximises long-term benefits to biodiversity. Our approach is based on four key steps: (1) characterising the biodiversity values of a region in which impacts are proposed or are likely to occur, (2) analyse the impacts on biodiversity values of a set of proposed development actions, (3) utilise a spatial conservation prioritisation tool to generate a set of candidate mitigation options, and (4) evaluate candidate options based on an independent species persistence analysis which utilises detailed biological and ecological information about a subset of the species in the region. We apply our approach to strategically assess and mitigate the impacts of development on biodiversity in a rapidly urbanising region of Australia, the Hunter Valley. The use of spatial conservation prioritisation tools coupled with ecologically realistic metapopulation dynamics models to strategically assess the tradeoffs between biodiversity conservation and development at a regional scale will help identify development strategies that allow for regional growth while minimising the impact on biodiversity.

Dr Amy Whitehead is a Research Fellow in the Quantitative and Applied Ecology Group at the University of Melbourne. She is an ecological modeler with interests in conservation planning and management across a wide range of taxa and ecosystems. Her current research focuses on identifying areas of high conservation priority within rapidly urbanising landscapes to develop strategies for avoiding and/or mitigating the impacts of development on biodiversity.

Wednesday 27 November

Stream C, Session 9

Movements of a native fruit pigeon within a fragmented urbanised landscape

Baranyovits, Alice¹; Rayner, Matt¹; Beggs, Jacqueline¹; Perry, George¹; Dennis, Todd¹; Landers, Todd²; Clout, Mick¹

¹University of Auckland

²Auckland Council

Long distance seed dispersal is essential to maintain connectivity between plant populations within fragmented landscapes. The amount of gene flow between fragments is determined by the frequency of dispersal events; low frequency can lead to a reduction in genetic diversity. Seed dispersal also largely determines the extent of range expansion, so can have important implications for the management of introduced plant species. Many fleshy fruited plants rely on vertebrate frugivores to disperse their seeds. Therefore, in order to accurately estimate the extent of dispersal, it is necessary to understand the movements of the frugivore.

In New Zealand, the kererū (*Hemiphaga novaeseelandiae*), a large (c.650g) endemic fruit pigeon, is a key disperser of large-fruited plants. Kererū are mobile, widespread and known to consume the fruits of over 70 native plant species and several introduced ones. Although their daily movements can be fairly limited, they are capable of flights of several kilometres. Little is known about the frequency of such flights within fragmented urbanised landscapes.

We present data from 13 birds fitted with satellite transmitters in the wider Auckland region. Movements were monitored over the breeding and peak fruiting seasons. These data provide insights into the connectivity and potential range expansion of plant populations.

Alice Baranyovits is a PhD candidate at the University of Auckland. Her research interests include movement ecology, landscape connectivity and in particular, the role of frugivores in long distance seed dispersal.

Wednesday 27 November

Stream C, Session 9

Identifying landscape connections for a small woodland bird in an urbanising ecosystem in Melbourne, Australia

Connelly, Christine¹; White, John¹; Aulich, Vincent¹; Lennox, Erin¹; Isaac, Bronwyn²; Cooke, Raylene¹; Weston, Michael A.¹

¹ Deakin University, School of Life and Environmental Sciences, Burwood, Victoria, Australia

² Monash University, School of Applied Sciences, Churchill, Victoria, Australia

Urbanisation is one of the leading causes of habitat fragmentation, disrupting the dispersal and movement patterns of many species. Increasing efforts are being directed towards preserving, enhancing and restoring landscape linkages for biodiversity conservation. Yet our understanding of the importance of landscape configuration to particular species remains limited, especially in urbanising ecosystems. Landscape connectivity models provide a useful tool for understanding these patterns and can be used to predict gene flow; however, the reliability of these models has been questioned. Here we explore the configuration of potential habitat for a small insectivorous woodland bird, the Eastern Yellow Robin, across the urban-forest gradient in eastern Melbourne, Australia. We modelled the spatial distribution of robins across the urban-forest gradient using presence-only species distribution modelling (SDM). Presence data were from a combination of field surveys conducted 2011-2013 (n = 608), supplemented with BirdLife Australia records since 2003 (n = 59). Several ecogeographical variables were used to model potential habitat. Predicted robin distribution across the landscape was associated with Normalised Difference Vegetation Index (NDVI), land use (impervious surfaces, tree cover, grass and water, derived from SPOT10 satellite imagery), road density, presence of riparian vegetation and tree cover. We converted the output of this SDM, predicted habitat suitability, to cost and resistance surfaces and compared two common connectivity models used to predict gene flow, least-cost modelling and circuit theory. We present these two connectivity models for consideration here, and will empirically compare their reliability in predicting gene flow *a priori* in a later study.

Christine is a PhD candidate with Deakin University, exploring the effects of urbanisation on Eastern Yellow Robins in eastern Melbourne, Australia. She is interested in understanding both local and landscape scale responses of wildlife to human disturbance.

Wednesday 27 November

Stream C, Session 9

How many birds are killed by cars on New Zealand roads, and does it matter?

Sullivan, Jon J.¹

¹Department of Ecology, Lincoln University

For ten years now, I've been logging the road kill on my bike ride to Lincoln University from Christchurch city. I've also been counting the live birds and mammals I see and hear. It has been eye-opening to discover how many birds are killed each year. Mammal carcasses are much more apparent and substantially longer-lived than bird carcasses which has led to the mistaken impression that cars kill many more mammals than birds. Along the 17 km length of my main route, on average I find one bird killed per kilometre every 10 days, while I find one mammal every 28 days. I use my estimates of carcass persistence to refine estimates of the total bird mortality along these roads. If my surveyed roads are representative of urban and peri-urban roads nationally, then the national bird road toll is easily

equivalent to several Rena oil spills each year. But what difference does that make to bird populations around our cities? I combine my road kill counts with estimates of local bird populations derived from my live count data, to estimate the proportion of bird populations lost to cars. I then ask whether rarer birds in the landscape tend to be most impacted. Based on my preliminary calculations, in areas with fast-moving traffic around the fringes of cities, more post-fledging birds appear to be killed by cars than by mammalian predators, including cats.

Jon Sullivan is an ecologist with interests in plant invasions, plant interactions with insect herbivores, and engaging the wider community in biodiversity exploration and monitoring. He is one of the founders of NatureWatch NZ (<http://naturewatch.org.nz>) and an avid phenoholic.

Wednesday 27 November

Stream C, Session 9

Catchment-based ecological restoration in urban settings: examples and conclusions from Wellington, New Zealand

Blaschke, Paul^{1,2}; Forsyth, Frances³; Bill, Amber⁴; Emeny, Myfanwy⁴; Wood, Nicci⁴

¹*Blaschke and Rutherford Environmental Consultants, Wellington, New Zealand*

²*Department of Public Health, Wellington Medical School, University of Otago, New Zealand*

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⁴*Wellington City Council, Wellington, New Zealand*

Urban catchments comprise a complex matrix of highly modified ecosystems with 'natural' patches that are usually very small and highly threatened. Aquatic ecosystems are often confined to piped systems. We describe opportunities we have had to apply an integrated catchment management (ICM) approach to restore ecological function within several urban catchments in Wellington City, building on existing nodes and reducing the level of threat experienced by remnant natural patches. Small fragmented portions of urban streams can be important foci of urban catchments. We see the ICM strategy as providing opportunities to use ecological restoration to enhance social and cultural cohesion while maintaining distinctive community styles.

Some of the strongest pressures on urban biodiversity arise as a direct result of infrastructure provision. Conventional development and infrastructure practices can lead to a range of adverse environmental and social impacts. Water-sensitive Low-Impact Urban Development (LIUD) provides an important alternative approach. The projects we describe illustrate a range of ICM and LIUD solutions to urban ecosystem issues including:

- improving functional connectivity in Wellington City's urban ecological network
- enhancing the aquatic and riparian biota of urban streams
- protecting ephemeral and first order streams above stormwater networks - critical to maintaining the integrity of remaining aquatic ecosystems
- identifying patches and corridors requiring targeted pest control and enhancement
- integrating amenity green space into the enhancement of indigenous ecosystems by recognising the ecosystem values of non-weedy introduced species
- better understanding how we can connect to the natural environment the city is built on.

Paul Blaschke is an independent environmental consultant and part-time university lecturer in environmental studies and environmental health. He is interested in all aspects of urban environments, an active member of his local streamcare group and a passionate born-and-bred Wellingtonian.

Wednesday 27 November

Stream C, Session 9

Larger frogs experience greater acoustic interference in urban noise

Parris, Kirsten M.¹; McCarthy, Michael A.¹

¹*School of Botany, The University of Melbourne*

Urban noise may hinder acoustic communication in animals by reducing the distance over which vocal signals can be detected, with potentially wide-ranging consequences for individual fitness. This distance is known as the active space of a signal. We will present a mathematical model of the active space of frog advertisement calls in urban noise as a function of body size. Despite having lower auditory thresholds, larger species with lower-frequency calls are predicted to suffer the greatest reduction in active space in noisy urban environments. During a field study in Melbourne, Australia, the southern brown tree frog *Litoria ewingii* was found to call at a higher frequency in traffic noise. However, modelling indicates that the observed frequency shift would confer only a modest increase in active space. Furthermore, as females of certain frog species appear to prefer lower-frequency advertisement calls, this strategy may improve the audibility of calls but reduce attractiveness to potential mates. Alternatively, calling more loudly may result in a larger increase in active space, but the high metabolic cost of this approach could limit chorus tenure and ultimately reduce breeding success. These results demonstrate the importance of conserving the acoustic habitat of frog populations in urban habitats.

Dr Kirsten Parris is a Senior Research Fellow in the Quantitative and Applied Ecology Group (QAECO) in the School of Botany at The University of Melbourne. Her research interests include urban ecology, amphibian ecology, conservation biology and field survey methods.

10. eResearch

Wednesday 27 November

Stream E, Session 7

The Biodiversity and Climate Change Virtual Lab: enabling research on climate change impacts on biodiversity

VanDerWal, Jeremy^{1,2}; Mackey, Brendan³

¹eResearch Centre, James Cook University

²Centre for Tropical Biodiversity and Climate Change, James Cook University

³Griffith Climate Change Response Program, Griffith University

Quantitative modelling that draws upon biological observational data, environmental information systems, and statistical analysis tools, is one of our most transparent approaches for understanding and predicting species responses to climate change and generating the information needed to inform adaptation management strategies for species and ecosystems. Such modelling can be technically difficult and involve significant time and effort in collating data and toolsets, cleaning and formatting data, executing the analysis with appropriate knowledge, and accessing high level computer resources. The NeCTAR funded Biodiversity and Climate Change Virtual Laboratory (VL) has been developed by a partnership of universities and government organisations to transform the accessibility of quantitative modelling for Australian biodiversity researchers (<http://bccvl.org.au/>). The aim of this VL is to enable high quality, cross-disciplinary assessments of the potential impacts of climate change on biodiversity. Benefits to researchers using the virtual laboratory include seamless access to:

- publicly available data (biological, environmental and climate) for Australia;
- tools for modelling species and biodiversity responses to climate change;
- a 'digital lab book' documenting a step-by-step history (metadata) of experiments;
- collaboration / sharing options for your key outputs and methods;
- access to a knowledge base to inform modelling decisions; and
- access to high performance computing and mass data storage.

This presentation will demonstrate the virtual lab capacity to transform biodiversity and climate change research by (1) enabling existing research questions to be investigated far more efficiently and effectively and (2) providing the means for Australian researchers to address new important questions.

Jeremy VanDerWal is jointly appointed as the Deputy Directory of JCU's eResearch Centre and as a spatial ecologist with the Centre for Tropical Biodiversity and Climate Change. His interests are in spatiotemporal modelling of species distribution and abundance.

Wednesday 27 November

Stream F, Session 7

Towards a framework for sharing an open set of data and tools for ecosystem modellers

Evans, Brad^{1,2}; Evans, Ben¹; Prentice, Colin^{1,3}

¹Terrestrial Ecosystem Research Network, ecosystem Modelling And Scaling infrasTructure (eMAST)

²Macquarie University, Department of Biological Sciences

The Ecosystem Modelling and Scaling Infrastructure Facility (e-MAST) is enhancing community capacity for assimilation and integration of data into modelling applications. Our focus is on dealing with the issue of scale in ecosystem modelling from individual leaves to continents- and beyond. Underpinning e-MAST's success is both the sharing of data and collaboration crossing scientific disciplines and TERN facilities. We are a collaborative organisation of ecophysiological, primary production, meteorological and hydrological modellers and data experts. Unlike operational institutions, our focus is on exploiting the best science has to offer, rather than the most efficient production method. Unlike climate system modellers, we focus on finding innovative ways to use all of the data available, rather than simplifying models for long-term, global circulation climate studies. Perhaps most importantly, we are bound by a desire to make our data and models openly available and without limitation. As an advocate of sharing, e-MAST will continue to play a key role in driving public availability of data and ecosystem models.

Brad is the Associate Director of eMAST and is based at Macquarie University. Brad's research focuses on tropical savannas and applying TERN data (AusCover, eMAST and ground observations) to improve modeling Australia's carbon and water cycles and monitoring forest health.

Wednesday 27 November**Stream F, Session 7****OzTrack: new online software for the analysis & visualisation of animal tracking data**Dwyer, Ross¹; Campbell, Hamish¹; Brooking, Charles²; Brimblecombe, Wilfred²; Watts, Matthew³; Hunter, Jane²; Franklin, Craig¹; .¹*School of Biological Sciences, The University of Queensland, Australia*²*eResearch Lab at the School of Information Technology and Electrical Engineering (ITEE), The University of Queensland, Australia*³*Environmental Decisions Group, The University of Queensland, Australia*

Ecologists seeking to use telemetry for their research have previously needed to become experts in data management, Geographic Information System (GIS) software, programming and spatial statistics in order to understand the movements of their study species. However, many ecologists do not have the resources to invest fully in all phases of the analyses.

OzTrack is new eResearch infrastructure (NeCTAR funded) which centralises the archiving, editing, visualisation and data analysis processes within a free and easy-to-use web platform (<http://oztrack.org/>). OzTrack provides functions for all steps of analysing telemetry data - including database and GIS functionality, accuracy filters, and tools to examine movement rates, home range and habitat use. Furthermore, OzTrack does not require expensive software licences and programming skills which are usually necessary to analyse telemetry data effectively.

OzTrack provides a graphical user interface in which the R software environment is accessible via the Web browser. This provides access to tools commonly used for analysing telemetric data - from contributed R packages and OzTrack's customised R functions. The results are displayed onscreen and may be overlaid on satellite imagery or environmental layers sourced from geospatial repositories. Results can be exported for further examination in Excel, ArcGIS and Google Earth. Our infrastructure not only assists ecologists analyse and interpret their telemetric data, but it will also help promote management decisions, increase awareness of local conservation issues and help foster collaboration across the ecological community.

In this presentation, the key functions of OzTrack will be demonstrated using telemetric data collected from estuarine crocodiles.

Ross Dwyer is a post-doctoral research fellow at UQ and scientific data analyst on the OzTrack project. His research uses GPS, geolocation and underwater acoustics to understand the principle drivers of animal behaviour in both terrestrial and marine systems.

Wednesday 27 November**Stream F, Session 7****Acou-informatics: searching for biologically relevant signals amongst the background noise of the world**Parsons, Stuart¹¹*School of Biological Sciences, University of Auckland*

Since the 1970s when the term "bioinformatics" was first coined by Paulien Hogeweg, science has developed new techniques for information processing in biotic systems. Much of this work is now focused at the cellular level, especially at nucleotide and amino acid sequences. Like DNA, sound is represented as a sequence of samples and the information it codes depends on the order of the sequence. Changes in amplitude and frequency code important information such as species presence, activity, diversity, and anthropogenic effects such as noise. In this talk I will highlight how signal-processing techniques similar to those used in traditional bioinformatics can be used to study the acoustic landscape, or "soundscape" of the world to reveal biologically meaningful patterns. I will show how we have used speech recognition technology and learning computer systems to detect calls of birds in long-duration recordings, identified them to species (and even individual), and used microphone arrays to track their movement. The algorithms we use work in better-than real time potentially allowing for real-time monitoring of species. Such techniques are central to future studies of biodiversity on a local to continental scale.

Stuart Parsons is an Associate Professor at the University of Auckland. His research interests primarily lie in the area of bioacoustics, including the identification of animals from their vocalisations and the use of this information for the study of behaviour, ecology and biodiversity.

Wednesday 27 November**Stream F, Session 7****ÆKOS: A new paradigm to enable discovery, access and re-purposing of complex ecological data**Turner, David^{1,2}; Chinnick Paul^{1,2}¹*University of Adelaide*²*Terrestrial Ecosystem Research Network*

Ecology is a data intensive science, with data generally expensive to collect and individual observations often irreplaceable. Many emerging problems in ecology now also require broad data coverage to adequately examine them, yet sponsorship for such collections is often challenging to obtain. In all cases re-purposing of suitable existing information may provide a satisfactory alternative to re-

collection and will also help maximise the value of the initial collection effort.

For data re-purposing to be viable, information needs to be stored and presented in a manner that facilitates re-examination and manipulation. Current barriers that restrict re-use by third party researchers, include poor discoverability, access constraints, and a general lack of necessary contextual information around the data.

ÆKOS – The Australian Ecological Knowledge and Observation System is endeavouring to greatly reduce the time spent by researchers assessing, acquiring and employing third party data, allowing them to more rapidly discover and assess suitability for incorporation into their research. ÆKOS is employing a series of best practice and innovative approaches from a diverse range of disciplines to meet this goal.

ÆKOS has reduced many of the technical barriers to ecological data re-purposing by constructing a purpose built data warehouse which is accessible via a web based portal. Effort has been expended developing the information models, semantics, ecological ontology and establishing the necessary partnerships to draw together key ecological datasets from across Australia. ÆKOS currently houses close to 100,000 ecological survey plots from across Australia. See <http://www.aekos.org.au> for additional information.

Authors are colleagues within the Terrestrial Ecosystem Research Network (TERN) Eco-informatics facility. David Turner currently leads the data analysis and modelling team. He is an ecologist by trade with broad interests in the field and in modelling and data management.

Wednesday 27 November

Stream F, Session 7

Easy access to reproducible computing and uncertainty propagation - the Tzar framework

Bastin, Lucy¹; Gordon, Ascelin²; Langford, Bill²; Satya, River²

¹Aston University, Birmingham, UK

²Royal Melbourne Institute of Technology, Melbourne, Australia

The availability and variety of environmental data and computational models is increasing at a spectacular rate. The potential for combining these resources into cross-disciplinary workflows for predicting environmental outcomes is huge, but many scientists cannot access the computational resources required – and processing becomes even more intensive when uncertainty is properly handled and propagated to achieve more reliable results for decision-making.

The authors have worked on problems such as systematic planning for conservation management under intense development pressure and with uncertain species information. To tackle computational demands, we built a software framework to spread work over many computers or virtual machines in the cloud, and collect results for statistical analysis. The framework ('Tzar') is freely available (<https://code.google.com/p/tzar-framework/>), and includes conservation-related models which can be re-used and combined with a user's own models in Python/Jython, R or Java. Tzar is simple to set up and use, allows dynamic parameter generation and global sensitivity analysis and enhances reproducibility of computational analyses by accessing versioned data and code. It is cross-platform and cross-language, with a Web-based UI that allows remote scheduling of model runs and interrogation of results.

We now plan to work with scientists from new domains to integrate their models into Tzar, and make our models 'talk to' models from other disciplines by exposing them as Web services. In this presentation we will present practical examples of Tzar analyses from the conservation planning domain.

Dr. Lucy Bastin is a Senior Lecturer in GIS (Geographical Information Systems) at Aston University, Birmingham. She currently applies spatio-temporal analysis techniques to health, environmental and socio-demographic research challenges, with a particular focus on handling and visualizing uncertainty.

Wednesday 27 November

Stream F, Session 7

Empowering Indigenous Land and Sea Managers to undertake natural and cultural resource management – I-Tracker initiative

McCree, Erica¹; Kennett, Rod¹

¹North Australian Indigenous Land and Sea Management Alliance Limited (NAILSMA)

Indigenous land and sea managers are responsible for vast areas of country across north Australia and undertake a range of management activities to protect and maintain the natural and cultural values of their Indigenous estates. In order to fulfil traditional and contemporary management priorities, Indigenous Knowledge is being combined with western science to improve management outcomes. I-Tracker, an initiative of the North Australian Indigenous Land and Sea Management Alliance Ltd (NAILSMA), uses world renowned CyberTracker software to develop customised data collection applications that can be viewed in CyberTracker's easy to use mapping interface. These applications support Indigenous land and sea managers across north Australia to undertake natural and cultural resource monitoring, research and management activities using digital technology and equipment, giving Indigenous people the power to make informed decisions.

North Australia's land and freshwater resources are regularly faced with new threats including inappropriate fire regimes, feral animal impacts and industrial impacts from activities like agriculture and mining. The development of new tools and systems to support Indigenous conservation and land management efforts is essential to the success of biodiversity conservation in a north Australian context. Partnerships with researchers and scientists encourage standardised monitoring methodologies, which have been adopted into the I-Tracker application developed to support land management. This helps to form a regional picture about the extent of environmental threats that can be used to protect culturally significant and threatened species, encouraging both local and regional management responses.

Erica, Project Officer for NAILSMA, is of Ngati Raukawa and Ngati Porou descent. She has worked in NRM across north Australia for the last 5 years and is focused on continuing to support Indigenous communities to meet their management aspirations.

11. Antarctic ecology

Wednesday 27 November

Stream A, Session 8

Terrestrial bioregionalisation for the Ross Sea region

Morgan, Fraser¹; Roudier, Pierre²; Aislable, Jackie³; McLeod, Malcolm³.

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³ Landcare Research, Private Bag 3127, Hamilton 3240.

Building on the success of the Environmental Domains for Antarctica classification, a new research programme is nearing completion that will incorporate new knowledge on soil, climate, and biological diversity and abundance into a terrestrial classification focusing on the Ross Sea Region. We have developed a range of abiotic geospatial data layers that capture the biogeographic variation within the region that focus on three broad areas, Climate; Landform; and Soil. The multivariate two-stage process used in the original classification has been revised to accommodate the unique challenges the region provides and to allow for biotic information to be used to validate and improve the level of biogeographic variation captured in the new classification. The paper will outline the new spatial layers, approach and biotic information used in the classification; and progress in developing the classification for the Ross Sea Region.

Fraser Morgan is a Senior Geographer at Landcare Research based in Auckland, New Zealand. Fraser's research interests range from terrestrial bioregionalisation in New Zealand and the Antarctic, species distribution models, and agent-based models of land use and land cover change.

Wednesday 27 November

Stream A, Session 8

Change in Ross Sea regional ecosystems: trophic relationships and climate-ecosystem linkages

Pinkerton, Matt¹; Bowden, David¹

¹ National Institute of Water and Atmospheric Research, Wellington, New Zealand

Climate change and fishing will affect marine ecosystems of the Ross Sea region of Antarctica in the coming century. Knowledge of how the system is likely to respond to predicted climate variability and continuing fishing is of fundamental importance to management of the region but linkages between the physical environment and ecosystem structure, function, and resilience remain poorly understood. We outline current research which brings together climate scientists, oceanographers, biogeochemists, palaeo-climate researchers, and ecologists, to explore interactions between physical and biological components of the ecosystem and thus the implications of change in the region. This work is at an early stage but we describe the Ross Sea ecosystem using an initial end-to-end ecosystem model developed to explore system-level characteristics of the food-web. In its current form the trophic model allows us to explore basic food-web relationships including biomass and flow of organic matter by trophic level, mixed trophic impacts, and trophic importance. The Ross Sea food web is a partially inverted biomass pyramid with a pronounced peak in biomass in the lower-middle part of the food-web, notably mesozooplankton and benthic invertebrates. The six groups with the highest trophic importance in the food-web model are phytoplankton, mesozooplankton, Antarctic silverfish (*Pleuragramma antarcticum*), small demersal fishes, Antarctic krill (*Euphausia superba*) and cephalopods. Crystal krill (*E. crystallophias*) are also likely to have high importance in the food-web of the continental shelf. Options for long-term monitoring of Ross Sea ecosystem are presented.

Matt Pinkerton is an ecosystem modeler and ocean colour remote sensing scientist. He is science leader of the four-year project "Protecting Ross Sea Ecosystems" which investigates potential ecosystem effects of fishing in the Ross Sea region.

Wednesday 27 November

Stream A, Session 8

Habitat heterogeneity and biodiversity in terrestrial Antarctica

Terauds, Aleks*¹, Chown, Steven L.² & Raymond, Ben¹

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²School of Biological Sciences, Monash University, Victoria, Australia

Recent bioregionalisation analyses identified 15 biologically distinct regions – the Antarctic Conservation Biogeographic Regions (ACBRs) - in terrestrial Antarctica. Although this work built on classification of Antarctica using physical parameters, the delineations were largely made on the basis of available, spatially explicit, biodiversity data, including microbes, invertebrates and plants. In consequence, one of the major challenges identified by the work was the need to identify ways to overcome missing biodiversity data. For Antarctica, terrestrial biodiversity data for most groups remains sparse, with the complication of growing evidence that widespread taxa are often turning out to be species complexes, which often confounds the use of existing data. In consequence, the use of environmental surrogates is an important alternative approach, especially for informing conservation management, a focus of rapidly growing interest for the terrestrial Antarctic.

Thus, here, we selected several environmental parameters (including climate and landscape based metrics) to describe and classify the habitat heterogeneity of terrestrial (ice-free) Antarctica. The resulting classifications showed that each ACBR encompasses several biologically meaningful, distinct environments. Differences among these environments are related to variation in the kinds of abiotic drivers identified previously as significant for structuring local diversity. Identification of these distinct environments provides important information for the development of representative protected area networks within each ACBR, and in conjunction with data on climate change and human activities, will greatly assist in providing the much-needed quantitative evidence-base for conservation planning in Antarctica.

Dr. Aleks Terauds is a senior research scientist at the Australian Antarctic Division. His research is focussed on understanding and modelling patterns of biodiversity in the Antarctic and sub-Antarctic, particularly in relation to environmental drivers and human impacts.

Wednesday 27 November

Stream A, Session 8

Ecological insights from the Antarctic meroplankton

Sewell, Mary A.¹

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Meroplankton, the planktonic larvae of benthic marine invertebrates and fish, are for many species the only dispersing life-history stage for the colonization of new habitats and determine the level of population connectivity and gene-flow among locations. In general, the Antarctic meroplankton community has been poorly studied; in part due to the remote location and its associated logistic challenges, as well as the general acceptance of Thorson's rule (Mileikovsky, 1971) that pelagic larval stages were less common in polar environments. Through the work of the Latitudinal Gradient Project (LGP) and the International Polar Year-Census of Antarctic Marine Life (IPY-CAML) voyage to the Ross Sea we have found a high degree of meroplankton diversity in this part of Antarctica and, with the use of molecular approaches, have been able to identify many common forms to the species-level. In this talk I will discuss the ecological trends we see in diversity and abundance with latitude and the implications of these findings to our understanding of Antarctic organisms, marine protected areas and the future impacts of global climate change.

Mary A. Sewell is an Associate Professor in Marine Biology at the University of Auckland with research interests in reproduction and larval development of marine invertebrates in temperate, tropical and polar ecosystems.

Wednesday 27 November

Stream A, Session 8

Biodiversity and ecosystem function in coastal ecosystems of the Ross Sea

Lohrer, Drew¹; Thrush, Simon^{1,2}; Cummings, Vonda¹

¹National Institute of Water and Atmospheric Research

²School of Environment, University of Auckland

Coastal Antarctic marine communities are highly diverse and represent a unique ecosystem. Different sources of primary production vary along the coast and provide clues as to how these communities will change associated with global warming. Here I will illustrate how changes in sea ice cover, and associated productivity affect foodwebs, community composition and ecosystem process. The nitrogen isotopic signature of 3 dominant seafloor species (*Laternula elliptica*, *Adamussium colbecki* and *Sterechinus neumayeri*) from different coastal locations highlight shifts in resource use and the importance of detrital food resources in dampening the impacts of fluctuation food resources. Large benthic animals also enhanced the efflux of dissolved inorganic nutrients from the sediment to the water column and play a greater role in nutrient regeneration at the sites with more food. Insights into the major changes associated with the presence of massive icebergs in the Southwestern Ross Sea provide further clues as to how community composition changes. Changes in the abundance of individual species and community composition were generally strongest when water column productivity was low. Regional scale changes in food resources and oceanography may have profound legacy effects, with a single settlement and growth event of the largest sponge species in Antarctica correlated with a region-wide shift in phytoplankton productivity driven by the

calving of massive icebergs. These studies highlight important interactions between the structure and function of communities and the role of different climate related drivers in interacting to shape the composition of resident communities in these comparatively pristine ecosystems.

Wednesday 27 November

Stream A, Session 8

High biodiversity revealed for the Central and Southern Transantarctic Mountains (83-87°S)

Hogg, Ian D.¹; Green, T.G Allan^{1,2}; Sancho, Leo G.²; Nielsen, Uffe N.³; Adams, Byron J.⁴; Wall, Diana H.⁵

¹University of Waikato, New Zealand

²Complutense University of Madrid, Spain

³University of Western Sydney, Australia

⁴Brigham Young University, USA

⁵Colorado State University, USA

We undertook a comprehensive survey of plants (lichens) and invertebrates (springtails, mites, nematodes, rotifers, tardigrades) in the central and southern Transantarctic Mountains. We tested the hypothesis that diversity of plants and invertebrates would decrease relative to increasing latitude along the Ross Sea latitudinal transect. In January 2011, six main sampling areas were visited (Mt Howe, Durham Point, Garden Spur, Mt Harcourt, Mt Kyffin, and an unnamed ridge near the mouth of Beardmore Glacier) as part of the joint US/NZ CTAM camp and represented the southernmost sites from the NZ Latitudinal Gradient Project (LGP). A total of 75 soil samples was obtained for invertebrate analyses. All soil samples were processed at McMurdo Station (USAP). Lichens, nematodes, rotifers, tardigrades and mites were found at all locations except for Mt Howe (87°S). Springtails were found at all sites except Durham Point (86°S) and Mt Howe. Over 20 species of lichen were recorded. Two new records of aquatic lichen and three new terrestrial species were found. At least one new species of springtail was also found, the first recorded on the continent in over 50 years. Distributional limits for nematode species and lichen taxa were extended. Overall, we found that diversity was higher in this region than that of well-studied sites 10-20° further north and supported the notion that within the Ross Sea Region, biodiversity is dictated by local climate and not a latitudinal gradient. We conclude that ice-sheet collapse and subsequent glaciation have promoted and maintained the levels of diversity we observed. Conservation efforts should be targeted towards protecting the biotic integrity of fragmented landscapes along the Transantarctic Mountains.

Ian Hogg is an Associate Professor in the Department of Biological Sciences at the University of Waikato. He is interested in aquatic ecology, Arctic and Antarctic biology and the consequences of global environmental changes for natural populations.

Wednesday 27 November

Stream A, Session 8

Short circuit co-evolution by the perfect parasite?

Antifreeze glycoproteins of fish leeches in Antarctica

Kolb, Jürgen B.¹; Rainey, Paul B.²; Evans, Clive W.³; Brunton, Dianne H.¹

¹Ecology, Behaviour and Conservation Group, Institute of Natural and Mathematical Sciences, Massey University, Auckland, New Zealand

²New Zealand Institute for Advanced Study, Institute of Natural and Mathematical Sciences, Massey University, Auckland, New Zealand

³School of Biological Sciences, University of Auckland, New Zealand

Antifreeze glycoproteins (AFGPs) play an important role in biochemical adaptation to the supercooled waters and the survival of notothenioid fish in Antarctica. These fishes have a well developed parasitic epifauna, which in turn is also exposed to freezing conditions. In order to retain their association with Antarctic fishes as the environment progressively cooled during the Miocene, leeches as fish associated ectoparasites had to either (i) evolve a mechanism to acquire the necessary life-saving chemical compounds from their host or (ii) adapt their own genome to confer protection from freezing.

We have found that Antarctic leeches (*Hirudinea: Piscicolidae*) contain antifreeze compounds at cellular level. We present evidence which strongly indicates an absorption pathway of these AFGPs with chemical structures characteristic for the fish proteins. A high capacity for freezing point suppression can be measured as thermal hysteresis with AFGP specific bidirectional ice crystal growth. This confirms the presence of functional AFGPs. Finally, mRNA was detected as intermediate step of AFGP biosynthesis and first indication of antifreeze genes in a leech genome.

We conclude that Antarctic fish leeches have in fact co-opted the survival mechanisms from their hosts, by biochemical exploitation only or additionally by horizontal gene transfer. This represents the first example in the animal kingdom of an instantly effective adaptive advantage provided by another species in a quasi short circuit co-evolution.

Jürgen Kolb, PhD at Massey University, research interests in polar biology with current work on Antarctic evolution and behavioural ecology of notothenioid fishes and their ectoparasites.

12. Impact of Phytophthora

Monday 25 November

Stream B, Session 1

Ecology and epidemiology of *Phytophthora* 'taxon Agathis' in kauri forest

Burns, Bruce¹; Perry, George²

¹*School of Biological Science, University of Auckland*

²*School of Environment and School of Biological Science, University of Auckland*

Kauri forest within New Zealand, dominated by stands of the giant conifer *Agathis australis* (kauri), is currently under threat from *Phytophthora* 'taxon Agathis' (PTA) a pathogen of this species. Previous field observations and glasshouse trials have led to the hypotheses that all size classes of kauri are equally susceptible to this pathogen, and that the disease is spatially aggregated within stands, suggesting infection moves at a local scale from tree to tree. We established several large plots (50m x 40m) within infected and uninfected kauri stands within the Waitakere Ranges to investigate the epidemiology of PTA within stands. Critical questions we sought to answer were how PTA affected the population size-structure and regeneration dynamics of kauri within infected stands, the rate and spatial characteristics of PTA infection within stands, and how kauri ecosystems change in composition and structure as a result of PTA infection. Initial results show that kauri populations in infected stands retained individuals in all size classes including seedlings and saplings, and that symptomatic and asymptomatic individuals were often close neighbours. This suggests that some form of kauri population may persist on infected sites but the dominance of this species may be largely reduced, and that the transmission and expression of the disease may be more variable among individuals than previously thought. Other conifers such as *Dacrydium cupressinum* (rimu) and *Phyllocladus trichomanoides* (tanekaha) are well-placed to take advantage of canopy openings resulting from kauri death. Further information on disease progress will be gained from following these plots long-term.

Bruce Burns is a Senior Lecturer in Plant Ecology at the University of Auckland, His research interests include forest ecology and the population dynamics of New Zealand conifers.

Monday 25 November

Stream B, Session 1

From the mountain to the sea, I am the tree and the tree is me

Ngakuru, Will^{1,2}

¹*Tangata Whenua Roopu, Kauri dieback joint agency response*

²*Te Roroa*

Comprehending a 'maori' response to Kauri dieback requires an understanding centered within a Maori conceptual framework. Whakapapa "to layer" can relate to genealogy, our ancestors and beyond the bounds of human, to the elder elemental offspring of Papatuanuku, earth mother and ranginui, sky father, we are taina the younger siblings in a very large family, which through the concept of mauri can extend to include animate and inanimate objects, Maori Marsden explains in his book the woven universe that mauri is the common thread that binds all things, think star wars and the force or sub atomic physics, at this level a distinction is made between the material and hihiri the energy component of mauri which can be enhanced or diminished. Our elders say Kauri dieback is affecting the mauri of the forest or ngahere, ngahere meaning to bind together explaining the Maori preference for holistic solutions to forest health, tiaki to guard and kai in this instance to do or work as opposed to kai meaning food, so Kaitiaki to actively guard or protect, at this point it is important to understand that the word mauri is too general as kaitiaki we are Te Roroa this is our home or place where our hands get dirty. Kaitiaki in the true sense of the word protects for the benefit of the protected not for their own gain, in this way the mauri, mana and tapu is enhanced, kaitiaki can also be plants, insects and animals its all about relationships.

Te Roroa representative to the Kauri Dieback response. Co-authored the Te Roroa Environmental management plan and Kauri Dieback Cultural effects assessment Completing Postgraduate Diploma of Fine Arts, University of Auckland, Researching indigenous ways of knowing, Kaitiakitanga and 'free' market economies.

Monday 25 November

Stream B, Session 1

Rehabilitation of *Agathis australis* (Kauri) ecosystems impacted by *Phytophthora* taxon Agathis (PTA), an international context

Scott, Peter¹; Williams, Nari¹; Margaret, Dick¹

¹*Scion, New Zealand Forest Research Institute*

Significant regions of Kauri forest have been decimated by the introduced pathogen *Phytophthora* taxon Agathis and potentially other *Phytophthora* species. Impacts include changes in the community composition; however, the long term impacts are not fully known. Crucial research is focussed on the epidemiology and management of the disease; however, work is also required to determine how these ecosystems are changing and how can they be best restored. What kind of ecosystem will replace impacted Kauri forests? How can infected Kauri be preserved and what management actions are required to regenerate Kauri? Internationally, introduced *Phytophthora* species have significantly impacted numerous natural ecosystems including: southern Western Australia,

where approximately 40% of species are susceptible to *P. cinnamomi*; Europe and USA, where *P. ramorum* has impacted many hosts including *Quercus* species; and Oregon and California USA, where *P. lateralis* has caused significant *Chamaecyparis lawsoniana* mortality. Different procedures have been used to restore these ecosystems including: modifying the soil profile and hydrology; chemical control; revegetation with different resistant species; and revegetation with affected species that have been bred for resistance. Internationally, screening and breeding for resistance has resulted in many host lines with resistance to different *Phytophthora* species. Notably, lines of *Eucalyptus marginata* resistant to *P. cinnamomi* in Western Australia, and *C. lawsoniana* resistant to *P. lateralis* in the USA, have been successfully used in restoration.

Dr. Peter Scott is a Forest Pathologist. His research interests include Epidemiology and Management of Phytophthora diseases; Forest Pathology and Mycology; and Mycorrhizal Ecology.

Monday 25 November

Stream B, Session 1

Impact and management of *Phytophthora* diseases in natural ecosystems in Western Australia

Hardy, Giles¹; Burgess, Treena, Burgess¹; Paap, Trudy¹; Fleming, Trish¹; Dundas, Shannon¹; William Dunstan¹

¹*Centre for Phytophthora Science and Management, School of Veterinary and Life Sciences, Murdoch University, Western Australia, 6150*

Worldwide *Phytophthora* diseases have significant direct and indirect impact on flora and fauna. In south-west Western Australia approximately 41% of the 5710 described plant species across a large number of plant families are susceptible to *P. cinnamomi* a pathogen listed as 'a key threatening process' to Australia's biodiversity by the Commonwealth Government. *P. cinnamomi* in Western Australia is considered a 'Biological Bulldozer' because of its ability to permanently change the structure and function of plant communities and the species they support. Through anthropogenic activities this introduced exotic pathogen and related species are now widely distributed and many unique plant community types are now infested or threatened. Concerted effort is now spent on mapping its occurrence, identifying areas that are pathogen-free, considered protectable in the medium to long-term and have high conservation value. This presentation will discuss the biology of *Phytophthora* as a genus and what makes them such devastating plant pathogens, the methods used to diagnose and map their occurrence and the procedures used to select 'protectable' communities of high value. Case studies will be used to discuss the impact of the pathogen on plant communities in terms of floristics and habitat change and how this in turn impacts on native fauna and ecosystem function. Control strategies including communication, hygiene implementation measures, the aerial application of phosphite and the use of eradication techniques for spot infestations will be also be discussed with regards to their benefits and possible detrimental effects to native plant communities.

Giles Hardy is Director of the State Centre of Excellence for Climate Change Woodland and Forest Health. He is interested in how plant diseases and in particular Phytophthora diseases impact on ecosystem function and health.

13. Functional community ecology

Tuesday 26 November

Stream C, Session 5

Environmental filtering and limiting similarity in functional community ecology

Laughlin, Daniel¹

¹*University of Waikato, Department of Biological Sciences*

The emerging synthesis of functional ecology and community ecology represents one of the most significant recent developments in ecology. Community assembly involves a paradox of two theoretically antagonistic processes: environmental filtering of functional traits tends to increase the functional similarity of species within communities leading to trait convergence, whereas competition is expected to limit the functional similarity of species within communities leading to trait divergence. How do we incorporate processes that select traits in opposite directions into a synthetic, predictive model of community assembly? A new predictive model called 'Traitspace' was recently developed to do just that. This model incorporates intraspecific trait variation into a hierarchical Bayesian framework to predict the relative abundances of every species in the regional species pool. This model produced significant predictions of tree species abundances along the Franz Joseph soil chronosequence on the South Island of New Zealand, where leaf nitrogen and phosphorus were modelled as functions of soil nitrogen and phosphorus. Leaf N exhibited greater interspecific variation than leaf P, and leaf P varied strongly within species along the soil nutrient gradient. The modelling scenario that accounted for niche differentiation as a nested process within the environmental filter yielded significantly better predictions than the model that included environmental filtering only. Using traits with strong interspecific variation is more important than obtaining strong trait-environment relationships when using community assembly models that emphasize environmental filtering. Traits with strong intraspecific variation are useful for predicting species abundances when niche differentiation is explicitly incorporated into the modelling framework.

Daniel Laughlin is a Senior Lecturer in Plant Ecology. His research focuses on developing predictive models of trait-based community assembly in a wide range of ecosystems.

Tuesday 26 November

Stream C, Session 5

Micro-environmental filtering drives functional convergence in species-rich grasslands

Price, Jodi^{1,2}; Gazol, Antonio¹; Tamme Riin¹; de Bello, Francesco³; Pärtel, Meelis¹

Session – Functional community ecology

¹University of Tartu, Estonia

²University of Western Australia, Australia

³Czech Academy of Science, Czech Republic

Functional trait convergence and divergence is often used to infer the relative importance of abiotic and biotic processes governing community assembly. Abiotic filtering producing convergence is expected to occur at larger spatial scales, whereas, trait divergence generated by competition is expected to occur at smaller scales if biotic filtering is important. We examined this in 33 dry calcareous grasslands in Estonia. In each site, we sampled along a transect (10 x 0.1 m), which was divided into 100 quadrats (10 x 10 cm). In each quadrat, we recorded species richness and composition, and measured various environmental variables. We collected trait data for the most abundant species in the transect; traits measured were plant height, specific leaf area, leaf size, leaf dry matter content, biomass and height:biomass ratio. We calculated functional diversity at different scales - the grassland community species pool, the transect, and the quadrat. We found evidence for environmental filtering (trait convergence) from the grassland community to the transect for most traits. We also found functional convergence for most traits at the quadrat scale compared to the transect scale. This suggests that even at very small-spatial scales co-occurring species are more similar than expected, and environmental filtering was even stronger at small-scales. We found environmental heterogeneity in soil depth and light availability was linked to functional turnover along the transects, and hence, probably drives this trait pattern. We suggest that small-scale heterogeneity drives functional convergence in these grasslands through micro-environmental filtering.

Jodi Price is a research associate in the Ecosystem Restoration and Intervention Ecology Research Group at the University of Western Australia. Jodi is broadly interested in plant community ecology, and most recently has been exploring general principles in grassland assembly processes.

Tuesday 26 November

Stream C, Session 5

How are competitive interactions influenced by traits? A global analysis based on tree radial growth

Kunstler, Georges^{1,2}; Falster, Daniel² Westoby, Mark²

¹Mountain Ecosystems Research Unit, Irstea, St-Martin-d'Hères, France

²Dept of Biological Sciences, Macquarie University, Sydney NSW 2109 Australia

It is widely assumed that species sharing similar traits compete more intensely for resources than dissimilar species. This is because in plants, traits, such as leaf, seed and wood characteristics, define the ecological strategy and thus niche of a species. Dissimilar traits values are thus supposed to promote resources partitioning between species. However, the assumed link between competitive intensity and trait similarity has rarely been tested against field or experimental outcomes. This is surprising because it is well known that competitive interactions among vascular plants are more complex. For instance, the ranking of competitive ability for a common limiting resource is also an important driver of competitive interaction, e.g. via competition for light. If ranking processes are dominant, competitive outcomes should be more closely related to the hierarchy of trait values rather than trait dissimilarity. It is crucial to test these alternative hypotheses of how traits influence competitive interactions against field data; here we do this for forest communities in multiple sites around the world. We use growth data from forest inventories and long term permanent plots to estimate local competition and its relation with traits. Our analysis covers tropical, subtropical, temperate and boreal forests, allowing us to test if the links between traits and competition vary across large climatic gradients.

Kunstler is a Marie-Curie International Outgoing Research Fellow. His research focus on how asymmetric competition and climatic constraints effect on individual demography shape forest communities and species range.

Tuesday 26 November

Stream C, Session 5

Is phylogenetic and functional community structure temporally labile? Yeah, but no, but yeah...

Letten, Andrew¹; Keith, David^{1,2}; Tozer, Mark²

¹ Australian Wetlands, Rivers and Landscapes Centre, University of New South Wales

² NSW Office of Environment and Heritage

Given limited scope for experimental manipulation in natural systems, a common approach in community ecology is to infer underlying processes from observed patterns. Inferring processes from patterns is of course non-trivial, relying as it necessarily does on a raft of soft assumptions about how the components of communities (i.e. species) respond to each other and their environment. This *modus*

operandi is nowhere more apparent than in the phylogenetic and trait-based approaches that have become increasingly popular in recent years. One potentially confounding factor of these approaches that has received comparatively little attention is the role of temporal change in the dominance of different processes and how this might affect observed patterns. Indeed, the vast majority of studies published to date have comprised 'static' analyses where assembly processes are inferred from patterns observed at a single snapshot in time. We investigated temporal stability in the phylogenetic and functional community structure of herbaceous vegetation over a 20 year period in a fire-dominated heathland. Contrary to expectations (and theory), phylogenetic community structure was relatively stable over time, with plots typically comprising species more closely related than expected by chance (phylogenetically clustered) throughout succession. However, early data exploration indicates that the apparent stability of phylogenetic community structure may be masking significant temporal turnover in both taxonomic and functional community composition. These provisional results not only highlight the importance of accounting for temporal instability in phylogenetic and functional community structure, but also strengthen the case for a multi-metric approach to studies of community assembly.

Andrew Letten is a PhD candidate interested in community assembly and the role of environmental fluctuations in mediating species coexistence. He would also be willing to offer 'in kind' support towards any project aimed at domesticating sloths.

Tuesday 26 November

Stream C, Session 5

Moving from demonstrating effects to predicting outcomes - the next step for functional ecology.

Mason, Norman¹

¹*Landcare Research, Hamilton, New Zealand*

Functional traits and functional trait diversity have dual roles as predictors of ecosystem function and indicators of the processes driving species turnover between communities. While there is a rapidly expanding literature using functional traits to answer ecological questions, the knowledge generated by this literature seems to play a limited role in decision making by conservation and agricultural managers. In this presentation I will briefly review some of the fundamental functional trait literature. I will then look at the predictive potential of existing studies for ecological management problems. I will then consider how we can design future functional trait research to make it more predictive.

Norman Mason is a quantitative ecologist with Landcare Research. His primary research interests are using functional traits and functional diversity to reveal the controlling community responses to environmental gradients and disturbance

Tuesday 26 November

Stream C, Session 5

Growth vs shade tolerance trade-offs and the dynamics of New Zealand's podocarp/broadleaved forests

Lusk, Chris¹; Bellingham, Peter²

¹*University of Waikato, Department of Biological Sciences*

²*Landcare Research, Ecosystems and Global Change Team*

Forest dynamics are widely believed to be underlain by an interspecific trade-off between shade tolerance and growth in high light. However, the dynamics of New Zealand's podocarp/broadleaved forests have seemed at odds with this idea. Although seedlings of most lowland podocarps are persistent and relatively slow-growing, their recruitment to the overstorey appears largely dependent on major disturbances, and broadleaved angiosperms tend to replace podocarps in old, undisturbed stands on equable sites. We tested for growth vs shade tolerance trade-offs by measured juvenile growth of five podocarps and five canopy angiosperms across a wide range of light environments in a warm-temperate rainforest. The light compensation point for growth was used as a measure of species light requirements, which we compared with height growth in 10% light. The growth vs shade tolerance trade-off differed significantly between podocarps and angiosperms: at a common compensation point, angiosperms were faster-growing than podocarps in 10% light. However, juvenile canopy angiosperms were scarce in the more open environments associated with forest margins. A conifer-angiosperm divergence in the growth vs shade tolerance trade-off may explain long-standing problems of the dynamics of these forests: the more vigorous response of angiosperms to canopy openings enables them to out-compete podocarps in old-growth stands on equable sites. The greater abundance of podocarp juveniles on forest margins cannot be ascribed to them outcompeting angiosperms there, and likely reflects superior resistance to frost and/or desiccation. The drivers of the dynamics of these forests therefore differ appreciably from those attributed to tropical and north-temperate forests.

Chris Lusk is a Senior Research Fellow in Plant Ecology. His research focuses on the functional basis of vegetation dynamics and of species sorting along environmental gradients.

Tuesday 26 November

Stream C, Session 6

Trait-environment relationships explain community assembly of dry rainforests in northern New South Wales

Curran, Timothy J.^{1,2}; Clarke, Peter J.²; Warwick, Nigel W.M.²; Bruhl, Jeremy J.²; Case, Bradley S.¹; Buckley, Hannah L.¹

¹Department of Ecology, Lincoln University, PO Box 85084, Lincoln, Canterbury 7647, New Zealand

²Botany, School of Environmental and Rural Science, University of New England, Armidale, NSW 2351, Australia

Relationships between plant functional traits and environmental gradients can help explain community assembly. The dry rainforests of inland regions of eastern Australia are thought to be the product of a drying climate over the last 15 million years. This drying is hypothesized to have caused the regional extinction of some species, while others either retreated to microclimatic refugia or adapted to the drier conditions. If this is the case we would expect it to be reflected in community-level trait patterns. To examine these ideas we assembled a dataset comprising 242 full-floristics plots with 428 species coded for 14 traits gleaned from the literature. We investigated trait-environment relationships at two scales: within the regional dry rainforest flora in inland northern NSW and by comparing dry rainforest sites with mesic rainforest sites east of the Great Dividing Range. In dry rainforest stands, drought-resistance traits such as small leaves, glaucous or pubescent leaves, pendulous foliage and deciduousness or leaflessness, were associated with plants from dry, hot habitats. Plants without such traits were considered less able to survive in such environments, but are likely to have a competitive advantage in moister habitats. This may explain why larger-leaved, less drought-resistant dry rainforest taxa are restricted to topographic refugia. Dry rainforest stands had a greater prevalence of these drought-resistance traits than mesic rainforest stands, suggesting that climatic sifting has occurred as predicted. We use these data to propose a model of community assembly in inland dry rainforest communities.

Tim Curran is a Lecturer in Ecology at Lincoln University, NZ. He is particularly interested in using plant functional traits to understand how plants survive extreme climatic events, such as drought, cyclones and frost, or other disturbances, such as fire, and using these findings in restoration ecology.

Tuesday 26 November

Stream C, Session 6

Incorporating functional traits into a multi-species model of plant growth

Thomas, Freya^{1,2}; Hauser, Cindy^{1,2}; Keith, David³; Vesk, Peter^{1,2}

¹Quantitative and Applied Ecology Group, The University of Melbourne

²ARC – Centre of Excellence for Environmental Decisions

³New South Wales Office of Environment and Heritage

Data required for optimal fire management of multiple plant species are quantitative information on 'vital rates' and 'life history characteristics', which specifically relate to growth, reproduction and survival. Our research aims to investigate the application of using plant functional traits to generalize patterns of plant growth and reproduction. Including functional traits into models of demographic rates is useful in producing predictions of growth trajectories based on trait information. Data on functional traits can be generalised across species that share similar traits and these data are easier to gather for many species compared to species-specific demographic data. Using hierarchical multi-species models also allows for the growth of unknown or rare species to be estimated because probability models for growth are drawn from common distributions between species.

Using height and trait data collected for multiple species along a chronosequence of time-since-fire sites in the Victorian Mallee, we built a hierarchical multi-species model of plant growth with parameters that vary by species. We use a three-parameter cumulative Weibull distribution, and functional traits (wood density, specific leaf area and seed mass) are included into this multi-species model as species-specific linear predictors of the model parameters. This approach reveals not just plant growth through time for individual species, but also how functional traits contribute to intraspecific species variation. These results will be discussed in relation to the practical application of generalising growth patterns and designating tolerable fire intervals for multiple plant species.

Freya Thomas, PhD Candidate with The Quantitative and Applied Ecology Group (qaeco.com) and The Centre for Excellence for Environmental Decisions (ceed.edu.au) at The University of Melbourne. Research interests are plant ecology, plant functional traits and fire ecology.

Tuesday 26 November

Stream C, Session 6

Aquatic metacommunities in an arid landscape: novel approaches to understand spatially structured communities

Morán-Ordóñez, Alejandra^{1,2}; Sim, Lien²; Pavlova, Alexandra²; Pinder, Adrian³; Sunnucks, Paul²; Thompson, Ross M.^{2,4}; Davis Jenny²

¹School of Botany, University of Melbourne, Melbourne, Victoria, Australia

²School of Biological Sciences, Monash University, Melbourne, Victoria, Australia.

³Department of Environment and Conservation, Woodvale, Western Australia, Australia.

⁴Institute for Applied Ecology, University of Canberra, New South Wales, Australia

Understanding how dispersal traits interact with landscape connectivity in shaping local community structure is critical to managing the impacts of habitat fragmentation and designing effective reserve networks. However, to date this understanding has been hindered by the often too simplistic representations of landscape structure used in metacommunity studies.

In this study, we assessed the influence of landscape resistance along riverine networks and across floodplains, in association with species dispersal traits, on the spatial structure of aquatic invertebrate communities in a large arid zone of Western Australia (Pilbara). Within different dispersal traits groups, we used community dissimilarities to test alternative models of landscape connectivity: isolation-by-resistance, which modelled effective connectivity among sites under different flooding regimes, integrating multiple dispersal paths and accounting for topographic constraints on connectivity, and isolation-by-distance, which modelled straight overland movement.

Community similarities of different trait-groups were best explained by different types of flood connectivity models. Obligate aquatic and passive dispersers were spatially structured by isolation-by-resistance and not by isolation-by-distance, whereas strong and weak aerial dispersers showed little relationship between spatial structure and network connectivity (isolation-by-resistance). We conclude that the structure of aquatic communities at regional scales is determined by interactions between the dispersal traits of taxa, the spatial configuration of connections along the riverine network, geographical factors and the dynamics of flood events. This complexity of factors should be considered in plans aimed at protecting aquatic biodiversity, ensuring that natural patterns of hydrologic connectivity and dynamics are maintained.

Alejandra Morán-Ordóñez is a postdoctoral research fellow currently looking at the potential of species distribution models to make robust predictions of future availability of habitat. Her research areas of interest include landscape ecology, spatial modelling and nature conservation and management.

Tuesday 26 November

Stream C, Session 6

Machinery of competition and assembly of strategy mixtures

Westoby, Mark¹; Falster, Daniel¹

¹*Dept of Biological Sciences, Macquarie University, Sydney NSW 2109 Australia*

May (1973) modeled interaction webs mediated by arbitrary coefficients. As an aside to his main aim, he noted that simple coefficients would fail to capture important mechanisms in real interaction webs. Forty years after May, theory for interaction webs among sessile life forms remains unable to model the actual composition of vegetation from first principles. The limiting-similarity formulation descended from Lotka, Volterra and Gause expects that species deplete resources differentially and that trait-dissimilarity reflects differential resource depletion. Neither of these assumptions is credible for vegetation on land. Plants all deplete the same essential resources of water, light and mineral nutrients. Species impact on each other does not necessarily decline as they become more widely separated in traits such as seed mass or leaf mass per area. We describe a model where strategies draw down a fitness surface in trait space until a mixture is assembled. Competition is for light in a successional patch-mosaic. The model allows traits to evolve as well as strategies to compete ecologically, and this has interesting consequences for the fitness landscape. The key advance in this model is a credible connection between traits and the machinery of competition. Current plans are to extend the theory to further traits and competition mechanisms and landscape settings.

Westoby is currently a Laureate Fellow. Previously he led the ARC-NZ Research Network for Vegetation Function (2005-10) and organized the yearly 1-day Australian postgrad course on Current Ecology and Evolution (2000-2011). His interests include rangeland dynamics, sociobiology, and ecological strategies.

Tuesday 26 November

Stream C, Session 6

Burn or rot: the role of leaf traits in fire and decomposition

Grootemaat, Saskia¹; Wright, Ian¹; Cornwell, Will^{2,3}

¹*Macquarie University, Sydney*

²*VU, Amsterdam*; ³*University of New South Wales, Sydney*

In fire-prone ecosystems there are principally two alternative fates for leaf litter: it either burns or decomposes. From individual experiments and global meta-analysis the influence of leaf litter traits on decomposition rate is now well understood: all else equal, decomposition rate is higher for litter composed of leaves with higher N and P concentrations, lower lignin concentration, and lower leaf mass per area (LMA). However, less is known about the influence of leaf traits on litter flammability. Are the same or different traits involved in driving the two alternative pathways? Are flammability and decomposability themselves related? We are investigating these issues in 32 perennial plant species from New South Wales, Australia. In this first project our focus was to quantify the influence of physical and chemical traits on the inherent flammability of individual leaves. Different aspects of flammability were driven by different leaf traits. E.g. variation in time to ignition could be explained by a combination of 1) physical leaf traits such as LMA and 2) leaf moisture content, while variation in flame and smouldering duration were firstly explained by fuel mass and secondly by leaf chemistry (N, P and tannin concentrations). Based on these results and our previous work on litter decomposition for the same species, we explore the potential relationship between decomposition and fire and to what extent these fates are driven by traits as part of a species' ecological strategy.

Saskia Grootemaat is a 2nd year PhD student in Ian Wright's "Plant Functional Ecology Group" at Macquarie University, Sydney. Her research explores the role that plant traits play in the different aspects of flammability.

Tuesday 26 November

Stream C, Session 6

Landscape-scale patterns of plant vulnerability to fire and Browsing in arid Australia

Nano, Catherine^{1,2}; Peter Clarke²; Jayne Brim-Box¹

¹*Flora & Fauna Division, Dep. Land Resource Management, Northern Territory Government, Australia*

²*University of New England, Armidale, NSW, Australia*

Rainfall is the key driver of woody cover and life history attributes in arid grassy biomes where disturbance is mostly rare and of low intensity. However, there is relatively little known about the causes of woody patterning in arid systems that are subject to periodic intense fire disturbance. This is particularly the case for the central Australian deserts where grassland and canopy fire can occur following above average rainfall, but for which there is limited information about species regeneration response patterns. Thus, predicting changes in vegetation structure in this fire-prone system remains fraught with uncertainty because the limiting factors to coexistence between grass and woody plants are not yet clearly resolved. Compounding this uncertainty, the region now supports a large population of feral camels, meaning that browsing may now also be a driver of vegetation patterns given its potential to thwart post-fire recovery of shrubs and trees. Moreover, the impacts of browsing are likely to be most severe in the driest portions of the landscape, where camel densities are greatest and where climate is likely to most strongly limit woody biomass post-fire recovery. We first tested the expectation that, at the landscape scale, resprouter proportions should increase with increasing fire disturbance and rainfall. Next, we analysed temporal and spatial patterns of browsing intensity in relation to fire and rainfall patterns in a selection of palatable woody species. We use the results to investigate landscape-scale patterns of plant vulnerability to 'top-down' pressures (fire effects and browsing) in the central Australian context.

Catherine Nano is a senior scientist with the Northern Territory Government's Flora & Fauna Division, Alice Springs. Her research interests include arid zone threatened species conservation, and understanding landscape-scale patterns of plant vulnerability to fire, drought and feral herbivore browsing.

14. Insects and climate change

Monday 25 November

Stream A, Session 1

Range shifts under climate change

Sgrò, Carla M.¹

¹*Monash University*

Despite the pervasiveness of the world's biodiversity, no single species has a truly global distribution. In fact most species have very restricted distributions. What limits species from expanding beyond their current geographic range? This has been classically treated as an ecological problem, but emerging research in *Drosophila* indicates that evolutionary genetics may hold the key. These new data suggest that species with restricted distributions and populations at species borders may simply lack genetic variation in ecologically important traits, limiting their ability to adapt to conditions beyond their current range. If this is a true and universal phenomenon, then these types of species and populations are likely to be fundamentally constrained in their evolutionary response to future climate change, and other threats, and will face high risks of extinction. Whether they generalise to different species is presently unknown.

I will present results from recent experiments in butterflies from the genus *Eurema* and an Australian endemic species of *Drosophila* that take an evolutionary perspective to understanding range limits and range expansions.

Dr Carla Sgrò, Senior Lecturer and ARC Future Fellow. My research is focussed on understanding the genetic basis of adaptation to environmental change. I also explore how evolutionary processes can be explicitly incorporated into biodiversity conservation and management.

Monday 25 November

Stream A, Session 1

Insects & Altitude: transcending taxonomic patterns

Kitching, Roger^{1,2}

¹*Environmental Futures Centre*

²*Griffith University*

A growing body of information has allowed us to identify altitude-restricted sets of taxa along a variety of ecological transects. Sets of beetles, flies, moths, springtails and other groups have verified the generality of these patterns. If this information is to be useful in further progressing both ecological understanding and the underpinning of management responses to changing climates, then the identification of these patterns is only a beginning. Two questions are particularly apposite. First, how do we convert taxonomically based information to information concerning the functioning of ecosystems and, second, how can we compare data from spatially disparate transects. Using information on beetles, flies, ants, plants and moths from seven rainforest transects located in Australia and south-western China, this presentation will explore guild patterns showing that ecosystems, even within continuous swathes of forest, function differently at different altitudes. Seeking generality by combining results from different transects demands careful

climate matching or, perhaps more interestingly, using chemical markers from the insects themselves to derive altitude equivalences. Preliminary data exploring options in this area will be discussed.

Professor Roger Kitching holds the Chair of Ecology at Griffith University in Brisbane. He is an insect ecologist interested in the patterns and processes underlying community structure, particularly in rainforests.

Monday 25 November

Stream A, Session 1

Predatory green ants mediate trophic cascades in Australasian fig wasp communities

Cook, James M.^{1,2}; al Beidh, Sarah A.³; Wang, Bo⁴; Wang, Rui-Wu⁴

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²School of Biological Sciences, University of Reading, UK

³Royal Horticultural Society, Wisley, UK

⁴Chinese Academy of Science, Kunming, Yunnan, China

The cascading effects of predators can dramatically alter community structure at lower trophic levels. Trophic cascades are well-documented for intertidal communities, and also in terrestrial vertebrates, but here we investigate their role in multitrophic insect communities that exploit the fruits of fig trees. The green or weaver ant, *Oecophylla smaragdina*, is an aggressive and dominant tree-nesting predator found widely in Asia and northern Australia. We show that green ants are key predators of fig wasps in *Ficus racemosa* trees in both China and Australia. Importantly, the ants impose heavy predation, and also deter egg-laying, of non-pollinating galling wasps that lay eggs through the fig wall. In contrast, they have less effect on the reproduction of pollinating wasps that enter the figs to lay eggs. Consequently, trees with green ant nests produce large numbers of pollinator wasp offspring, while those with other (or no) ants produce more non-pollinating wasp offspring. Green ant exclusion experiments further confirm the role of these predators in suppressing galling wasps, which compete with pollinators to lay eggs in fig flowers. Since trees with green ants also produce more seeds, this widespread and dominant arboreal predator not only influences community structure, but also indirectly benefits the fig/pollinator mutualism by increasing the reproductive success of both plant and pollinator.

James Cook is an evolutionary ecologist who leads the Plants, Animals and Interactions Research Theme at the Hawkesbury Institute for the Environment. His research focuses on multitrophic interactions involving insects, plants and microbes, and how these respond to environmental change.

Monday 25 November

Stream A, Session 1

Climate change and above-belowground herbivore interactions: phloem feeders versus root chewers.

McKenzie, Scott^{1,2,3,4}; Vanbergen, Adam²; Hails, Rosie¹; Jones, Hefin³; Johnson, Scott⁵.

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³Cardiff University, Cardiff, U.K.

⁴James Hutton Institute, Dundee, U.K.

⁵Hawkesbury Institute for the Environment, Sydney, Australia

Despite being spatially-separated herbivores feeding above- and belowground are able to interact via their shared plant host. The importance of these plant-mediated interactions is becoming more apparent. Little research, to date, has been carried out investigating how climate change, in its many guises, affects these interactions. Climate change has the potential to alter and disrupt plant-herbivore and herbivore-herbivore interaction outcomes. This can occur directly (e.g. temperature effects on phenology) or indirectly (e.g. via changes in plant chemistry or morphology). Our previous work has demonstrated reciprocal feeding facilitation between the large raspberry aphid (*Amphorophora idaei*) aboveground and the larvae of the black vine weevil (*Otiorhynchus sulcatus*) belowground on multiple raspberry (*Rubus sp.*) plant cultivars. This occurs irrespective of which herbivore arrives first on the plant. With increased CO₂ influencing the plant, it may cause a modification to the facilitative interaction. This may occur due to differences in herbivore guild. For example, phloem feeding aphids respond better to increased CO₂ than chewing insects, such as vine weevil larvae. Here we present results showing changes in insect abundance and compensatory feeding. Plant biometrics were also investigated including changes in plant toughness, biomass and alterations in the carbon : nitrogen ratio. Data presented here highlight the importance in considering the rhizosphere when considering the implications of a predicted increase in atmospheric CO₂ in future environments.

Scott McKenzie is a NERC funded PhD student at the Centre for Ecology and Hydrology. His research focuses on the interaction between above- and belowground herbivores; its effect on the plant; and how this may be modified by climate change.

Monday 25 November

Stream A, Session 1

How is dung beetle biology, resource competition and responses to environmental change currently being assessed?

Andrew, Nigel R.¹; Hemmings, Zac¹,

¹ Zoology, University of New England, Armidale, NSW, Australia.

Dung beetles (Coleoptera: Scarabeinae) are important ecosystem service providers. They are critical to the maintenance of agricultural ecosystems in Australia, and provide an opportunity to offset a substantial proportion of the greenhouse gas (GHG) emissions from cattle, and other ungulates, by burying the manure from these animals. Dung beetles also increase soil carbon and soil health, and reduce fly numbers.

Therefore understanding their biology, as well as how this information is being collected, understood and interpreted is critical for assessing their behavioural, ecological, and physiological responses to large scale abiotic impacts such as climate change. Here we will present a network analysis methods to assess dung beetle research worldwide. Ecological networks have been used extensively to identify how observed complexity in nature impacts on ecosystem functioning is organised: with the nodes identifying species or groups, and links identifying the strength and direction of the interaction. Patterns among trophic relations suggest the clustering of nodes, which can identify functional groups, trophic levels, and keystone species. Data collected will include biotic and abiotic information, species, location, key experimental traits, and responses that can be developed and assessed using network analysis.

Nigel is President-elect of ESA and Associate Professor of Entomology at UNE. Current research focuses on impacts that extreme variation in temperature and precipitation regimes will have on dominant/functionally important insects: assessing their behaviour/ ecology/physiology, and roles in structuring insect communities.

Monday 25 November

Stream A, Session 1

Some like it hot: comparison of climate change predictions for four pasture pests

Gerard, Pip¹; Bell, Nigel¹; Kean, John M.¹; Philips Craig²

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New Zealand is a long narrow island with dramatically different climate zones, from warm subtropical in the north to cool temperate in the south. With 33% of land-cover in high producing grassland, predominantly ryegrass and white clover, it is unsurprising that this resource has been colonised by pests whose presence, populations and impacts vary with region. As mean temperature increases, black beetle *Heteronychus arator*, a subtropical scarab currently restricted to the northern North Island, will extend its distribution further south and outbreaks that are currently associated with successive La Niña events will become more prolonged. Similarly, the clover-feeding nematode *Meloidogyne trifoliophila* will expand its range southwards from the North Island into the South Island, with associated increases in clover damage. In contrast, clover in Northland, Auckland and northern Waikato will no longer be prone to clover flea *Sminthurus viridus* damage. However, by 2070, clover flea will become a significant pest of clovers in dairy and beef pastures in the central North Island, Taranaki, in higher rainfall areas of the lower North Island, and in the Nelson region. Regional pest population status will also depend on the resilience of natural enemies and plant-resistance to climate change. Argentine stem weevil *Listronotus bonariensis* is found nationwide. Its biocontrol agent *Microctonus hyperodae* has within-species genetic variation that should enable it to adapt to annually changing conditions and to climate change. However, elevated CO₂ can decrease the levels of insect-active alkaloids produced by endophytic fungi in grasses, which could reduce plant resistance to some pests.

Pip Gerard is an applied entomologist with over 30 years' experience, specializing in the biology, ecology and biocontrol of grassland invertebrates.

Monday 25 November

Stream A, Session 3

Climate change in the underworld: root herbivore responses to C₃ and C₄ grasses under elevated CO₂

Johnson, Scott¹; Lopaticki, Goran¹; Hartley, Susan²

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Despite the ecological significance of root herbivores, little is known about how global climate change, including predicted increases in atmospheric carbon dioxide (CO₂), will affect them. Root herbivores are particularly abundant in grassland systems, so grasses might be especially vulnerable to any change in their pest status due to climate change. This may occur if the widely observed pattern of decreased plant nutritional quality under elevated CO₂ (eCO₂) leads to compensatory feeding and increased damage. C₃ grasses are often better hosts for herbivores because they have higher nutritional status. Moreover, eCO₂ may cause a greater decline in nutritional quality of C₃ than C₄ grasses, potentially altering the relative performance of herbivores. We investigated the impacts of eCO₂

on a C₃ (*Microlaena stipoides*) and C₄ (*Cymbopogon refractus*) grass species and the performance of a root herbivore (*Sericesthis nigrolineata*). Root N concentrations were 44% higher and herbivores consumed more root tissue and performed better on *M. stipoides* than *C. refractus*. eCO₂ had no impact on *C. refractus*, but increased root C:N ratio and decreased N concentrations in *M. stipoides*. There was evidence for compensatory feeding on *M. stipoides* at eCO₂, with herbivores consuming c. 46 mg more tissue (118% more than at aCO₂), though this was inadequate to compensate fully and herbivore biomass remained depressed by 24% at eCO₂. These results suggest that compensatory feeding under eCO₂ may make some grass species particularly vulnerable to attack, potentially leading to a shift in the community composition of grasslands under future climate change.

Scott Johnson is Senior Lecturer in ecology at the Hawkesbury Institute for the Environment at the University of Western Sydney. His research focus is in insect-plant interactions, particularly those encompassing aboveground-belowground ecology and global climate change.

Monday 25 November

Stream A, Session 3

How does climate change mediate belowground effects on aboveground aphids in lucerne?

Ryalls, James¹, Riegler, Markus¹, Moore, Ben¹ and Johnson, Scott¹

¹Hawkesbury Institute for the Environment, University of Western Sydney, NSW, Australia

Interactions between above- and belowground herbivores have been prominent in the field of aboveground-belowground ecology from the outset, with more recent studies also incorporating plant-associated microbes. Little is known about how climate change affects these organisms when they share the same plant, and the interactive effects of multiple factors associated with climate change such as elevated temperature (eT) and elevated atmospheric carbon dioxide (eCO₂) are untested. We investigated how lucerne (*Medicago sativa*) root damage by biotic agents (e.g. nodule herbivory by the lucerne weevil, *Sitona discoideus*) and abiotic means (e.g. simulated herbivory) affected the pea aphid (*Acyrtosiphon pisum*) under eT and eCO₂ conditions. *Sitona discoideus* neonates, which feed on root nodules housing N₂-fixing rhizobial bacteria, are significant pests of lucerne in Australia and more latterly in New Zealand. Root damage had a weak negative effect on aphid performance, potentially due to impairment of nitrogen acquisition because nodules were damaged. eT severely reduced root nodulation by 76%, whereas eCO₂ promoted nodulation by 80%, but only at ambient temperatures. Effects of eT and eCO₂ on root nodulation were mirrored by weevil emergence (larval development success); eT and eCO₂ reduced and increased weevil emergence, respectively. These results demonstrate that eT can negate the effects of eCO₂ on lucerne nodulation and herbivory belowground, an important consideration for determining future outcomes of climate change.

James Ryalls is a PhD candidate researching the effects of climate change on aboveground-belowground insect pest interactions in lucerne.

Monday 25 November

Stream A, Session 3

Will elevated CO₂ and temperature facilitate host switches in eucalypt leaf beetles?

Gherlenda, Andrew¹, Haigh, Anthony², Moore, Ben¹, Johnson, Scott¹, Riegler, Markus¹

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Elevated atmospheric CO₂ concentrations (eCO₂) are expected to reduce the palatability and quality of eucalypt leaves to herbivorous insects via the dilution of essential elements, such as nitrogen while increasing leaf defence compounds. Elevated temperature (eT) in combination with eCO₂ may ameliorate these foliar chemistry changes, and thus reduce the impact on insect performance. The *Eucalyptus* genus contains over 700 species with varying foliar chemistry traits that can display idiosyncratic responses to eCO₂ and eT which may shift insect-plant interactions. The main objectives of this study were to assess how CO₂ concentrations and temperature alter foliar chemistry and how this may impact insect performance. The study used two *Eucalyptus* species with differing but overlapping home ranges; *Eucalyptus tereticornis* and *Eucalyptus robusta*, grown in a glasshouse in a multi-factorial design for eight months. Larvae of *Paropsis atomaria*, a common eucalypt leaf beetle, were placed onto each tree and insect performance was scored for the entire larval development to adulthood. eCO₂ reduced foliar nitrogen, phosphorous, tannin (*E. tereticornis* only) and moisture content while total non-structural carbohydrates and leaf mass area increased. eT had no effect on foliar chemistry. Insect developmental time increased as a result of eCO₂, while eT was found to ameliorate the effects of eCO₂. Survival of *P. atomaria* larvae was found to increase when feeding on *E. robusta* under eCO₂, however, survival decreased when feeding *E. tereticornis* under eCO₂. This study suggests that idiosyncratic responses of insect herbivores may occur as a result of plant mediated responses to eCO₂.

Andrew Gherlenda, Ph.D candidate, studies tri-trophic interactions of eucalypt feeding insects and their natural enemies such as parasitoids under a changing climate, specifically elevated CO₂, temperature and their interactions.

Monday 25 November

Stream A, Session 3

Trophic cascades in a changing environment: the impact of elevated CO₂ on multi-trophic interactions

Hentley, William T.^{1,2,3}; Hails, Rosemary S.¹; Jones, T. Hefin³; Vanbergen, Adam J.¹; Johnson, Scott N.⁴.

¹Centre for Ecology and Hydrology

²The James Hutton Institute

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⁴Hawkesbury Institute for the Environment, University of Western Sydney

Global atmospheric CO₂ concentration is rapidly increasing and is predicted to double by 2100. The ecological consequences of rising atmospheric CO₂ will depend on complex multi-trophic interactions between all affected species. An increasing number of studies have investigated the impact of elevated CO₂ concentrations of lower trophic levels, but little is known of how higher trophic levels will respond. Ecosystems rely on bottom-up (plant resistance) and top-down (natural enemy) processes to regulate insect herbivory. To understand the impact of elevated CO₂ concentrations on natural communities, the response of the higher trophic levels must first be characterised.

We investigated the impact of elevated CO₂ concentrations on a plant-herbivore-predator interaction. A model system was used, comprising three cultivars (low, medium and high susceptibility to aphid herbivory) of the European red raspberry (*Rubus idaeus*), the large raspberry aphid (*Amphorophora idaei*) and the aphidophagous harlequin ladybird (*Harmonia axyridis*). In a large scale controlled environment facility, the CO₂ concentration was increased to 650ppm. We found plant growth was enhanced by elevated CO₂ but there was no concurrent increase in aphid abundance on the two susceptible cultivars. In elevated CO₂, aphid abundance increased on the resistant cultivar, possibly by a breakdown of plant resistance. The aphid's ability to compromise plant resistance in elevated CO₂ and reach high densities was, however, nullified by predation.

William Hentley is a PhD student funded by the Natural Environment Research Council and based at the Centre for Ecology and Hydrology, UK. His research has focused on understanding multi-trophic interactions and how these will be impacted by climate change.

Monday 25 November

Stream A, Session 3

Projecting changes in phenology using temperature based growing degree days

Harris, Rebecca¹; Lee, Greg¹; Fox-Hughes, Paul^{1,5}; Bindoff, Nathaniel L.^{1,2,3,4}

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⁵Bureau of Meteorology, Hobart

Changing phenology has been identified as one of the most important impacts of climate change on biodiversity. Periodic life cycle events such as emergence, breeding and migration are important determinants of species distributions, species interactions and the structure and function of all ecosystems.

Growing degree days (GDD) are a measure of heat accumulation that can be used to link phenology to the underlying climate drivers that are projected to change over the next century. Using daily maximum and minimum temperatures from a regional climate model for Tasmania, Australia, we demonstrate the changes that are projected to occur in the total GDD for the growing season, the start and end dates of the growing season and the time taken to accumulate GDD. We present results from 6 downscaled global climate models (GCMs) and three future periods, 2020, 2050 and 2080. We also show the shifts in the growing season that have occurred in Tasmania since 1901. We calculate GDD for various base and upper temperatures to account for the different thermal requirements of a range of insects and their host plants, including pest species (European wasp, Codling Moth) and endemic insects of high conservation significance (Ptunarra Brown Butterfly). Different methods of calculating GDD give slightly different results, but the overall trend is for earlier and longer growing seasons. We relate these projected changes to the GDD requirements for development, to illustrate the potential for shifts in phenology under climate change.

Rebecca Harris is a climate research fellow at the Antarctic Climate Ecosystems CRC, currently working on methods to improve the application of climate science to ecological research by incorporating the high frequency and seasonal information available in regional climate projections.

15. Ecosystems and economics

Wednesday 27 November

Stream B, Session 7

Why ecologists and economists should have plenty of common ground

Livesey, Chris¹; Blaschke, Paul²

¹Chris Livesey Consulting

²Blaschke and Rutherford Environmental Consultants

Human beings derive many benefits from healthy, functioning ecosystems. Much ecological work is concerned with maintaining and enhancing the existence and health of particular ecosystems and ecosystems in general. Most often this requires the reinforcement of some human behaviours and the changing of others; it also requires society to allocate resources to the task.

Economics is focused on increasing human wellbeing and has useful insights into how to effectively influence human behaviour and into how to decide between competing alternatives so that resources are allocated to those activities that best increase human wellbeing. Economics can also give guidance on some of the things that are needed to increase the likelihood of more of society's resources being directed to better understanding ecosystems and to their effective maintenance and enhancement. For all these reasons, ecologists and economists should have plenty of common ground.

Further, to be useful in today's 'full-of-humans' world, many economists need to understand that human activity ('the economy') is embedded in and dependent on the biosphere. For this reason too, those who seek to understand nature's economy (remembering that nature includes homo sapiens and its activities) and those who seek to understand the household's economy (of which nature is an essential part) should have plenty of common ground.

Chris Livesey is an ecological economist who has made his career at the intersection of economics and the environment. He has worked in New Zealand and Australia, principally for central/federal government but also in regional government, engineering/environmental consulting and on his own account.

Wednesday 27 November

Stream B, Session 7

Ecosystem services: providing a link between natural and human ecosystems

Greenhalgh, Suzie¹

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Ecosystem services provide an anthropogenic lens through which to look at ecosystems; and are described as the benefits humans derive from ecosystems. This provides a useful link between natural systems and their importance and value to human systems.

Framing decisions around the impacts and dependencies of the decision on ecosystem services is a powerful mechanism that enables the interactions between economic, social, cultural and environmental values to be articulated, and possibly modelled. Most importantly it provides a structured approach to identify what trade-offs arise when humans consider and make decisions.

This presentation outlines a framework for using an ecosystem services approach to inform decision-making. It will also demonstrate how economic models can consider impacts on ecosystem services to compare different policy scenarios aimed at protecting or enhancing the condition of ecosystems, and outlines how economic valuation may or may not be appropriate for making trade-offs and the role of economic instruments in preserving, restoring and enhancing ecosystems.

Suzie Greenhalgh is the Portfolio Leader for Enhancing Policy Development at Landcare Research NZ. Her research covers environmental and agricultural policy analysis, design and implementation with a focus on freshwater, biodiversity, climate change and ecosystem services.

Wednesday 27 November

Stream B, Session 7

The Rarakau Program: Practical challenges on the supply side of ecosystem service markets.

Weaver, Sean¹

¹Carbon Partnership Ltd

The Rarakau Program is a payment for ecosystem services (PES) program for indigenous forest protection on Maori land in New Zealand, designed and built by Carbon Partnership between 2009 and 2012. This program has been built by means of a pilot project in Western Southland. A portfolio of ecosystem services are delivered through voluntary forest protection by means of a covenant. In the absence of a user-friendly PES market modality, the Rarakau Program uses the international voluntary carbon market infrastructure to provide the quality controls and quality assurance necessary to demonstrate performance-based delivery of ecosystem service outcomes. The purpose of the effort, discipline, cost and risk associated with quality-assured ecosystem service delivery is to attract a buyer, and command a price capable of meeting the opportunity costs to landowners who, to be eligible to participate, must relinquish

the right to legally degrade the same ecosystems. The challenges to supply-side actors in this arena are multiple. Firstly, there is considerable risk to landowners contemplating participation in a new market system, because it precludes their access to relatively long-term commercial timber revenues through well-proven market channels. There are also market watchdogs and gate-keepers who demand quality controls and assurances that are orders of magnitude more onerous than those required of the timber industry. And finally there is the need to locate buyers and command prices sufficient to deliver on-going tangible commercial outcomes to landowners for payment for ecosystem service markets to work in an enduring manner.

Dr Sean Weaver has been involved in forest conservation finance since 1987. He has been a senior REDD+ policy and finance consultant for Pacific Island governments, and a forest carbon project development consultant in New Zealand and the Pacific Islands.

Wednesday 27 November

Stream B, Session 7

Extending the ecosystem services concept to include the net return from animal activity

Luck, Gary¹

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Animals provide benefits to society through the provision of ecosystem services, but also inflict costs such as damaging crops. These benefits and costs are mostly examined independently, rather than comparing the trade-offs of animal activity in the same system and quantifying the net return from beneficial minus detrimental activities. I introduce and examine the net return concept by quantifying the economic costs and benefits of bird activity in almond orchards. Pre-harvest, the consumption of harvestable almonds by birds cost growers AUD\$57.50 ha⁻¹. Post-harvest, the same bird species provide an ecosystem service by removing mummified nuts from trees that would normally be removed by growers to reduce threats from fungal infection or insect pest infestations. The value of this ecosystem service ranged from AUD\$82.50 ha⁻¹–\$332.50 ha⁻¹ based on the replacement costs of mechanical or manual removal of mummified nuts, respectively. Hence, bird consumption of almonds yielded a positive net return of AUD\$25–\$275 ha⁻¹. The sign and magnitude of the net return is dependent on the amount of damage birds inflict on crops pre-harvest, the market value of almonds and the cost of replacing the ecosystem service. At current market value, crops may sustain up to 4% damage when replacement costs are modest, and up to 20% damage when replacement costs are based on labour-intensive, but more reliable methods of mummified nut removal. Similar cost-benefit trade-offs exist across nature, and quantifying net returns can better inform land management decisions such as when to control pests or promote ecosystem service provision.

Gary Luck is Professor in Ecology and Interdisciplinary Science. His research focuses on identifying and valuing the ecosystem services provided by animals, and the socio-ecological dynamics of urban ecosystems.

Wednesday 27 November

Stream B, Session 7

Do biodiversity offset policies risk entrenching a baseline of biodiversity decline?

Maron, Martine¹; Gordon, Ascelin²

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²*ARC Centre of Excellence for Environmental Decisions, Interdisciplinary Conservation Science Research Group, RMIT University, Melbourne 3001*

Biodiversity offsetting is one of the more controversial areas of conservation policy. We examine current biodiversity offset policies with a focus on the potential for perverse incentives to arise. Despite rapid growth in biodiversity offsetting globally, the policy goals in terms of biodiversity outcomes are usually poorly articulated. In particular, the baseline against which 'no net loss' is measured is rarely specified, but implicitly is usually one of ongoing decline. This is of particular importance where offsets are designed to "avert loss" that would otherwise occur. In essence, this means that a baseline of decline may be entrenched by the operation of the policy. This results in a perverse incentive, as efforts to improve protection of biodiversity or act to reduce rates of biodiversity decline would reduce the baseline rate of decline, hence increasing the difficulty and cost of achieving adequate offsets. The greater the reliance on biodiversity offsetting as a biodiversity conservation tool, the greater the risk that existing rates of decline will continue. Averted loss offsets and baselines of decline are most appropriately used in settings such as countries in early stages of economic development, where biodiversity loss is accepted as unavoidable during transition to a developed economy. We argue that biodiversity offset policies should be developed in the context of broader biodiversity conservation goals in order to reduce the risk of perverse outcomes. This should include planning for the future obsolescence of averted loss offsets in the context of slowing and ultimately halting biodiversity declines.

Martine Maron is a Senior Lecturer in Environmental Management at The University of Queensland. Her research foci include the mechanisms behind species decline and conservation policy including environmental offsets and land stewardship.

Wednesday 27 November

Stream B, Session 7

Systematic evaluation of ecological compensation in New Zealand

Brown, Marie A.¹; Clarkson, Bruce D.¹; Barton, Barry J.²¹Faculty of Science and Engineering, University of Waikato, Private Bag 3105, Hamilton 3240, New Zealand²Faculty of Law, University of Waikato

Ecological compensation (mitigation, offsetting etc) is an approach which allows for positive conservation measures to be put forward in order to counter-balance the adverse effects of development. Presently in use in various forms around the world, New Zealand implements the concept in an *ad hoc* manner, with limited policy guidance and evaluation. The present research sought to systematically evaluate the current use of ecological compensation under the Resource Management Act 1991 in three main ways:

1. Evaluate regulatory compliance with resource consent conditions related to ecological compensation across 81 case studies nationwide
2. Determine how 110 current agreements around New Zealand recognise key implementation issues of biodiversity offsetting as outlined in McKenney & Kiesecker 2010
3. Undertake 116 semi-structured interviews with stakeholders regarding the implementation of ecological compensation, attitudes to key concepts and potential practical and policy improvements.

This paper will share results of these analyses and shed light on the role of ecological compensation in the present and future resource management environment of New Zealand. This research demonstrates that many requirements for ecological compensation are not being achieved and that there is significant variation in compliance levels across activity, applicant and condition types – evidencing significant systemic failures. The results of the three study sections clearly demonstrate that more formal approaches to ecological compensation are needed, in conjunction with strengthening of the underpinning resource management system.

Marie Brown is the Senior Policy Analyst for the Environmental Defence Society, with a background in local government policy and enforcement. Marie has recently submitted a PhD, focussing on the implementation of ecological compensation in New Zealand.

Wednesday 27 November

Stream B, Session 7

The SWAEI Strategic Framework for Biodiversity Conservation in Western Australia

Eber, Sue¹¹WWF-Australia

The Southwest Australia Ecoregion is one of WWF's Global Ecoregions covering 686,871 km² (69 million ha) in extent, and constitutes 9% of the total area of Australia. In 2007 the Southwest Australia Ecoregion Initiative (SWAEI) initiated a project to identify priority biodiversity areas in the SWAE Ecoregion. Marxan was used to analyse 1391 conservation features based on the input from over 260 participants to identify priority biodiversity areas for conservation work. The output is a spatial mapping product available at www.swaecoregion.org showing priority areas for conservation work to be used for informed conservation planning, on-ground conservation action and targeted investment. The results of the analysis are compiled into two reports; the SWAEI Strategic Framework for Biodiversity Conservation Report and the Technical Report.

Sue Eber is the Initiatives Manager for the WWF-Australia Southwest Australia Ecoregion Program. The SWAE Program focusses on creating a collaborative and integrated program for conservation in the Southwest Australia Ecoregion.

Wednesday 27 November

Stream B, Session 8

Valuing Australian Avitourism: Assessing preferences for bird assemblages using a choice experiment.

Steven, Rochelle¹; Smart, Jim²; Castley, J. Guy¹; Morrison, F. Clare¹¹International Centre for Ecotourism Research, Griffith School of Environment, Griffith University, Gold Coast campus²Griffith School of Environment, Griffith University, Nathan campus

Nature-based tourism continues to be heralded as an opportunity to deliver conservation benefits to species and ecosystems. However, research examining the sub-sector of avitourism has largely focused on the localised economic impacts of the industry and socio-demographic aspects of the participants. This study aims to quantify avitourists' relative preferences for different categories of birds and estimate their willingness to pay for the opportunity to view different bird assemblages when visiting a birding site. Birders completed a choice experiment in which they were asked to select between hypothetical birding sites characterised by: number of regionally endemic species present, number of threatened species present, overall avian species richness and an entry fee for access. Respondents were willing to pay most for sites with higher numbers of endemic species, followed by higher avian diversity and, finally, more threatened species. These findings quantify the relative importance of different types of bird assemblages, and illustrate the complex way in which birders view and select a birding destination. Birders appear to display higher preferences for opportunities to see birds they are unlikely

to see elsewhere, rather than by seeing threatened species. This contrasts with findings supporting the 'last chance to see' tourism market. For avitourism to deliver increased benefits for conservation, marketing strategies should focus on species that are endemic to certain areas, rather than those facing imminent extinction.

Rochelle Steven, PhD Candidate, Bird Conservation, Conservation Tourism and Avitourism in Australia.

Wednesday 27 November

Stream B, Session 8

The Economic Value of Bird-watching in New Zealand

Vas, Krisztian^{1,2}

¹*Auckland University of Technology*

²*New Zealand Tourism Research Institute*

Birding is the activity of viewing birds in their natural environment for the purposes of recreation and education. Bird-watching is also considered a fast-growing segment of nature-based tourism. According to the U.S. Fish and Wildlife Service, there were 46 million birdwatchers (1 in 5 Americans) in 2001 spending \$32 billion in retail sales, which accounted for \$85 billion in overall economic output, contributed \$13 billion in taxes and created 863,406 jobs. Although the economic impact of birding can be significant, there are no substantial studies on the economics of bird-watching in New Zealand. I used a web-based audit to determine and map where major birding sites are within New Zealand. The second step was to interview tour operators, followed by the distribution of 1000 (500 domestic and 500 international) surveys to birdwatchers through these operators. Lastly, two micro-level case studies were selected: Stewart Island and Muriwai, where the local economics of birding was explored. The results indicate that birder expenditures are directly correlated with commitment level. The more committed a birder, the further they travel and more they spend. Most international birders are part of organized birding tour groups with an average of 8-12 individuals, each paying between \$300-400NZD for a day trip. The case studies show contrast, as Stewart Island is evolving into a mature birding destination, whereas at Muriwai birding is a supplementary attraction to beach tourism.

My name is Krisztian Vas; I am a Canadian Commonwealth Scholar and PhD Candidate at Auckland University of Technology (AUT) researching the economic and conservation value of birding in New Zealand. My research interests revolve around nature-based and wildlife tourism.

Wednesday 27 November

Stream B, Session 8

Value and price: how systems-thinking narratives can assist communities in reconstructing ecological identities

Creagh, Dr. Karen¹; van den Belt, Associate Prof. Marjan²; Morgan, Dr. Kēpa³

¹*Auckland Council*

²*EERNZ, Massey University*

³*University of Auckland, School of Engineering*

This paper presents findings related to doctoral research (2008-9) on perceptions and attitudes towards paying for ecosystem services related to water management. The research established the presence of consumer surplus for water related ecosystem services in two New Zealand communities; Auckland City and Christchurch City. Ecological and economic benefits from a pricing structure for urban water that promote sustainable water management are presented. The findings of attitudinal and preference statements points to the importance of communities' cultural-ecological identity constructs, and the differences perceptions of water. These 'identity constructs' present both barriers to and opportunities for the uptake of sustainable technologies, influence acceptance of full-cost, user pays water charges, and the relationship between the communities and their natural assets. Understanding the components and drivers of different perceptions, the interlinkages between components and how they change over time can become a vehicle for fostering stronger ecological resilience. Pricing tools can enhance conversations and build awareness of water issues and solutions, however understanding the multiple interacting components leading to different value propositions beyond 'price', is equally important. For example, the Maori concept of kaitiaki, the regard for the mauri of water, of and the cultural-economic damage caused by loss of mauri, as well as the reciprocal relationship between humans and nature, provides a unique platform for shaping new ecological identities. This paper presents a system-thinking view of the relationship between place based identities, cultural, economic and ecological components, and illustrate how systems-thinking narratives can assist communities in reconstructing ecological identities.

Dr. Creagh is currently a freshwater policy advisor with Environmental Strategy and Policy, Auckland Council. Of particular focus is the effort to implement a strong integrated catchment community collaborative model, and to promote accounting for ecosystem services in decision-making.

Wednesday 27 November**Stream B, Session 8****How do we communicate the value of ecosystem services to human wellbeing?**Roberts, Lin¹*¹Lincoln University, PO Box 85084, Lincoln 7647, Christchurch, New Zealand*

Nature contributes abundantly to human wellbeing, from providing basic survival needs such as food and water, through to the spiritual nourishment we may derive from a deep sense of place. A recent study funded by Department of Conservation has gathered together the existing evidence of the myriad ways that indigenous ecosystem services contribute to New Zealand wellbeing. A prime function of the ecosystem services framework is to render visible the value of nature's services in a world where value is much more commonly measured in financial capital and GDP. Society is increasingly aware that GDP is not a good measure of wellbeing and is moving away from purely monetary measures to a more diverse set of indicators of a community's or nation's wellbeing. At the same time, work on ecosystem services is generally moving in the opposite direction to try and communicate the wide variety of different types of value of nature's services in dollar terms. Recent years have seen the development of increasingly sophisticated techniques for assessing the value of many non-market goods in monetary measures, but many challenges remain, including how to better address equity (e.g. willingness to pay implicitly gives greater weight to what a rich person's values) and cumulative effects (e.g. do the first and last tonne of soil lost from a farm have the same value?). As awareness grows that wellbeing depends on so much more than money, perhaps we need to think more creatively about how to communicate the value of what nature's ecosystem services provide.

Lin Roberts is a Senior Lecturer at Lincoln University, and has worked in ecology, public policy, and advising, teaching and researching on sustainable enterprise. She is currently leading a DOC funded study on ecosystem services and New Zealand wellbeing.

Wednesday 27 November**Stream B, Session 8****Technical information and judgement for conservation decisions**Bau, S. Sana¹*¹The University of Melbourne**²ARC Centre of Excellence for Environmental Decisions (CEED)*

Environmental decision making is becoming increasingly technocentric as the body of understanding about ecological phenomena is now vastly more information-rich than ever before. An evidence-based approach to policy and management is widely advocated in response to the underlying uncertainty and potential for controversy that characterise environmental decision contexts. However, effectively translating evidence into practice requires a high level of comprehension of the scientific basis for decision making.

Ecological applications are often characterised by a gulf dividing research and implementation; yet obstacles to knowledge transfer are rarely investigated. The challenging nature of interpreting technical evidence and determining its credibility and relevance may contribute to this predicament. I aimed to investigate this hypothesis by testing the extent to which technical information influences judgement in conservation decision making.

A questionnaire was developed to elicit judgements of verbal and statistical representations of technical information relative to plain language explanations used to inform a series of hypothetical conservation management scenarios. Target groups were experts, undergraduate students in ecology (and related disciplines) and non-academic environmental professionals. Preliminary findings indicate that comparative judgements of technical versus plain language explanations are most divergent in the expert group, suggesting that experts perform better than non-experts in evaluating the quality of scientific claims. As multi-stakeholder decision making contexts are becoming increasingly the norm, a trained scepticism acquired through expertise adds weight to the responsibility for experts to engage in decision processes in novel ways, such as effectively synthesising, summarising and communicating the evidence supporting policy and management alternatives.

Sana Bau is a PhD candidate who is interested in topics related to the intersection of science and policy, particularly in relation to how to integrate science (i.e. models for decision support) and practice to deliver better conservation outcomes.

Wednesday 27 November**Stream B, Session 8****Can we secure climate-adapted sanctuaries for the future as a key adaptation strategy?**Gilfedder L.^{1,2}, Carter O.¹; Faulkner F.¹*¹Department of Primary Industries, Parks, Water & Environment, Hobart, Tasmania Australia.**²Landscape & Policy Research Hub, Centre for Environment, UTas. Hobart, Tasmania Australia.*

The protection and management of refugia is increasingly identified as an important adaptive strategy in the face of global change. Terrestrial and freshwater refugia have been defined as places where physical and biological attributes combine to provide an environment that is more resilient to climatic variation than surrounding areas. They can act as refuges from contemporary or future threats and disturbances such as fire, weed invasion, diseases and pests, and play an important role in terms of habitat connectivity

and dispersal pathways. However, refugia are afforded limited protection under current legislative, regulatory and planning processes. On the island state of Tasmania the *Natural Systems Resilient to Climate Change* Project aims to identify potential climate change adaptation actions to enhance the resilience of Tasmanian's natural systems, and a key focus is refugia. This paper outlines the current work identifying climate-adapted sanctuaries (evolutionary refugia and contemporary refuges). Existing and potential approaches to address the challenges of managing climate refugia in Tasmania are discussed. We propose that dedicating areas (identified by their biophysical characteristics and condition) as climate sanctuaries is a workable landscape-scale strategy for securing refugia. A risk assessment approach has been used and we highlight how the characteristics of refugia (sensitivity) may also make them highly vulnerable to disturbance with a high consequence of loss. Climate sanctuaries are proposed as areas set aside to maintain functioning natural ecosystems and ecological processes, and for their function as refuges for natural values.

Louise Gilfedder works at the Department of Primary Industries, Parks, Water & Environment where she leads the Natural Systems Resilient to Climate Change Project. Louise also works Knowledge Broker at the Landscape & Policy Hub (UTas), including collaborating on refugia work.

Wednesday 27 November

Stream B, Session 8

Application of IUCN threatened ecosystem criteria to terrestrial ecosystems in Auckland, New Zealand

Boow, Jonathan¹; Osborne, Brenda¹; Hill, Karlene¹; Sawyer, John¹; Jamieson, Alastair¹; Singers, Nick².

¹Auckland Council

²Nicholas Singers Ecological Solutions Ltd.

Prioritising conservation management effort worldwide often focuses on the conservation status of species. In 2013, the IUCN published criteria for evaluating the conservation status of ecosystems (Keith et al. 2013). This paper presents the regional implementation of the IUCN threat assessment methodology in Auckland, New Zealand. Since 2011, Auckland's terrestrial ecosystems have been mapped and classified according to a recently developed national ecosystem classification system (Singers, Leathwick and Rogers, In Press). This was done to achieve a range of statutory and non-statutory environmental directives.

A preliminary threat assessment was done for Auckland's 35 terrestrial ecosystems using mapping and local expertise to determine the following for each ecosystem type:

- Historic and current extent
- Extent of occurrence
- Area of occupancy
- Disruption of biotic interaction
- Degradation of abiotic environment

Ecosystems were categorised using the IUCN's eight categories: Collapsed, Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern, Data Deficient and Not Evaluated. The results showed that 21 of the ecosystems were threatened including ten of 12 forest types, eight of 10 wetland types, two saline types and one dune type. One wetland ecosystem was identified as Collapsed. Seven ecosystem types were ranked as Least Concern as their current and historic range and condition have not changed considerably. Five ecosystems were not evaluated as their geographic extent is yet to be determined. This regional threat assessment has provided vital insights into the state of Auckland's ecosystems. It will provide guidance for statutory protection and help to prioritise active management.

Jonathan Boow is the Principal Advisor to Auckland Council's Biodiversity group and involved in the development and implementation of council's ecosystem and species management programme.

16. Indigenous ecology

Thursday 28 November

Stream B, Session 10

Caring for Aboriginal-owned Country in South Eastern Arnhem Land using innovative two-way learning and management approaches

Ens, Emilie²; Nelson, Edna¹; Roberts, Maritza¹

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The Yugul Mangi Rangers are Traditional Owners and managers of seven ancestral clan estates to the south east of Arnhem Land, northern Australia. Arnhem Land was declared an Aboriginal Reserve in 1931, gazetted as Aboriginal land in 1976 under the *Aboriginal Land Rights Act* (NT) and remains a stronghold of Australian Indigenous Law and Culture. The remoteness of this country presents

numerous challenges for management by Traditional Owners who aspire to care for their ancestral estates using a mix of Traditional and modern scientific techniques – a two-way approach. Some of the challenges include resource, socio-economic, health and climatic challenges. In this presentation we will discuss some of the diverse management activities undertaken by the rangers and also focus on a recent biodiversity survey we have conducted which is based on Aboriginal priorities for management – culturally significant sites, bush foods and bush medicines. In this survey we have used motion sensor cameras to look for small mammals which are in dramatic decline across northern Australia. We have found that rocky hills offer refuges for small mammals which are severely threatened by feral cats, feral ungulates which alter habitat structure and altered fire regimes which are characterised by late dry season intense fires. We have also established monitoring sites for bush tucker and bush medicine plants which elders want the Rangers to protect. Intergenerational knowledge transfer is an important part of our work. Despite the challenges in working in remote Australia, we are committed to Caring for our Country and culture.

Emilie Ens is an ecologist who has worked with the Yugul Mangi Rangers since 2008. She is an Early Career Research Fellow at the Australian National University who is passionate about building socio-ecological resilience for sustainable management of Australia's biocultural resources.

Thursday 28 November

Stream B, Session 10

A Framework for Māori Cultural Health Indicators for Kauri Ecosystems

Chetham, Juliane^{1,2}; Shortland, Tui^{1,3}

¹Tangata Whenua Roopu, Kauri Dieback Programme

²Patuharakeke Te Iwi Trust Board Inc

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This presentation will outline a key research priority for the Tangata Whenua Roopu of the Kauri Dieback Programme. Tangata whenua assert that the use of cultural indicators to complement scientific methodologies currently being undertaken in the response to the disease is required in order to focus on assessing kauri health and building resilience to disease. To date, an extensive interview process with a number of cultural experts has occurred, in which a substantial set of values and indicators for kauri were identified. An important conclusion reached from discussions with tohunga/kaumatua was that health of kauri cannot be ascertained by looking at kauri alone, rather a “ngahere”, or kauri ecosystem approach should be taken. This effectively signified that indicators for kauri health must be derived from other species within the forest in addition to the kauri. The presentation will summarize the development of a methodology framework that will be used to determine if there are Cultural Health Indicators that can determine the state of health of kauri forests in different kauri ecosystems; anticipate or predict the presence of PTA; and indicate resilient kauri trees or forests that resist the impact of or susceptibility to PTA. The Tangata Whenua Roopu consider the tool created will provide significant opportunities for potentially inexpensive field techniques and transferral of practice and knowledge that will allow mana whenua to express their kaitiakitanga in a real and tangible way.

Juliane Chetham: Trustee on Patuharakeke Te Iwi Trust Board responsible for the resource management and fisheries portfolios and an independent consultant. Her key focus is ensuring that Matauranga Maori is recognized and incorporated in ecological research and management.

Thursday 28 November

Stream B, Session 10

Manaaki Taha Moana

Smith, Huhana¹; Aroha Spinks²; Moira Poutama³

¹Taiao Raukawa Environmental Resource Unit

²Massey University, Palmerston North

This presentation melds aspects of cultural, spiritual and local knowledge of place within six environmental projects, which have emerged as part of *Manaaki Taha Moana: Enhancing Coastal Ecosystems for Iwi and Hapū (MTM)* research project. The projects are led by kaitiaki (environmental guardians) within a south west coastal region of Horowhenua/Kāpiti coastline, Aotearoa New Zealand. The projects are action/Kaupapa Māori research orientated within a wider research collaborative. Mātauranga Māori is used alongside other specialist's knowledge, including hydrological, technological, ecological, ecological economics, design and landscape architecture-oriented expertise. Backed by a range of completed research reports with actions underway, visual devices like maps help determine better futures for waterways and the lands they run through. The visual device presented, encompasses the area between Hokio and Waitohu Stream along the west coast to the foothills of the case study region. It includes cadastral lines, natural changes in watercourses and soil types of the areas. The map communicates the pre-colonial nature of such complex wet environments, then overlays all drains, wetlands, rivers and stream systems. It offers the potential of riparian enhancement scenarios from 5-30m+. Maps are created for use at wānanga (intensive learning gatherings at marae), local community, local council and regional council meetings to encourage and facilitate positive and more solutions-focussed discussion between kaitiaki, private landholders, environmental groups and other parties. All hands-on actions aim to reconnect kaitiaki, communities of interest and statutory bodies to natural areas in decline, and enable solutions for rehabilitation.

Dr Huhana Smith (Ngāti Tukorehe, affiliated to Ngāti Raukawa ki te Tonga) is an artist, academic and kaitiaki (environmental guardian). She is Research Leader Māori, MTM Horowhenua case study. The MTM team work with: Massey University's School of People Environment and Planning, Palmerston North; Cawthron Institute, Nelson; Waka Digital and Manaaki Taiao, Tauranga; iwi and hapū from Tauranga (for Tauranga case study) and Horowhenua, and Taiao Raukawa Environmental Resource Unit.

Thursday 28 November

Stream B, Session 10

Emancipatory Resource Management: A Hapū Story

Davies, Shelly¹; MacDonald, Nicola¹

¹*Ngāti Rehua Ngātiwai ki Aotea Trust Board*

Ngāti Rehua Ngātiwai ki Aotea are the mana whenua (indigenous guardians) of Aotea (Great Barrier Island). This small hapū (subtribe) is in the process of settling a Treaty of Waitangi claim for cultural, economic and land redress. As a new Trust Board in 2012, one of the first undertakings was the development of a Hapū Management Plan. This presentation details the collaborative, co-constructive approach used in development of the plan. It then goes on to share significant successes for the hapū as a result of that process.

Hapū (or Iwi) Management Plans are strategic documents created by mana whenua and filed with regional councils and local authorities. They outline the geographical areas of concern, the distinctive character and culture of the hapū, and dictate appropriate methods of engagement and consultation with hapū. Under the Resource Management Act 1991, local authorities are required to take plans such as this into account any relevant planning and decision making. This makes these powerful legal documents which reassert the kaitiakitanga (guardianship) rights of mana whenua and support our management of ecological, natural and cultural resources.

Nicola MacDonald (Ngātiwai, Te Rarawa, Te Atiawa) is a national manager for the Wise Group, and is a branch president for the Māori Women's Welfare League. Nicola has a Masters in social psychology and degrees in education and health.

Thursday 28 November

Stream B, Session 10

Bridging Indigenous Knowledge and Western Science in Innovative Ways for a Sustainable Future - The Tropical Indigenous Ethnobotany Centre

Turpin, Gerry^{1,2}; Wason, Steve³

¹*Tropical Indigenous Ethnobotany Centre, Australian Tropical Herbarium, James Cook University, Cairns, Australia*

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³*Watsonville Aboriginal Corporation, Mbabaram Traditional Owner, Atherton, NQ*

Traditional owners have long called for an ethnobotany centre in Australia dedicated to Indigenous Australian knowledge of plants. To progress this concept, Traditional Owners from across the Wet Tropics bioregion and Cape York Peninsula, together with scientists, herbarium botanists and policy-makers interested in ethnobotany from across south-east Queensland, the Northern Territory and the Australian Capital Territory were invited to attend a workshop. The purpose was to consider whether establishment of an ethnobotany "centre" could be a valuable means of supporting Traditional Owners in the conservation, management and communication of their ethnobotanical knowledge. The principal outcome of the workshop was the formation of the Indigenous-driven Tropical Indigenous Ethnobotany Centre (TIEC). The TIEC is unique as it is the first of its kind in Australia and is a concept initiated and driven by Traditional Owners. The main aim of TIEC is to provide assistance to Traditional Owners in recording and documenting, protecting, managing and maintaining their cultural knowledge on the use of plants. TIEC activities are grouped under four themes: i) Research, ii) Training and Education, iii) Intellectual Property, Protocols and Agreements and iv) Collation of Existing Data and Collections.

Gerry Turpin is an Indigenous Ethnobotanist who oversees the development of the Indigenous-driven Tropical Indigenous Ethnobotany Centre. Has been involved in Regional Ecosystem mapping and Vegetation Survey projects and is a Weed Spotters contact officer for Cape York. Curator of the grass family (POACEAE) for the Australian Tropical Herbarium and the Queensland Herbarium.

Thursday 28 November

Stream B, Session 10

The angel in the detail: Diverse burning for cultural and environmental outcomes in Australia

Standley, Peta-Marie¹; Crowley, Gaye²

¹*James Cook University Cape York Natural Resource Management*

²*James Cook University*

Fire management in Australia is polarised by the use of terminology that simplifies our understanding of its inherent complexities. Typically the good vs bad fire typology is the only one present in western management frameworks such as; hazard reduction (HR) and early dry season (EDS) burning.

Hazard reduction burning is important in a fire prone continent particularly given recent increasing wildfire events and changing climate futures. Unequivocally espoused by many as necessary and good. Equally, early dry season burning has been shown in a northern Australian context to reduce greenhouse gas emissions and the severity, intensity and scale of uncontrolled late season wildfire. Recognised internationally as an important tool in the carbon economy, the use of EDS fires also generally regarded as good. The corollary hot late season fire is bad.

These examples typify the good vs bad fire typology and limit our capacity to understand the importance of diverse fire regimes for

diverse environments and desired outcomes. Interestingly, the importance of early dry season or winter burning and cool fires emerges from studies of, and increasingly over the last decade, with indigenous peoples.

Historical and contemporary accounts of Indigenous Australian fire management clearly show fire was/is used all times of the year for multiplicity of purpose. The sensitivity and purpose of fire management understood within Indigenous ecological knowledge systems can help inform current frameworks implementing and evaluating the impacts of fire in the landscape.

Peta-Marie Standley (BA Arts Mj Ed. MA Env. Mgt) has fourteen years experience in community natural resource management. She is a PhD candidate writing about the Indigenous led co-generative action research of the TKRP Kuku Thaypan Fire Management project. Her work promotes action learning, multiple knowledge sets and collaborative spaces on and off country in undertaking respectful knowledge generation for solving wicked social-ecological problems.

Thursday 28 November

Stream B, Session 11

Transforming Agriculture with Native plants and Indigenous Knowledge

Johnson, Marion¹; Hudson, Maui², Champeau, Olivier³, Ataria, Jamie³

¹Centre for Sustainability (CSAFE) University of Otago

²Te Kotahi Research Institute, University of Waikato

³Cawthron Institute, Nelson

The Indigenous Agroecology (He Ahuwhenua taketake) project draws upon mātauranga Māori (Maori traditional knowledge) and tohungatanga Moriori (Moriori traditional knowledge) and science to develop an agricultural system that reflects the cultural values and aspirations of Māori, Moriori and many Pakeha.

One of the aims of the project is to increase biodiversity on farm lands by encouraging the planting of native species. We believe that the enhancement of indigenous biodiversity on productive lands is more likely to succeed if it is done in partnership with agriculture and is understood to bestow multiple benefits. The loss of biodiversity under industrial agriculture reduces the ability for tangata whenua (people of the land) to participate in many cultural practices

This presentation will describe two aspects of the Indigenous Agroecology project; the role traditional medicine can play in animal health and the inclusion of native plant material in a riparian biowall system.

In Aotearoa New Zealand there is no documented ethnoveterinary tradition and until recently little discussion of the use of rongoā (Maori traditional medicine) in livestock. We have discovered that there are anecdotal accounts of the use of native plants for animal health and that some farmers still utilise the bush.

Clean water is vital to communities, whether human, animal or plant and agriculture is dependent upon water. We are investigating the inclusion of mulch from native plants in riparian biowall systems to act as filters for potential pollutants. Initial results indicate that some species could reduce biological and chemical pollutants that would otherwise contaminate waterways.

Dr Marion Johnson is a Research fellow at the Centre for Sustainability (CSAFE) University of Otago. She is funded by Ngā Pae o te Māramatanga and leads the Indigenous Agroecology project. Her main research interests are in Agroecology and Ethnoveterinary practices.

Thursday 28 November

Stream B, Session 11

Cultural Burning - Diversity of Fire

Costello, Oliver¹; Ferguson, Marcus²

¹ Nature Conservation Council of NSW (NCCNSW) and Jumbunna Indigenous House of Learning, University of Technology, Sydney (UTS)

² Jali Local Aboriginal Land Council

Cultural burning is a story of place and has many uses, characteristics and outcomes. This presentation will explore what we can learn from cultural burning. Fire's function in the landscape is as diverse as the country and people interconnected with it. Fire is known by many terms in many languages. The Firesticks project uses the term **cultural burning** to describe the myriad ways fire exists in a cultural context to achieve the same or different objective as contemporary fire management. The cultural values and practices that manifest as cultural burning are underpinned by the fundamental intent of Aboriginal People to care for country. Cultural connections to Country vary among people and group, but generally can be understood as interconnected relationships between landscapes, elements and beings. Country is more than a tangible landscape as it encompasses all things including cultural lore and the stories of Country which relate to the people, plants, animals, landscape, water, sea, wind and sun, moon and stars. Aboriginal people's cultural values and practices are increasingly being recognised as important in contemporary land and natural resource management. The impacts of colonisation have, without doubt, affected Indigenous people's ability to openly implement their cultural practices and pass on Traditional Knowledge in the way it has been done for thousands of years. That is not to suggest that the knowledge has been lost. Across Australia there still exists strong cultural lore, knowledge of burning practices, connection to country and a physical memory that is present within the landscape.

Oliver Costello a Bundjalung man is Firesticks Project coordinator at NCCNSW, he has a BA in Adult Education and Community Management from the University of Technology, Sydney (UTS) where he is a Visiting Fellow at Jumbunna Indigenous House of Learning.

Thursday 28 November

Stream B, Session 11

Grassroots in Urban Landscapes – Aboriginal Leadership in Environmental Management within Government structures.

Phillips, Rebecca¹;

¹Aboriginal Leadership Team, TEK Coordinator

²Parks Victoria

In Victoria, Aboriginal people are mostly urbanised and have complex and complicated systems and legislation in which to engage with Parks Victoria in protecting and preserving Cultural Heritage within the Cultural Landscapes. Most Aboriginal Communities at the grassroots level have struggled to operate successfully with government organisations as our systems of management, governance and environmental perspectives have been not well understood. Strategic policy and planning has often already been established and Aboriginal perspectives and ways of Caring for Country have been made to fit existing corporate structures. Parks Victoria has a diversity of relationships with different Traditional Owner groups and different levels of engagement. This is not only confusing for operational staff but also Victorian Traditional Owners.

So how can Aboriginal perspectives within the organisation influence these structures?

Can the existing work programs accommodate Aboriginal cultural values without derailing or degrading the different knowledge systems?

Parks Victoria has undergone a change process and restructure which has enabled the establishment of an Aboriginal Leadership Team consisting of Aboriginal staff with diverse roles and expertise. Its main purpose is to provide autonomous and non-hierarchical advice to Parks Victoria's Executive Management Team and the Chief Executive Officer. It functions independently to assist Parks Victoria making informed decisions based upon the values of Victorian Aboriginal Groups and individuals where concerned with Park Management. The outcome sought in filling this knowledge gap is reaching a sustainable balance of cultural integrity with our environments, our living cultural heritage and our park visitors.

Rebecca Phillips is a Pangerang, Dja Dja Wurrung, Macedonian Australian and has a degree in Nature Tourism. Interests include, Cultural Landscapes and Cultural Heritage. Rebecca worked as a Ranger, Indigenous Education/Interpretation Officer and currently is Traditional Ecological knowledge Coordinator and Secretary of the Aboriginal Leadership Team.

Thursday 28 November

Stream B, Session 11

Savanna burning, greenhouse gas emissions and Indigenous livelihoods: Introducing the Tiwi Carbon Study

Richards, Anna E.¹; Andersen, Alan N.¹; Schatz, Jon¹; Cook, Garry D.¹; Dawes, Tracey Z.¹; Eager, Robert¹; Hadden, Kate²; Liedloff, Adam¹; Scheepers, Kelly¹

¹CSIRO Ecosystem Sciences

²Tiwi Land Council

Savanna burning for greenhouse gas abatement presents an opportunity for remote Aboriginal communities of northern Australia to engage with the mainstream economy while fulfilling cultural obligations for land stewardship. The recently established 'Tiwi Carbon Study' aims to identify the biophysical and economic potential of fire management for total greenhouse gas abatement on the Tiwi Islands north of Darwin, as a basis for possible livelihood opportunities for Tiwi people. The project is a partnership between the Tiwi Land Council, Tiwi Plantations and CSIRO. Currently, non-CO₂ greenhouse gas emissions from fires on the Tiwi Islands average 68 000 t CO₂-e y⁻¹. We discuss scenarios for greenhouse gas abatement through management of these fires by Tiwi people, consistent with the new savanna burning methodology under the Federal Government's Carbon Farming Initiative. In addition to abatement of non-CO₂ emissions, fire management also has the potential to alter rates of carbon sequestered in soil and vegetation. Current ecosystem carbon stocks (excluding roots) on the Tiwi Islands range from 60 to 160 t C ha⁻¹ and we discuss several model scenarios (using the CENTURY and FLAMES model) for predicting rates of change to stocks under reduced fire frequency and intensity. Lastly, we discuss potential co-benefits and trade-offs from fire management for greenhouse gas abatement in terms of biodiversity and Tiwi cultural requirements and livelihood aspirations.

Dr Anna Richards is a research scientist at CSIRO Ecosystem Sciences in Darwin. She is a plant ecologist whose research focuses on below-ground carbon fluxes in tropical savanna ecosystems and the impact of different disturbances, such as fire, on carbon dynamics.

Oral Presentations

Wednesday 27 November

Stream B, Session 9

Genetic diversity influences productivity in marine invertebrate populations

Aguirre, David¹; Miller, Seth²; Morgan, Steven²; Marshall, Dustin³

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³Monash University, Victoria 3800, Australia

The positive relationship between species diversity and ecosystem function has received increasing attention in ecology. Recently, it has also become apparent that genetic diversity within-species can have similar benefits at the population level to those that species diversity has at the community level – populations with higher genetic diversity are more stable and productive, as well as resistant to disturbance, disease and invasion than populations with lower genetic diversity. However, fundamental gaps in our understanding of genetic diversity effects remain. First, current efforts to investigate biodiversity effects, and in particular genetic diversity effects, suffer from taxonomic and ontogenetic biases. Second, studies identifying the processes that underlie ecological genetic diversity effects are relatively rare. Here, I present a series of experiments targeting these gaps in our understanding of genetic diversity effects. Overall, I found marine invertebrates respond strongly to the genetic diversity of the surrounding population, and that both selection and complementary effects contribute to the benefits of biodiversity. These ecological consequences of genetic diversity manifest within a single generation, and may change the way we view and manage populations.

David Aguirre is a post-doctoral research fellow based at The University of Queensland. His major research interests center on examining the ecological and evolutionary consequences of differences in genetic variation among populations.

Wednesday 27 November

Stream A, Session 7

Alteration of fuel load, structure and fire hazard due to African Olive invasion in eucalyptus Woodland

Aires, Felipe¹; Bell, Tina¹; Matthews, Stuart²

¹Faculty of Agriculture and Environment, University of Sydney

²CSIRO Ecosystem Sciences

The effects of woody weeds on fuel load and structure, fire regimes and intensity remains poorly understood, particularly in Australia. The ecological effect of African Olive invasion has recently been demonstrated but there are no studies investigating the impact of this species on fuel structure and fire behaviour. This study aimed to determine the effect of invasion of African Olive on fuel load and structure. Areas representing two stages of African Olive invasion were selected: initial invasion (II; 0-7 years of invasion) and long-term invasion (LI; 15+ years), and an area of uninvaded Cumberland Plain Woodland (CPW). Visual scoring, pin-intersect method (vertical cover) and destructive sampling (biomass) were used to characterise fuels. For total fine fuel biomass there were no significant differences among the three study areas. Long-term invaded areas had greater amounts of dead fine fuel and litter biomass than II or CPW. LI areas also had greater percentage cover scores for different fuel fractions and higher fuel hazard scores than II and CPW. There were significant differences among total vertical cover in all areas, with greater vertical cover in the lower layers (0-50 cm) of CPW and LI due to the presence of grass. LI and II had greater cover in the upper layers than CPW due to dense olive canopies. The near-surface fuel layer contributes to the propagation and vertical development of fire, therefore the differences in fuel arrangement in LI and II can potentially alter fire behaviour compared to areas of CPW that are often invaded.

Felipe Aires is originally from Brazil and has Bachelor and Teaching degree in biological sciences, a Master in Ecology researching grass weeds and fire interaction. For his PhD he is investigating fire behaviour and its interaction with woody weeds.

Thursday 28 November

Stream C, Session 11

Climate change and conservation prioritization

Anderson, Barbara, J.¹

¹Rutherford Discovery Fellow, University of Otago, New Zealand

To be effective conservation planning for the 22nd century needs a threefold strategy. Firstly, priority must be given to those areas that best protect biodiversity from current threats (including non-climate change related threats). Secondly, the areas that are currently the most suitable may under a changing climate become marginal or even climatically unsuitable. We must therefore identify those regions that are likely to be the most important for biodiversity in the future. In many cases these will be regions which are buffered against climatic change. There is also uncertainty in the future climate, by explicitly incorporating the variability between eighteen general circulation model (GCM) projections into the analysis, I present both a high-risk high-return solution and a more robust low-risk solution. Thirdly, if species are to shift their ranges as the geographic space that is climatically suitable shifts some level of connectivity must be maintained between the areas that are currently of high conservation priority for biodiversity and those areas that are likely to be of high

priority under future climate change. As reserve networks are increasing asked to fulfil all three of these objectives efficient management will depend on managers being able to identify both the regions of highest priority and the drivers behind their inclusion in the network. Our results highlight both the synergies and tensions between areas of high current and high future conservation priority.

Barbara J. Anderson, Rutherford Discovery Fellow, University of Otago, Conservation Prioritization and Modelling Species Responses to Climate Change.

Tuesday 26 November

Stream E, Session 6

To bee or not to bee?: interrogating the role of introduced honeybees (*Apis mellifera*) in native ecosystems

Anderson, Sandra¹; Beggs, Jacqueline¹; Pruchniewski, Andrew¹

¹*School of Biological Sciences, University of Auckland, Auckland, New Zealand*

Honeybees are globally successful invaders and the findings from research investigating their impact on native pollination systems are equivocal. They are introduced to New Zealand and there is potential for them to compete with native pollinators for nectar and pollen. They may also have an impact on the reproductive output of both native and exotic plants but there has been little research on this to date.

The Department of Conservation (DoC) in New Zealand has historically granted concessions so that beekeepers can stock conservation land with hives for commercial gain. The lack of information on the ecological impacts of honeybees compromises the ability of DoC to make clear decisions on the costs and benefits of granting such concessions.

We investigated the situation on Rangitoto, a volcanic island of predominantly *Metrosideros* forest in the Hauraki Gulf near Auckland. The site is of particular interest because a recent mammalian pest eradication programme has substantially increased the conservation value of the island. Consequently, the continued presence of commercial honeybee operations in the restoration plans for the island is under reconsideration.

In a preliminary study we asked whether honeybees affected the reproductive success of *Metrosideros excelsa* (pohutukawa), whether they significantly reduced the standing crop of nectar, whether they displaced other floral visitors from pohutukawa and whether they were visiting other plants, particularly weed species. The information from the study is intended to inform management decisions regarding honeybee operations on conservation land.

Sandra Anderson is an ecologist at the University of Auckland, New Zealand where her research interests are the importance of mutualistic interactions between animals and plants in maintaining ecosystem function.

Wednesday 27 November

Stream D, Session 8

Long-term effects of repeated prescribed fires on coarse woody debris in an Australian temperate forest

Aponte, Cristina¹; Tolhurst, Kevin G. ¹; Bennett, Lauren T. ¹

¹*Department of Forest and Ecosystem Science, The University of Melbourne*

Coarse woody debris (CWD) is a key structural component of many forest ecosystems. CWD provides habitat for vertebrates, insects and microorganisms, acts as a nursery site for tree regeneration and may store a significant amount of carbon and nutrients. Despite its relevance to ecosystem functioning, the influence of a common management practice such as repeated prescribed fire on CWD remains under-examined. We assessed the impacts of four prescribed fire treatments (two seasons x two frequencies) on coarse woody debris after 26 years. Stocks of CWD by size and decay classes were estimated using the line-intercept method. In addition, the carbon and nitrogen concentration and wood density of the different classes was determined. Fire significantly reduced CWD stocks, particularly in large and rotten pieces, which often play a critical role for sustaining biodiversity. Charring due to prescribed fires changed carbon and nitrogen concentrations and C to N ratios of CWD but did not affect mean wood density. Fire impacts on CWD were larger in high frequency fires and fires in drier conditions. These findings point to a potential trade-off between sustained reduction of wildfire risk, and the ecological consequences of changes in CWD stocks and attributes.

Cristina Aponte is a postdoctoral fellow working in the Integrated Forest Ecosystem Research (iFER) program that studies carbon, water, biodiversity, resilience and social and economic values in various forest ecosystems.

Tuesday 26 November

Stream C, Session 4

Classifying the diets of the extant Macropodidae demonstrates local and universal factors in dietary adaptation

Arman, Sam¹¹*School of Biological Sciences, Flinders University, Australia*

This study collates dietary information for Kangaroos to determine dietary groups. Intake of four major dietary items - monocot leaves, dicot leaves, fruits/seeds, and fungi - were compared using percentage intake for 13 species, and categorical data for 35 species. ANOVA tests were used with cluster analysis and principal components analysis to align species into four dietary groups. Mycophagists (n = 5) have nutrient-rich diets that primarily consist of fungi and fruits. Relative proportions of monocots to dicots separate the remaining taxa into browsers (n = 3) which eat > 70 % dicots; grazers (n = 7) which eat > 70 % monocots; and mixed feeders (n = 20) which fall between these extremes. Comparisons with dietary classification based on dental morphology, suggests that only a low number of species with a 'browser grade' dentition are actually browsers. Instead, most are mixed feeding, which is likely an adaptation to fall-back feeding on lower quality food during periods of poor productivity, which is adaptively advantageous when environmental conditions are unpredictable. Body mass was correlated with proportional monocot/dicot intake. The relationship between monocot/dicot intake and body mass, as well as the percentage cut-off between dietary groups mirror those found in bovids, suggesting that some factors may be universal for mammalian herbivores. Differences between bovids and macropodids reflect intricacies of macropodid evolution in Australian biogeography and climate. Diet is constrained by long term adaption in body size and dental morphology, while diet itself changes over shorter time frames in response to local environmental conditions.

Sam Arman is currently undertaking a PhD in macropodid palaeontology, focusing on determining diet and adaptation of kangaroos over the Pleistocene using Dental Microwear Texture Analysis

Monday 25 November

Stream D, Session 3

Ecological importance and long-term viability of shrubs on New Zealand gravel beaches

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Gravel beaches are a naturally rare ecosystem in New Zealand. Often poorly understood and managed, they also support a number of rare and threatened plant species. Extreme environmental conditions and high levels of disturbance combined with close proximity to highly modified landscapes make this a challenging environment for many species to survive in. An observational study showed that facilitation is likely to be occurring in this highly stressed environment. There also appears to be a failure in the recruitment of native woody species. The low levels of native shrub recruitment are likely to have long term impacts on the plant community structure. Two planting experiments were set up to assess which factors may be limiting the successful recruitment of native shrub seedlings. The first experiment tested if established shrubs could facilitate recruitment by planting seedlings under the shelter of shrubs or in bare gravel and monitoring their growth and survival. Fertiliser and water were added as randomized treatments to these planted seedlings to test if there was either water or nutrient limitation. The second experiment tested if an exotic forb could facilitate seedling recruitment by planting seedlings next to the forb, where the forb had been removed, and in bare gravel. Both studies showed that a number of interacting factors impacted on seedling survival including seedling species, the planting treatment and the distance from the sea. Of these factors seedling species appeared to be the dominant factor. The results indicate that while facilitation may influence seedling recruitment, surprisingly it is not the most important factor and there are a number of interacting processes which may be limiting recruitment.

Elise Arnst is currently a masters student at the Department of Ecology, Lincoln University. Research interests include plant community ecology, weed invasion and community-based conservation.

Wednesday 27 November

Stream E, Session 7

The interplay of habitat and seed type on conditional mutualism in fragmented Afromontane forest landscape

Babale, Aliyu^{1,2}; Chapman, Hazel¹; Zubairu, Misa²; Moltchanova, Elena³; Forget, Pierre Michel⁴,¹*School of Biological Sciences, University of Canterbury, PB 4800, Christchurch, New Zealand.*²*Nigerian Montane Forest Project, Yelwa village, Taraba State, Nigeria.*³*Department of Math and Statistics, University of Canterbury, PB 4800, Christchurch, New Zealand.*⁴*Département Ecologie et Gestion de la Biodiversité, Muséum National d'Histoire Naturelle, CNRS UMR 7179, 1 avenue du Petit Château, 91800 Brunoy, France.*

Our knowledge of scatter hoarding by rodents and its potentially vital role in forest regeneration is based largely on single species

interactions. How such behaviors and outcomes are context-dependant remains to be explored. Here we explore for the first time in Africa the interplay of habitat and seed type on a conditional mutualism. We quantify how land use and seed palatability interact to affect the balance between seed predation and dispersal by rodents. We distinguish between buried and cached seeds, and measure dispersal distances. Our study combines information on two understudied areas, Afromontane forests and bat dispersed seed species. We tested three hypotheses around context-dependant outcomes in conditional mutualisms: i) the balance between predation and dispersal will favour predation in palatable, relative to less palatable seed species; ii) rates of scatterhoarding will be relatively higher for less palatable than palatable seed species sharing the same habitat; and iii) in habitats where land use is such that fruit is scarce, such as fragmented/degraded forest, rodents will act more as predators than dispersers relative to habitats with an ample fruit supply. We found support for hypotheses i) and iii). We found that seed was moved by pouched rats by at least 10m from the experimental plots and was predated, cached and buried in proportions varying with habitat. We conclude that rodents likely play an important role in secondary seed dispersal in Afromontane forests where primary frugivores are scarce,

Babale Aliyu is lecturers in the Biology Department of Gombe State University Nigeria and is a PhD candidate at Canterbury University (UC). His field work is based at the UC Nigerian Montane Forest Project field site on the Nigerian/Cameroon border.

Wednesday 27 November

Stream A, Session 9

A dung fight at Te Paki?

Ball, Olivier¹; Whaley, Patrick²

¹*NorthTec, Applied and Environmental Sciences Department*

²*Kaitiāia Area Office, Department of Conservation*

New Zealand's native dung beetles (Scarabaeidae: Scarabaeinae) are unusual as they are flightless, have evolved in the near absence of mammals (the usual source of nutrients for dung beetle species elsewhere) and appear to be obligate forest-dwellers. Little is known about their diets and life cycles or about their interspecific interactions where dung beetles are sympatric. We investigated the distribution, seasonality and relative proportions of two species of dung beetle, *Saphobius edwardsi* and *S. squamulosus*, in 10 native forest sites across the Te Paki Ecological District in Northland, New Zealand. We found that in areas where *S. squamulosus* was either not recorded, or was very scarce, *S. edwardsi* numbers consistently peaked in spring. In areas where both species were abundant, *S. edwardsi* numbers peaked several months later in summer, whereas *S. squamulosus* numbers were highest in autumn. This suggests that interspecific competition could be an evolutionary force affecting life history traits of *S. edwardsi*. Competition from high numbers of *S. squamulosus* in autumn may either delay egg laying or larval development, or perhaps temporarily reduce adult fecundity. Dung beetles play an important ecological role in the recycling of nutrients within ecosystems and could be useful indicators of environmental status and change. Thus, understanding population dynamics and the roles that habitat and interspecific competition play for these species is crucial in our attempts to restore and manage our forest ecosystems.

My name is Olivier Ball and I have been a senior tutor in the Applied and Environmental Sciences Department at NorthTec since 2000. My research interests centre on the taxonomy and ecological interactions of beetles, spiders and amphipods in Northland.

Tuesday 26 November

Stream F, Session 4

Effects of temporary captivity used as a soft-release method for translocating eastern bettongs (*Bettongia gaimardi*).

Batson, William¹; Fletcher, Don²; Gordon, Iain³ and Manning, Adrian¹

¹*The Fenner School of Environment and Society, The Australian National University.*

²*Environment and Sustainable Development Directorate, ACT Government.*

³*James Hutton Institute, Scotland.*

In reintroduction biology, captivity is sometimes associated with negative outcomes induced through behavioural changes and relaxed selection. However, temporary captivity can allow translocated populations to acclimatise, recover and improve condition prior to release in to a wild environment. The effect of incorporating a period of temporary captivity into a translocation process was investigated during the first mainland reintroduction of eastern bettongs (*Bettongia gaimardi*) from the wild in Tasmania into the Australian Capital Territory. A soft-released cohort was temporarily housed at a captive breeding facility at Tidbinbilla Nature Reserve (TNR) prior to release into a 5 sq km predator-free mainland island at Mulligans Flat Woodland Sanctuary (MFWS). An additional cohort was hard-released into MFWS within 24 hours of initial capture in Tasmania. The primary differences between the housing conditions at TNR and MFWS were that supplementary foods were provided, and mate access was controlled at TNR, but not at MFWS. At TNR, reproductive outputs decreased despite improvement in body condition. These trends were reversed once the temporarily captive cohort was released into MFWS. Continuous breeding was achieved for both cohorts following release into MFWS and body condition was maintained above condition when captured in Tasmania. Due to the high post-release survivorship in both cohorts there was no significant difference in survivorship. Further, investigation is required to identify the mechanisms behind the apparent differences, and the findings could be used to improve practises in subsequent projects.

William Batson, PhD Scholar, My interests lie within the fields of species conservation and habitat restoration. I am especially interested in improving ecological outcomes by successfully integrating these two fields.

Tuesday 26 November

Stream E, Session 5

Eeny, meeny, miny, moe: is the choice of species distribution model algorithm important?

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The last decade has seen an explosion in the application of species distribution models (SDMs). While it is generally accepted that different SDM algorithms can estimate current distributions of species with similar accuracy, they can vary substantially in the magnitude and direction of projected changes to habitat suitability when projected onto novel environments such as different climate scenarios. This transferability issue is a property of an SDM extrapolating beyond the environmental conditions sampled during calibration. Unfortunately, multi-model comparisons have been unable to identify a single 'best' performing SDM and guidance on the selection of SDMs is lacking. Hence, researchers often use multiple models for impacts assessments and 'ensemble' (combine) the results. We asked "Can we identify a 'best (worst) performing' subset of SDMs that modellers should include (exclude) in their studies?" To address this, the most comprehensive assessment of the performance of SDMs to date was undertaken. Using 14 SDM algorithms, we modeled the potential distributions of ~1700 Australian vertebrates, identifying which SDMs have similar accuracy *and* highly correlated spatial projections under i) current and ii) future scenarios. Selection of SDM is important! We identify SDMs that consistently predict decreases or increases when projecting onto novel space; more concerning, several SDMs predict implausible, 'extreme' range shifts. This information is used to generate guidelines on selection of SDMs for assessing species responses to environmental change. Further, we utilize this project to demonstrate recent advances in eResearch and cloud-based infrastructure that have been incorporated in the Biodiversity and Climate Change Virtual Laboratory.

Linda Beaumont is an ecologist and lecturer at Macquarie University. Her research explores biological responses to climate change, e.g. understanding uncertainty in species distribution modelling, adaptive potential of species and conservation implications of climate change.

Thursday 28 November

Stream E, Session 11

Chasing the dragon: A species resilience to climate change in the Wet Tropics, Queensland

Bernays, Sofie^{1,2}; Schmidt, Daniel^{1,2}; Hughes, Jane^{1,2}

¹Griffith School of Environment, Griffith University

²Australian Rivers Institute

Future climate change is expected to affect most geological and biological systems in Australia although some areas and species will be more sensitive to change than others. These sensitive areas are expected to experience a disproportionately negative effect because they contain high species diversity, species abundance and endemic abundance whilst being geographically restricted. Within these regions, an organism's sensitivity may be dependent on its temperature tolerance and its morphological-environmental correlations (physical traits that correspond to environmental variables). These sensitivity indicators often identify the Wet Tropics World Heritage Area in northern Australia as a sensitive region and they will be used to examine the at-risk *Hypsilurus boydii* (Boyd's Forest Dragon), the region's only forest dragon. By examining the species' temperature tolerance (using historical phylogeographic and climatic data) and examining morphological-environmental correlations (by regional comparisons), the project will predict the species' resilience to climate change, future distributions and the survival of *Hypsilurus boydii* in a warming environment. Genetic results have revealed genetic divergence corresponding to historical geographic and climatic barriers. These results are similar to other species in the region with historical restriction to dispersal occurring across this same corridor. Determining if the sensitivity indicators may limit or aid future dispersal is important in order to determine the level of resilience for the species

Sofie Bernays is currently a PhD candidate at Griffith University with research interest in molecular ecology. Her studies have taken her focus from freshwater streams to chasing down the elusive rainforest dragon.

Monday 25 November

Stream C, Session 1

Specialists or generalists? Nitrogen fixing bacterial communities of invasive acacias in Australia

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Although some Australian acacias are amongst the most notable invaders world-wide, information on the relative role of soil biota, particularly beneficial microbial communities such as rhizobia, in their invasion success remains elusive. We examined the nitrogen fixing

bacteria (henceforth NFB, focus on rhizobia) in native and introduced populations across New South Wales, Victoria, South Australia and Western Australia of four weedy *Acacia* spp. and a sister-taxon *Paraserianthes lophantha* using 454 sequencing to identify the NFB community composition and diversity in the rhizosphere and nodules. We hypothesized that if these acacias are specialists, they will associate with similar NFB subsets in their nodules across the continent and are likely to be constrained in the introduced populations if compatible microorganisms are absent from the rhizosphere. However, if these acacias are generalists, they will successfully form relationships with novel NFB in the introduced range populations and are unlikely to be constrained by the absence of suitable soil mutualists. Results showed that overall the rhizosphere NFB communities were different across the continent (south-east vs south-west), while similar across the ranges (native vs introduced) in the nodules of the host species. The most dominant rhizobial taxa in the rhizosphere and nodules were slow-growing *Bradyrhizobium*. These results suggest that acacias are specialists that predominantly associate with *Bradyrhizobium* in their nodules across native and introduced populations. However, this does not translate into an invasion constraint since *Bradyrhizobium* is common in the soils across the south-eastern and south-western populations of these acacias.

Dr. Christina Birnbaum is a Research Assistant in Terrestrial Ecology Research Laboratory at Murdoch University, Western Australia. Her research interests include invasion biology and plant-soil interactions.

Thursday 28 November

Stream D, Session 10

Monitoring changes in the state of indigenous biodiversity within the Waitakere Ranges Heritage Area, 2008 - 2013

Bishop, Craig¹; Landers, Todd¹

¹Research Investigations and Monitoring Unit (RIMU), Auckland Council

²Wildland Consultants, Auckland

The Waitakere Ranges Heritage Area covers approximately 27,000 ha, immediately to the west of the Auckland urban area, and contains one of the two largest blocks of continuous vegetation in the Auckland Region. The Heritage Area is subject to the special protections of a separate act of parliament (Waitakere Ranges Heritage Act 2008) which mandates five yearly reporting on the state of a wide variety of natural and cultural features. This paper summarises results of natural environment reporting from the first five yearly reporting cycle (2008 – 2013). We will also compare the reporting framework for the Heritage Area with other similar systems being developed for landscape scale monitoring of natural values in New Zealand by the Department of Conservation and Regional Councils. More than 50 different indicators are planned for future use. However, numerical data was only available for 27 of these indicators for the 2013 report. Change was detected in 9 of the 27 indicators for which we have data, and the majority these changes were negative (c.88%). Overall, there was a decrease of 0.012 to 0.015 points on a 1000 point 'ecological quality' scale for the heritage area. These data suggest there has been a small reduction in indigenous biodiversity/ natural heritage values in the Heritage Area over the last four years. However, more accurate information about the changes that are occurring and/or a longer term dataset is required to reach firmer conclusions.

Craig Bishop is a senior scientist with the Research, Investigations and Monitoring Unit (RIMU) of Auckland Council. He manages the regional biodiversity monitoring programs and helps with the design, collection and analysis environmental data throughout the council and wider community.

Tuesday 26 November

Stream E, Session 5

Interacting global change drivers limit the distribution of a thermally-sensitive freshwater fish.

Boddy, Nixie C. M.¹; Godsoe, William K. W.¹; & McIntosh, Angus R.¹

¹University of Canterbury

Interacting global change drivers such as invasive species, climate warming and altered disturbance regimes are likely to have major influences, especially on aquatic ecosystems. Modified water temperature and disturbance regimes will likely cause shifts in the amount and distribution of suitable habitat, and highly competitive invasive species may decrease habitat availability, thus altering both fundamental and realized niche size. We examined how distributions of a thermally sensitive freshwater fish, Alpine galaxias (*Galaxias paucispondylus*), were influenced by these global change drivers and interactions between them, with a view to extrapolate this model to predict distribution shifts in response to warming and disturbance associated with climate change. Large scale electrofishing surveys of four replicate catchments were undertaken to determine native and invasive fish distributions. Key abiotic variables were measured at whole catchment scales, including water temperature, substrate size, disturbance, macrophyte coverage, stream width, and flow characteristics. Alpine galaxias were more likely to be present at sites with flooding disturbance and large substrate. Non-native trout had stronger limiting effects on galaxiid distributions at less disturbed sites, indicating an important disturbance-invader interaction. Duration of warm temperatures were more important than maximum or average stream temperatures in determining galaxiid distributions. Moreover, because trout were also thermally sensitive there were direct and indirect effects of temperature on galaxiid distributions. Thus global change drivers will likely interact to alter the distribution of thermally-sensitive freshwater species. Moreover, species responses are likely to depend on the configuration and characteristics of local habitat networks because these constrain distribution responses.

Nixie Boddy is a BSc Honours student at the University of Canterbury, researching large-scale spatial and temporal patterns in fluvial environments and how they can influence species distributions.

Tuesday 26 November

Stream E, Session 6

Ecology and pollination of deceptive New Zealand greenhood and spider orchids (*Diplodium* and *Nematoceras* spp.)

Bodley, E.¹; Beggs, J.¹; Gaskett, A.C.¹¹*School of Biological Sciences, University of Auckland. NZES.*

The Orchidaceae is a highly diverse family of plants that have various mechanisms to attract pollinators and create a pollinator-plant specific interaction. Sexually deceptive species produce scents that mimic those produced by female insects in order to attract male pollinators. In contrast, broodsite deceptive species mimic oviposition odours produced by males to encourage female insects to lay their eggs on flowers. Greenhood orchids are thought to use sexual deceit as they have a trigger mechanism to trap potential pollinators and are thought to only attract male pollinators. *Nematoceras* species are widely believed to be broodsite deceptive. Greenhoods and *Nematoceras* are diverse in New Zealand, but the form and extent to which deception is used is largely untested as orchid pollination rates are typically low and pollinator observations are often very rare. We aim to better understand the pollination of a greenhood orchid, *Diplodium brumale*, and several species of *Nematoceras* by investigating olfactory and tactile pollinator cues via scanning electron microscopy (SEM). For *D. brumale*, we also investigate the phenology, mating system, pollination success, pollen movement patterns and potential pollinators in the field. This will contribute to the understanding of the evolution of deceptive plant-insect interactions, and hopefully resolve whether greenhood orchids are indeed sexually deceptive.

Emma Bodley will be presenting this research. I am a current Masters student at the University of Auckland, being supervised by Dr Anne Gaskett and Assoc. Prof. Jacqueline Beggs. My research interests are in plant-insect interactions and New Zealand flora and fauna, particularly orchids.

Wednesday 27 November

Stream E, Session 9

High reproductive efficiency as an adaptive strategy for plants in competitive environments

Bonser, Stephen¹¹*Evolution and Ecology Research Centre, School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, 2052 Australia*

How plants allocate resources to reproduction across environments varying in the intensity of competition is central to our understanding of adaptive strategies. Plant strategy theory predicts that reproductive efficiency should decrease under competition. For example, intense competition is predicted to favour the presence of relatively long-lived species with low yearly allocation to reproduction. Contrary to the predictions of traditional plant strategy theory, short-lived semelparous species are observed to live in highly competitive environments. Further, relatively long-lived iteroparous species often allocate heavily to reproduction in competitive environments. Here, I use life history theory to advance a prediction that reproductive allocation and efficiency should increase under intense competition for both short-lived and relatively long-lived herbaceous plants. I surveyed the literature for studies on plants including measurements of vegetative and reproductive allocation in high and low competition treatments. Allocation to reproduction increased with increasing competition intensity. Patterns of allocation to reproduction under competition support the existence of a competitive annual strategy and a reproductive perennial strategy. The competitive annual strategy suggests that competition plays a major role in shaping adaptive strategies of many short-lived plant species. The reproductive perennial strategy is favoured under conditions where competition slows growth and increases mortality of competitively suppressed iteroparous plants. Competitive strategies, where plants delay reproduction in competitive environments in order to gain competitive superiority, are favoured under low or moderate competition. Life history theory provides a predictive framework for understanding strategies of reproduction in competitive environments observed across species.

Stephen is a senior lecturer at UNSW. His research interests are in understanding how plants evolve and adapt to variable environments. Current research projects include the evolution of competitive strategies, and in understanding the conditions favouring sexual reproduction.

Tuesday 26 November

Stream F, Session 5

Objectively measuring the biodiversity of recreational green space

Bowden, Will¹

¹*Sports Surface Design & Management (SSDM) Measuring the ecological biodiversity of recreational green space is often subjective. Various key stakeholders have their own priorities and preconceptions of what is a) contractually required and, b) ecologically diverse. The SSDM Green space Ecological Review System has been developed to provide an objective and scientifically based form of measuring the ecological value of a green space.*

The system has been developed with input from New Zealand Forest and Bird and Land care Research. The process objectively measures and scores 10 key components (zones) in order to build an accurate picture of how the green space is being managed

in terms of its ecological biodiversity and how this can be enhanced further long-term. The key objectives being: 1) to enable key stakeholders to plan and align appropriate resources for future enhancement and, 2) to afford the green space a certification of ecological merit that is both transparent to and acknowledged by the local community.

The system has the potential to be a tool used to justify ecological funding applications, resources required by local community volunteer groups and schools and also a proactive and high level scoring system that can be adopted throughout New Zealand.

Will Bowden. Sport Turf Consultant for Sports Surface Design & Management (SSDM). Technical agronomist and ecological services to the New Zealand recreational sector.

Wednesday 27 November

Stream B, Session 9

Patchiness of resources determines heterogeneity of density dependent effects in arid lands of southern Australia

Bowman, Alexandra¹; Facelli, José M².

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²*The University of Adelaide*

There is much debate in literature whether competition occurs, and if so how important it is, in arid environments. This is because plants in unproductive environments are adapted to survive harsh conditions, thus being poor competitors but highly stress tolerant. However, the distribution of water and nutrients in arid land ecosystems is highly heterogeneous, typically containing patches with high resource availability within a matrix of very low resource availability. This can create heterogeneity in the intensity of density dependent effects. We studied the annual plant community associated with fallen logs (fertile patches) and open spaces (low resource matrix) in a chenopod shrubland. Both field and glasshouse experiments were conducted manipulating the density of the plant community under high and low water regimes. Our results provide some evidence of stronger density dependence of annual plant communities associated with fallen logs. Biomass decreased with increasing number of plants in soil next to logs and under the high water availability. No competitive effect was detected for plants grown in open space soil or under low water regime. Our results suggest that plants in open spaces with very poor resources may simply be struggling for survival, while the increase in resource availability next to logs and additional water creates conditions for higher plant densities and growth, leading to competition. Future studies need to determine the overall effect of this pattern on biodiversity maintenance.

Alexandra is a PhD candidate in the School of Earth and Environmental Sciences at the University of Adelaide. Alexandra studies terrestrial plant ecology in the arid lands of South Australia.

Wednesday 27 November

Stream A, Session 8

***Didymosphenia geminata* impacts on benthic algal and invertebrate diversity and community composition in New Zealand Rivers**

Bray, Jon¹; Harding, Jon.¹; Kilroy, Cathy²; Gerbeaux, Philippe³

¹*University of Canterbury*

²*NiWA*

³*Department of Conservation*

Didymosphenia geminata (Didymo) is an invasive freshwater diatom, whose effects on ecosystems and rapid global spread is of international concern. On restricted spatial scales *D. geminata* alters habitats and primary productivity, with subsequent effects throughout aquatic ecosystems. Assessing the impacts of an invasive, requires understanding of assemblage and diversity changes across broad spatial scales, whilst accounting for competing niche controls. We surveyed 55 sites across a gradient of *D. geminata* within the South Island of New Zealand to determine the effects of *D. geminata* on β diversity in algal and invertebrate assemblages. β diversity, as community turnover, occurred over a gradient of *D. geminata* in both algal (adonis $P < 0.001$) and invertebrates assemblages (adonis $P < 0.05$). Increased community homogeneity was also observed in both algal (betadisper $P < 0.005$) and invertebrates (betadisper $P < 0.05$). *D. geminata* biomass drove compositional changes in algal ($R^2 = 0.64$, $P < 0.001$) and invertebrate assemblages ($R^2 = 0.29$, $P < 0.001$). While variance partitioning and path analysis support the finding that *D. geminata* primarily drove algal composition, physicochemical niche based drivers and space were observed to be increasingly important for invertebrates. Thus weakened effects on invertebrates suggest resilience, and outline the fundamental differences that exist between organisms and the effective scale of niche drivers, based on organism size and trophic position.

Jon's research interests include conservation of aquatic ecosystems, native fish, aquatic terrestrial subsidies, D. geminata ecology and the evolutionary significance of the organisms paradoxical bloom formation.

Thursday 28 November

Stream C, Session 11

Effects of forest loss and fragmentation on New Zealand passerinesBrocknerhoff, Eckehard¹; Luc Barbaro, Luc²; Deconchat, Marc²; Henley, David¹; Paul, Thomas³¹Scion, PO Box 29237, Christchurch, New Zealand, email: eckehard.brocknerhoff@scionresearch.com²INRA, France³Scion, Rotorua, New Zealand

Forest loss and fragmentation are known to affect the abundance and presence of forest birds. However, it is not clear how bird species vary in terms of their tolerance to habitat loss and whether there are critical levels of forest cover below which different species disappear from the landscape. We studied the presence and abundance of forest birds by conducting three five-minute bird counts at 825 points across 25 landscapes measuring 5 km x 5 km, from Banks Peninsula to Arthurs Pass National Park in inland Canterbury. The study areas ranged from landscapes that had a high level of forest cover (up to about 80%) to landscapes that had lost most forest (less than 5% forest cover), consisting of either natural forest, regenerating native forest, or planted forest. Bellbird, brown creeper, kereru, rifleman and tomtit responded most strongly to the presence to native woody vegetation, with a secondary preference for exotic woody vegetation. Grey warbler and shining cuckoo responded positively to both native and exotic woody vegetation. As expected, bird species varied in terms of tolerance of forest loss. While bellbird was present in landscapes with less than 5% forest cover, rifleman, brown creeper and tomtit were not or only rarely recorded when forest cover was less than 10%.

Ecki Brocknerhoff is a forest ecologist and entomologist and a principal scientist with Scion. His research interests include biological invasions and biosecurity, forest biodiversity and ecosystem services, and the role of planted forests in mitigating forest loss and fragmentation.

Thursday 28 November

Stream D, Session 10

Ecotones as indicators: do they have potential as a monitoring tool for wetland plant communities?Brownstein, Gretchen¹; Johns, Caitlin¹; Blick, Ray¹; Bricher, Phillippa¹; Pritchard, Daniel²; Fletcher, Andrew¹ and Erskine, Peter¹¹ Centre for Mined Land Rehabilitation, Sustainable Minerals Institute, The University of Queensland, Brisbane, Australia² School of Planning, Architecture and Civil Engineering, Queen's University Belfast, Belfast, Northern Ireland

It is widely thought that evidence of anthropogenic change in plant communities should be most apparent at the extremes of environmental gradients. Ecotones, as representative of environmental limits of species and communities, have been suggested as focal points for detecting early shifts in composition due to anthropogenic impact. Using data from the Blue Mountains, NSW, Australia we examined if changes in ecotone location or ecotone features can be used as reliable indicators of hydrological change in temperate wetland communities. We examined 28 woodland-wetland-woodland transitions, distributed across four sites with different anthropogenic disturbance histories and hydrological traits. We tested whether: 1) ecotones are present, 2) the ecotones are associated with environmental gradients, and 3) the location or features of these ecotones are influenced by disturbance history. Using an objective (ordination derivative) moving window analysis we identified 32 potential ecotone locations. Well defined ecotones were associated with steep gradients in soil depth and soil moisture, but in highly disturbed sites this link between ecotones and environment was not apparent. We discuss the potential for changes in these ecotone features, and locations, to act as indicators of anthropogenic impact in these ecologically sensitive wetland communities.

Gretchen Brownstein, Postdoctoral Research Fellow, Plant community ecologist; my research focuses on how environmental drivers and species traits (i.e. form and function) interact to determine community composition and structure.

Thursday 28 November

Stream D, Session 10

Phylogenetic patterns of algal selectivity in epiphytic lichens

Buckley, Hannah L.; Rafat, Arash; Pannetier, Maelle; Ridgway, Hayley J.; Cruickshank, Robert H.

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The aim of this research was to improve our understanding of phylogenetic constraints on the development of symbiotic relationships. Epiphytic lichens, a symbiosis most commonly between a fungus and a green alga (Chlorophyta), provide an excellent case study system for addressing this goal due to the close symbiotic relationship between the partners and the diversity of easily-sampled specimens. Previous research shows that lichenised fungi can have a range of levels of selectivity in algal partner, however, the great majority of this work has been conducted at the within-species level. We sequenced the fungal and algal DNA from a range of different epiphytic lichen species forming communities on mountain beech trees (*Nothofagus solandri* var. *cliffortioides*), which were reinvading a grassland area of less than one square kilometre in the foothills of the Southern Alps. We show wide variability in algal selection among fungal species within this community of epiphytic lichens. These results suggest that although phylogeny may constrain the development of the symbiosis in some fungal taxa within this lichen community, it does not in other taxa. This has important implications for the study of symbioses at the community level.

Hannah Buckley is a Senior Lecturer in Ecology at Lincoln University. She did a BSc in Botany at Victoria University of Wellington, PhD in Community Ecology at the University of Alberta and a postdoctoral fellowship at Florida State University. Her research focuses on understanding the processes that structure biological communities. In particular, she is interested in spatial patterns in species diversity, community assembly, and the role of phylogeny in community structure.

Thursday 28 November

Stream E, Session 11

Biome predictions based on leaf phenology

Buitenwerf, Robert¹; Higgins, Steve²; Rose, Laura¹

¹ Institut für Physische Geographie, Goethe Universität, Frankfurt am Main

² Department of Botany, University of Otago, Dunedin

Remotely sensed spectral data has tremendous potential for monitoring changes on the Earth-surface however popular land cover classification schemes such as MODIS Land Cover and Global Land Cover 2000 disagree significantly in their predictions. The differences are particularly large for semi-arid ecosystems such as tropical grasslands, savanna, and scrublands, which cover most of Australia and Africa. We explore the potential of phenological metrics calculated from MODIS Enhanced Vegetation Index (EVI, similar to NDVI) in differentiating these economically important biomes. We show that intuitive and ecologically meaningful parameters derived from EVI time series such as the length of the growing season and proxies of primary production (the integral of the annual EVI) can be used effectively to classify vegetation units. This approach stresses the potential of spectrally-derived phenological metrics that have a distinct ecological interpretation. We show that biome maps created using this phenological scheme agree better than existing satellite derived biome maps with floristically derived biome maps. We conclude that this method of defining vegetation units could be used as a sensitive tool for monitoring shifts in biome distributions.

Robert is a PhD student at Goethe University. He likes using a variety of approaches including field experiments, plant physiology, remote sensing, and modeling to understand the processes that drive vegetation patterns. I have mainly worked in African savannas.

Monday 25 November

Stream E, Session 1

Grazing changes behaviour of grassland lizards

Bull, Michael¹; Pettigrew, Melissa¹

¹School of Biological Sciences, Flinders University

The endangered pygmy bluetongue lizard is now restricted to a few isolated fragments of native grassland in the mid-north of South Australia. All known populations are on privately owned land, and most sites have been subjected to grazing by sheep for extended periods. To make some informed recommendations to land owners about appropriate grazing regimes to maintain their lizard populations, we experimentally investigated behavioural changes under simulated local grazing. With less grass we considered lizards might be disadvantaged by greater exposure to avian predators, but advantaged by higher visibility of invertebrate prey items. Video recordings of lizards both in the field and in enclosures showed that lizards basked more and detected prey more successfully with reduced vegetation around their burrows. Increased exposure to predators did not appear to influence behavioural changes. However when offered a choice, they preferred burrows with more grass cover, perhaps because these were more stable after heavy rains. Translating detailed behavioural and ecological knowledge into recommendations to the wider local community becomes relatively easy when those recommendations are largely compatible with current farming practice. In this case sheep may have replaced previously common grazing marsupials.

Michael Bull is Managing Editor of *Austral Ecology* and researches ecology, behaviour and conservation of scincid lizards.

Tuesday 26 November

Stream F, Session 6

Native forest regeneration under *Leptospermum scoparium* in Awarua-Waituna wetland, Southland: constraints, trajectories, and predictive ability

Burge, Olivia Rata¹; Kelly, Dave¹; Wilmshurst, Janet²; Ledgard, George³.

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Native forest regeneration under a nurse canopy is expected to be constrained by the density of the canopy and by seed supply. In Awarua-Waituna wetland, Southland, there is an abundance of *Leptospermum scoparium* (manuka), a documented nurse canopy for native forest. However, later-successional woody regeneration is rare and patchy. Vegetation communities have been classified in the wetland at a 10 m² scale, including two types of manuka communities differentiated by canopy coverage. We investigated whether existing and experimentally manipulated canopy classifications predicted (a) sown seedling success (germination, survival and growth) of seven native forest species; and (b) presence of natural regeneration. We also investigated which environmental variables

would best supplement the canopy classification in the wetland to improve these predictions. We found that canopy classifications provided similar accuracy to quantitative canopy openness measures for predicting seedling success, but that predictions could be improved by variables that differentiated between wetter, peat sites and drier, mineral-soil sites. Pest surveys indicated the presence of rats, possums and stoats within the wetland, and we found protecting sown seeds and seedlings from predation and herbivory doubled sown seedling germination and survival. We investigated whether allowing regeneration to occur without pest control would affect resulting species richness, diversity and the trajectory of regeneration within the wetland complex. We found that regeneration trajectories began to differ at <10 cm in seedling height, making seed predation and seedling herbivory a cryptic pathway to an alternative stable state.

Olivia Burge is currently studying towards an MSc at the University of Canterbury in terrestrial ecology. She has previously worked as a solicitor in resource management law. Her research interests are in ecology, ecological policy frameworks and how the two interact.

Tuesday 26 November

Stream G, Session 4

Plant defense against megaherbivores: biogeography, heteroblasty and trait matching

Burns, K.C.¹

¹Victoria University of Wellington

Species interactions often promote trait matching, which occurs when species evolve traits that coincide with local interaction partners in ways that enhance their fitness. I quantified plant structural defences in two spatial dimensions (vertically and geographically) to test whether plants deploy prickles, thorns and spines in ways that match the distribution of large, herbivorous mammals. In mallee scrublands of Western Australia, where adult plants are within the reach of megaherbivores, plant structural defences increased vertically and were deployed preferentially by adult plants. Conversely, in woodlands of Eastern Australia and California, where adult plants commonly grow above the reach of megaherbivores, structural defences decreased vertically. Populations of closely related woodland taxa on Lord Howe Island and Santa Cruz Island exhibited significant reductions in structural defence in the absence of megaherbivores. However, *Coprosma quadrifida*, a member of a diverse clade of woody plants that radiated in New Zealand, evolved vertical changes in structural defence after colonising Australia, where it is exposed to megaherbivores. Overall results illustrate a diverse array of spatial patterns in plant structural defence that match the distribution and foraging behaviour of large mammals, providing a multi-scale perspective on how megaherbivores have shaped the evolution of plant form and function.

K.C. Burns is a senior lecturer in biology that is interested in plant-animal interactions, biogeography and macroevolution.

Monday 25 November

Stream F, Session 1

Spatio-temporal changes in density and distribution of burrow-nesting petrels following predator removal

Buxton, Rachel^{1,4}; Taylor, Graeme²; Jones, Christopher³; Lyver, Philip³; Moller, Henrik⁴; Cree, Alison¹; Towns, David²

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The size and distribution of burrow-nesting seabird colonies is thought to be partly regulated by the availability and quality of suitable breeding habitat and partly by predation. In New Zealand, the availability of safe nesting habitat was first limited by the introduction of rats by humans, and more recently restored by rat eradication for restoration of island ecosystems. We tested whether petrel colonies expand in extent (i.e. colony size) or increase in density after rat eradication by mapping colonies on a chronosequence of: (i) four islands from which rats were eliminated 3 to 26 years ago; (ii) an island that has never had rats, and (iii), an island with rats still present; while controlling for habitat availability. We also measured a time series of burrow densities and occupancies in plots on each island to compare temporal changes after rat eradication. Using geostatistical techniques, we found that burrow density and colony extent increased with time since rat eradication, with colonies eventually filling entire islands 20 years after eradication. Variogram modelling indicated larger-scale spatial structure of burrows (i.e. more clustering) on islands with the least amount of time since rat eradication. However, we found a decrease in burrow occupancy after eradication, suggesting that an increase in burrow density may not fully indicate the population level responses.

Rachel Buxton is a PhD candidate investigating the response of seabird colonies to the eradication of introduced predators in New Zealand. Her research interests include seabird ecology, habitat modeling, and restoration biology.

Thursday 28 November

Stream E, Session 11

TERN: Building new ecological plot infrastructure to enable Australian science

Caddy-Retalic, Stefan^{1,2}; Sparrow, Ben^{1,2} & Thurgate, Nicole^{1,2}

¹*School of Earth and Environmental Sciences, University of Adelaide*

²*Terrestrial Ecosystem Research Network*

AusPlots and allied TERN programs represent significant long-term investments in Australian ecological infrastructure. Collaboration across rangeland jurisdictions has led to an agreed survey methodology compatible that is both compatible with existing methods and versatile enough to provide useful data and sample collections to all ecosystem scientists investigating Australian ecosystems. The AusPlots survey methodology has been designed as a series of separate modules, including vegetation composition and structure, novel triple photopoints, plant genetic and isotopic sampling, soil characterisation and soil metagenomics with invertebrate and vertebrate survey modules under development. A purpose build mobile app has been developed to collect data in the field to minimise data handling errors and facilitate seamless transition to a publically accessible publishing database (AEKOS). To date, over 300 1-ha plots have been surveyed across more than a quarter of IBRA bioregions, with ongoing surveys planned for the next 5 years. All data is available in publically accessible TERN databases and sample collections are available for the scientific community to use. This investment represents one of the largest investments in Australian ecological infrastructure in recent years and will facilitate open-access data and collections for bioregion or continental scale scientific analyses.

Stefan Caddy-Retalic is Director of the Australian Transect Network, a facility of the Terrestrial Ecosystem Research Network. He has a background in ecology and public policy, specialising in the interface between research and policy development.

Wednesday 27 November

Stream D, Session 9

Spatio-temporal Trade-offs In Fire Management For Threatened Species Persistence

Cadenhead, Natasha¹; Kearney, Michael²; Moore, Danae³; James, Alex³; Wintle, Brendan¹

¹*School of Botany, University of Melbourne, Melbourne, Australia*

²*Department of Zoology, University of Melbourne, Melbourne Australia;*

³*Australian Wildlife Conservancy, 280 Hay St, Subiaco, Western Australia 6008, Australia*

Fire is an integral part of the Australian landscape, yet fire management is difficult, particularly for threatened species. Even species that rely on fires to maintain suitable habitat can experience a direct mortality cost from fires. For small populations of threatened species, this increase in mortality can outweigh the indirect benefits of fire on habitat suitability. The trade-off between mortality and habitat suitability presents a spatially and temporally complex management challenge. We model the distribution of great desert skinks in central Australia, investigating the drivers of their distribution with a particular focus on the effects of fire on this threatened species. We build and validate species distribution models with new and existing occupancy surveys. We use the resulting maps as the foundation for spatially-explicit metapopulation models in a landscape where habitat suitability depends on the timing and spatial arrangement of fire. We model metapopulation persistence under different management scenarios, identifying fire management strategies that maintain suitable skink habitat with a minimum direct mortality. Our results indicate that management strategies which most rapidly achieve suitable habitat mosaics also incur the highest direct mortality. They therefore highlight the importance of fire management that explicitly considers the temporal aspects of fire mosaics, as well as the more commonly considered spatial aspects. Once a species becomes threatened, disturbance processes such as fire, which previously helped maintain suitable habitat, can reduce the probability of long-term persistence of the species. Species distribution and metapopulation modelling can help determine the best management options in complex, fire-driven systems.

Natasha Cadenhead is a Masters student in the Quantitative and Applied Ecology group at the University of Melbourne. Her research interests include spatial modelling, arid ecology and research-management facilitation.

Tuesday 26 November

Stream F, Session 4

Effects of belowground space limitation on performance of *Eucalyptus* seedlings: barrier sensing or nutrient limitation?

Campany, Courtney¹, Medlyn, Belinda², Duursma, Remko¹

¹*University of Western Sydney, Hawkesbury Institute for the Environment*

²*Macquarie University, Department of Biological Sciences*

The purpose of this study was to induce root restriction with *Eucalyptus tereticornis* seedlings across a range of container sizes to test how patterns of aboveground growth are coupled with constrained belowground growth. How much soil volume seedlings in containers need before root restriction affects growth is still unknown, yet physical restriction of root proliferation might impact root growth, development, or morphology before this occurs. We grew *Eucalyptus tereticornis* seedlings in a range of container sizes (from 5 to 35 litres), and compared growth, photosynthesis and carbohydrate storage with a freely rooted seedling. The entire experiment was carried out in the field, and all seedlings were well watered. We expected that the impact of root restriction in smaller containers would induce rapid negative effects on growth, while larger containers would maintain growth rates similar to free-grown seedlings.

We observed a negative 'pot effect' on aboveground growth and photosynthetic rate soon after the experiment was initiated, and after four months freely rooted seedlings displayed a total leaf area 8 times larger than the average potted seedlings. The differences between container seedlings and the freely rooted seedling were much larger than between container sizes, suggesting that seedlings in containers may sense physical root restriction and reduce total growth accordingly. We found evidence for functional balance, as the ratio of total fine root mass to leaf mass was highly conserved across treatments. Our results show that when space becomes limited, plants respond by reducing aboveground growth to avoid excessive shoot to root ratios.

Courtney Campany is a post graduate research student whose research focuses on investigating the feedbacks of limiting resources and environmental change on plant physiology and subsequent biomass allocation across plant components.

Wednesday 27 November

Stream E, Session 7

A mammoth mouthful? A test of the idea that big animals disperse big seeds.

Chen, Si-Chong¹; Moles, Angela T.¹

¹*Evolution & Ecology Research Centre, School of Biological, Earth and Environmental Sciences, The University of New South Wales, Sydney, NSW 2052, Australia*

It has been widely assumed that large seeds generally require large dispersers to ingest and disperse them, but this relationship has only been quantified in single animal groups (e.g. birds) and in a few communities. We made the first global-scale study across all vertebrate groups (fish, amphibians, reptiles, birds and mammals), to test the prediction that large animals are able to ingest both large and small seeds while small animals ingest small ones. Literature data were compiled for over 12,000 seed dispersal interactions from over 300 study sites globally. Quantile regression showed a triangular relationship between seed size and disperser size ($p < 0.001$ for both 95th and 5th quantiles). The slope and significance of the relationship between body weight and ingested seed size varied between animal groups, presumably because of their diversified foraging behaviours, movement modes and digestive characteristics. Both reptiles and birds showed a significantly positive relationship, whereas mammals showed the opposite, indicating that absence of some dispersers differentially affected seed dispersal of large- and small-seeded species. In conclusion, the upper-bound size of ingested seed was positively correlated with the disperser's body weight. Our broad-scaled study confirmed that the size of ingested seeds depended on the body size and taxonomic group of the animal feeding on it, and indicated that elimination of large-bodied animals by hunting or habitat loss might impose restrictions on the regeneration of large-seeded plants.

Si-Chong Chen is a PhD student in A/Prof Angela Moles' group, UNSW. She is interested in plant-animal interaction, ecological network, and species distribution.

Monday 25 November

Stream B, Session 3

The slow and the fast: native versus exotic conifers in extreme New Zealand environments

Cieraad, Ellen¹; McGlone, Matt¹

¹*Landcare Research, Lincoln*

World wide, conifers have adapted to extreme environmental conditions. New Zealand is no exception and a number of native podocarps are dominant on nutrient-poor soils and under droughty, cool or frost-prone climates. Their slow growth in such circumstances has been commonly attributed to their adoption of a very conservative life history strategy. In contrast, at these same sites, exotic *Pinus* species can invade and accumulate biomass at a much greater rate while being as resistant as the native conifers to environmental stress.

Here, we present a comparison of the growth of co-occurring native podocarps and exotic *Pinus* at two extreme environments: at one of New Zealand's driest and coldest sites (near Omarama), and the treeline ecotone. Frost resistance measurements show that both native conifers and *Pinus* can tolerate temperatures lower than any recorded in New Zealand, and much lower than those encountered at the sites. However, photosynthesis measurements show that the native podocarps cannot take advantage of optimal growing conditions whereas *Pinus* does. Similarly, growth ring data support the notion of the natives being stress-tolerators, whereas the exotic *Pinus* has a more opportunistic strategy.

The successful invasion of *Pinus* into extreme New Zealand sites shows conclusively that there is a 'pine niche' that indigenous species have not filled. We discuss the reasons for the failure of indigenous trees to evolve a pine-equivalent.

Ellen Cieraad is a plant ecologist. Her research focuses on the distribution and functioning of plants along environmental gradients. Recent projects have assessed the effects of temperature, nutrients and drought on plant performance.

Wednesday 27 November

Stream E, Session 9

Tree fern hydraulic functioning

Clearwater, Michael¹; Simpson, Angela¹; Lusk, Chris¹; Richardson, Sarah²; Pittermann, Jarmila³

¹Department of Biological Sciences, University of Waikato, Hamilton, NZ

²Landcare Research, Lincoln, NZ

³Department of Ecology and Evolutionary Biology, University of California Santa Cruz, Santa Cruz, USA

Tree ferns are the only group of arborescent plants that has persisted to the present day in the face of competition from woody plants. In New Zealand in particular they are an emblematic feature of the landscape and a major player in forest dynamics. Yet they belong to a group usually dismissed as inferior – ferns produce no wood and their tracheid based xylem lacks the vessels found in angiosperms and the heterogenous pits that enhance tracheid efficiency in conifers. The aim of this project was to provide the first description of the hydraulic properties of tree fern stems, for comparison with other ferns and to the woody stems of arborescent seed plants. We hypothesised that tree fern stems would have a low ratio of xylem area to leaf area, but high hydraulic conductivity per unit xylem area (k_s), resulting in leaf area specific hydraulic conductivity (k_l) comparable to co-occurring seed plants. Plants up to 6 m tall of three species (*Cyathea medullaris*, *C. dealbata* and *Dicksonia squarrosa*) were harvested, leaf area recorded and hydraulic properties and anatomy of trunk tissues examined. Methods were developed to measure trunk hydraulic conductance while minimizing the effect of copious mucilage production. Ratios of xylem area to leaf area were low, but k_s was exceptionally high (30 kg m⁻¹MPa⁻¹s⁻¹) compared to published values for most ferns and seed plants, resulting in tree fern k_l values comparable to woody plants. Stem anatomy and hydraulic functioning also varied significantly between the tree ferns species and may well correlate with their differing ecological behaviour.

Mike Clearwater, Senior Lecturer, University of Waikato, Plant ecophysiology and water transport.

Thursday 28 November

Stream C, Session 10

Interactions between assembly order and environmental change can alter both short and long-term community composition

Clements, Christopher F¹; Warren, Philip H.¹; Collen, Ben²; Blackburn, Tim³; Worsfold, Nicholas⁴; Petchey, Owen⁵

¹Department of Animal and Plant Sciences, University of Sheffield, Sheffield, UK.

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⁵Institute of Evolutionary Biology and Environmental Studies, The University of Zurich, Zurich, CH

Both the order in which species arrive in a community, and environmental conditions, such as temperature, are known to affect community structure. Little is known, however, about the potential for, and occurrence of, interactions between assembly history and the environment. We explore the influence of assembly history, temperature, and the interaction between the two on the structure of communities of competitors, using small-scale protist microcosm communities where temperature and assembly order were manipulated factorially. In our experiment, the most important driver of long-term abundance was temperature but long-lasting assembly-order effects influenced the relationship between temperature and abundance. Any advantage of early colonisation proved to be short lived, and there was rarely any long-term advantage to colonising a habitat before other species. The results presented here suggest that environmental conditions shape community composition, but that occasionally temperature could interact with the stochastic nature of community assembly to significantly alter future community composition, especially where temperature change has been large.

Christopher Clements is a PhD student at the University of Sheffield whose work primarily focuses on understanding extinction events, but also covers conservation, community assembly processes, theoretical and population ecology, and the effects of temperature on populations and communities.

Thursday 28 November

Stream A, Session 11

Vertebrate extinctions: the relative impacts of humans and other invasive mammals

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Widespread and rapid extinctions of vulnerable native vertebrates have followed the colonisation of islands by humans and introduced mammalian predators. For example, recent analyses (Duncan *et al.* 2013) suggest that c.1000 species of non-passerine landbirds became globally extinct following human colonisation of the Pacific islands. The exact cause of most of these extinctions is unclear, although over-exploitation, habitat loss, predation by invasive mammals, or some combinations of these, are all implicated. In this paper we use a population modelling approach to assess the relative impacts of humans and predation by introduced mammals as causes of extinction of endemic vertebrates, using New Zealand extinctions as a case study.

Mick Clout is based at the University of Auckland where his research is focused on conservation biology of threatened wildlife, especially birds, and the ecology of invasive species.

Thursday 28 November

Stream F, Session 10

Restoration of ecosystem engineers affects habitat use by a key detritivore

Coggan, Nicole¹; Gibb, Heloise¹; Hayward, Matthew, W.²

¹La Trobe University, Melbourne, Australia

²Bangor University, Bangor, United Kingdom

Regional extinctions of Australian mammals in the 21st century have outpaced global averages of species declines. Reintroducing regionally extinct species to their former habitats is regarded as a viable solution against extinction. We addressed a key assumption of threatened species conservation, wherein interactions between locally extinct and persisting species are expected to recover automatically as a result of reintroductions. We uncovered important information regarding historic interactions between regionally extinct fossorial marsupials and ground-dwelling invertebrates that can inform planning for the sustainability of habitats chosen for conservation. Termites' use of buried resources was significantly altered by reintroduced marsupial activity: A smaller proportion of resources buried within reach of marsupial foraging pits were consumed by termites when we tested the effect of soil disturbance intensity caused by reintroduced marsupials. Proportionally more termites were also lost from buried resources over time when we tested the response of termites to direct resource disturbance. Climatic restrictions on resource availability and the attraction of predatory ant species to disturbed resources had minor influences on the strength of termites' reactions to resource manipulation. Our research suggests that small-scale patterns of habitat use by termites changed after marsupials were reintroduced, and highlights the importance of understanding the contexts of biotic and abiotic interactions between species and their habitats in species restoration.

Nicole Coggan is a PhD candidate supervised by Drs. Heloise Gibb and Matt Hayward. Her research focuses on the impacts of marsupial extinction and reintroduction on insect biodiversity and ecosystem processes. Nicole's primary research interests include ecology and entomology.

Wednesday 27 November

Stream D, Session 9

Impacts of long term frequent burning and post-harvest regeneration on live tree biomass and demography

Collins, Luke^{1,2}, Penman, Trent¹, Ximenes, Fabiano³, Bradstock, Ross¹, York, Alan⁴

¹Centre for Environmental Risk Management of Bushfires, University of Wollongong, Wollongong, New South Wales

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⁴Department of Forest and Ecosystem Science, University of Melbourne, Creswick, Victoria

The management of carbon has been receiving increasing attention globally. Forests have the highest carbon storage capacity of all ecosystems and therefore management of forests has important implications for carbon accounting. Timber harvesting and frequent fuel reduction burning are two common management practices within temperate eucalypt forest of Australia that will influence the amount of carbon biomass stored in forests. This study examines how tree biomass and demography is affected by frequent prescribed burning and regrowth following harvesting. The study utilised data collected by Forests NSW between 1969 and 1992 at a long term experiment site which was designed to examine the impact of frequent burning on forests dynamics. The experiment was established in a recently logged (10 years prior) sclerophyll forest. Two burning treatments were established across 14 plots, with plots being either burnt notionally every three years (i.e. frequently burnt; 7 plots) or protected from fire (i.e. unburnt; 7 plots). The results suggest that the rate of biomass recovery of commercial species following harvesting was lower within burnt plots than unburnt plots, resulting in approximately 20% lower biomass in frequently burnt plots by 1992, 23 years after the experiment began. Reduced growth rates and survivorship of smaller trees on the frequently burnt plots compared to unburnt plots appear to be driving these patterns. These findings suggest that a sustained (i.e. >15-20 years) regime of frequent low intensity burning can reduce the amount of carbon stored within wet sclerophyll forests and reduce biomass accumulation rates following timber harvesting.

Luke Collins is a Postdoctoral Fellow at the Hawkesbury Institute for the Environment, University of Western Sydney. His current research focuses on the effect elevated CO₂ has on vegetation structure and ecosystem flammability.

Monday 25 November

Stream F, Session 1

A hot bird is a desirable burrow-mate

Corkery, Ilse¹; Bell, Ben²; Nelson, Nicola²

¹NorthTec, Whangarei

²Victoria University of Wellington

There have been many examples of co-habitation of ectothermic vertebrates with endothermic organisms but it was only within the last decade that a study finally recorded and quantified the transfer of heat between the individuals of two different species. Ecologists know little about this category of thermoregulation termed kleptothermy or heat stealing. In order to add to the limited data on interspecific kleptothermy, we used a reptile-seabird cohabitation as our study system. We measured the body temperatures of free-ranging tuatara (*Sphenodon punctatus*) sharing burrows with fairy prions (*Pachyptila turtur*) and those occupying empty burrows. Results revealed that environmental temperatures rarely permit tuatara preferred body temperatures to be attained. However, when tuatara share a burrow

with a seabird their thermal physiology is affected and their body temperature is higher for between one and fifteen hours per 24h period. Tuatara maintain territories, thus a seabird-occupied burrow that acts as an enhanced thermal refuge may act like a renewable resource for tuatara, with the bird returning year after year. If some individuals within a population exploit these thermal refugia, this could lead to a fitness advantage. Altered thermal environments have numerous impacts on the ecology of a species, and it is possible that positive inter-specific interactions may alleviate thermal stress across the range of a single species. Thus, categorising the full range of thermal interactions between species and understanding the costs and benefits to those interactions are fundamental if we are to understand the full fitness implications of kleptothermy.

Ilse Corkery received her Doctor of Philosophy (2012) from Victoria University of Wellington, NZ for her research on the interactions between tuatara and fairy prions. She currently lectures in the Conservation and Environmental Department at NothTec, in Whangarei, NZ.

Tuesday 26 November

Stream E, Session 5

A geographic mosaic of climate change impacts: which areas are most at risk?

Cornwell, William K.; Ackerly, David, D²

¹BEES, UNSW, Sydney, Australia

²UDept of Integrative Biology, UC Berkeley, California, USA

Climate change is expected to profoundly impact terrestrial vegetation. Understanding spatial variability of these impacts is critical to development of conservation strategies and projections of ecosystem services under future climates. We present a probabilistic model of the projected impacts of climate change on the distribution of vegetation types in the San Francisco Bay Area using a novel application of multinomial logistic regression. The distribution of 22 vegetation types is modeled as a function of climate, climatic water deficit, soil depth, wind and radiation; the output of the model is a vector of the relative probability of occupancy by each vegetation type, for each pixel in the landscape. Dissimilarity of the probability vectors modeled under present versus future climates provides a measure of projected impact of climate change, which can be further decomposed as the product of two components, reflecting the exposure (i.e. magnitude) of climate change and the sensitivity of each vegetation plot to the projected changes. We apply this method to the vegetation of the San Francisco Bay Area (California, USA), based on a new set of high resolution, downscaled climate projections. The results point to two novel conclusions. 1) The magnitude of climate change impacts will be a function of the proximity, in climate space, of each point to biological thresholds for particular vegetation types, not by the degree of exposure or by intrinsic sensitivity of vegetation types as a whole. 2) In most, but not all cases, local micro-climates will allow organisms to adjust to climate change through local movement. This approach provides a new way to use spatial data to help forecast and mitigate climate change impacts.

Will Cornwell just moved from Vrije Universiteit, Amsterdam to UNSW where he is a senior lecturer interested in plant functional ecology in the context of climate change.

Monday 25 November

Stream E, Session 1

Weighed down by science: do collar-mounted tags affect cat behaviour?

Coughlin, Cayley¹; van Heezik, Yolanda¹

¹Zoology Department, University of Otago

Animals involved in telemetry studies, such as GPS are potentially subject to a number of instrument effects which can negatively impact survival, reproduction and behaviour. The recommendation is that transmitter weight shouldn't exceed 3% of body mass for aerial species and 5% for terrestrial species. However, the 5% rule of thumb has little or no empirical basis and recent studies have found that transmitters weighing less than 3% body mass may still have impacts on energy expenditure and other behavioural parameters. Telemetry and other observational studies on domestic cats have used collars of various weights carrying kitty-cams and GPS tags ranging in weight between 30g - 125g. These studies assume that the device carried is not affecting behaviour, however, this has not been tested quantitatively. The purpose of this research is to examine possible impacts of wearing collared devices of different weights on domestic cat movements and behaviour. Movement data will be presented on cats wearing three different GPS collar weights: (1) light, 30g, (2) a medium-heavy, 80g and (3) heavy, a collar weighing approximately 130g.

Cayley Coughlin is carrying out a Masters in Wildlife Management, exploring the use of accelerometers together with GPS in identifying predatory behaviour and spatial habitat use by domestic cats, as well as determining instrument effects on cat activity and movements.

Tuesday 26 November

Stream G, Session 4

Is life in the tropics really more colourful? A cross-taxa test for a latitudinal gradient in colour

Dalrymple, Rhiannon¹; Kemp, Darrell²; Flores Moreno, Habacuc¹; Laffan, Shawn³; Hemmings, Frank³; Tindall, Marianne¹; Moles, Angela¹.

¹ *Evolution and Ecology Research Centre, University of New South Wales*

² *Department of Biological Sciences, Macquarie University*

³ *School of Biological, Earth and Environmental Sciences, University of New South Wales*

Colour is one of the most pervasive and striking signals on the planet; it is immensely important in signalling for mate attraction, pollination, competition and predation. It has long been believed that the tropical regions of the world are inhabited by species that are more colourful, vibrant and contrasting. However, recent analyses have seen some classic assumptions about lower latitudes overturned, such as there being more intense ecological specialisation and higher rates of herbivory in the tropics. In light of this, it is time to revisit this colourful idea. To date, there has been no quantitative assessment of a latitudinal gradient in the colourfulness of species across taxonomic groups on a broad scale. Addressing this knowledge gap is my main aim. Using quantitative colour measurements of close to 1500 species, from 3 major taxonomic groups – one vertebrate, one invertebrate and one plant – I will finally provide an answer to this long standing tenet of ecology.

Primarily driven by an obsession with flowers, Rhiannon's research focuses on patterns of colour across communities. She is interested in how diversity, competition, relatedness and disturbance affect community colour-space. PhD Candidate supervised by Angela Moles and Darrell Kemp, E&ERC UNSW.

Tuesday 26 November

Stream F, Session 5

Biodiversity Management for Terrestrial Ecosystems in the Waikato Region

Deng, Yanbin¹; Beard, Catherine¹; Vare, Matthew¹

¹*Waikato Regional Council, Hamilton, New Zealand*

The Waikato region supports approximately 696,000 hectares of highly diverse indigenous terrestrial ecosystems that provide critical environmental services, and act as important ecological buffer zones. However, some terrestrial ecosystems, particularly the forest and scrub remnants, are currently under threat from factors such as weeds, introduced predators, expanded pastoral farming, horticulture and forestry, coastal & rural development, and climate change. As a consequence, some indigenous terrestrial ecosystems have declined in extent by more than 70 per cent in the region, and many indigenous habitats and species have been lost. The Waikato region is facing many difficult challenges in maintaining its terrestrial biodiversity. To this end, it is imperative that the Waikato Regional Council assesses these remaining indigenous ecosystems and habitats, and establishes an inventory of the Significant Natural Areas (SNA) on private lands in order to effectively prioritise the management of biodiversity.

The Council's strategic approach to protecting terrestrial ecosystems includes: completing and maintaining a comprehensive SNA database for the region, refining methodology to better define representative habitat types; enhancing biodiversity protection and building ecosystem resilience; controlling vegetation clearance to achieve no net loss of regional biodiversity; setting up collaborative and strategic processes for implementing regional policy at the TA (Territorial authorities) level; collaborating with other agencies, monitoring and measuring success. The proposed strategy will manage to protect the most threatened ecosystems, habitats and species; safeguard the remnants of rare ecosystems; identify and enhance ecological linkages; and standardise monitoring methods.

Yanbin Deng is a terrestrial ecologist at Waikato Regional Council, New Zealand. Yanbin's job involves providing expertise, and information on issues relating to terrestrial ecology and also evaluating data to quantitatively characterise the biodiversity "hot spots" in the Waikato region.

Wednesday 27 November

Stream D, Session 9

'Phos-fire-us' – Can fire intensity and P availability predict population densities of woody legumes after bushfire?

Densmore, Valerie S.; Bell, Tina L.; Adams, Mark A.

¹*Faculty of Agriculture and Environment, University of Sydney, NSW, Australia*

Woody legumes, such as *Acacia* spp. often display rapid and widespread germination following moderate- to high-intensity bushfires. Many *Acacia* species are able to fix atmospheric nitrogen (N), and higher phosphatase concentrations are often associated with the rhizosphere of woody legumes. Thus, these species have the potential to 'restore' soil N and 'remobilise' soil P following bushfire. Densities of regenerating populations typically vary several orders of magnitude over small distances, producing patchy distributions that are currently unpredictable. The aim of this study was to characterise soil properties and climate and geographic factors that significantly influence the densities of woody legumes following bushfire. In February 2009, the 'Black Saturday' bushfires burned over 90,000 hectares of National Parks in the state of Victoria. Six representative species of woody legumes that germinated post-fire were

identified growing at two to three densities. Ordinal logistic regression was used to analyse variables including physical and chemical characteristics of soil (0-10 cm depth) and geographic factors derived using ArcGIS and a one-second (30 m) digital elevation model. The best predictive model selected using discriminant analysis elucidated factors that influence fire intensity and availability of P. On the basis of this finding, fine roots from all six species were collected and PCR used to investigate whether they possessed and expressed genes to increase available P. This study helps elucidate the role of woody legumes in restoring ecosystem processes following bushfire and will inform decisions when planning hazard-reduction burns.

Valerie Densmore is currently completing a PhD at the University of Sydney investigating factors influencing distributions of woody legume species, with particular emphasis on phosphorus. Her research interests include interactions between plants and their communities that promote healthy diverse ecosystems.

Wednesday 27 November

Stream E, Session 7

Dispersal research in conservation biology. Do we need to get better at it?

Driscoll, Don A.¹; Banks, Sam C. ¹; Barton, Philip S. ¹; Ikin, Karen¹;Lentini, Pia¹; Lindenmayer, David B. ¹; Smith, Annabel L. ¹; Berry, Laurence E. ¹; Burns, Emma¹; Edworthy, Amanda¹; Evans, M. John¹; Gibson, Rebecca¹; Heinsohn, Rob¹; Howland, Brett¹; Kay, Geoff¹; Munro, Nicola¹; Scheele, Ben C.¹; Stirnemann, Ingrid¹; Stojanovic, Dejan¹; Sweaney, Nici¹; Villaseñor, Néida R. ¹; Westgate, Martin J¹.

¹*Centre of Excellence for Environmental Decisions, National Environmental Research Program Environmental Decisions Hub, Fenner School of Environment and Society, Australian National University.*

A good understanding of dispersal is needed for managing and conserving biodiversity. However, dispersal knowledge is often inadequate, and this may relate to the quality and method of data collection. After systematically reviewing 485 conservation related papers and additional source papers, we assessed (i) the extent to which dispersal knowledge is lacking, (ii) the consequences of limited dispersal knowledge, (iii) the questions asked in dispersal-related conservation research, (iv) the methods used to study dispersal and, (v) the quality of dispersal data. We also tested for changes over time and for differences among five sub-topics in conservation; climate change, habitat restoration, population viability analysis, land planning and invasive species.

We found scant evidence of change over the past ten years in the way dispersal knowledge is collected and used. This is worrying because much of our dispersal knowledge arises from low quality methods, including occupancy, expert opinion and modelling. Low quality data, combined with the widely recognized knowledge gap about dispersal and the serious consequences of a lack of dispersal data, means that developing better understanding of dispersal is critical. To improve our understanding of dispersal, progress in three areas is a priority (i) researchers need to work harder to embrace new technology and new analytical methods that will lift the quality of data available, (ii) research is needed to better understand the complementarity, concordance and potential surrogacy of different methods and, (iii) better understanding is needed of the value of different kinds of dispersal information for supporting management decisions.

Don Driscoll is Associate Professor and leads research programs in fire ecology, ecological theory and dispersal. Don and co-authors work in the vibrant Conservation and Landscape Ecology group at ANU, which has a strong focus on applied empirical ecology.

Monday 25 November

Stream C, Session 1

Metabarcoding soil biodiversity on a forested offshore island

Drummond, Alexei¹; Dopheide, Andrew¹; Myles, Ben¹; Heled, Joseph¹; Xie, Dong¹; Nelson, Nicola¹; Buckley, Thomas¹; Newcomb, Richard¹

¹*Allan Wilson Centre for Molecular Ecology and Evolution, New Zealand*

Extracting DNA sequences directly from heterogeneous environmental samples has transformed our understanding of microbial community diversity. The increasingly routine application of next-generation amplicon sequencing to the characterization of microbial communities has dramatically changed the scale on which such data is produced. Very recently next-generation amplicon sequencing from environmental samples such as soils has been targeted at both ancient and modern plant and animal DNA. This heralds the promise of rapid, large scale biodiversity assessment of plants and animals by metabarcoding. Here we describe the application of a metabarcoding approach to a biodiversity assessment of forest soil samples from an elevational series collected from Hauturu, a protected offshore island of New Zealand. We have applied this approach alongside more traditional ecological assessments of the biodiversity of birds, vascular plants, and litter-dwelling invertebrates in the same elevational series. The results illustrate the promise of metabarcoding methods, but also the numerous considerations necessary if metabarcoding is to fulfil the promise of a quantitative methodology that scales across the broad range of taxonomy, organismal sizes and occurrence distributions encountered in environmental samples.

Alexei Drummond is Professor of Computational Biology at the University of Auckland and a Principal Investigator of the Allan Wilson Centre for Molecular Ecology and Evolution. His interests include Bayesian phylogenetics, infectious disease dynamics and molecular evolution.

Wednesday 27 November

Stream B, Session 9

Pardalotes, lerps, and parasites: causes of decline in forty-spotted pardalotesEdworthy, Amanda¹; Heinsohn, Robert²; Langmore, Naomi¹¹Australian National University, Research School of Biology²Australian National University, Fenner School of Environment and Society

Forty-spotted pardalotes have declined by 60% in the past twenty years. Potential threats to their populations include nest hollow limitation, habitat loss, high parasite loads, introduced predators, and inbreeding depression. Forty-spots are highly dependent on white gum trees for foraging and tree hollows for nesting. However, the impacts and relative importance of habitat degradation and other threats are uncertain. Habitat specialists are predicted to suffer the most from habitat loss, but recent declines of forty-spots have occurred largely within existing habitat. We studied factors affecting breeding density and nest success of forty-spotted pardalotes in southeastern Tasmania. Fly parasites were a major cause of mortality in nestlings, with parasite loads increasing throughout the summer. Nest hollows appear to limit breeding density; forty-spot nest densities were higher at sites with boxes than sites without boxes. Predation rates were low at island populations, but are uncertain on the mainland, where the greatest declines have occurred. Our results suggest that while habitat loss and degradation are major threats to forty-spotted pardalotes, factors including heavy parasite loads may drive further declines within otherwise suitable habitat.

Amanda Edworthy is a PhD student at the Australian National University. Previously she studied demographics of tree cavities used by vertebrates for nesting in British Columbia, Canada. She is interested in how tree cavities shape bird populations and communities.

Wednesday 27 November

Stream E, Session 8

Elevated CO₂ in an Australian woodland (EucFACE): Are phosphorus limitations to trees truth or myth?Ellsworth, David S.¹; Crous, Kristine Y.¹; Ösvaldsson, A.^{1,2}¹Hawkesbury Institute for the Environment, University of Western Sydney, Locked bag 1797, Penrith, NSW 2751 Australia²Department of Biology, Case Western Reserve University, Cleveland, OH 44106-7080 USA

Ancient, weathered soils low in phosphorus pervade on the Australian continent and other tropical and subtropical regions. On such soils, there is evidence that photosynthetic capacity (A_{\max}) correlates with leaf P concentration rather than the better-known relationship between A_{\max} and leaf N. By extension, such trees should show improved growth on sites with higher phosphorus availability. On the other hand, evidence for P limitations may be spurious because the correlations are based on mass rather than area-based photosynthesis-nutrient relationships. A second possibility for the myth is that these trees are adapted to grow and photosynthesise under low P conditions and may have mechanisms like mycorrhizal associations and organic acid secretion that should minimise P limitations. We measured A_{\max} and leaf P for a range of Australian species in eastern and western Australia to test whether A_{\max} correlates with leaf P. We also established a three year-long mature-tree fertilisation experiment at the *Eucalyptus* free-air CO₂ enrichment experiment to experimentally test whether P limited photosynthesis and/or growth of mature trees. A_{\max} was correlated with leaf P across a range of species and soils for leaves varying four-fold in leaf P concentration. At saturating measurement CO₂ concentrations, A_{\max} showed a saturating relationship with leaf inorganic P pools. Mature fertilised trees showed a 55% stimulation in wood growth and a 30% stimulation in leaf P with P addition over three years. The results not only show that Australian trees are indeed P-limited in terms of growth, but also in terms of leaf function.

David Ellsworth, Professor at UWS' Hawkesbury Institute, interests in tree gas exchange and how it is affected by climate change and atmospheric CO₂ concentration.

Thursday 28 November

Stream C, Session 10

Aggregated distribution modifies competitive effects in an annual plant guild in arid lands of Australia.Facelli J.M.¹; Muller C.¹¹The University of Adelaide

Diversity maintenance is achieved through a combination of mechanisms that prevent competitive exclusion. Clumped distributions of competitively dominant species can benefit subdominant species, because individuals of the dominant species are subject to strong intraspecific effects, reducing their biomass and hence interspecific competitive effects. We tested this in a guild of annual plants in a chenopod shrubland of South Australia using a combination of field and glasshouse studies. In the field we created plots with high or low density and random or clumped arrangement of *Carrichtera annua* (the dominant species) by thinning of seedlings that emerged naturally. In addition, half of the plots were watered to create high resource availability. In the glasshouse we achieved these treatments by planting different numbers and arrangements of seeds of *C. annua* in trays with soil containing the natural soil seed bank, thinning as required, and having two watering levels. In the field we found weak effects of density and arrangement of *C. annua*, while in the

glasshouse the effect was stronger. *Carrichtera annua* competed strongly intraspecifically when grown at high densities and in an aggregated distribution under higher water availability. As a result several species performed better, which resulted in higher evenness. The results suggest that the importance of aggregation varies with environmental favourability. Spatial distribution can thus be a factor contributing to the structure and diversity of communities even in systems where density dependent effects are variable.

José is interested in interactions between organisms, and in the causes and consequences of spatial and temporal variability. His research addresses how plants interact with other plants, animals, and microbes, in particular in connection to arid lands and invasive species.

Monday 25 November

Stream D, Session 2

Can excluding cane toads from water provide biodiversity benefits for arid Australia?

Feit, Benjamin^{1,2}; Letnic, Mike²

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²School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, NSW 2052

The invasion of cane toads (*Bufo marinus*) across northern Australia has been an ecological tragedy. Cane toads contain novel toxins that are absent from Australian frogs, and consequently, many predators die after attacking or consuming toads. Populations of goannas, snakes, and northern quolls have severely declined following the arrival of cane toads and the toads are now expanding their range into semi-arid regions of the continent, where they pose a serious threat to the persistence of a rich suite of carnivorous reptiles.

Unlike native arid-adapted frogs, cane toads require regular access to water to survive the long-dry periods that occur in semi-arid Australia. Consequently, sites with permanent artificial water (bore-fed dams) function as invasion hubs for cane toads, allowing toads to survive dry spells and penetrate further into the arid zone after rain. A recent study demonstrated that landholders could eradicate toads from large areas by replacing their open earthen dams with above-ground tanks made of plastic or steel that gravity feed into raised cattle troughs. These tanks do not allow toads to access water. We evaluated the effectiveness of this toad control strategy to reduce cane toad impacts on ecosystems by comparing goanna abundances and lizard communities in regions where toads can access water in bore-fed dams, with regions where toads cannot access bore-fed water sources. Our results suggest that the replacement of bore-fed dams with water tanks, by reducing toad abundance, could provide significant benefits for ecosystems in semi-arid regions of Australia.

Ben Feit is a PhD candidate at the Hawkesbury Institute for the Environment (University of Western Sydney). In his research Ben is focusing on strategies to control cane toads in semi-arid regions of Australia.

Tuesday 26 November

Stream C, Session 4

Luderick, *Girella tricuspidata*, exhibit strong site fidelity and higher abundance within marine sanctuaries

Ferguson, Adrian¹, Harvey, Euan¹, Knott, Nathan²

¹The UWA Oceans Institute and School of Plant Biology, Faculty of Natural and Agricultural Sciences, The University of Western Australia, Crawley, WA, Australia

²NSW Department of Primary Industries, Jervis Bay Marine Park, Huskisson, NSW, Australia

The key herbivore, luderick (*Girella tricuspidata*), plays an important ecological role due to its large biomass and associated grazing on temperate rocky reefs. Luderick are also heavily exploited by both commercial and recreational fisheries. Limited data exist on the ecology and behaviour of luderick, but what does exist suggests that they may be highly mobile and exhibit poor site fidelity, therefore considered unlikely to benefit from "no-take" sanctuary zones within marine parks. To evaluate whether this was actually the case we tested the hypotheses that (a) luderick would not exhibit strong site fidelity on shallow subtidal reefs (including within sanctuary zones) and that (b) there would be no difference in the abundance of luderick between sanctuary zones and fished areas. To test these hypotheses we combined the use of acoustic telemetry and stereo diver operated video (stereo-DOV) to assess fine and broad-scale movements and to quantify the abundance of luderick between sanctuary zones and fished areas in Jervis Bay Marine Park, New South Wales. Contrary to our predictions formed from the initial limited observations, luderick exhibited strong site fidelity on shallow subtidal reefs and were more abundant in sanctuary zones compared to fished areas. These results indicate that sanctuary zones are likely to play a beneficial role for luderick and highlight the need for clear quantitative assessment of abundance and movement patterns at the correct spatial and temporal scales to appropriately assess the effects of marine parks.

Adrian Ferguson, PhD candidate at the University of Western Australia, area of research interest: marine ecology, conservation biology, animal movements.

Wednesday 27 November

Stream F, Session 9

In the beginning: Phenotypic change of three species through their first 200 years since introduction.

Flores-Moreno, Habacuc¹; Garcia-Treviño, Edgar²; Moles Angela T¹

¹*Evolution & Ecology Research Centre, School of Biological, Earth and Environmental Sciences, The University of New South Wales, NSW 2052, AUSTRALIA*

²*Department of Electrical and Electronic Engineering, Imperial College London, SW72AZ London, U.K.*

Previous studies have demonstrated that introduced species go through rapid phenotypic change somewhere within decades to hundreds of years of their introduction. However, little is known about the trends these phenotypic changes follow through time. Using herbarium specimens we track the phenotypic change on the leaf area, leaf shape and plant height of three species (*Epilobium ciliatum*, *Senecio squalidus* and *Veronica persica*) through their first ~200 years since introduction to the U.K. We asked whether or not the introduced species are still changing ~200 years after their introductions and found that on average all of the species are still undergoing phenotypic change long after being introduced. Interestingly, *S. squalidus* and *V. persica* showed higher rates of change in leaf shape compared to leaf area or plant height, while *E. ciliatum* showed a higher rate of change in leaf area compared to any other trait. Then we asked whether the rate of phenotypic change is greater at the beginning of the introduction or whether there is a lag phase. We found no consistent trend across our species. *E. ciliatum* highest rate of phenotypic change was during the first two decades after its' introduction (1890-1910); *S. squalidus* highest rate of phenotypic change was 100 years after its' introduction (1800's); while *V. persica* highest rate of phenotypic change was ~200 years after its' introduction (1980-2000's). Our results improve our understating of the influence of new environments on species' phenotype and processes of change, ultimately advancing ideas in trends and rates of character evolution.

Habacuc Flores-Moreno is a PhD candidate at the Big Ecology Lab at UNSW. He is mainly interested in plant functional traits and their connection to fitness. Currently, he is working on broad scale patterns on invasive species.

Monday 25 November

Stream B, Session 3

The role of sexual and asexual reproduction in threatened native semi arid Acacia populations in far western NSW.

Forrest, Cairo¹; Roberts, David²; Denham, Andrew³; Ayre, David⁴

¹*University of Wollongong*

²*University of Wollongong*

³*Office of Environment and Heritage*

⁴*University of Wollongong*

A rare La Nina rain event has provided an important opportunity to assess the role and importance of sex in long lived semi arid acacia species that have rarely been observed to set fruit, but reproduce asexually via suckering. Using a comparative approach and a range of habitat, demographic and genetic data sets, we ask whether the highly fragmented landscape within which these populations exist is likely to affect levels of sexual and asexual forms of reproduction. We found that the current importance of sexual reproduction varies dramatically among species and even among populations within species. While some species rely strongly on sexual recruitment, most populations of *A. carneorum* are currently monoclonal and this species may be trending towards obligate clonality. By investigating a variety of key mating system parameters including pollinator services, presence of mate choice mechanisms and level of self compatibility, we looked for links between mating system restrictions and reproductive failure. While we found no evidence that historic and current failure to sexually reproduce was unnatural, or that fragmentation affected the fitness of the next generation, we found that increased isolation served to reduce genetic diversity of seed cohorts dramatically. Given predicted climate change and an apparent lack of genetic diversity in many populations, especially of *A. carneorum*, we suggest that pre-emptive genetic rescue strategies should be considered as a conservation tool to increase the adaptive ability of certain populations and thus chances of future persistence.

Cairo Forrest is a PhD student interested in the reproductive strategies /mating systems of long lived plants, their response to anthropogenic disturbance such as fragmentation and the use of 'genetic rescue' as a conservation strategy.

Wednesday 27 November

Stream D, Session 8

Are wallabies bad for spiders? Indirect interactions between large herbivores and arthropods in a post-fire environment.

Foster, Claire¹; Barton, Phillip^{1,2}; Lindenmayer, David^{1,2,3}

¹*Fenner School of Environment and Society, The Australian National University, Canberra ACT 0200, Australia.*

²*Australian Research Council Centre of Excellence for Environmental Decisions and the National Environmental Research Program Environmental Decisions Hub, The Australian National University, Canberra ACT 0200, Australia.*

³*The Long-term Ecological Research Network, The Australian National University, Canberra ACT 0200, Australia.*

Large herbivores play a central role in the structure and functioning of ecosystems worldwide and affect other organisms through

both direct and indirect pathways. How herbivory interacts with other disturbance processes such as fire remains poorly understood. We conducted a randomised blocked experiment to investigate the effect of wallaby and kangaroo exclusion on other fauna in both undisturbed and recently burnt environments. Here we report results for web-building spiders, which were sampled using web counts. Three months after fire, spider webs were twice as abundant on unburnt sites as burnt sites, while nine months after fire there was no difference between burnt and unburnt sites. Similar patterns were evident for web richness. Web community composition also differed significantly between burning treatments with leaf curling orb webs (*Phonognatha* and *Araneus spp.*) and horizontal sheet webs (*Achaearanea spp.*) being at low abundance on burnt sites compared with unburnt sites. Less than a year after herbivore exclusion, web spiders had also responded to the herbivory treatments. Web abundance and diversity were both higher in herbivore exclusion sites than in unfenced controls for both burnt and unburnt treatments. There were no significant treatment interactions. Changes in the spider community were likely mediated through changes in the vegetation structure; treatments with high web abundance and diversity also had higher percentage cover of shrubs and grasses and lower dominance of ferns. The web-building spider community recovered rapidly after disturbance; both after the discrete disturbance of fire and after relief from the chronic disturbance of herbivory.

Claire is studying for a PhD in Environment at the ANU. Her research investigates how highly abundant native herbivores interact with fire to affect plant and animal communities. Broader research interests include species interactions and community dynamics.

Monday 25 November

Stream D, Session 1

Evaluating the restoration potential of transferred topsoil

Fowler, William^{1,2}; Fontaine, Joe¹; Enright, Neal¹

¹ *Environment and Conservation Sciences, Murdoch University, Perth, Australia*

² *Department of Environment and Agriculture, Curtin University, Perth, Australia*

Global change, population growth and urbanisation are ever-increasing pressures on biodiversity and ecosystem function. Given that conservation of existing natural fragments will not be sufficient to maintain extant biodiversity or meet conservation goals, there is a major need for the practice of ecological restoration whereby degraded lands are managed to increase and maintain indigenous species. However, technical capacity lags and research on restoration tools is vitally needed.

One increasingly common restoration tool is topsoil transfer, moving quality topsoil and its associated soil seed bank (SSB), nutrients, and soil fauna to degraded areas. To assess the capacity of topsoil transfer, several key aspects of the SSB were examined parallel to a real-world topsoil transfer in south-west Australia. We evaluated restoration values of topsoil transfer, by investigating plant functional traits, SSB similarity to extant vegetation, exploring mechanisms to improve restoration outcomes, and what influence the process of topsoil transfer has on germinable seed.

Glasshouse germination was monitored over 13 weeks from 24 pre and 24 post-transfer soil samples. Treatment included soil depth and smoke plus heat combined. Topsoil transfer resulted in significant seed dilution, equal mixing through the soil profile relative to pre-transfer soils and a marked change in species composition (including lack of perennial species). Smoke and heat failed to stimulate additional germination post-transfer.

Topsoil transfer, while successfully translocating native seeds, influences restoration success through dilution and lack of perennial species, thus suggesting a need for topsoil transfer to be supplemented by other restoration techniques, and therefore limiting its cost effectiveness.

William Fowler is currently a Research Assistant with the Plant Ecology and Evolution Group at Curtin University, Western Australia. William is interested in a broad range of ecological issues, focused on plant ecology and restoration.

Tuesday 26 November

Stream E, Session 4

The potential of New Zealand native plants to mitigate nutrient transport from agricultural land

Franklin, Hannah¹, Dickinson, Nicholas¹ and Robinson, Brett¹

¹ *Lincoln University, PO Box 85084, Christchurch, 7647, +64 3321*

The success of agricultural production in New Zealand is dependent on maintaining a "Pure Clean Green" brand and avoidance of real or perceived contamination risk. Of increasing concern is management of more mobile forms of nitrogen from fertilisers and wastes that may leach to waterways or contribute to greenhouse emissions. Coupled with this, there is growing recognition of the benefits associated with increased biodiversity in agricultural landscapes. Riparian or paddock-edge vegetation is potentially a cost effective and environmentally-friendly nutrient mitigation technique. Plants and their rhizospheres can assimilate nutrients and filter soil-water before it enters waterways. Native plants also provide habitat linkages in agricultural landscapes and ecosystem services, such as increased crop pollination, pest and disease control. However, relatively little is known about the capability of New Zealand's native plants to mediate nutrient fluxes. In the present paper we focus on native plant growth response, assimilative capacities and the role that variable rhizospheres play in these processes. A combination of glasshouse and field studies have used species that are currently widely used in restoration efforts. This paper will present data from analyses of plant growth and nutrient assimilation, together with an investigation of soil pore water leachates and nitrous oxide emissions from plant rhizospheres. Native plants are shown to significantly differ in their modification of soil nutrients through their differing rhizospheres. It is argued that this knowledge of the ameliorative capabilities of native plants could be used to make informed decisions in sustainable agricultural management.

Hannah Franklin is a second year Ph.D candidate in Ecology Department at Lincoln University. Research interests include both landscape and freshwater ecology, particularly the biogeochemistry of these systems.

Wednesday 27 November

Stream F, Session 8

The curious case of the non-flammable grassland

Fraser, Imogen P.¹; Williams, Richard J.²; Murphy, Brett P.¹; Camac, James S.¹; Vesk, Peter A.¹

¹School of Botany, The University of Melbourne, Parkville, Victoria, Australia

²CSIRO Tropical Ecosystems Research Centre, Winnellie, Northern Territory, Australia

Factors governing landscape flammability are poorly understood, yet critical to managing fire regimes at local, regional and continental scales. Studies of the extent and severity of the extensive 2003 fires in the Australian Alps showed marked differences in flammability between vegetation communities (closed heathland > open heathland >> grassland). To explain this spatial variation in flammability, we assessed life form and landscape-scale variation in two fundamental physical properties of fuel – mass and bulk density. We surveyed fuels at 56 sites (both burnt and unburnt in 2003) across the Bogong High Plains. Shrub cover was strongly and positively related to mass and negatively related to bulk density. Closed heathlands were characterised by high shrub cover, high fuel mass and low bulk density (i.e. well aerated fuels). In comparison, grasslands had lower shrub cover, lower fuel mass, and much higher fuel bulk density. Fuel mass and bulk density can be predicted with high accuracy using simple measures of canopy height and shrub cover. We also conducted field-based burning experiments on individual shrubs and snowgrass patches to test life form flammability directly. By all measures shrubs were more flammable than dense snowgrass patches. The substantial differences in fuel mass and structure observed between heathlands and grasslands, and the differential flammability of shrubs and snowgrass, are highly consistent with burning patterns observed in 2003, and suggest that alpine landscapes are differentially flammable owing to differences in the flammability of the dominant life forms.

Imogen Fraser is an Honours student. Her research interests include fire ecology, vegetation flammability, fire behaviour and fuel management.

Thursday 28 November

Stream F, Session 10

The effect of natural flooding on floodplain understorey vegetation, following extended drought in Northwestern Victoria

Freestone, Fiona^{1,2}; Campbell, Cherie^{1,2}; Cranston, Greg^{1,2}

¹Murray-Darling Freshwater Research Centre

²La Trobe University

This study looks at the ability of flood-responsive plant species to regenerate following a natural flood, after extended drought, on the floodplain. River regulation has reduced flood variability of the Murray River on Hattah Lakes, Lindsay, Mulcra and Wallpolla (LMW) Islands. As a result it is anticipated that flood-responsive vegetation habitat will reduce and communities will be replaced with drought tolerant species. Current research recommends River Red Gum (RRG) vegetation communities be inundated once in three to five years, and Black Box Woodland (BBW) communities be inundated once in ten years for the survival of flood-responsive species. Little work has been undertaken to understand the specific requirements of floodplain understorey vegetation communities in this region. Floodplain understorey vegetation has been surveyed annually (2006–07 to 2012–13) at Hattah Lakes and LMW as part of condition monitoring under The Living Murray program. Natural flooding in 2010–11 provided opportunity to monitor response to disturbance in a natural habitat. Prior to the natural flood, sites in RRG communities had not been inundated for 10 to 15 years and were dominated by drought tolerant species. Following the flood, these sites recorded an array of flood-responsive species. This response demonstrates the resilience of floodplain communities to withstand extended drought. Most BBW sites were not inundated in 2010–11 and have now been dry for ~20 years and remain dominated by drought tolerant species. This study contributes to existing research on floodplain understorey vegetation, and may have implications for water management practices.

Fiona Freestone has been a Vegetation Research Technician for one year at the Murray-Darling Freshwater Research Centre in Mildura. She is interested in the dynamics of floodplain and wetland vegetation communities and their response to disturbance, such as flooding.

Monday 25 November

Stream F, Session 1

Studying sensory adaptations of petrels for use in conservation

Friesen, Megan¹; Beggs, Jacqueline¹; Gaskett, Anne¹

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Seabirds are thought to have evolved unique sensory adaptations as a result of their extreme environments. Tube-nosed seabirds (Procellariiformes) have been at the center of many of these studies. Their unique behaviours, such as foraging at great distances

from land and returning to their burrows in colonies at night, mean that Procellariiformes rely greatly on chemical and auditory cues. Procellariiformes are also one of the most-rapidly declining orders of birds in the world. We believe that understanding and integrating their sensory adaptations into management practices is the key to more effective conservation. Our aim is to *i.* compare the birds' odour profiles to nesting material for the end goal of using these scents to aid in translocation efforts, *ii.* analyse and compare vocalizations for optimal success in acoustic attractions. We extracted volatile organic compounds from feathers and nest material using solid phase microextraction coupled with gas chromatography mass spectrometry analysis. Additionally, we recorded and measured vocalizations of prospecting adults. Our results show similarities between calls, and odours exhibiting plant-based compounds specific to their nesting material (including terpenes, aldehydes, aromatic hydrocarbons, and others). Currently, data is being investigated to understand the link between the generated odors and the life history of the petrels and how these unique traits can be used to improve conservation practices

Megan Friesen is currently a PhD student at the University of Auckland. She is interested in seabird biology, sensory ecology and wildlife conservation.

Wednesday 27 November

Stream B, Session 9

Trade-offs and dispersal in unpredictable environments: generalist invertebrate persistence in ponds

Galatowitsch, Mark L.¹; Goldstien, Sharyn¹; McIntosh, Angus¹

¹*School of Biological Sciences, University of Canterbury, Christchurch, New Zealand*

Flexible life-history traits and dispersal may allow generalist populations to persist across a range of heterogeneous habitats despite experiencing variable selection pressures. Temporary pond generalist invertebrates must develop quickly and disperse as adults, or have wide environmental tolerances. Conversely, in permanent ponds they must avoid a suite of predators (e.g., fish and dragonflies). This 'predator-permanence gradient' results in life-history trade-offs that influence fitness, population dynamics, and genetic structure. In addition, recruitment between habitats may be crucial to maintain generalist populations. We examined *Xanthocnemis* damselfly and *Sigara* waterboatman populations in New Zealand lakes and irregularly drying ponds through field surveys, mesocosm experiments, and microsatellite analyses to test whether: (1) generalists have flexible developmental and behavioural traits to survive different habitat conditions, and 2) terrestrially-dispersing generalists oviposit across habitat types to maximize reproductive potential.

We found generalist invertebrates used alternative life-history strategies to exploit habitats across the predator-permanence gradient. *Xanthocnemis* had longer development and consequently were exposed to more biotic and abiotic stressors. This was offset by flexible predator avoidance behaviours and drying tolerance. In contrast, *Sigara*'s rapid and inflexible life-cycle enabled them to exploit more temporary habitats, but were intolerant of drying. While generalists had different life-history flexibilities, dispersal was critical to maintain generalist populations across unpredictable disturbance regimes. Our microsatellite analyses indicate extensive genetic mixing across the predator-permanence gradient. However, irregular disturbance may be limiting genetic variation. Life-history traits that allow generalists to persist across unpredictable habitats may be crucial to their response to altered hydrology under climate change.

Mark L. Galatowitsch is a PhD student with interests in the role of invertebrate dispersal to sustain populations across heterogeneous environments and how these movements may influence their evolutionary ecology.

Monday 25 November

Stream E, Session 1

Planned fire, gullies and refugia. Where do bush rats go?

Galindez Silva, Carolina¹; Di Stefano, Julian¹; York, Alan¹; Thavamanikumar, Saravanan¹

¹*University of Melbourne*

Movement is a fundamental process that influences the behavioural response of species to a change in habitat structure. Fire changes the distribution and abundance of important resources that animals need for survival and reproduction forcing them to find resources elsewhere. In a burnt region, areas that remain unburnt are associated with increased survival. In this way, unburnt gullies may act as refugia, providing a safe place to escape from fire.

This research studied the response of bush rats (*Rattus fuscipes*) to a planned burn in Victoria, Australia. It is focused on the role of gullies as refugia during the fire event. The study area includes a site burnt in March 2012 as part of the Department of Environment and Primary Industries (DEPI) program of planned fire, as well as a nearby location with similar vegetation characteristics. Bush rats were trapped before and after fire, tissue samples were collected for DNA fingerprinting and microsatellite genotyping to study population movement due to fire.

Results show evidence that bush rats used the same area after the fire as they had beforehand. This specific planned burn was of low intensity and did not have a significant effect on resources; suggesting that bush rats did not need to find refugia in gullies. These results will help improve the capacity for land managers to consider the ecological effects of planned fire by linking fire, resources and behavioural responses.

Carolina Galindez Silva is a PhD Candidate at the University of Melbourne. Her interests include Behavioural ecology, Fire ecology.

Monday 25 November

Stream E, Session 1

Behavioural responses of stoats to the presence of a dominant competitor

Garvey, Patrick¹; Pech, Roger²; Glen, Al²; Clout, Mick¹

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Interference competition between predators strongly influences the structure and composition of ecological communities. These interactions are usually asymmetrical as larger predators dominate in aggressive encounters. Smaller predators are therefore forced to balance the conflicting demands of obtaining food while reducing the risk of a confrontation.

We tested the behavioural responses of 16 wild captured stoats (*Mustela erminea*) to the presence of two larger predators, the feral cat (*Felis catus*) and the ferret (*Mustela furo*). Stoats were individually released into an outdoor arena and nocturnal activities were recorded on infra-red video cameras. On treatment nights, one of the larger predators was placed inside a segregated holding cage within the arena, while a control cage was placed in the other peripheral pen. A stoats' daily food allocation was divided into two equal portions, one placed in front of each holding cage to form a food "patch". A stoats' perception of risk was assessed by comparing behaviour at the high-risk versus the low-risk areas.

We found that stoats harvested significantly less food, increased levels of vigilance and avoided the area containing the larger predators both spatially and temporally. The results show that stoats alter their foraging behaviour due to interference competition when they encounter larger predators. Understanding trophic interactions is essential when making conservation decisions where mustelids are invasive species. Pest control directed specifically at feral cats and/or ferrets is likely to alter the behaviour of stoats, potentially leading to increased predation on prey species particularly susceptible to stoats.

Patrick Garvey, PhD Student, I'm interested in ecological interactions between invasive animals, the consequences of removing top predators and the preservation of ecosystem processes.

Tuesday 26 November

Stream F, Session 6

Use of drip irrigation to improve floodplain blackbox (*Eucalyptus largiflorens*) woodlands.

Gehrig, Susan¹;

¹ South Australian Research and Development Institute (SARDI, Aquatic Sciences Division)

From 2001 to 2010, the southern Murray-Darling Basin (MDB) experienced severe drought conditions and a concurrent dieback of floodplain eucalypts (river red gums, *Eucalyptus camaldulensis* and black box, *Eucalyptus largiflorens*). To improve floodplain eucalypt health during low flow periods and drought, regular watering interventions (e.g. filling temporary wetlands, weir pool manipulations) were used as an effective management intervention tool. In 2010/11 there was widespread flooding across the MDB leading to improved condition. Nonetheless, many black box trees at higher elevations on the floodplain remained unflooded, leaving these trees vulnerable to further decline without short to medium term interventions. To alleviate further declines in tree health the use of drip irrigation as a direct watering technique for black box woodlands was trialled on the Markaranka Floodplain (lower River Murray, South Australia). The preliminary phase of the project tested the effectiveness of this technique using a range of tree condition, eco-physiological and understorey vegetation assessments. During the 22-week experimental period (November 2012 to April 2013) irrigated plots were watered weekly at a precipitation rate of ~18 mm week⁻¹ (total water volume = 4.2ML). Despite seasonal variations, black box tree condition scores, tree water potential (Ψ), understorey species richness and percentage cover, all significantly improved in irrigated versus unirrigated plots, indicating the technique is effective. Ongoing trials aim to focus on determining the optimal watering regime (volume, frequency, duration) to identify key thresholds and indicators of black box woodland condition.

Dr Susan Gehrig is a Senior Research Officer within the Plant Ecology sub-program at SARDI, Aquatic Sciences. Her areas of interest include the ecology of freshwater systems and in particular the water requirements of vegetation communities.

Thursday 28 November

Stream C, Session 11

Optimal fire management strategies are sensitive to conservation objectives and taxonomic focus

Giljohann, Katherine M¹; McCarthy, Michael A¹; Regan, Tracey J¹; Kelly, Luke T¹

¹ARC Centre of Excellence for Environmental Decisions, The University of Melbourne, Australia

Maintaining the conditions required for the persistence of all species is a primary goal of conservation management. However, conditions that promote persistence may differ for the species in the community, and management objectives may be specified in a number of ways. Thus, the best management action to take now to ensure future preservation can be complex and unintuitive. This is especially pertinent for systems subject to stochastic disturbances such as fire.

This study investigates a number of alternate management objectives to maximize community diversity using a decision-theoretic approach. Objectives are based on three biodiversity indices and incorporate the modelled abundance of multiple species across post-fire successional vegetation. This provides a clear link between species presence and the management objectives. Case study data are sourced from field surveys of birds, reptiles and small mammals in semi-arid Australia. We also explore a recent government policy of fixed annual prescribed burning targets and assess potential conservation impacts from burning between 0-5% of the landscape.

The optimal management strategy for the community was sensitive to the choice of objective function and to the species included in the analysis. For example, birds did not prove a good surrogate for reptile persistence. This indicates that selection of an appropriate objective requires careful consideration as does the choice of species for monitoring. Potential costs from fixed burning targets indicate that over the next 100yrs a 5% target could increase the probability of extinction for the modelled species by 7% compared to the optimal management scenario.

Kate Giljohann, PhD student in the School of Botany at The University of Melbourne. Research interests are plant ecology with a particular focus on landscape disturbances (fire and invasive species), species dynamics and biodiversity conservation.

Tuesday 26 November

Stream F, Session 4

Does alien grass invasion affect recruitment dynamics and reproduction of resident native plants?

Gooden, Ben¹; French, Kris¹

¹*Institute for Conservation Biology and Environmental Management, University of Wollongong, NSW, Australia*

Alien plant invasion is commonly associated with reduced species diversity of indigenous plant communities, yet the mechanisms underlying community responses are poorly known. We assessed the effects of alien grass (*Stenotaphrum secundatum*) invasion on recruitment dynamics of three native plants (prostrate herb *Tetragonia tetragonioides*, rhizomatous graminoids *Baumea juncea*, *Juncus kraussii*) in an endangered swamp community along the southern Australian coastline. Using a multi-site comparison procedure, we determined how three components of species' recruitment pathways differ between invaded and native (reference) habitats: (1) their frequency of occurrence (i.e. distribution) and abundance in the standing vegetation; (2) reproductive output (i.e. total number of fruit), effort (i.e. number of fruit as a function of plant biomass) and fecundity (i.e. proportion of original floral units developing into propagules) of reproductively mature plants; (3) distribution and density of propagules in the soil seed bank. Invasion had no effect on the likelihood of any species occurring in the standing vegetation, although abundances of *B. juncea* and *J. kraussii* were significantly lower in invaded than native habitats. The biomass and reproductive output (but not effort) of mature plants were significantly lower in invaded habitats for all species. Despite reduced reproductive output, invasion had no effect on the occurrence or density of propagules in the seed bank for any species. We conclude that invasion is likely to drive the displacement of natives by reducing the germination of propagules, establishment of recruits, and reduced growth of mature plants rather than inhibiting the supply of their propagules to invaded sites.

Ben is finishing his PhD (Wollongong University) on the community responses to grass invasion in coastal forests of eastern Australian, and wishes to pursue postdoctoral research on plant community assembly dynamics in the face of global environmental change (www.bengooden.com).

Wednesday 27 November

Stream A, Session 7

Killing possums collaboratively: the invasion of public knowledge into pest control decision making.

Greenaway, Alison¹

¹*Manaaki Whenua Landcare Research Ltd.*

The issue of whose voices matter in possum control decision making, and for which decisions, remains fairly contentious in NZ. Increased community engagement and more collaborative decision making can improve acceptance of possum control operations. However, increasing participation in decision making can be politically risky, financially costly and difficult to operationalize. This paper puts forward the question – how invasive should public knowledge be in possum control decision making? This question responds to insights gained from an MBIE funded research programme exploring how conflict can be managed through public participation in pest control decision making. Social science approaches to understanding decision making will be presented. Alison will discuss frameworks for addressing knowledge transfer processes and questions of trust, evidence and risk. Better understanding of the many publics and sites of possum control decision making will help determine where public knowledge incursions might lead to less conflict and more robust possum control decision making.

Alison Greenaway is a Social Scientist in the Governance and Policy Team at Manaaki Whenua Landcare Research, based in the Auckland office. Over the last 9 years she has worked at many interfaces of sustainable development knowledge and practice, including issues of urban development, climate change and more recently pest control decision making.

Thursday 28 November

Stream A, Session 11

Can airborne laser scanning enhance ecological outcomes of large scale *Salix cinerea* control?

Griffiths, James¹; Howell, Clayton¹; Burlace, David¹.¹Department of Conservation 18-32 Manners Street, Wellington, New Zealand

We investigated the potential of Airborne Laser Scanning (ALS) to enhance ecological outcomes of aerial herbicide broadcast for large scale control of *Salix cinerea*, an invasive weed in New Zealand's palustrine wetlands. In particular, we focused on two metrics; tree height and canopy density, which influence the efficacy and off-target impacts of herbicides aerially broadcast by helicopter for tree weed control.

We compared ground-based measures of *S. cinerea* height, canopy density, and aerial herbicide deposition with canopy height and density metrics derived from ALS data at three wetland sites in New Zealand. Analysis revealed strong linear relationships between ground and ALS metrics indicating ALS data could be used to produce accurate high resolution digital maps of *S. cinerea* height and canopy density. These maps could be uploaded to helicopter navigation computers to guide optimal aerial herbicide placement, maximising *S. cinerea* mortality and reducing off-target indigenous plant mortality. The ability to quickly and accurately assess tree stand architecture over large areas, and the development of computer guided variable flow-rate technologies that allow precise herbicide application, suggest that ALS could play an increasingly important role in the conservation management of *S. cinerea* and other tree weeds.

James Griffiths works as ecologist for the New Zealand Department of Conservation. Research interests include; application of remote sensing technology to conservation management, and improving ecological outcomes of large scale plant and animal pest management.

Monday 25 November

Stream B, Session 3

Do reproductive strategies in clonal plants change along a stress gradient?

Griffiths, Joshua¹; Bonser, Stephen¹¹Evolution & Ecology Research Centre, School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, NSW, 2052 Australia.

Understanding how organisms respond to stressful environments remains a central goal in ecology. Stress often induces sexual reproduction in facultatively sexual species (species capable of both sexual and asexual reproduction). Sexual reproduction can increase rates of adaptation and can be advantageous in stressful environments. However, not all facultatively sexual plant species increase sex allocation in stressful environments. Many plant species exhibit allometry in reproductive allocation. In other words, allocation to sexual reproduction tends to be greater in large plants and plants in benign environments. Thus, any relationship between the allocation to sexual reproduction and environmental stress may be complex and potentially non-linear. We tested the reproductive responses of a range of facultatively sexual (clonal) plant species along a nutrient stress gradient maintained by controlled addition of liquid fertiliser. Using a stress gradient we predict reproductive strategies will change with increasingly stressful and harsh growing conditions in a non-linear way. Nutrient impoverishment significantly reduced growth in all species; however allocation to sexual reproduction was highly variable between species. Some species allocated more to reproduction in low stress environments. For these species, allocation to reproduction is consistent with an allometric interpretation. Other species allocated to reproduction in high stress environments. For these species, allocation to reproduction is consistent with an adaptive interpretation. Our results are an important step in explaining the observed range of reproductive strategies on stress gradients in plants.

Joshua Griffiths is a second year PhD student studying life history ecology and evolution in clonal plants. Interested in how clonal plants reproduce in stressful environments.

Thursday 28 November

Stream D, Session 10

Context-dependence complicates the prediction of invasion outcomes: a case study with the invasive yellow crazy ant

Gruber, Monica¹¹Victoria University of Wellington

The risks of invasive species are routinely assessed with reference to the effects of the species in other invaded areas. Often the most well-studied (and publicised) invasions are those associated with extreme negative effects. However, in some cases these extreme effects may be rare and unpredictable, which complicates both risk assessment and management strategies. Here I outline the invasion history and population dynamics of the yellow crazy ant in a number of locations throughout the Pacific, compared with an extreme scenario of an 'invasion meltdown' on Christmas Island in the Indian Ocean. In some cases in the Pacific the effects of this ant are negligible. However, in rare cases of high abundance the negative effects are extreme. Moreover, the ecological predictors of abundance are not consistent. This talk highlights the ecological and social implications of the context-dependence of invasion outcomes.

Monica Gruber is a post-doctoral researcher with interests in the underlying mechanisms that drive the population dynamics that lead to the success (and failure) of species invasions.

Thursday 28 November

Stream F, Session 10

Small mammal and reptile response to a 15-year old integrated management program in a semi-arid environment

Haby, Nerissa¹; Brandle, Robert¹

¹Natural Resources, SA Arid Lands, Department for Environment, Water and Natural Resources

Prolonged unsustainable grazing regimes in the past, combined with the invasion of introduced herbivores and predators, has degraded communities in the semi-arid central and northern Flinders Ranges, South Australia. To improve the capacity of the landscape to support native species, multiple, integrated pest control and monitoring programs were activated under 'Bounceback'. To track the response of small mammals and reptiles to the removal of a regulated grazing regime (cattle and sheep) and rabbit control, eight monitoring webs were surveyed between 1997 and 2011. Fine-scale environmental composition varied between webs, leading to the data being stratified before testing for differences in species richness between areas using univariate statistics (ANOVA). Additional generalised linear mixed effect models were used to explore drivers of species-specific responses. Preliminary results identified greater species richness in ungrazed (cattle, sheep) low and tall shrub vegetation on sloping loamy soils, and tall shrubs on sloping and flat sandy soils, or in areas of rabbit control in low shrubs in ephemeral creeks. In contrast, more species were detected in areas under a grazing regime in low and tall shrubs on flat topography, and tall shrubs in ephemeral creeks. Mixed support for increased small mammal and reptile richness in response to reduced herbivory by introduced species highlights the need to consider the contribution of native herbivores to total grazing pressure in a semi-arid environment, and an appropriate scale to sample environmental change as well as species' responses, when designing a monitoring program.

One of Nerissa's roles as a Landscape Ecologist, Natural Resources Arid Lands, is to aid in the review of a long-term monitoring program: Bounceback. This program has been supported by a large number of people.

Wednesday 27 November

Stream B, Session 9

Eucalypt psyllid population dynamics and psyllid-induced tree decline – a case study from Western Sydney

Hall, Aidan¹; Cook, James¹; Johnson, Scott¹; Riegler, Markus¹

¹Hawkesbury Institute for the Environment, University of Western Sydney, Locked Bag 1797, Penrith NSW 2751, Australia

The Cumberland Plain Woodland (CPW) of Western Sydney is experiencing massive infestations by a psyllid species belonging to the lace lerp genus of *Cardiaspina*. CPW is listed as a critically endangered ecological community under the Threatened Species Conservation Act 1995. This psyllid outbreak severely impacts ecosystem function and is raising severe community concerns as the only host species of this psyllid, *Eucalyptus moluccana* (Grey Box), is the dominant tree species in the region. Trees throughout a large portion of CPW remnants have been severely defoliated, with apparent mortality increasing due to consecutive years of defoliation. The psyllid outbreak has been surveyed over a 12 month period. This study included examination of the biology of the psyllid, its antagonists, climate factors and overall tree decline. We found a significant decline in tree health over time with increasing tree mortality and subsequent spread of the outbreak. This psyllid species is able to achieve four generations per year. Four parasitoid morphospecies were recognised to be involved as parasitoids and hyperparasitoids. Molecular characterisation of the parasitoids confirmed four distinct clades and facilitated the study of their ecological role. Although parasitism rates reached up to 40%, leaf availability and not parasitism more strongly regulated this psyllid outbreak. Finally, our study demonstrated that climate variables, in particular rainfall and temperature, are key drivers in initiation, intensity and collapse of this outbreak.

Aidan Hall, PhD Candidate, is interested in plant-insect and insect-microbe interactions, with a focus on eucalypt insect herbivores and their symbionts. He is also interested in insect responses to climate change implications for population dynamics.

Wednesday 27 November

Stream F, Session 9

Prime time: do fungi prime litter for invertebrates?

Harrop-Archibald, Hilary¹; Hobbs, Richard J.¹; Standish, Rachel J.¹; Didham, Raphael K.²; Tibbett, Mark³

¹School of Plant Biology, The University of Western Australia, 35 Stirling Hwy, Crawley, WA 6009, Australia

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³School of Applied Sciences, Cranfield University, Bedfordshire, MK43 0AL, UK

Fungi and invertebrates are key players in litter decomposition yet our understanding of their interactions is limited. Litter with high lignin content may experience a time lag between time of fall and time of attack by soil animals; the consumption of low quality litter by invertebrates has been shown to increase with time. Microflora condition sclerophyllous litter through enzyme activities, improved carbon to nutrient ratios, and the breakdown of inhibitory compounds, and may be necessary for subsequent digestion of litter by saprophagous arthropods. Yet the conditioning of leaf litter by soil fungi for soil animals has seldom been studied.

This study examined the potential priming effect of both brown-rot and white-rot saprotrophic fungi on the leaf litter of eucalyptus and acacia species for invertebrate decomposers. Sterile microcosms containing leaf litter of *Eucalyptus loxophleba* and *Acacia acuminata*

were inoculated with Beefsteak fungus (*Fistulina hepatica*), Lilac Bracket fungus (*fomitopsis lilacinogilva*), and Scarlet Bracket fungus (*Pycnoporus coccineus*). The Portuguese millipede (*Ommatoiulus moreleti*), was introduced to the microcosms once the fungi were established. Response variables included changes in lignin, cellulose, and hemicellulose, leaf carbon to nutrient ratios, leaf area, and leaf fragmentation. Covariates included percentage fungal colonization and initial millipede weight. Preliminary results seem to indicate greater leaf area loss for *Eucalyptus loxophleba* inoculated with *Pycnoporus coccineus*. Understanding the interactions between organisms that influence decomposition processes and drive nutrient cycling is a fundamental component of linking above-ground and below-ground ecology.

Hilary Harrop-Archibald, PhD Candidate, decomposition, fungi, food webs, insect ecology

Wednesday 27 November

Stream E, Session 9

Attractiveness of volatiles from natural honeybee hive products to the small hive beetle *Aethina tumida* (Coleoptera: Nitidulidae)

Hayes, R. Andrew¹; Rice, Steven J²; Leemon, Diana M²

¹Horticulture and Forestry Science, Department of Agriculture, Fisheries and Forestry, Queensland, Brisbane, Australia

²Animal Science, Department of Agriculture, Fisheries and Forestry, Queensland, Brisbane, Australia

Small hive beetle *Aethina tumida* is a scavenger of European honeybees, *Apis mellifera*. In its native sub-Saharan Africa it is a minor pest infesting weak or stressed colonies. Since 1996 the beetle has become established and a major apiary pest in the USA and then Australia. The beetles feed on unprotected bee brood, eggs, honey and pollen and contaminate hive products with their waste. The beetles are associated with a yeast, *Kodamaea ohmeri*, that is believed to be primarily responsible for fermentation of hive products. The resulting fermented honey (or “slime”) is rejected by honeybees and cannot be marketed by the beekeeper. Heavy infestations result in hive death, queens ceasing to lay eggs or bees absconding from hives. Between 2009 and 2011 recorded losses in Queensland alone were in excess of \$8 million. The beetles are attracted to a range of hive odours, particularly that of adult worker bees and the odours of fermenting hive products.

We used gas chromatography-mass spectrometry and choice-test behavioural assays to investigate changes in volatile profiles through time of hive products altered by the action of beetle larvae and *K. ohmeri*, and differences in attractiveness of these hive products to the beetle. Attractiveness of the slime increased as fermentation progressed, and volatile profiles became more complex. Slime remained extremely attractive for more than 30 days. These results have strong implications for the development of an out-of-hive attractant trap to assist in the management of this invasive pest.

Andrew Hayes is a Senior Scientist (Chemistry and Chemical Ecology) with the Queensland Department of Agriculture, Fisheries & Forestry. He has studied the chemical ecology of a variety of vertebrate and invertebrate species towards sustainable pest management.

Tuesday 26 November

Stream E, Session 5

A physiologically based model for projecting the potential distribution of invasive plants

Higgins, Steven¹; Magarey, Roger²

¹University of Otago

²North Carolina State University

We adapt the Thornley Transport Resistance (TTR) Model for modelling plant species distributions. The TTR model is a physiologically based model which simulates how the transport of nitrogen and carbon between roots and shoots influences plant growth. We link the TTR model with functions that describe how the model's parameters are influenced by abiotic environmental factors. We use indirect statistical methods to estimate the model's parameters from species distribution data. We first show that the model does a reasonable job of predicting the distribution of European tree species. In a second analysis we show that the model can predict the invasive range of invasive plant species. We conclude that physiologically based models can be used to derive the physiological niche dimensions of plants. Our test of the method using native and invasive ranges of invasive plants suggests that the TTR model is a promising avenue for the future development of species distribution models.

Steven I. Higgins is a Professor of Botany at the University of Otago. His research explores how interactions between plants and their environment shape ecological systems.

Wednesday 27 November

Stream E, Session 9

You changed your tune: diurnal variation in avian song complexity

Hill, Samuel David¹, Ji, Weihong¹

¹Human-Wildlife Interactions Research Group, Institute of Natural and Mathematical Sciences, Massey University, North Shore Mail Centre, Private Bag 102904, Auckland, 1131, New Zealand

The vocal activity of breeding birds can vary diurnally. Dawn is a time of day notoriously associated with long and complex bouts of singing in birds. It is thought that optimal climatic conditions could be why dawn song is so elaborate. Complex songs have been shown to be produced most frequently during the dawn chorus. Singing during dawn and dusk can function in territory assertion. Studies investigating vocal variation as a function of time of day however remain scarce. Song structure differences between dawn, meridian and dusk have been demonstrated in some species whereas song output has been shown to be greater at dawn than dusk. However, diurnal variation in song complexity has not been investigated. We aimed to compare the variation in song complexity in tui between dawn, meridian and dusk with the hypothesis that dawn songs would be more complex than at other times of day. We recorded tui songs for three hours at dawn, meridian and dusk during breeding season. Song complexity was determined by measuring four parameters: syllable diversity, syllable rate, trill duration and Shannon entropy in every song that was recorded. We analysed 412 songs from 18 males. Preliminary statistical analyses suggest significant differences in song complexity between the three times of day. Song complexity has been linked with underlying circadian endocrinological drivers. This study on the diurnal variation of complex song could provide a platform for future studies investigating the hormonal basis of diurnal variation in song complexity by key circadian components such as melatonin.

I'm a PhD student. My area of research is avian song. I use the tui as a model system due to its high levels of vocal complexity. In previous research, I've quantitatively demonstrated that song complexity in tui varies geographically.

Tuesday 26 November

Stream G, Session 4

The latitudinal gradient in plant longevity

Hitchcock, Timothy¹; Hemmings, Frank¹; Zhang, Hongxiang^{1,2}; Gutierrez, Alvaro G. ³; Moles, Angela¹

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³Swiss Federal Institute of Technology, ETH Zurich, Department of Environmental Systems Science, Forest Ecology, Universitätstrasse 16, Zürich 8092, Switzerland

Longevity is central to a plant's ecological strategy, yet it is surprisingly understudied. For the first time ever, we have quantified the latitudinal gradient in plant lifespan. We used 2 datasets: continuous longevity data for 722 species × site locations from the global literature, and a continent-wide binomial dataset (annual or perennial) for 4,800 species × site combinations from *Flora of Australia Online* and the *Atlas of Living Australia*. We observed in both datasets that on average species have significantly longer life spans towards the equator. Between 0° and 23° absolute latitude average age was 335 years, compared to 231 years between 23° and 68°. This relationship was more pronounced in the northern hemisphere. Within Australia there is generally a higher proportion of perennial plants along the coastal fringes and a higher proportion of annual species in the arid zones. These results provide fascinating insight into the huge variation that exists in plant lifespan. That there are more long-lived species near the equator suggests that stable climate plays a major role in allowing plants to live longer. It is possible that harsh seasonal changes in climate at the higher latitudes reduce the benefits of persisting for hundreds or thousands of years in most species. Despite this, the oldest known individual plants come from high latitudes (e.g. *Pinus longaeva*, 4884 years, at 37°N). More research focus must be turned to understanding this crucial characteristic in plants.

T. D. Hitchcock, Honours Student, Big Ecology Lab, School of Biological Earth & Environmental Sciences, Univ. of New South Wales. Timothy's current research interests lie in the ecological significance of whole plant longevity.

Monday 25 November

Stream D, Session 1

A forest dynamics model to predict carbon sequestration during secondary succession

Holdaway, Robert J.¹; Lines, Emily R.²; Easdale, Tomás E. ¹; Mason, Norm W.H. ³; Carswell, Fiona E¹

¹Landcare Research, Lincoln, New Zealand

²Department of Geography, University College London

³Landcare Research, Hamilton, New Zealand

The conversion of non-forest land to natural forest via secondary succession has the potential to generate carbon credits across ca. 1 million ha of marginal farmland in New Zealand. Realising this opportunity requires considerable understanding of natural successional processes, stand dynamics, and the ability to monitor and predict carbon change over time. This talk will discuss the development and parameterisation of an individual-based forest dynamics model designed specifically to predict carbon sequestration rates during secondary succession. Our model is parameterised using species specific growth and mortality relationships derived

from ~3000 permanent vegetation plots throughout New Zealand, and uses the Perfect Plasticity Approximation (PPA) to model light competition. We validate our model predictions using an independent dataset of 81 plots sampling three mānuka/kānuka successional chronosequences. These chronosequences provide novel data on forest structure, composition, carbon stocks and carbon sequestration rates for the first 100 years of secondary succession. We find that the inclusion of natural variability in model parameters such as tree height is essential in order to accurately predict carbon change over time.

Robert Holdaway is a plant/ecosystem ecologist at Landcare Research, Lincoln. He is interested in cross-disciplinary ecological research that includes; forest dynamics, forest carbon estimation; biodiversity assessment methodology, ecosystem risk assessment and agricultural ecology.

Wednesday 27 November

Stream E, Session 8

Drought and temperature effects on carbon transport and allocation: results from $^{13}\text{CO}_2$ pulse labeling experiments

Hunt, John¹; Barthel, Matti^{1,2}; Cieraad, Ellen¹; Hammerle, Albin^{2,3}; Sturm, Patrick²; Gentsch, Lydia^{2,4}; Knohl, Alexander^{2,5}; Zakharova, Anna¹

¹Landcare Research, Ecosystems and Global Change, Lincoln, New Zealand

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⁵University of Goettingen, Chair of Bioclimatology, Goettingen, Germany

Understanding the effect of temperature and drought stress on the fate of newly assimilated plant carbon is crucial as terrestrial ecosystems face a higher risk of extreme climatic events in coming decades. However, studies assessing the effect of stress on carbon transport and allocation within the atmosphere-plant-soil system are still rare.

Here, we present results from two $^{13}\text{CO}_2$ canopy pulse labeling experiments: one investigated the impact of drought on *Fagus sylvatica*, the other the effect of cold temperature on *Lolium perenne*. Stable carbon isotopes provide a non-invasive tool to trace the carbon flow within the atmosphere-plant-soil system. We used real time online laser spectroscopy technology to measure $\delta^{13}\text{C}$ of root and shoot respiration. In addition, $\delta^{13}\text{C}$ of bulk shoots and roots were analysed to allow for full carbon budgeting between respiration and biomass investment.

Drought stress significantly reduced the carbon transport speed from above to belowground as indicated by the $\delta^{13}\text{C}$ signal of root respiration ($\delta^{13}\text{C}_{\text{RR}}$). That is, the time-lag from the actual canopy labeling to the first appearance of the label in $\delta^{13}\text{C}_{\text{RR}}$ was about 2.5 times longer under drought. Similarly, under cold temperatures (10°C), carbon transport to roots was delayed 1.5 times compared to warm (25°C) temperatures. Moreover, analysis of bulk shoot and root material revealed that stressed plants (either by cold or drought) invest relatively more carbon into respiration rather than growth or storage.

Dr. John Hunt is a researcher at Landcare Research, Lincoln. His work includes using UV-B, stable carbon isotopes, and eddy covariance to study ecosystem carbon exchange. Current work is on the contribution of intensive dairy production to greenhouse gas emissions.

Monday 25 November

Stream D, Session 2

Guard dog: the dingo protects small native mammals from invasive predators in eastern Australia

Hunter, Dan¹ and Letnic, Mike¹

¹The University of New South Wales, Sydney

In the temperate forests of New South Wales, Australia, dingoes are subject to intense baiting, trapping and shooting as they are a known predator of many livestock species. However, removal of top order predators from ecosystems doesn't come without repercussions. Studies of dingo removal in arid Australia have demonstrated that the removal of dingoes promotes an environment where the red fox (*Vulpes vulpes*) and feral cat (*Felis catus*) can flourish in the absence of any top-down suppression – known as the mesopredator release hypothesis. Research was conducted in the Greater Blue Mountains World Heritage Area (GBMWhA) and Myall Lakes National Park. To test the effects of dingo removal on native small mammal abundance we surveyed areas where dingoes were locally uncommon and locally common. This was determined by the presence or absence of lethal 1080 poison baiting. Surveys consisted of small mammal trapping and large scale camera and sand plot surveys at both control and treatment sites. Initial results demonstrate that at sites where dingoes are locally common, mesopredator incidence is lower and native small mammal abundance is significantly higher compared with sites where dingoes are locally uncommon. This suggests that dingo presence is positively associated with native small mammal abundance in temperate forests of NSW. This research provides clear evidence of the dingo's role as an important conservation tool in the battle against invasive predators in forest ecosystems of eastern Australia.

Dan Hunter is currently a PhD candidate at the Australian Wetlands, Rivers and Landscapes Centre at The University of New South Wales. His research interests include predator ecology in forest systems, predators as trophic regulators and the reintroduction of species to original habitats.

Wednesday 27 November

Stream E, Session 8

Drought stress in *Eucalyptus marginata* – water relations and carbohydrates

Jakob, Sonja^{1,2}; Veneklaas, Erik^{1,2}

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²Centre of Excellence for Climate Change, Woodland & Forest Health, School of Biology & Biotechnology, Murdoch University, South Street, Murdoch WA 6150, Australia

A recent drought event in southwestern Australia has led to a widespread canopy collapse in the dominant tree species jarrah (*Eucalyptus marginata*). It is unknown if this canopy collapse is due to direct hydraulic failure or carbon starvation. In a glasshouse experiment, we have used a combination of a drought treatment and 50% defoliation to study the physiological mechanisms of drought-induced tree mortality, with a focus on carbohydrates. Our experiment aimed at investigating effects of altered carbon source-sink relationships on drought responses of jarrah seedlings. We anticipated that defoliation would make the seedlings more likely to suffer from carbon starvation than hydraulic failure due to an increased water status as a result of a higher root:shoot ratio. We also expected carbohydrate levels to increase in the drought treatment but to decrease in the defoliation treatment.

Leaf, stem and root tissues were sampled every second week for carbohydrate analysis. Leaf gas exchange and chlorophyll fluorescence were measured under 21% as well as 2% oxygen to evaluate source-sink limitation. Also, we measured leaf water and osmotic potentials along with transpiration.

Severe drought stress developed over a six-week period, as evidenced by increasingly negative midday water potential values (>-4 MPa) and by shedding of leaves in the non-defoliated plants (but not the defoliated plants). Defoliation led to enhanced photosynthesis in droughted and well-watered seedlings – most likely due to a reduced sink limitation and an improved water status. Changes in pools of carbohydrates in all shoot and root tissues will be presented.

The presenting author will be Sonja Jakob. She is a third-year PhD student at the University of Western Australia interested in carbon source-sink relationships and physiological responses to drought.

Tuesday 26 November

Stream F, Session 6

Plant functional groups: an effective indicator for detecting hydrological disturbance in groundwater-dependent wetlands?

Johns, Caitlin¹; Brownstein, Gretchen¹; Cooke, Jessica¹; Blick, Ray¹; Bricher, Phillipa¹; Fletcher, A¹; and Erskine, Peter¹

¹Centre for Mined Land Rehabilitation

²The University of Queensland

Globally, changes in water regime caused by anthropogenic disturbance are a leading cause of wetland degradation and loss. Where land development and wetland conservation priorities conflict, monitoring is crucial to detect early signs of an impact and to trigger management change. Freshwater wetland plant communities are often highly variable in species composition and abundance, making it difficult to: 1) predict changes in species composition likely to occur if water regimes are altered, 2) choose indicator species to monitor, or 3) define management response triggers that will be relevant, across multiple sites. Assessments of plant functional group composition have been recommended for addressing these issues. However, questions exist around how to best to define these groups. We evaluated three different functional group classifications and species-level data, to compare their effectiveness at demonstrating patterns in community composition associated with differences in water availability. We used vegetation survey data from wetlands in the Blue Mountains of NSW, Australia, to test for patterns in community composition at several spatial scales. At the species level, community composition varied significantly between wetlands, between transects across each wetland and between elevations within transects. Functional group classification removed the significant variation between transects within wetlands, while retaining significant differences between elevations and between wetlands. The magnitude of differences between wetlands either declined or stayed similar, depending on classification method. Our results demonstrate that these wetland plant functional groups can be more effective than species for demonstrating patterns in vegetation composition linked to hydrology at multiple scales.

Caitlin Johns is a Postdoctoral Research Fellow and a vegetation ecologist. Her current research focus is on plant functional traits and quantifying relationships between aspects of water regime and plant community composition.

Wednesday 27 November

Stream E, Session 7

Are smaller seeds less fit? A 7-year test in *Beilschmiedia tawa*, and implications for frugivore loss

Kelly, Dave¹; Ladley, Jenny J¹; Wotton, Debra M¹

¹Biological Sciences, University of Canterbury

The loss of large frugivores worldwide might mean that dispersal becomes limited to only smaller fruits within a species, and a recent paper (Galetti et al 2013 Science) showed a decline in seed size in defaunated Brazilian forests. This poses the question of whether

smaller seeds of large-fruited species have lower fitness than large seeds. We ran several trials with *Beilschmiedia tawa*, a New Zealand endemic tree with single-seeded fruits averaging 15.5 mm width, the fourth-widest in the NZ flora. Firstly, large and small seeds were individually weighed (fresh mass 0.5 - 3.8 g), then grown in a glasshouse for up to 2 years. Initial seed mass had no effect on germination or survival. Seed mass did significantly affect seedling size at 1 and 2 years of age, but the effect became weaker over time. Secondly a field experiment was established in natural tawa forest with large (12.3-14.4 mm seed diameter) and small (7.8-10.3 mm) seeds grown in competition in a checkerboard pattern. There was no difference in germination, and no significant difference in survival after 2, 6 or 7 years. Large seeds produced significantly larger seedlings at ages 2, 6 and 7 but the differences were small (6.5 vs 5.3 leaves/seedling after 7 yr) and became less significant over time. The differences in seed fitness to age 7 years appear to be trivial. This suggests that reliance on smaller frugivores may have very small fitness consequences for large-seeded plants, contrary to popular assumption.

Prof. Dave Kelly has worked at the University of Canterbury since 1985 on plant demography and plant-animal interactions, especially bird pollination, fruit dispersal, and mast seeding. He also owns eight bicycles and rides them all, though not simultaneously.

Monday 25 November

Stream D, Session 1

Facilitation and decline – the story of leguminous woody weeds post-fire

Kenny, Sally¹; Moxham, Claire¹

¹Arthur Rylah Institute for Environmental Research, Department of Environment and Primary Industries

Fire is a major disturbance in Australia's landscapes and many models of population or species recovery post-fire have been developed. These models have been applied to native plant and animal species but infrequently to invasive exotic plant species. We aimed to determine which model could be applied to leguminous woody weeds by focusing on *Cytisus scoparius* (Scotch Broom), *Genista monspessulana* (Montpellier Broom) and *Ulex europaeus* (Gorse) in the dry sclerophyll forests of Victoria.

Four potential models were examined: facilitation and decline, reduction and recovery, recruitment and thinning, and a modified version of reduction and recovery. Each species, individually and in combination, followed the facilitation and decline model. Thus, these leguminous woody weed species are stimulated to germinate by fire before slowly declining as time-since-fire increases. Fire not only facilitates mass germination from the soil seed bank but also allows these species to out-compete native species and affords land managers the opportunity to reduce soil seed bank capacity. If land managers undertake control measures before these species reach reproductive maturity then additional seed will not be added to the soil seed bank thereby reducing, albeit minimally in some instances, their capacity for mass germination following the next fire. Where resources allow the combination of pre- and post-fire control within the planned burning regime will result in a reduction in the capacity of these species to recover from fire. This will also allow native plant species the opportunity to return to landscapes where they were once out-competed by these leguminous woody weeds.

Sally Kenny is a Scientist at the Arthur Rylah Institute for Environmental Research. Her research interests include invasive species, fire, grazing, semi-arid ecosystems and landscape ecology.

Wednesday 27 November

Stream F, Session 9

Monitoring and reporting biodiversity change within Auckland's urban landscape

Khin, Jade¹; Lockie, Stacey¹; Bishop, Craig¹

¹Research Investigations and Monitoring Unit (RIMU), Auckland Council

The Auckland metropolitan urban area covers c. 55,000 hectares. While it is dominated (c.86 %) by urban landcover, the city still encompasses significant remnants of indigenous vegetation; mostly within the extensive network of Auckland Council managed parks, but also including significant areas of native habitat in private tenure. The Auckland Council terrestrial biodiversity programmes encompass over 600 forest and wetland plots across the region. This network captures landscape scale changes in biodiversity and subsequent pressures, enabling assessment of alignment with policy goals and biodiversity management. . . A higher density of monitoring plots has been established within the Auckland metropolitan limits. This has been done to ensure a sufficient sample size to independently track changes in urban biodiversity, and provide data that is timely and relevant for biodiversity advocacy purposes. Baseline measures for the plot network show there are some major differences in urban forest and wetland habitat - in comparison with the same ecosystems in rural or back-country environments. For example, urban ecosystems have a greater number of exotic and weedy plant species across all structural classes (seedlings, saplings and stems), a higher biomass of exotic and weedy plants, and lower total and average diversity of indigenous plants. This paper will summarise and discuss these differences and the consequences for the management of biodiversity in urban landscapes.

Jade Khin is an Environmental Specialist with the Research Investigations Monitoring Unit (RIMU) at Auckland Council. She coordinates the operations of the terrestrial biodiversity forest and wetland monitoring programs.

Wednesday 27 November

Stream A, Session 7

Geospatial Smartphone Apps and the use of Crowd Sourcing for the Recording of Invasive Species

Kilbey, David¹; Tredgold, Jasper¹; Bailey, Chris¹; Partridge, Julian¹; Pocock, Michael¹;

¹University of Bristol

Obtaining accurate data about the distribution of invasive, non-native species is of paramount importance when it comes to assessing impact and formulating an appropriate response. But data provision is often patchy and records are usually unverifiable and lacking accurate geospatial information. The Nature Locator team has addressed these problems by combining the development of a family of smartphone applications with the power of crowd sourcing data collection. The apps facilitate large-scale, public engagement and enable high quality data to be collected by non-scientists in the field. Crucially, records collected by the apps are both verifiable and accurately geo-located, since the apps utilise the phone's inbuilt camera and GPS capabilities. Our inaugural project "Leaf Watch" was principally used to provide more information on the UK distribution of the invasive horse-chestnut leaf miner moth (*Cameraria ohridella*). 5500 records were collected from all over the UK in the four month recording period. "PlantTracker" is crowd sourcing information on 14 species of invasive, non-native plants within the UK and has provided over 6,000 records in its first year. It has enabled early intervention in many new outbreaks of high priority species. "Sealife Tracker" and "AqualInvaders", which launched in the summer 2013, focus on marine and freshwater invasive species respectively. See our website for further details of these and our other projects: <http://naturelocator.org/>

Dave Kilbey is the director of the Nature Locator programme. He is an ecologist with a passion for using technology to enable anyone with an interest in biodiversity to collect and contribute high quality data to the scientific community.

Thursday 28 November

Stream A, Session 11

Swimming capabilities of stoats and the threat to inshore sanctuaries

King, Carolyn¹; Veale, Andrew²; Patty, Bruce¹; Hayward, Lisa¹

¹ Centre for Biodiversity and Ecology Research, University of Waikato, Hamilton 3240

² University of Auckland

Stoats (*Mustela erminea*) are small carnivorous mammals invasive in New Zealand that have long been known to be capable of swimming to islands 1-1.5 km offshore. Islands further out have usually been assumed to be safe from invasion, therefore routine stoat monitoring on them has been considered unnecessary. Recent incursions, including a stoat found on Rangitoto Island (3 km offshore) in 2010, and another which was later deduced to have reached Kapiti (5 km offshore) in 2009, along with distribution modelling and genetic studies, strongly support the proposition that stoats can swim much further. Acceptance of this hypothesis depends on estimating the probability that such small animals could indeed swim so far unaided.

This paper reports the results of a project designed to assist this debate by recording the paddling action, speed and minimal endurance of nine stoats observed (once each) swimming against an endless current in a flume at the Aquatic Research Centre, University of Waikato. Four of the five males and two of the four females could hold a steady position against a current of 50 m/sec (the maximum available). They all used a rapid quadrupedal paddling action (250-300 strokes/min, stronger with the spread forepaws). Four of the nine swam strongly for >1 hour, including one female who covered 1.8 km in nearly 2 hours non-stop. Results from such artificial conditions cannot be conclusive, but support suggestions that wild stoats could indeed swim much further, hence the "risk zone" for stoat reinvasions of inshore islands has been under-estimated.

Associate Professor in the Department of Biological Sciences; lifetime research interest in the ecology of small mustelids; present role teaching courses in advanced zoology, animal behaviour and pest control and supervision graduate students interested in these fields.

Wednesday 27 November

Stream A, Session 9

Quantifying the connectedness of terrestrial/freshwater meta-ecosystems.

Klemmer, Amanda J.¹; McIntosh, Angus R.¹

¹University of Canterbury, School of Biological Sciences, Christchurch, New Zealand

Ecosystems are open entities that receive energy and nutrients from adjacent systems, have mobile predators that feed across boundaries, and include organisms with complex life stages that develop as larvae in one system and emerge to be adults in another. This connectedness likely integrates adjacent food webs into one meta-ecosystem. Multiple factors may affect the relationship between connected systems: entry trophic level, subsidy amount, and timing of subsidies, as well as the donor and recipient ecosystems' level of production. To investigate whether ecosystem productivity affects the connectedness of meta-ecosystem food webs we surveyed subsidy exchange between terrestrial/freshwater meta-ecosystems around South Island, New Zealand. We predicted that 1) as productivity of terrestrial ecosystems increase, the productivity of the freshwater system decreases; and 2) the more productive the separate ecosystems, the more connections (subsidies) within the meta-ecosystem. Contrary to our hypothesis, we found productivity

of terrestrial and freshwater ecosystems was positively correlated. However, in support of our second hypothesis, subsidy exchange (or connectedness) within the meta-ecosystem was positively related to combined productivity of the meta-ecosystems. The change in connectedness across productivity gradients will likely influence trophic dynamics within the whole meta-ecosystem because of an increase in subsidy exchange between food webs. Future anthropogenic effects (warming, deforestation, water abstraction, etc.) will therefore lead to food web ramifications that cross terrestrial aquatic ecosystem boundaries.

Amanda J. Klemmer is a Ph.D. candidate at the University of Canterbury investigating subsidy exchange between terrestrial and freshwater ecosystems and its effect on food web dynamics.

Tuesday 26 November

Stream E, Session 5

Short circuit co-evolution by the perfect parasite? Antifreeze glycoproteins of fish leeches in Antarctica

Kolb, Jürgen B.¹; Rainey, Paul B.²; Evans, Clive W.³ and Brunton, Dianne H.¹

¹*Ecology, Behaviour and Conservation Group, Institute of Natural and Mathematical Sciences, Massey University, Auckland, New Zealand*

²*New Zealand Institute for Advanced Study, Institute of Natural and Mathematical Sciences, Massey University, Auckland, New Zealand*

³*School of Biological Sciences, University of Auckland, New Zealand*

Antifreeze glycoproteins (AFGPs) play an important role in biochemical adaptation to the supercooled waters and the survival of notothenioid fish in Antarctica. These fishes have a well developed parasitic epifauna, which in turn is also exposed to freezing conditions. In order to retain their association with Antarctic fishes as the environment progressively cooled during the Miocene, leeches as fish associated ectoparasites had to either (i) evolve a mechanism to acquire the necessary life-saving chemical compounds from their host or (ii) adapt their own genome to confer protection from freezing.

We have found that Antarctic leeches (*Hirudinea: Piscicolidae*) contain antifreeze compounds at cellular level. We present evidence which strongly indicates an absorption pathway of these AFGPs with chemical structures characteristic for the fish proteins. A high capacity for freezing point suppression can be measured as thermal hysteresis with AFGP specific bidirectional ice crystal growth. This confirms the presence of functional AFGPs. Finally, mRNA was detected as intermediate step of AFGP biosynthesis and first indication of antifreeze genes in a leech genome.

We conclude that Antarctic fish leeches have in fact co-opted the survival mechanisms from their hosts, by biochemical exploitation only or additionally by horizontal gene transfer. This represents the first example in the animal kingdom of an instantly effective adaptive advantage provided by another species in a quasi short circuit co-evolution.

Jürgen Kolb, PhD at Massey University, research interests in polar biology with current work on Antarctic evolution and behavioural ecology of notothenioid fishes and their ectoparasites.

Thursday 28 November

Stream F, Session 10

Feed the birds: propagation of female Buloke (*Allocasuarina luehmannii*) for revegetation.

Krauss, Laurie¹; Kodym, Andrea¹; Delpratt, John¹

¹*Melbourne School of Land and Environment, Burnley Campus, University of Melbourne, Victoria, Australia*

Allocasuarina luehmannii (Casuarinaceae) is a critically endangered Australian endemic dioecious species. It is a seasonal food source for the south-eastern red-tailed black cockatoo (*Calyptorhynchus banksii graptogyne*), also endangered. Its environment has become highly fragmented due to intense land clearing for agriculture and stock. Revegetation with a higher proportion of female trees concentrates the food source for the cockatoos in a smaller area. This plant species does not reach sexual maturity for ten to fifteen years. There is currently no genetic test available to determine the sexual expression of seedlings therefore *in vitro* culture allows for the selective propagation of female *A. luehmannii*. Suckers excised from female trees had very low establishment rates in the glass house. Successful propagation via axillary shoot formation and via callus from shoot tip cuttings *in vitro* was achieved by using a medium containing maltose but not sucrose. Using the cytokin 6-Benzylaminopurine (BAP) enhanced both callus regeneration and shoot growth. Once the plantlets achieved shoot growth of approximately 5 cm with comparable root growth, they were transplanted into a potting medium and acclimatised in a glass house. An initial transfer of unsexed *in vitro* raised seedlings achieved a 93% success rate after 21 months. A second acclimatisation trial with only female plants is currently underway having 88% survival after two months. Through the use of plant tissue culture female *A. luehmannii* have now been successfully grown. Further research to ascertain field viability is being carried out.

Laurie Krauss has a Masters in Applied Science Horticulture from the University of Melbourne. She is a tutor in first year plant biology and her research area is the propagation of endangered Australian native flora for revegetation.

Wednesday 27 November

Stream A, Session 7

Native plant recovery following control of ground cover weeds in New Zealand lowland forests

Lamoureaux, Shona L.¹; McAlpine, Kate G.²

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While the annual investment in managing weeds in NZ's natural ecosystems is huge (approximately \$20million/year by DOC alone), there is little quantitative evidence that this effort results in enhancements to native plant biodiversity. The focus of most weed management programmes is on killing the weed, and overly aggressive control methods often lead to re-invasion by the same or different weed species with no net gain, and possibly even a loss, for native flora. We hypothesised that there might be a 'Goldilocks' rate of herbicides that would achieve sufficient weed control *and* minimise collateral damage to natives. We applied four treatments (herbicide at full-strength, herbicide at half-strength, manual removal, no control) to three species of lowland forest ground cover weeds (*Tradescantia fluminensis*, *Plectranthus ciliatus*, *Asparagus scandens*), and monitored subsequent weed and native plant recovery for 18 months. All treatments initially reduced abundance of all weed species by an average of 98%. *Plectranthus* was most successfully controlled by the herbicide treatments, but rapidly re-colonised from seed following manual control. *Tradescantia* biomass returned to pre-treatment levels within 12 months in sunny plots, but remained low 18 months after treatment in shady plots. *Asparagus* control was variable, but largely unsuccessful. Native plant responses were generally most positive in manual control compared to the other treatments. However, there was no difference in native response between the two herbicide treatments suggesting that although the half-rate herbicide treatment achieved weed control at less cost, it did not result in better native recovery.

Shona is a scientist in the Pest and Weed Management Team at AgResearch Ltd, Lincoln. Her research focuses on understanding the population ecology of weed species to improve control strategies thereby making weed management more cost effective.

Tuesday 26 November

Stream F, Session 6

Propagation of Austral bracken fern (*Pteridium esculentum*) for revegetation.

Lang, Mirini¹; Kodym, Andrea¹; Delpratt, John¹

¹University of Melbourne – Burnley Campus, Melbourne School of Land and Environment, Victoria, Australia

The Australian Austral bracken is a keystone species required for revegetation but is unavailable due to low success with vegetative propagation and infrequent sporulation. Often thought of as a nuisance by farmers, bracken is used for erosion control and weed suppression especially along revegetated creeks. Tissue culture techniques were used to cultivate gametophytes from summer and autumn spore collections around Melbourne. Different methods of inducing sporophytes *in vitro* are being trialled using cytokinins, medium with/without sugar, and clumping /suspension of gametophytes. Currently, gametophytes are being acclimatised in the nursery using different potting mixes and watering regimes. Results showed spore germinated and propagated readily *in vitro*. Spore germination occurred after one week and subculturing was done every four to six weeks. Gametophytes on sugar medium had a low survival rate (25%) and became chlorotic after six weeks. Clumping was about three times more likely to produce sporophytes than the suspension method. Acclimatisation and induction of sporophytes was most successful in the fog house with high humidity on a capillary bed. Gametophytes were particularly sensitive to periodic hot or dry conditions. Protocols for successful robust methods of bracken propagation are being developed for integration into standard nursery practices.

Observational studies of field plantings are being conducted in two revegetation sites to monitor the survival rate and growth of tissue cultured bracken. So far, after one month, 99% of bracken have survived. Through tissue culture, large scale propagation of bracken has now become possible.

Mirini Lang, Master of Urban Horticulture student, interested in Australian flora in urban landscapes, committee member of the Fern Society of Victoria.

Wednesday 27 November

Stream A, Session 7

Impacts of an invasive mycorrhizal fungus on native fungal diversity

Lebel, Teresa^{1,2}; Dunk, Christopher³

¹Royal Botanic Gardens Melbourne, Australia

²Landcare Research, Auckland, New Zealand

³Latrobe University, Melbourne, Australia

The exotic ectomycorrhizal (ECM) fungus *Amanita muscaria* is able to form associations with *Nothofagus* in Australia and New Zealand, in the absence of introduced plant hosts. A classic weed, it produces abundant mushrooms with lots of spores (dispersal agents), that in native vegetation are most often found in disturbed sites. However little is known about its invasion ecology. The extent of the mycelium of *A. muscaria*, and impacts on native ECM fungal diversity were investigated.

The study site was a trailhead for a tramping track in old-growth *Nothofagus* forest in western Tasmania. Five transects (7m apart)

were set up on either side of the tramping track, and soil cores collected at 1,5,10,20,40,75m from the main gravel track, over a 2yr period. Root-tips were morphotyped and sequenced. Fruit-body data over a 3yr period gives a close approximation of the extent of *A. muscaria* mycelium, which is well-established within 5-12m of disturbed areas. No root-tips or fruit bodies were recorded >15m from disturbed areas. A high diversity of 44 genera and 109 species of native ECM fungi was recorded over the two years of fruit-body and root-tip sampling. Native ECM root-tip diversity in soil cores was significantly less in the presence of *Amanita muscaria* (1-3 spp. vs 6-11 spp). Also, hiking boots can act as dispersal agents of spores. This study provides a baseline to monitor the rate of expansion of *A. muscaria*, and impacts on native fungal diversity.

Dr Teresa Lebel is a Mycologist-Ross Beever Memorial Fellow. Teresa's primary focus is the taxonomy, systematics and biogeography of truffle-like fungi and related mushrooms, boletes and punks. This research underpins investigations into interactions between fungi, plants, insects and animals, and their ecology and conservation.

Thursday 28 November

Stream C, Session 10

Community assembly and historical contingency over evolutionary timescales

Lee, William¹; Leopold, Devin²; *Tanentzap, Andrew*¹; Peter Heenan⁴; Fukami, *Tad*²

¹Landcare Research, Private Bag 1930, Dunedin, NZ

²Department of Biology, Stanford University, Stanford, CA

³Department of Plant Science, University of Cambridge, UK

⁴Landcare Research, PO Box 40, Lincoln, NZ

Until recently, direct evidence of historical contingency in community assembly has been limited to laboratory manipulations and field experiments over short time scales. We investigate the role of historical contingency and priority effects in shaping communities over evolutionary time scales using the New Zealand alpine zone as a model system because of its known age, presence of major plant radiations, and intactness. Molecular dating of monophyletic phylogenies was used to reconstruct immigration history into New Zealand over the last 10 million years of 17 alpine plant genera. Community composition was derived from 262 5 x 5 m plots across an elevation range of 780 – 1620 m and a precipitation gradient of 2500 – 5000 mm yr⁻¹. Using Bayesian methods, we investigated interactions between radiation age and abiotic conditions to explain modern community structure. We have shown that community dominance (i.e. cover dominance - % cover of the focal genus / % cover non-focal genera and richness dominance - # focal congeneric species / # non-focal species) of alpine plant species increases with radiation age. However, the magnitude of these effects varied spatially across environmental gradients, with significant direct effects of elevation and precipitation on both dominance measures and a negative interaction between elevation and radiation age for cover dominance, but not richness dominance. These results suggest that immigration order and priority effects, on a time scale of millions of years, may influence modern community structure, but that these effects are mediated by current, local conditions.

William (Bill) Lee is a conservation ecologist at Landcare Research in Dunedin and part of the Joint Graduate School of Biodiversity and Biosecurity, University of Auckland.

Monday 25 November

Stream D, Session 2

Making use of old biased estimates: A trait-based model of microbat survival

Lentini, Pia¹; Bird, Tomas¹; Griffiths, Stephen²; Godinho, Lisa³; Wintle, Brendan¹

¹School of Botany, The University of Melbourne, Parkville VIC Australia 3010

²School of Life Sciences, LaTrobe University, Bundoora VIC Australia 3085

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Survival rates form key demographic parameters in population studies, and must be estimated precisely to predict how populations will fluctuate through time. For many mammals, annual survival and longevity can be estimated by body mass. This is not the case for microbats, *which live for decades in spite of their size, so it is a priority to identify alternative traits which will allow for estimation of vital rates. Ample data are available for this as* researchers have been banding bats and estimating survival since the 1920s, but these are likely to be biased due to the statistical methods, and trapping and marking techniques historically used. We conducted a literature review and collected 194 published estimates on 44 species. We then constructed a predictive model of survival based on reproductive, feeding, and demographic traits, accounting for biases associated with older studies. We used this model to predict annual survival rates for *Chalinolobus gouldii* and *Tadarida australis*, which were the subject of an eight-year bat box monitoring program. The predictions were used to construct informative priors for Cormack-Jolly-Seber survival modelling of the bat box data in a Bayesian analysis framework. We demonstrate that incorporation of an informative prior greatly increases the precision of survival estimates, and reduces the number of years required to reach a given level of precision compared with empirical data alone. Bats are currently facing a suite of threats, so any technique which reduces the amount of field time required to build reliable population models presents a great advantage.

Pia Lentini is a Postdoctoral Research Fellow with the University of Melbourne's Quantitative and Applied Ecology Group. Her research focuses on wildlife ecology and management in highly modified and fragmented landscapes, and surrogacy and connectivity in conservation planning.

Wednesday 27 November

Stream A, Session 9

Evaluating the role of the dingo (*Canis lupus dingo*) as a trophic regulator in differing Australian ecosystems.

Leo, Viyanna¹; Letnic, Mike¹

¹*School of Biological, Earth and Environmental Sciences, University of New South Wales*

The importance of top-order predators in maintaining ecosystem function has been demonstrated in many marine and terrestrial systems. Top-order predators often have positive effects on biological diversity by limiting populations and reducing impacts of their prey and/or subordinate competitors. Consequently, restoring and maintaining populations of top predators has been identified as a critical imperative for the conservation of biodiversity and ecosystem services. In this project, I am investigating how Australia's largest predator, the dingo, affects the diversity of ecosystems by determining the lethal and non-lethal effects they have on other species. Within each treatment area (dingoes common, dingoes rare) the abundance of dingoes, mesopredators and small-medium mammals was measured using a combination of survey techniques including camera traps and track plots. Results from arid regions indicate a positive correlation with dingo abundance and small mammal diversity including that of the endangered dusky hopping mouse, while reducing numbers of macropods and mesopredator the red fox. Initial results from tropical regions indicate that dingoes are limiting the abundance of the kangaroos and northern nail tailed wallabies but not the smaller spectacled hare wallaby. In contrast to desert regions dingoes do not appear to effectively control the abundance of mesopredators, with feral cat numbers equal in both treatments. These results have implications to conservation agencies who require better knowledge on how dingoes provide ecosystem services to improve recovery programs for species threatened by invasive predators and will be of particular value to managers who are faced with decisions to kill dingoes or not.

Viyanna Leo is a PhD student with a specialty in large carnivore conservation, olfactory communication and community ecology.

Monday 25 November

Stream B, Session 3

Validating an ecosystem response model: assessing model performance under wet and dry conditions

Lester, Rebecca E.¹; Barton, Jan L.¹; Fairweather, PG²

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²*School of Biological Sciences, Flinders University, GPO Box 2100, Adelaide, Australia, 5001*

Model validation is one aspect of ecosystem modelling that is not done often. Usually all available data are required to develop a robust model in the first place, and it is rare that models can be revisited years later when additional data have been collected. We revisited an ecosystem response model which was developed for the Coorong, the estuary of the Murray-Darling Basin, Australia, using an approach called 'ecosystem states', to assess the model simulations against five years of data that had been collected in the interim. The ecosystem states model has been used extensively to assess competing management actions in the region (e.g. methods of delivering environmental flows) and to simulate the likely future impact of climate change. Since the development of the model in 2008, the additional data has been collected for intervening years, which included both very wet and very dry years. These data enabled an assessment of the model under a range of conditions, including the first data documenting ecological recovery after prolonged drought. This assessment provides an objective assessment of the conditions under which the ecosystem states model performs well and can be reliably used as a tool to assist management, and where additional development is required.

Rebecca Lester is a Lecturer at Deakin University, Australia. Her research focuses on whole ecosystem ecology and the use of ecological models and statistics to inform natural resource management of aquatic ecosystems.

Tuesday 26 November

Stream F, Session 4

A broad view on forest response to CO₂: experiments, models, concepts

Leuzinger, Sebastian¹

¹*Institute for Applied Ecology New Zealand, School of Applied Sciences, Auckland University of Technology, Auckland, New Zealand*

Forests play a vital part in shaping the future carbon and water cycles by responding to changing environmental conditions. Numerous approaches have tried to characterise these responses, ranging from greenhouse trials to large field experiments and models of various levels of complexity. Scenarios for the future carbon and water cycle often vary, depending on the perspective they are looked at and the methodologies used. This talk takes you on a journey across a wide range of spatial and temporal scales and methodologies from which you can look at forest responses to global change.

Starting at the leaf level, I will show that responses to for example CO₂ may differ greatly as we move up in spatial scale, sometimes because second-order responses are triggered, which may eventually dominate the primary response. Vegetation models tend to be based on leaf-level processes such as rates of photosynthesis, which overlooks larger-scale ecological drivers of vegetation dynamics. Field experiments may provide more realistic answers, but we still subject small islands of forest to future conditions and thus forcedly disregard large-scale feedback. For example, atmospheric feedback effects are substantial and have the power to reverse initial

response patterns, as is evidenced by the coupling of a regional climate model with a dynamic vegetation scheme. Concurrent changes in several environmental drivers further complicate the picture and make us predominantly rely on ecosystem models. One way forward may be global meta-analyses and the distillation of general response patterns to provide robust conceptual models of forest response to global change.

Sebastian Leuzinger recently took up a position as senior lecturer at AUT. After his PhD in 2006, he worked in the labs of Christian Körner and Harald Bugmann using experimental and modelling approaches to study global change responses of forests.

Monday 25 November

Stream C, Session 1

Testing the core-periphery hypothesis: genetic signatures across the latitudinal range of a coral reef fish

Liggins, Libby¹; Booth, David J.²; Figueira, Will F.³; Tonk, Linda¹; Harris, David A.¹; Trembl, Eric A.⁴; Riginos, Cynthia¹

¹*School of Biological Sciences, The University of Queensland, St. Lucia, Queensland 4072, Australia*

²*Fish Ecology Laboratory, Department of Environmental Sciences, University of Technology Sydney, New South Wales 2007, Australia*

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⁴*Department of Zoology, The University of Melbourne, Victoria 3010, Australia*

Genetic patterns are expected to vary across a species distribution according to range position. The ‘core-periphery hypothesis’ predicts that genetic diversity will be higher within the core of the species range than in the periphery and that peripheral populations will be more genetically divergent. The demographic processes leading to such patterns could be both historical and contemporary (e.g. range expansion, population age, population isolation/connectivity etc.). Range-wide genetic patterns have rarely been investigated in marine systems, particularly in tropical organisms that are distributed across the equator. Our study investigates genetic patterns of the neon damselfish, *Pomacentrus coelestis*, a fish common to shallow coral reef habitat throughout much of the Indo-Pacific. Our 354 de novo sequences (mtDNA, control region) were combined with published sequences (540 sequences total) covering the latitudinal extremes of the species range (35°N, Japan - 37°S, Australia). We found that nucleotide diversity was significantly higher in the core of the species range than in the northern and southern periphery. We found no significant difference in haplotype diversity across the species range, however there were informative differences in the ‘nestedness’ (differences due to diversity) and ‘turnover’ (differences due to evolutionary novelty) components of haplotype richness. Evolutionary novelty (turnover) contributed most to haplotype richness in the northern periphery of the range, whereas in the southern periphery there was very little evolutionary novelty. Our study reveals that despite the environmental similarity of the northern and southern periphery of the neon damselfish’s range, these regions have had divergent population histories.

Libby Liggins is a PhD candidate at The University of Queensland interested in using population genetics methods to increase our understanding of population demographics, shifting species ranges and biogeography in the sea.

Wednesday 27 November

Stream F, Session 8

The Same but Different: Avian Influenza Infection Dynamics on Both Sides of the Equator

Lisovski, Simeon¹; van Dijk, Jacinta¹; Klaassen, Marcel.¹

¹*Centre for Integrative Ecology, Deakin University, VIC-3220 Geelong*

²*Netherlands Institute of Ecology, Wageningen, Netherlands*

The Avian Influenza Virus is globally distributed and infections in wild birds, particularly in waterbirds, are a common phenomenon. Immunological naïve juveniles and migrating birds, were identified as key factors of local infection dynamics. Due to the strong seasonality in the northern hemisphere and the deterministic breeding and migration time periods, a reoccurring annual pattern of high infection frequency in late summer and early autumn was found in the majority of surveillance studies. Similar seasonal pattern occur in coastal areas of south-east Australia, however large parts of Australia including the interior (“outback”) are rather influenced by the El Niño Southern Oscillation (ENSO), a non-annual climatic cycle inducing alternating periods of intense rainfall and intense droughts. We analysed data of acute infection as well as individual infection histories through antibody detection of wild bird populations. Comparing data from the northern hemisphere (Netherlands) as well as from the Australian interior (South Australia) and the coastal area (Victoria) we tested the hypothesis that the key drivers in the infection dynamic, namely juveniles and migrating/nomadic birds, are equal in all areas but the temporal pattern of the infection dynamic differ significantly due to the different annual demographic constraints affected by the local climate.

Simeon Lisovski is currently a PhD student at Deakin University and the Australian Animal Health Laboratory (AAHL) in Geelong. Besides interests in wildlife disease dynamics I am involved in a broad range of movement research topics tackling questions like decision making processes in long-distance migration and assessing impacts of environmental change along flyways.

Monday 25 November

Stream D, Session 3

Change with the climes: widespread variation of climate sensitivity in a rainforest specialist

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Many species have distributions that encompass a wide variety of climates. In such species, the climate encountered by an individual can vary dramatically depending on the individual's location within the species' distribution. There are numerous examples of species adjusting to this variation by tailoring their thermal and desiccation sensitivities to local conditions. However, it is unclear how closely such climate-relevant traits covary with local conditions, and how adjustment to local conditions might be limited by phylogenetic constraints and gene flow from neighboring populations. To address these questions, we studied the thermal sensitivity and desiccation resistance of a rainforest endemic from north Queensland: the rainforest sunskink (*Lampropholis coggeri*). We tested skinks from populations that differed in terms of: (1) the climate they are exposed to, (2) their geographic isolation from other populations (influencing gene flow), and (3) the genetic lineage group they belong to. Substantial differences between populations in climate sensitivity were detected; these differences appear to reflect local climate rather than phylogenetic constraints or the population's isolation. Thus, a species whose distribution encompasses a wide range of climates has been able to adjust to local climatic conditions on a fine scale, with neighboring populations differing in their climate sensitivities. It remains unclear, however, whether this local adjustment is a result of evolutionary adaptation and/or phenotypic plasticity.

John Llewelyn is a postdoctoral research fellow whose research interests include: evolutionary biology, ecophysiology, animal behaviour, global change biology, invasive species and herpetology.

Tuesday 26 November

Stream F, Session 5

Rapid recovery of Hochstetter's frog in a predator-free environment

Longson, Christopher¹; Brejaart, Ria¹; Baber, Matthew²; Babbitt, Kimberley³

¹EcoQuest Education Foundation; ²Tonkin and Taylor Ltd, Auckland Office; ³Department of Natural Resources and the Environment, University of New Hampshire

Maungatautari Ecological Island is a predator-free reserve of 3400 hectares, largely composed of a forested mountain, and enclosed by a predator-proof fence. A small population of the endemic Hochstetter's Frog (*Leiopelma hochstetteri*) was discovered on the mountain shortly before the completion of the fence in 2006, and standardised surveys have since been carried out on a three-yearly basis. During the most recent survey, in November 2012, we found four times as many frogs as during the 2009 survey. We also found frogs in 15 of 22 surveyed stream sites, up from 9 of 23 sites in 2009, and an increase in the relative proportion of juvenile frogs in the population. This suggests that the frog population has increased rapidly in both numbers and extent in the relatively short time since mammalian predators were removed from Maungatautari. Equivalent surveys in mainland pest-controlled (but not pest free) areas show at best slight increases in the frog population over the same time period. Maungatautari is the only population of Hochstetter's frog in a pest-free environment, and the species is not known to occur on any pest-free offshore islands. Currently, management plans assume that Hochstetter's can co-exist with introduced pests: our results suggest that even low numbers of pests are likely to significantly suppress populations of this vulnerable frog.

Chris Longson lectures in ecology and environmental management for EcoQuest Education Foundation. His main research interests are in the fields of evolutionary biology and population ecology, and he particularly likes it when traits of individuals have interesting implications for both.

Wednesday 27 November

Stream E, Session 8

Growth of kauri (*Agathis australis*) trees: source or sink limited?

Macinnis-Ng, Cate¹; Schwendenmann, Luitgard¹

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Kauri are amongst the largest trees in the world but they are more short and fat rather than long and lean. The current diameter at breast height (DBH) of the largest living kauri, Tane Mahuta is almost 5 m, representing huge store of carbon in a single tree. Biomass stocks of kauri trees have been reasonably well defined but rates of carbon fluxes have not been intensively studied until now. We recorded stem increment for 26 trees of varying sizes across a 3 year period at the University of Auckland Research Reserve at Huapai. There was a strong linear relationship between total annual growth and DBH. Canopy dominant trees contributed by far the most to stand-scale basal area increment for each year. However, when stem increment was normalised for stem diameter, the largest trees had much lower growth rates per unit stem. For very small trees, there was a strong linear increase in normalised stem increment as DBH increased. Normalised annual growth reached a maximum for co-dominant trees and declined for canopy dominant tree. We argue that this growth pattern indicates smaller trees within the canopy of the forest are source-limited while larger trees are sink-limited in their growth. We will quantify seasonal patterns in carbon uptake and discuss the role of varying meteorological conditions in annual growth

patterns of kauri trees.

Cate Macinnis- Ng is a Senior Research Fellow in the School of Environment at UoA. She is interested in carbon and water fluxes in trees. Her Marsden-funded research is exploring the impacts of drought on kauri and associated species.

Tuesday 26 November

Stream E, Session 6

Seedling ecology of *Cassytha pubescens*, a native hemiparasitic vine

Maciunas, Elizabeth¹; Facelli, José M¹; Watling, Jennifer R¹

¹University of Adelaide

Cassytha pubescens is a rootless Australian native hemiparasitic vine, distributed throughout Eastern Australia. Fire is a common disturbance throughout the distribution of this species, and it is an important factor to consider when examining this species' seed dormancy as adult plants lack any underground parts from which to re-sprout. A study of the emergence of *C. pubescens* in the field was carried out, as there is limited data regarding this species' emergence from the soil seed bank. This was complemented by examining seed response to smoke-water, dry heat and subsequent exposure to water and wet/dry cycling in the lab, as well as the influence of the age of seed, seed freshness, and seed size on germination success.

Fire recovery was documented using quadrats in two National Parks in the Mount Lofty Ranges, South Australia, in areas that were to be subjected to a spring prescribed burn. After the fires, patch recovery was monitored monthly, however the appearance of *C. pubescens* seedlings did not occur until the following spring. This delay was longer than expected, and much longer than the recovery of other vegetation at the site. This may reflect a strategy of delayed germination to maximise the chances of the parasitic seedling finding a suitable host quickly. The lab experiments also indicate the presence of mechanisms that spread germination, a classic bet-hedging strategy.

Elizabeth is a third-year PhD student at the University of Adelaide. Her project is diverse, encompassing seedling ecology, dispersal, host-parasite interactions and parasite physiology. She is also interested in palaeobotany, a field in which she completed her honours.

Wednesday 27 November

Stream D, Session 8

Germination syndromes in *Boronia* (Rutaceae): complex interactions between heat shock, smoke and season

Mackenzie, Berin^{1,2}; Ooi, Mark³; Auld, Tony²; Keith, David^{1,2}

¹University of New South Wales

²Office of Environment & Heritage (NSW)

³University of Wollongong

The timing of seedling emergence has important consequences for seedling survival and growth, and ultimately for plant community composition, and is determined by the type of seed dormancy and germination cues required. Physiologically dormant seeds require stratification at certain temperatures to overcome dormancy. Once dormancy is broken, non-dormant seeds persist in the seed bank and remain viable but will not germinate until they receive specific germination cues. These commonly include a particular seasonal temperature, and may include additional fire-related stimuli such as heat shock and/or smoke to promote significant levels of germination, often resulting in a seasonal post-fire flush of seedling emergence. Multiple germination cues are rarely assessed in combination and recent research is revealing the complex ways in which multiple fire cues interact with one another, and with other environmental cues such as seasonal temperatures, light and moisture. We used a fully factorial experimental design to investigate seasonal patterns in dormancy and germination responses of fresh and buried seeds to multiple interacting cues in seven species of *Boronia* (Rutaceae) from fire-prone south-eastern Australia. Germination syndromes were highly variable between species but broad patterns correlated well with seed size and morphology. Temperature significantly influenced interactions between different fire cues in several species, suggesting the potential for fire season to affect the magnitude of seedling recruitment and depletion rates of soil seed reserves. This has important implications for current fire management practices and population persistence under climate change where fire season is predicted to widen.

*Berin Mackenzie works for OEH and is a PhD candidate at UNSW. He is studying the role of fire and seasonal cues in dormancy and germination of *Boronia* (Rutaceae), and potential impacts of climate change on soil seed bank dynamics.*

Tuesday 26 November

Stream F, Session 5

How will ocean acidification affect the free-living stages of marine parasites?

MacLeod, Colin¹

¹Department of Zoology, University of Otago

In the past 15 years, it had been established that ocean acidification (OA) has had a significant effect on the chemistry of the global

oceans, and will likely have negative effects on a wide variety of marine species. However, the effects of OA on ecological processes such as inter- and intra-specific competition, predation, and parasitism remain poorly understood. A study of host-parasite interactions in the context of OA may provide a useful tool to investigate how relationships between species could change in an acidified marine environment. Parasites are a ubiquitous component of all marine ecosystems, infect species from different trophic levels to complete their life cycles, and utilise infection pathways that may prove vulnerable to the stressors associated with OA.

Preliminary data show that exposure of parasitic larvae to acidified seawater (7.1 and 7.4 pH) can cause a 20-30% increase in encystment rates over a 12 hour period. These results indicate that increased seawater acidity reduces the infective period of free-living parasitic larvae. Any OA mediated change to the activity, survival, and, ultimately, transmission success of parasitic species could have broad implications for parasite prevalence and host abundance. Consequently, evidence that coexisting parasite species exhibit differential tolerances to acidified conditions could suggest that OA has the potential to shift the composition of host communities and alter competition dynamics between host species, especially in the case of parasites that reduce fecundity or increase mortality.

Colin MacLeod is a PhD student at the University of Otago, where I study the effects of ocean acidification on host-parasite interactions.

Thursday 28 November

Stream E, Session 11

Joint modulation of leaf economic trait relationships by soil and climate, at global scale

Maire, Vincent¹; Wright, Ian¹; Prentice, Colin¹

¹*Department of Biological Sciences, Macquarie University, North Ryde, NSW 2109, Australia*

The role of climate in modulating broad-scale relationships between leaf photosynthetic traits is well-established in the literature but the role of soil fertility is less well understood, and the interplay between climate and soil effects even less so. Based on a trait dataset of 1508 species from 288 sites worldwide, and soil and climate data taken from global datasets, we quantified the relative power of soil fertility for predicting leaf photosynthetic capacity (A_{\max}). As expected species on higher fertility soils tended to have higher photosynthetic capacity (per leaf mass or area) and higher leaf N and P concentrations, but (unexpectedly) lower specific leaf area (SLA) - because of a negative correlation between soil fertility and precipitation. These trends were most apparent in woody species (shrubs, trees), and less so in herbaceous species (grasses, herbs). Among woody species, only the elevations of these trends were different between deciduous and evergreen species. Globally, A_{\max} increased with soil fertility at a given leaf N or at a given SLA, or at a given leaf N *and* SLA. Soil fertility effects were more pronounced at less arid sites for the A_{\max} -N relationship but the opposite was true for the A_{\max} -SLA relationship. Considering climate and soil effects jointly, A_{\max} prediction was significantly improved (+4-8% for mass and area bases, respectively), with soil fertility having the highest relative importance. These results nicely illustrate the considerable value in jointly considering the effects of soils and climate when quantifying global patterns in leaf photosynthetic traits, and trait relationships.

Vincent Maire is a post-doc who works on plant functional strategies for C-N-H₂O cycling within and between habitats. He undertakes data analysis and hypothesis testing to construct and evaluate plant vegetation models.

Tuesday 26 November

Stream F, Session 4

Woody plant seedling establishment success is reduced in a model grassland system under elevated CO₂

Manea, Anthony¹; Leishman, Michelle¹

¹*Macquarie University*

The expansion of woody plants into grasslands has been observed worldwide and is a major threat to the integrity of these systems. It has been proposed that the expansion of woody plants into grasslands is linked to the increases in atmospheric CO₂ levels that have occurred over the last 200 years. The cover of adult woody plants in grasslands is most limited by seedling establishment. This suggests that rising atmospheric CO₂ levels should enhance the establishment success of woody plant seedlings in grasslands. In this study we examined the effect of CO₂ concentration on the competitive interactions between C₄ grasses and C₃ woody plant seedlings by growing C₃ woody plant seedlings in mesocosms together with C₄ grasses under four competition treatments (no competition, root competition only, shoot competition only and complete competition) under ambient and elevated CO₂. We found that woody plant seedling biomass was suppressed by competition from grasses with root and shoot competition having the same competitive effect on the woody plant seedlings. Woody plant seedling biomass in the complete competition treatment was significantly greater under ambient CO₂ compared to elevated CO₂. This result was due to less competition from the grasses for belowground space and water under ambient CO₂. Our results suggest that the establishment success of woody plant seedlings and the subsequent expansion of woody plants into grasslands in the future will likely be strongly coupled to the CO₂ response of the grasses within those systems.

Anthony Manea is a PhD candidate in the Plant Invasion and Restoration Ecology Laboratory at Macquarie University. His research interests include grass/woody plant competitive interactions, grassland responses to extreme drought and grassland flammability under elevated CO₂.

Tuesday 26 November

Stream F, Session 5

Flying-fox management; the Sydney relocation is working (thus far) but there is no 'silver bullet' for all nuisance colonies

Martin, John¹;¹Royal Botanic Gardens and Domain Trust, Sydney Australia

The relocation of the Grey-headed (GHFF) and Black Flying-foxes from the Royal Botanic Garden Sydney (RBG), Australia, commenced in June 2012 under strict approvals from the New South Wales (NSW) and Commonwealth governments. In less than one week of pre-dawn and sunset noise disturbance the colony of ~5000 flying-foxes no longer used the RBG as a day-time roost. However, the noise disturbance has continued pre-dawn each day to prevent the colony from re-establishing. During the first six months following the initial dispersal, a peak of 2100 ($\bar{x} = 577 \pm 448$ sd) flying-foxes were observed attempting to resume roosting; whereas, during the latter stages of the second six months this number reduced to zero. The number of flying-foxes that may attempt to resume roosting in the next 6 months, or 6 years, remains to be seen; consequently pre-dawn noise will continue as permitted by the NSW and Commonwealth governments.

To monitor where the flying-foxes relocated we fitted 50 males and 50 females with satellite transmitters. This sample of flying-foxes dispersed across 204 colonies over a 12-month period; from Geelong in Victoria to Gladstone in Queensland. The GHFF population was estimated at 674 000 in 2005, is listed as vulnerable to extinction and is known to be panmictic. The movement data collected supports previous studies that demonstrate that culling is not an appropriate method to manage flying-foxes. The RBG relocation demonstrates that in certain circumstances this method may be effective; it also demonstrates that it is an expensive method with no guarantees.

John is the wildlife officer at the Royal Botanic Gardens three estates; his research focuses on urban ecology and wildlife management.

Monday 25 November

Stream C, Session 1

Contrasting phylogeographic patterns of two co-distributed Australian freshwater rainbowfish

Mather, Andrew¹; Riginos, Cynthia¹¹The University of Queensland, School of Biological Sciences

Diversity in Australia's freshwater fish fauna is relatively depauperate when compared to other landmasses. However the family Melanotaeniidae, and the genus *Melanotaenia* is one of Australia's most widespread and speciose groups of freshwater fishes. This study uses two co-distributed *Melanotaenia* species to test the hypothesis that a widespread habitat generalist will have lower levels of genetic diversity and population structure than a closely related habitat specialist. We use mitochondrial and nuclear sequence data to investigate patterns of genetic diversity in *M. splendida* and *M. trifasciata* and to determine how differences in habitat preference and historical changes in drainage boundaries have affected patterns of connectivity and isolation. *Melanotaenia splendida*, a widespread species found in the vast majority of freshwater habitats in northern Australia, shows low levels of genetic diversity, and very little population structure across its entire range, with major genetic clades matching already described subspecies. Conversely, *M. trifasciata*, having a greatly contracted distribution to the northernmost rivers of Queensland and the Northern Territory and habitat preference to faster flowing, highly oxygenated upland streams, shows extremely high levels of population structure, with up to four genetically distinct clades found in Queensland alone. These results suggest that, although these species are co-distributed they appear to have experienced different evolutionary histories, with differences in habitat preference within waterways resulting in contrasting genetic patterns.

Andrew Mather is a PhD student at the University of Queensland, studying population genetics and phylogeography of a range of Australian freshwater fish, with a particular focus on rainbowfish in northern Australia.

Thursday 28 November

Stream A, Session 11

Facilitating native seedling recruitment in the presence of ground cover weeds and seed/seedling predators

McAlpine, Kate G.¹; Lamoureux, Shona L.²; Wotton, Debra M.¹¹Department of Conservation, PO Box 10-420, Wellington 6143, kmcalpine@doc.govt.nz²AgResearch Ltd, Private Bag 4749, Lincoln 8140

Ground cover weeds can inhibit native seedling recruitment in New Zealand lowland forests. Pest animals that eat native seeds and seedlings, such as rats, rabbits and deer, pose an additional threat. Seed size may also influence which native plant species are able to regenerate in the presence of weeds and pest animals. We examined these relationships by sowing the seeds of ten native plant species into 192 lowland forest plots with high, medium, low, or zero abundance of ground cover weed (*Asparagus scandens*, *Plectranthus ciliatus*, or *Tradescantia fluminensis*). Seed size of the ten native plant species ranged from 1.38 g to 0.0005 g. We used mesh cages to exclude mammals (except mice) from half of the plots. Twelve months after seed sowing, 8 native species had

germinated successfully, but we were unable to detect an effect of seed size on seedling recruitment. Seedling recruitment was least successful in plots with high weed abundance, even where seeds had been added. In plots with low or zero weed abundance, seed addition increased seedling numbers by 300% on average. Excluding seed and seedling predators generally resulted in higher numbers of seedlings, particularly where seeds had been added. Overall, seedling recruitment was highest in plots with low weed abundance, where seed had been added and mammals excluded. This suggests that attempts to facilitate native seedling recruitment by sowing native seed will be most successful where both ground cover weed and pest animal abundance is low.

Kate McAlpine is a weed ecologist at the Department of Conservation. Her main area of research interest is the facilitation of native plant recruitment and succession in dense weed populations.

Wednesday 27 November

Stream G, Session 8

Empowering Indigenous Land and Sea Managers to undertake natural and cultural resource management – I-Tracker initiative

McCreedy, Erica¹; Kennett, Rod¹

¹*North Australian Indigenous Land and Sea Management Alliance Limited (NAILSMA)*

Indigenous land and sea managers are responsible for vast areas of country across north Australia and undertake a range of management activities to protect and maintain the natural and cultural values of their Indigenous estates. In order to fulfil traditional and contemporary management priorities, Indigenous Knowledge is being combined with western science to improve management outcomes. I-Tracker, an initiative of the North Australian Indigenous Land and Sea Management Alliance Ltd (NAILSMA), uses world renowned CyberTracker software to develop customised data collection applications that can be viewed in CyberTracker's easy to use mapping interface. These applications support Indigenous land and sea managers across north Australia to undertake natural and cultural resource monitoring, research and management activities using digital technology and equipment, giving Indigenous people the power to make informed decisions.

North Australia's land and freshwater resources are regularly faced with new threats including inappropriate fire regimes, feral animal impacts and industrial impacts from activities like agriculture and mining. The development of new tools and systems to support Indigenous conservation and land management efforts is essential to the success of biodiversity conservation in a north Australian context. Partnerships with researchers and scientists encourage standardised monitoring methodologies, which have been adopted into the I-Tracker application developed to support land management. This helps to form a regional picture about the extent of environmental threats that can be used to protect culturally significant and threatened species, encouraging both local and regional management responses.

Erica, Project Officer for NAILSMA, is of Ngati Raukawa and Ngati Porou descent. She has worked in NRM across north Australia for the last 5 years and is focused on continuing to support Indigenous communities to meet their management aspirations.

Monday 25 November

Stream E, Session 1

Spoilt for choice – spatial ecology of waterfowl in arid and agricultural landscapes is shaped by individual movement decisions

McEvoy, John¹; Roshier, David¹; Ribot, Raoul¹; and Bennett, Andy¹

¹*Centre for Integrative Ecology, Deakin University, Victoria, Australia*

Individual flexibility of responses to underlying temporal and spatial dynamics of resource distribution can greatly influence observed patterns of animal movement at the community or population level. This study uses GPS tracking to analyse the spatial ecology of a nomadic species of waterfowl Pacific black duck (*Anas superciliosa*) tracked in arid and agricultural ecosystems with very different patterns of resource distribution in time and space. By using a combination of techniques to identify phases of behaviour in a wide ranging nomadic waterfowl species we show that individual Pacific black duck can be highly flexible in their choice of movement behaviour over time. We use measures of realised mobility and movement coordination between individuals to quantify how these movement decisions influence broad patterns of movement at the level of populations.

John McEvoy is a final year PhD student at the Centre for Integrative Ecology at Deakin University. John is presenting work from his PhD thesis focusing on the movement ecology of nomadic birds in response to unpredictable resource distributions.

Tuesday 26 November

Stream E, Session 5

Quantifying uncertainty in species distributions under climate change: a case study in South-Eastern Australia

McGregor, Karen J.¹; Regan, Tracey J.¹

¹The School of Botany, The University of Melbourne, Parkville, Australia (email: karenm@student.unimelb.edu.au)

Effectively managing biodiversity in the face of climate change requires an understanding of how and when future climates may alter species ranges. Typically this is done using species distribution models (SDMs) which predict suitable habitat based on correlations between known occurrences of species and climatic and/or other environmental characteristics. These models are projected into the future using global climate models (GCMs), which characterize changes in climatic variables through time. Multiple GCMs have been produced, relying on different parameters and functions. However the influence of GCM choice on predicted habitat suitability in the future is not well understood.

This study aims to understand the influence the choice of GCM has on predicted species distributions under climate change and to understand the underlying environmental drivers of any differences. We developed a presence only maxent model for *Xanthorrhoea resinosa*, a long lived plant species found along the east coast of Australia. We projected the model into the future using five GCMs: the IPCC ensemble, CSIRO Mk3.5, GFDL 2.0, Max Planck and HadGEM1, for the A1FI emissions scenario. Results suggest there is large variation in how suitable habitat will change over time depending on the GCM used, with CSIRO Mk3.5 resulting in the greatest change and the IPCC ensemble showing the least. Further interrogation highlighted that precipitation of the driest period, influenced the differences the most. When projecting SDMs into future climates we recommend several exploration tools to better understand future predictions and to guide evaluation and model development.

Karen McGregor is a final year Master of Science (Botany) student with an interest in conservation and using GIS technology to understand the effect climate change will have on Australia's native plants and animals.

Thursday 28 November

Stream C, Session 10

Experimental evidence that habitat size influences multiple aspects of river community stability

McIntosh, Angus¹; Greig, Hamish^{1,2}; McHugh, Pete³; Thompson, Ross⁴

¹School of Biological Sciences, University of Canterbury

²School of Biology and Ecology, University of Maine

³Statewide Salmon and Steelhead Unit, Washington Department of Fish and Wildlife

⁴Institute for Applied Ecology, University of Canberra

Habitat reduction is a major driver of biodiversity loss and is particularly important in rivers where flow alterations are contracting habitat size. We experimentally investigated relationships between river habitat size and community stability using a bed scouring disturbance applied to ten rivers spanning three orders of magnitude in size, and communities were sampled pre and post-disturbance. Over the experiment the coefficient of variability (CV) of total abundance was significantly lower than the mean CV of abundance for each species' abundance, which is consistent with compensatory dynamics at the population level contributing to stability at the aggregate community-level. Habitat size did not affect any measure of aggregate or population-level variability for primary and intermediate consumers. However, variability in total taxa richness was greater in smaller habitats, and this destabilising effect of habitat size was most pronounced at higher trophic levels. Evaluation of resistance and resilience measures indicated instability in smaller habitats was due to reduced resistance; post-disturbance declines in abundance and diversity were greatest in small rivers. However, this decreased resistance was offset by more rapid recovery to pre-disturbance conditions in small rivers. Thus, resilience as measured by the rate of post-disturbance community change was positively correlated with habitat size for both taxa richness and community composition. Overall, compensatory dynamics at the population level and greater resilience in smaller habitats were able to offset some of the destabilising effects of small habitat size, but small habitats still had much larger variability in richness, and thus a higher risk of biodiversity loss.

Angus McIntosh is Mackenzie Foundation Chair of Freshwater Ecology and co-leader of the Freshwater Ecology Research Group at the University of Canterbury. He is interested in applying knowledge of spatial processes, community dynamics and food webs to freshwater ecosystems.

Thursday 28 November

Stream D, Session 10

Breaking the paper mold: electronic data capture for biodiversity monitoring at Auckland Council

McMurtry, Mike¹; Khin Jade¹

¹Research Investigations and Monitoring Unit (RIMU), Auckland Council

Paper is old, parchment is older, and proven electronic data capture is not the 'way of the future', it is *the way of the now*. The Auckland Council forest and wetland biodiversity monitoring programmes encompass over 600 sites region-wide, generating extensive datasets. The quantity and detail of biodiversity data collected is of substantial value to a multitude of stakeholders, hence data needs to be accurate, safe and timely. Paper data collection has been standard practice for forest and wetland plots in New Zealand, however it is fraught with systemic errors. Data validation is critical, yet paper cannot control information recorded, blurring strict protocol and individual subjectivity. Data is susceptible to entry errors and transcription inevitably introduces inaccuracies and misinterpretation. Turnaround rates of data from collection to reporting are slow, reducing accessibility. National and international industry experience has proven electronic data capture (EDC) systems are viable for collecting biodiversity data. With an ISO accreditation focus on continuous improvement, Auckland Council embarked on building a useable, effective EDC system to implement in biodiversity monitoring. The resulting gains in data quality, validity, efficiency and timeliness of biodiversity data are substantial. The Auckland Council experience demonstrates that EDC can preserve data quality and integrity, while promoting further efficiencies through robust systems and structured processes. Breaking the paper mold will deliver uncompromised solutions to common biodiversity data capture and data management failings.

Mike McMurtry is a Senior Environmental Specialist with the Research Investigations Monitoring Unit (RIMU) at Auckland Council. His work focuses on data management and system improvements across a series of ecology and water quality monitoring programmes.

Tuesday 26 November

Stream G, Session 4

Testing assumptions about herbivory and plant defence on islands

Meredith, Floret L.¹; Moles, Angela T.¹

¹Evolution and Ecology Research Centre, School of Biological, Earth and Environmental Sciences, University of New South Wales, NSW 2052

Since the days of Darwin and Wallace, islands have acted as nurseries for some of the most influential theories in ecology, most of which are still firmly ensconced in contemporary thought. As a result, ecologists hold assumptions about fundamental community processes and species traits on islands. It is largely accepted that island plants suffer less herbivory and have lower levels of defence in comparison to mainlands. These assumptions are based on observational studies or anecdotal evidence such as missing large mammalian fauna and the loss of spines or chemical defences in some plants on islands. Despite the age of these assumptions and the importance of herbivory and plant defence as drivers of speciation and community structure, our study is the first to quantitatively test these long-held beliefs at a large geographic scale. We compiled data from studies that measured herbivory and defence traits on islands and mainlands. For the first time, our results show that plants on islands suffer about 50% more herbivory and are about 50% less defended than mainland plants. These results challenge the assumption of lower herbivory in island ecosystems and present opportunities to explore the relationships between species diversity, herbivory, and plant defence. Our results about island communities are useful for ecologists interested in fundamental ecosystem processes, and also for managers protecting island biota from existing and emerging pressures.

Floret Meredith started her PhD under Dr Angela Moles at UNSW within the E&ERC in March 2013. Her interests include island ecology, biogeography, community assembly, plant-herbivore interaction and plant defence strategies.

Tuesday 26 November

Stream C, Session 4

A quantification of anti-herbivore defences on land and in the ocean

Meredith, Thomas G.¹; Wallis, Ian R.²; Foley, William J.²; Bennett, Scott³; de Bettignies, Thibaut^{3,8}; Durrant, Halley MS.⁴; Dworjanyn, Symon A.⁵; Edwards, Will⁶; Gurgel, Carlos FD.⁷; Huggett, Megan J.⁸; Marshall, Dustin J.⁹; McMahon, Kathryn⁸; Meredith, Floret L.¹; Nelson, Tiffanie M.¹⁰; Samper-Villarreal, Jimena¹¹; Wernberg, Thomas³; Moles, Angela T.¹

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¹¹*School of Biological Sciences, University of Queensland, St Lucia, QLD 4072, Australia*

Herbivory in the ocean is much more intense than on land. One possible explanation for this is that anti-herbivore defences, such as protein binding by tannins, are greater in terrestrial plants. Previous studies have been unable to precisely quantify these defences due to the inaccuracy of available methods (e.g. colorimetric assays) and the inability of feeding trials to mimic natural conditions. We provided the first test of the hypothesis that tannin protein binding, as a system of anti-herbivore defence, is greater in terrestrial plants by using a recently developed method of simultaneously measuring tannin protein binding capacity and nitrogen digestibility. We compared 92 terrestrial and 88 marine plant and algal species, and found that on average protein binding was higher, and digestibility was lower, in terrestrial plants, which equates to a lower proportion of nitrogen being available to herbivores. Overall, these results are consistent with observed differences in rates of herbivory between the two systems and support the hypothesis that terrestrial plants are more defended against herbivory. These results also demonstrate the effectiveness of measuring functional defence traits, as opposed to the concentration of secondary compounds, and provide a base for further research defence and herbivory in the two systems.

Thomas Meredith is currently completing his BSc. Honours research in the Evolution and Ecology Research Centre at the University of New South Wales. His research interests include plant-herbivore interactions, plant defence traits and plant ecology.

Wednesday 27 November

Stream F, Session 9

Integrating ecological concepts into urban park design

Metherell, Zoë¹; McDonnell, Mark²; Hahs, Amy²

¹*School of Botany, University of Melbourne*

²*Australian Research Centre for Urban Ecology, Royal Botanic Gardens Melbourne*

The integration of ecological principles into landscape design is critical to create sustainable cities. The conservation of nature in urban areas traditionally focuses on remnant vegetation and reserves and the potential of the recreational park to contribute to urban biodiversity has often been overlooked. To inform the development of local government biodiversity policy we undertook an experiment that utilised an interdisciplinary design process to test the application of ecological concepts to an urban park.

We report on the results of a process that threw up tensions between the fields of ecology and landscape architecture. We demonstrate how urban parks can provide for both people and biodiversity and describe the crucial role of people within the urban ecosystem. We also explore the ongoing mismatch between ecological theory and spatial design, for example, how does the establishment of ecological processes relate to the spatial design of a place? Finally, we found that more research is required into the design of novel plant assemblages which will form functioning novel ecosystems.

Zoë Metherell is a landscape architect and a PhD candidate at the University of Melbourne. Her research focuses on the integration of ecology and design in urban landscapes.

Tuesday 26 November

Stream C, Session 4

Macropod herbivory on vegetation regrowth after fire: trophic cascades in the Great Lakes area NSW

Mills, Charlotte¹; Letnic, Mike¹

¹*Australian Wetlands, Rivers and Landscapes Centre, The University of New South Wales*

The effect of macropods on Australia's forested ecosystems is poorly understood and this research aims to provide a clearer picture of the interaction. Using exclosures in forests located in the Great Lakes Area of NSW we measured the impacts of herbivory on plant community structure and composition. These exclosures are designed to exclude only macropods from grazing and allow access for other herbivores.

The exclosures have been placed in three different research sites, each with a different history of lethal dingo control. There is evidence that a trophic cascade exists between dingoes, macropods and vegetation in arid areas. Research on this interaction in forested areas is minimal, although the effects of macropod grazing on vegetation and dingo predation on macropod abundances are both well recognised. Scat counts and camera traps were used to determine relative population sizes of dingoes and macropods.

Data collection is currently in process and results will be presented at the conference, but preliminary comparisons of differences between treatments and control plots reveal that macropods have a strong influence on the structure of understorey vegetation.

Charlotte Mills is an honours student in the Australian Wetlands, Rivers and Landscapes Centre at The University of New South Wales. She is currently interested in herbivory, interspecies interactions and advancing her knowledge of natural history.

Tuesday 26 November

Stream G, Session 4

An intercontinental comparison of savanna tree architecture

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Savannas are widespread in Africa and Australia and superficially appear to have similar structure and function, with a continuous grass layer, discontinuous tree layer, seasonal aridity and frequent fire. However, savanna tree species evolved independently on each continent, with each flora bringing a unique set of adaptations and constraints associated with its evolutionary history. Here we examine divergence in savanna tree architecture between Africa and Australia and consider the implications for responses to disturbance and continental-scale patterns of tree structure. Height and stem diameter allometries as well as the allometry of canopy diameter and stem diameter are compared, first by aggregating data for each continent, and then by calculating species-specific parameters while controlling for covariation in architecture among related taxa. Large allometric differences exist between the savanna tree flora of Australia and Africa at the continental scale, with Australian trees being taller with narrower canopies for any given diameter. These differences are, however, greatly reduced when comparing individual species and accounting for evolutionary history. Continental-scale differences are driven by the divergent architecture of dominant taxa - the relatively short African Acacias and relatively narrow canopied, tall Australian Eucalypts - rather than systematic differences between Australian and African species. Patterns of tree structure along environmental gradients and the limits of savannas have been shown to differ between Africa and Australia. This divergence may be partially explained by differences in tree architecture through feedbacks to fire impacts and canopy structure.

Glenn Moncrieff is a PhD student at Goethe University in Frankfurt, Germany. He is interested in disturbances such as fire and herbivory, and how these processes influence continental and global vegetation patterns.

Monday 25 November

Stream D, Session 1

Cue-less correlation: differential-temperature model fits simulated mast seeding without being a flowering cue

Monks, Adrian¹; Tanentzap, Andrew J.^{1,2}; Monks, Joanne M.³

¹Landcare Research, Dunedin

²York University, Toronto, Canada

³Department of Conservation, Christchurch

Seedfall from mast seeding species is a critical driver of mammalian predator densities in New Zealand forests and the alpine zone. Flowering intensity in these species is believed to be primarily triggered by temperature. It is therefore important to understand how climate change will affect intensity and frequency of seedfall. Kelly et al. (2013) argue that the superior fit of the differential-temperature ($\Delta T = \text{Temp}_{t-1} - \text{Temp}_{t-2}$) model means mast-seeding patterns are insensitive to climate change because ΔT is a relative measure and robust to shifts in average temperature. We tested the conclusion that superior fit of the ΔT model implies that it is a causal mechanism by developing a simulation model of mast seeding that does not assume that ΔT triggers flowering. The model provided a very good fit ($r^2 > 0.9$) to observations of flowering in four *Chionochloa* species. We then simulated 1000 data sets for each of 81 combinations of parameter values and fitted the four statistical models of Kelly et al. to the resulting data. We demonstrate that ΔT can predict seedfall up to 97% of the time even if it is not the mechanism that induces flowering. We suggest that the superior fit of the ΔT model arises due to its correlation with floral induction and seeding associated resource depletion. Consequently, the conclusion that climate change will not affect the frequency and intensity of mast seeding is premature.

Adrian Monks is an ecologist with Landcare Research in Dunedin. His research interests are varied, but include quantitative ecology, restoration ecology, plant-animal interactions, conservation planning, general plant ecology and mast seeding.

Thursday 28 November

Stream D, Session 10

Predator impacts and potential monitoring techniques for New Zealand's alpine birds

Monks, Jo¹; O'Donnell, Colin¹; Palmer, Dan¹

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New Zealand's alpine fauna has traditionally been thought of as relatively secure from the impacts of introduced mammalian predators because cold temperatures limit activity of mammals above the treeline. However, circumstantial evidence points to recent declines in specialist alpine birds. Measuring the effectiveness of conservation interventions is hampered by a lack of validated monitoring techniques. We conducted a nesting study of rock wrens, *Xenicus gilviventris*, during the 2012/13 summer season in the Homer and Gertrude Valleys, Fiordland, and compared field techniques that produce indices of abundance with known numbers of birds at Fiordland and South Westland (Haast Range) sites. Population estimates based on mark-resight data and indices of abundance from transect counts were correlated with results from territory mapping at the Haast Range site in all seasons. However, indices were poorly

correlated at the Fiordland site where monitoring assumptions were violated due to predation events. All 20 nests we monitored failed; ten were attributable to stoat predation and cause could not be determined with certainty for the other ten. Adult birds were killed on the nest in at least three (up to seven) predation events. However, only low numbers of both stoats and mice were detected through tracking tunnel monitoring. Our results point to the episodic nature of predation on rock wrens, which can occur even when predators are at low density. Low cost field methods that produce indices of abundance may be effective for monitoring of rock wren populations, providing an opportunity to evaluate population trajectories and management intervention.

Jo Monks (née Hoare) is a Science Advisor at the New Zealand Department of Conservation and Editor-in-Chief of the New Zealand Journal of Ecology. Her research focuses on measuring effectiveness of management and development of monitoring techniques for terrestrial fauna.

Monday 25 November

Stream B, Session 3

Do koalas prefer hot dinners? *Eucalyptus* leaf quality in a warmer world

Moore, Ben¹; Drake, John¹; Rymer, Paul and Tjoelker, Mark

¹*Hawkesbury Institute for the Environment, University of Western Sydney, Richmond NSW*

Globally increasing temperatures are fundamentally changing the constraints and challenges faced by plants, which, in many cases, exhibit local adaptation to pre-industrial climatic conditions. Of particular concern in Australia is how the widespread, ecosystem-dominant tree genus *Eucalyptus* will respond to warming and what the consequences will be for herbivores that rely on this resource. We investigated spatial patterns in foliar nutritional and secondary chemical traits, including the contributions of genotype and environmental temperature, in the widespread eucalypt species, *Eucalyptus tereticornis*. We grew trees from ten different provenances spanning its Australian distribution (Victoria to north Queensland) in two glasshouse chambers, one with its climate controlled to match that of the trees' site of origin, and one with the temperature raised by 4 degrees, before harvesting and analysing foliage. Foliar nitrogen (N) concentrations declined strongly with increasing temperature among plants grown at their home temperatures, yet altering the growth temperature did not produce a plastic response. This effect was not produced by a dilution effect (i.e. increasing foliar proportion of structural carbohydrates). Total phenolic (TP) concentrations increased with home temperature, yet plants exposed to warmed conditions showed reduced TP concentrations. The *in vitro* digestibility of leaves declined with temperature, but appeared not to be affected by provenance. Concentrations of formylated phloroglucinol compounds (FPCs), which are potent antifeedants, were highly variable but were not related to either home temperature of the provenances nor to the temperature at which plants were grown.

Ben Moore studies plant-animal interactions, especially the ecology of plant chemical defence against herbivory. He has worked in Canberra, Townsville, Sydney and Scotland and undertaken research in eucalypt and pine forests, with herbivores including koalas, possums, beavers, deer and invertebrates.

Tuesday 26 November

Stream E, Session 5

Upslope establishment after wildfire of the obligate-seeding montane tree *Eucalyptus delegatensis* fails to keep pace with 20th century warming

Morgan, John¹; Vincent, James¹

¹*Department of Botany, La Trobe University, Bundoora 3086, Victoria, Australia*

How species respond to climate change at local scales will depend on how edaphic and biological characteristics interact with species physiological limits and traits such as dispersal. Obligate-seeders, those species that depend on fire for recruitment, have few and only episodic opportunities to track a changing climatic envelope. In such cases, long-distance seed dispersal will be necessary to take advantage of rare (but potentially highly successful) recruitment opportunities. We use post-fire observational and experimental studies at the upper timberline (i.e. the range edge) to assess the upslope response of an obligate-seeding Australian montane tree (*Eucalyptus delegatensis*) to stand-replacing fire in the context of regional warming. There was minimal upslope migration of the species after fire; all saplings were observed near seed-bearing timberline trees. Transplanted seedlings and saplings, however, survived equally well when planted well-above existing timberlines (relative to saplings at, and below, timberline), and their rate of growth over one season was no different across these locations, hinting that upslope growing conditions are unlikely to limit initial establishment of trees. Rather, it is more likely that traits governing seed dispersal modulate responses to environmental gradients, and global change more generally.

John Morgan is a lecturer in plant ecology interested in long-term vegetation dynamics as mediated by seedling recruitment processes.

Tuesday 26 November

Stream C, Session 4

What are the nutritional drivers of foraging strategies in common brushtail possums in New Zealand?

Morley, Jenifer E.¹; van Heezik, Yolanda²; McDowell, Arlene³; McLeod, Bernie J.³; Hassall, Mark¹

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Foraging strategies have evolved to optimise the costs and nutritional benefits of an animal's foraging pathways and diet composition. Many optimal foraging models quantify profitability in terms of energy intake divided by the sum of search and handling times. For herbivores that are limited by nutritional constraints (especially nitrogen) and energy requirements, this approach is too simple. We examine the hypothesis that the foraging pathways of a largely folivorous marsupial, the brushtail possum, have been selected to maximise energy intake while simultaneously meeting daily nitrogen requirements. Possums at forest-pasture margins are conservation and agricultural pests, yet the nutritional drivers of mixed forest and pasture foraging are unknown. We used high resolution GPS telemetry to map foraging pathways of brushtail possums in native bush fragments within farmland in Otago, New Zealand. We measured residence times at feeding sites, travel times and distances between feeding sites. Spatial models determined possum responses to variation in availability of nutrients and energy within the home range. Water soluble carbohydrate, total organic matter content, total nitrogen and available nitrogen in known possum foods sampled from observed feeding sites are included as parameters in a simple foraging model. The foraging model is validated with data from a second geographically distinct site, enabling us to test the central hypothesis: herbivore foraging traits balance both nutrient and energy requirements.

Jenny Morley is a PhD research student investigating nutritional explanations for possum behavior in New Zealand. Areas of research interest include wildlife tracking, animal movement and spatial ecology, foraging models, impacts of invasive species and nutritional ecology of marsupials.

Wednesday 27 November

Stream E, Session 9

Value of information analysis for Box-Ironbark forest and woodland management

Morris, William K¹; Vesk, Peter¹; Runge, Michael²

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²*US Geological Survey, Patuxent Wildlife Research Center, MD 20708, United States.*

When managers encounter uncertainty, monitoring or experimentation can facilitate decisions with greater expected benefits. But it is only rational to monitor if the expected net gain is positive. A value of information analysis can a priori assess the efficacy of seeking to reduce uncertainty via monitoring or experimentation. We performed a value of information analysis for Box-Ironbark Forests and Woodland management in central Victoria, Australia. Our analyses reveal whether to monitor to reduce uncertainty in a system model, as well as which aspects of model uncertainty are most cost-effective to address with a targeted sampling strategy. We found that the outcome of forest management was much more sensitive to some model parameters than others and that the more sensitive parameters tended to have the greatest value of sample information. Of a set of plausible sampling strategies, those that focused on monitoring the current management method and the most common vegetation state were found to achieve the greatest cost effectiveness. We demonstrate how to apply a value of information analysis for managing the Box-Ironbark Forest and Woodlands of Victoria, Australia. We show how such analyses can be performed for a continuous model of a decision problem with a continuous decision space. Our analysis show it is more cost-effective to monitor certain aspects of the system and employ a targeted sampling design than to monitor with a view to reducing uncertainty in all dimensions of model space simultaneously.

William K Morris is PhD student with the Quantitative and Applied Ecology Group. His research interests include statistics, decision theory, structured decision making and vegetation management.

Wednesday 27 November

Stream F, Session 8

Fire extent and small mammal declines in northern Australia

Murphy, Brett^{1,2}; Lawes, Michael³; Russell-Smith, Jeremy^{3,4}; Fisher, Alaric⁵; Woinarski, John^{3,5}; Andrew Edwards^{3,4}

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Mammals, especially small mammals (<5kg), have declined dramatically in abundance and species richness in many parts of northern Australia over two decades. Although there are many putative causes of mammal decline, change to fire regimes is one of the most prominently supported causes. To date the focus has been on fire frequency and at the best studied locations there is a trend of lower species richness at sites with greater fire frequency. However, there is considerable variation about the estimates of richness suggesting

other mechanisms or aspects of fire history are also responsible for the declines. In this study we examine the effect of fire extent, in conjunction with fire frequency, on mammal declines. In recent decades fires have typically burned at a landscape scale over large areas, whereas before then they tended to be small scale patch burns. Small mammals have small home ranges and cannot easily escape the effects of large and less patchy fires. We investigate whether fire extent is a better or additional predictor of small mammal declines in northern Australia than fire frequency alone.

Brett Murphy is a fire and vegetation ecologist with a particular interest in the tropics. His work focuses on the role that fire has played in shaping the Australian biota, and how to best manage fire regimes for biodiversity conservation.

Monday 25 November

Stream F, Session 1

Flyway-wide effects of climate and threats on the non-breeding abundance of a migratory shorebird

Murray, Nicholas J.¹; Marra, P²., Studds, Colin E.¹, Fuller, Richard A.¹

¹The Ecology Centre, University of Queensland, St Lucia, QLD, Australia

²Migratory Bird Centre, Smithsonian Conservation Biology Institute, Washington, DC, USA

Migratory shorebirds in the East Asian-Australasian Flyway traverse an entire hemisphere during their annual migration, spending different parts of their annual cycle in geographically isolated locations. Understanding the impacts of threatening processes and changing environmental conditions throughout the annual cycle is vital for managing migratory bird populations, yet few studies have attempted to disentangle these factors and relate them to population trends. Reports of rapid declines of several species of migratory shorebird are emerging from Australia and New Zealand, and knowledge of when and where in the annual cycle the declines are driven would allow targeted implementation of conservation actions. Here, we use N-mixture models and five global-scale satellite datasets, including a new remote sensing dataset of coastal habitat loss, to investigate the relative impact of anthropogenic and climate factors at breeding, non-breeding and staging areas on the population trends of two declining sub-species of migratory shorebird. The two sub-species of bar-tailed godwit (*Lamosa lapponica*) have contrasting migratory flyways, one of which includes the longest non-stop migratory flight of any bird, which allows this novel investigation. We show that a combination of factors, most notably habitat loss at staging sites in East Asia, is causing declines of both sub-species. By accounting for all stages of the annual cycle, we present the most detailed study to date that encompasses drivers of population decline on a migratory species. Our results allow conservation actions to be spatially and temporally targeted to regions of the flyway that are driving population declines.

Nick Murray is a PhD candidate working on a multi-disciplinary project focused on identifying the drivers of recent shorebird declines in the East Asian-Australasian flyway. He uses remote sensing, spatial analyses and conservation planning to address international conservation problems such as conservation of migratory species.

Thursday 28 November

Stream C, Session 11

Impact of stress and grazing on the importance of facilitation by *Acacia gerrardii* in arid environments in Saudi Arabia

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³King Abdul-Aziz City for Science and Technology (KACST) – Riyadh, Saudi Arabia

Facilitation (positive interactions between individuals) is believed to be important in plant communities in stressful arid environments. The stress gradient hypothesis predicts that the importance of facilitation increases with increasing environmental stress. Abiotic and biotic stresses may affect facilitation or even shift the interactions between plants from positive to negative (competition). We tested for impacts of grazing herbivory and environmental stress on facilitation using herbaceous and shrub communities common under the canopies of *Acacia gerrardii* in the Taif region in Saudi Arabia. The impact of grazing on facilitation by *A. gerrardii* was examined by comparing plant species abundance inside and outside the ungrazed Sudyrah reserve. In each location (inside and outside the Reserve) we measured plant cover and density under the canopy, at the edge of the canopy, and a few metres away from the canopy of a several selected trees of *Acacia gerrardii*. We show that plant cover and density inside the Reserve was greater than that of outside. We also conducted a neighbour removal experiment under canopies in the reserve. We found that the intensity of competitive interactions was greater under the canopy (low stress) than at the edge of the canopy (high stress). Our results demonstrate that herbivory can decrease the importance of facilitation in stressful environments. Further, where facilitation from canopy plants reduces environmental stress, competition between understory individuals can become important in structuring communities.

Ali Namazi is a second year PhD. student at UNSW, interested in plant ecology particularly the interactions between species in the arid environments. He conducted his experiments in Saudi Arabia.

Wednesday 27 November

Stream F, Session 8

Determining the spatial extent of pest management outcomes

Nathan, Eruera¹; Glen, Alistair²; Stanley, Margaret¹

¹Centre for Biodiversity and Biosecurity, School of Biological Sciences, University of Auckland

²Landcare Research

While the impacts of introduced mammalian predators on native biodiversity are generally well understood, less is known about the spatial extent of these impacts. We aimed to determine the spatial relationship between pest management and biodiversity outcomes. Predicted outcomes included: 1) higher levels of benefit to native biodiversity at the core of the pest management area; 2) reduced benefit inside but close to the border of the pest management area (edge effect); and 3) some benefit in the area immediately surrounding the pest management area (spill-over effect). Biodiversity indices were measured along 1200 m transects with 600 m either side of the border of a pest management area within a native forest park. These indices included diversity and relative abundance of pest mammals, native birds, lizards and invertebrates and density of seedlings. Stoat and rat densities were found to decrease linearly from the point furthest outside to the point furthest inside the pest management area. Lizards were never observed. For all other biodiversity indices, at least some taxa were observed with increasing frequency from the point furthest outside to the point furthest inside the pest management area. These results suggest the occurrence of both edge and spill-over type effects occurring at the borders of the pest management area. This information is useful to conservation managers to improve efficiency and cost-effectiveness of pest management. Evidence of spill-over benefits also indicates that localised pest management may improve biodiversity outcomes over a larger spatial scale by promoting landscape connectivity.

Eruera Nathan has recently submitted his MSc thesis at the University of Auckland. His areas of research interest include mammalian pest ecology and behaviour and the optimization of mammalian pest management.

Monday 25 November

Stream D, Session 3

Modelling time series data with missing values

Nguyen, Vuong¹; Wardle, Glenda¹

¹ Desert Ecology Research Group, University of Sydney

Time series data often contain missing values or gaps due to logistical or financial constraints. State-space models are able to overcome this limitation whilst accounting for observation error. We investigate using a multivariate auto-regressive state-space (MARSS) modelling framework to explore the population dynamics of plants, using long-term survey data obtained from the Simpson Desert. Our study species is the ephemeral desert herb *Trachymene glaucifolia*, which exhibits pulses of dramatic population increases (booms) followed by periods of absence (busts) of above ground plants. Counts were conducted in four sites, each with a burnt and unburnt region from 2004 - 2011. Here, we extend the framework by incorporating multiple life stages in the form of a seed bank, and test whether populations of *T. glaucifolia* can be divided into subpopulations based on fire history and site. We found no distinction between populations of *T. glaucifolia* across sites or burn history and that it was best modelled as a single, structured population. To test the reliability of the state predictions during periods with missing values, we systematically removed known, observed datapoints and reconstructed the models to determine whether booms and busts were recovered. The models were generally not effective at recovering booms and busts correctly. Predictions from models using longer, simulated datasets performed better in recovering these dynamics. We conclude that a longer time series with more consistent sampling over time is more important than surveying multiple spatial locations to adequately predict the dynamics of *T. glaucifolia*.

Vuong Nguyen is a PhD candidate at the University of Sydney. His research interests are in statistics, dealing with uncertainty and population modeling.

Tuesday 26 November

Stream E, Session 4

Response of belowground communities to short-term phosphorus addition in a Cumberland Plain Woodland

Nielsen, Uffe N^{1,2}; Prior, Samantha¹; Delroy, Brendan¹; Ellsworth, David¹; Powell, Jeff R¹

¹Hawkesbury Institute for the Environment, University of Western Sydney

²School of Science and Health, University of Western Sydney

Soil biota regulate ecosystem processes such as organic matter turnover and nutrient cycling but our understanding of the factors that influence belowground communities remain limited. We investigated the response of symbiotic arbuscular mycorrhizal (AM) fungi, nematodes and microarthropods to short-term phosphorus (P) fertilisation in an endangered Cumberland Plain Woodland considered to be P-limited. These taxa are important drivers of nutrient and carbon dynamics but we have no knowledge of their contributions to these processes in this ecosystem. Five plots received P-fertiliser applied as superphosphate (equivalent to 30kg and 20kg per hectare in September, 2011 and January, 2012, respectively) and another 5 plots received no fertiliser. In April 2012, we estimated aboveground and belowground understory plant biomass within the 10 plots, and collected soil samples for chemical analyses, estimation of fungal hyphal lengths, and extraction of nematodes and microarthropods. Additional roots were sampled for estimation of AM fungal

colonisation. Phosphorus fertilisation increased belowground plant biomass only. AM fungal hyphal length increased with fertilisation, but only at the soil surface (0-5 cm). The proportion of root length colonised by AM fungi was not significantly different between treatments but vesicular (storage structures) colonisation decreased with fertilisation. Collembola showed greater abundances in the fertilised plots but no other invertebrate taxa responded to fertilisation. Collembola are mainly fungal feeders while AM fungi are dependent on photosynthate fixed by the host plant. It appears that P-enrichment of eucalypt woodland soils may have supported a greater abundance of Collembola through bottom-up effects on a short-term scale.

Dr Uffe Nielsen is a Research Lecturer at the Hawkesbury Institute for the Environment, University of Western Sydney with broad interest in belowground communities and their impact on ecosystem functioning.

Thursday 28 November

Stream F, Session 10

Can riparian seed banks facilitate the geomorphic and ecological recovery of degraded streams?

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Rivers worldwide have been degraded by vegetation removal and subsequent bank instability and erosion. Riparian rehabilitation efforts largely focus on re-establishment of vegetation, with *in situ* manipulation of naturally occurring seed banks increasingly investigated as an alternative to revegetation methods such as direct seeding and tube stock planting. We assessed the extent to which riparian seed banks may be utilised for revegetation to facilitate *biogeomorphic* succession, and support the geomorphic and ecological recovery of degraded streams. We compared floristic and growth form composition of the seed bank with the standing vegetation of within-channel bars and depositional benches, and the floodplain of streams in the Hunter catchment, Australia. We also assessed seed dispersal mechanisms to infer likely seed sources. We found strong similarities between the seed bank and the pioneer vegetation commonly observed on bars, suggesting the potential for vegetation to establish directly from the seed bank on these frequently disturbed structures. The seed bank of benches and the floodplain was dominated by pioneer sedges, rushes and herbs, and had low abundance of the later successional species that were frequently observed on these features, such as vines, shrubs and trees. These species however, most effectively aid sediment stabilisation and capture, and are thus important drivers of biogeomorphic succession, particularly on benches. Recruitment of later successional vegetation on benches and floodplain may rely more on a direct supply of transient propagules from standing vegetation, highlighting the limitations of the seed bank in revegetation efforts and the importance of remnant riparian vegetation patches.

Jessica O'Donnell is a PhD student whose research is concerned with riparian seed banks and their potential role in the rehabilitation of degraded streams and rivers. Her research incorporates principles of both ecology and fluvial geomorphology.

Tuesday 26 November

Stream G, Session 4

Quantifying the spatial distinctiveness of alpine climate niches

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¹Geography Department, University of Otago, Dunedin, New Zealand

²Swiss Federal Institute for Forest, Snow and Landscape Research

Any location is characterised by a multivariate set of environmental conditions and these conditions are one of the filters determining which species occur at that location. For many species, however, information on distribution, niche breadth and the degree to which niche conservatism vs. niche evolution occurs is often limited, making predictions of their spatial response to changing environmental conditions difficult. Instead of a species-specific approach to mapping climate niches, we here present a location-specific approach. The climatic distinctiveness index presented here quantifies the distinctiveness and spatial extent of the climatic conditions of a location within a given region around that location. Characterising the spatial extent of the climatic conditions of a region usually relies on some form of classification of climatic conditions with arbitrary cut-offs. The index we present here is continuous and is based on the relationship between the proportion of neighbourhood area with climatic conditions analogous to those of the target location, and the climatic niche breadth of the neighbourhood region. The index ranges from 0-1 with smaller values indicating that the climatic conditions of the target location are uncommon within the neighbourhood and with larger values indicating that the climatic conditions are widespread within the neighbourhood of the target location. Mid-elevation locations are generally characterised by low climatic distinctiveness, while low land and upland areas often show high climatic distinctiveness. Our study provides a climatic niche explanation of the mid-domain effect often observed in elevational species richness gradients.

Ralf Ohlemüller is a lecturer in biogeography with research interests in climate change ecology, forest dynamics and conservation biogeography.

Wednesday 27 November

Stream D, Session 8

Post-fire soil seed bank resilience of obligate seeders: bet-hedging capacity and increased fire frequency

Ooi, Mark¹

¹*Institute for Conservation Biology and Environmental Management, School of Biological Sciences, University of Wollongong*

Obligate seeders are dependent primarily upon stored seed for population persistence after fire and are particularly susceptible to decline in the face of increased fire frequency. For many obligate seeders, particularly those with a long primary juvenile period, persistence of some viable and ungerminated seeds in the soil after fire provides a bet-hedging capacity. A projected increase in fire-frequency under climate change makes understanding residual seed bank persistence after the passage of fire, and the identification of other bet-hedging strategies, of particular importance. Soil seed banks of *Leucopogon exolasius*, a threatened obligate-seeding species, were studied over time at sites subjected either to fire-free conditions or a single fire event. Without fire, *L. exolasius* seed banks were long-lived. However, viability of the experimental seed bank subjected to fire less than two years after burial declined rapidly. Increased levels of germination over the first two emergence seasons post-fire were the main cause of decline. No viable seeds remained after approximately 3.5 years post-fire and loss of viability of intact seeds over time was attributed to lethal soil temperatures. Reduced tolerance to heat by imbibed seeds makes both fire intensity and soil moisture potential contributors to increased levels of seed mortality. This study has shown that soil seed banks, at least for some species, aren't guaranteed to buffer plant populations from the effects of high frequency fire. Other bet-hedging mechanisms, such as a spread of germination over time, may offset a lack of residual seed bank to some extent.

Mark Ooi is currently an ARC Research Fellow based at the Institute for Conservation Biology and Environmental Management at the University of Wollongong. He studies plant population dynamics and has a particular interest in seed ecology.

Monday 25 November

Stream D, Session 1

Effects of species evenness and dominant species identity on multiple ecosystem functions in model grassland communities

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Ecosystems provide multiple services upon which humans depend. Understanding the drivers of the ecosystem functions that support these services is therefore important. Much research has investigated how species richness influences functioning, but we lack knowledge of the role of other community attributes. Species evenness, species spatial arrangement, and the identity of dominant species are three attributes that could affect ecosystem functioning, by altering the relative abundance of functional traits and the probability of synergistic species interactions such as facilitation and complementary resource use. We tested the effect of these three community attributes and their interactions on ecosystem functions over a growing season, using model grassland communities consisting of three plant species: a grass (*Anthoxanthum odoratum*), a forb (*Plantago lanceolata*), and a nitrogen-fixing forb (*Lotus corniculatus*). We measured multiple ecosystem functions that support ecosystem services, including ecosystem gas exchange, water retention, carbon and nitrogen loss in leachates, and plant biomass production. Species evenness and dominant species identity strongly influenced all measured ecosystem functions. Although increases in evenness initially had variable effects on functioning, by the end of the growing season it consistently enhanced functioning; this effect occurred regardless of dominant species identity. The identity of the dominant species under which the highest level of functioning was attained varied across the growing season. Spatial arrangement had the weakest effect on functioning, but interacted with dominant species identity to affect some functions. Our results highlight the importance of understanding the role of multiple community attributes in driving ecosystem functioning.

Kate Orwin is a researcher at Landcare Research. Her research focuses on how plants influence soil processes and how those processes feedback to affect plant communities, and whether the traits of above- and below-ground organisms can predict ecosystem functioning levels.

Wednesday 27 November

Stream B, Session 9

Trade-offs between body and weapon size in the New Zealand giraffe weevil: A new approach to Bergmann's rule

Painting, Christina¹; Buckley, Thomas^{1,2}; Holwell, Gregory¹

¹*School of Biological Sciences, University of Auckland*

²*Landcare Research, Auckland*

Sexual selection has driven the evolution of a diverse range of exaggerated traits in animals, including those used by males as weapons. Exaggerated traits are expected to evolve rapidly in response to environmental variation, but studies documenting this pattern are

relatively rare. In comparison, studies on latitudinal variation in body size according to Bergmann's rule are more common, and here we present a combined analysis of these two phenomena. Latitudinal variation in body size and weapon allometry were determined for the giraffe weevil (*Lasiorhynchus barbicornis*), a large-bodied brentid weevil endemic to New Zealand. Males display an extremely elongated rostrum which is used as a weapon, and exhibits a steep positive scaling relationship with body size. We found that mean body and rostrum size increased with latitude in accordance with Bergmann's rule; however weapon allometry showed the opposite trend. Variation in body size and weapon allometry is likely due to developmentally plastic responses to environmental change. The decreasing allometric slope could be due to trade-offs between body size and rostrum length, such that males investing increasingly more into body size at higher latitudes have fewer resources to allocate to rostrum size. Also, as sexually selected traits are expected to be condition-dependent, cooler climates at high latitudes may result in less investment in rostrum size relative to body size. To our knowledge, this is the first study documenting a latitudinal cline in weapon allometry, and is therefore a novel contribution to the collection of work on Bergmann's rule and exaggerated trait variation.

Christina Painting is a PhD student at the University of Auckland, with a particular interest in the evolution of exaggerated traits in animals. Her PhD is focused on the ecology and behaviour of the charismatic New Zealand giraffe weevil.

Monday 25 November

Stream E, Session 2

A practical approach to monitoring ground-dwelling mammals across landscapes

Paull, David¹; Claridge, Andrew^{1,2}

¹University of New South Wales Canberra

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Monitoring populations of cryptically behaved small-medium sized, ground-dwelling mammals presents considerable challenges for wildlife ecologists, especially across broad landscapes. For example, the design of field monitoring programs for this faunal group must include finding the most appropriate sampling device, understanding how many of those devices you might need and how they should be allocated in space and time. At all stages the biology of the target species, such as their movement behaviour and habitat use, must also be taken into account. Achieving these objectives is difficult but made more-so when operating across vast areas with poor access. To illustrate these complexities we describe the design of an ongoing landscape scale monitoring program for bandicoots and potoroos in south-eastern New South Wales. In the monitoring design phase, we established 252 remote infrared digital camera stations across 20,000 ha of forest, swamp and heath. These individual sites were continuously monitored for 30 days and the resultant occurrence data used to develop a statistical foundation for monitoring. Post-stratification analysis of vegetation has revealed that the camera positions in the subsequent monitoring phase of our work proportionally represented the landscape with minor exception. Our overall approach to designing this monitoring program has relied upon setting a series of simple experimental questions and answering those questions in sequence. Given this firm basis, we believe that future trends in our target species can now be reliably measured.

David Paull is a Senior Lecturer in Geography with research interests in the biogeography, ecology and conservation of endangered Australian fauna. Other interests include landscape ecology, environmental monitoring, Geographic Information Systems and Remote Sensing.

Wednesday 27 November

Stream F, Session 9

A time to die: a high-precision extinction chronology for moa (Aves: Dinornithiformes)

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The late Holocene avifaunal extinctions that occurred across the Pacific with the spread of humans are some of the most dramatic in the late Quaternary fossil record. The nine species of moa that were extant in NZ at the time of human settlement did not escape this wave of extinction, representing the loss of an entire order (Aves: Dinornithiformes). We provide a precise spatio-temporal chronology of moa extinction by applying sightings methods to a database of high-quality radiocarbon dates from all species of moa. Dated remains of moa included bones, egg shells, gizzard contents, flesh and coprolites preserved in both natural and archaeological deposits. We apply these same statistical methods to estimate the time of human arrival using Pacific rat (*Rattus exulans*) gnawed seeds as a proxy. Throughout the South Island of NZ, where most radiocarbon dates are available, moa population density was highest and hunting pressure probably highest, extinction occurred within c. 140 years of human settlement. Taxa of all sizes appear to have gone extinct at the same time, but local extinction happened within shorter windows at archaeological than at natural sites. While previous studies have used a similar approach to estimate extinction time for prehistoric fauna, we are in the unique position of having a precisely defined point at which human impacts began and this supports one of the most precise examinations of the prehistoric extinction of any guild of animals yet.

George Perry is based at the University of Auckland where his research is focussed on the dynamics of forest landscapes and the impacts – past and present – of people on such ecosystems.

Tuesday 26 November

Stream E, Session 6

Species richness, traits, and flowering: how they influence species role and the structure of flower-visitor networks

Popic, Tony John¹; Davila, Yvonne C¹; Wardle, Glenda M^{1,2}

¹*Desert Ecology Research Group, The University of Sydney, Australia*

²*Long Term Ecological Research Network (LTERN)*

Ecological systems have varying capacities to cope with disturbance, but future environmental change will place communities under increasing stress. Networks of species interactions play an important role in the maintenance of biodiversity, ecosystem response to perturbation and represent vital ecosystem services. Flower-visitor interaction networks are non-randomly structured by neutral and trait-mediated processes, but as ecological communities change, network structure also changes, and it is not clear how network function will be maintained. We investigate the mechanisms through which rainfall determines network structure and species role in a pulse-reserve system, using a spatio-temporally resolved set of 18 flower-visitor networks. Flower-visitor network structure responds to rain-driven changes in flowering intensity, with a disproportionate increase in visitor species compared to plant species. Increases in visitor and plant species richness are incorporated into the network differently, with visitors driving the size of modules and plant species driving the number of modules. Flowering intensity increases the number of links per species, leading to an increase in the proportion of connectors and a corresponding decrease in the proportion of ultra-peripherals per network. In addition, as rainfall increased, morphological complementarity increased among species assemblages, leading to more connectors and fewer ultra-peripherals. We conclude that recent rainfall stimulates changes in flowering intensity and species richness, which directly changes network structure and the role of species.

Tony Popic has recently finished his doctoral studies on flower-visitor interaction networks in the Simpson Desert, based at The University of Sydney. He is interested in pollination, community ecology, conservation ecology, and native bees.

Tuesday 26 November

Stream F, Session 5

Is there a future for coastal saltmarshes in southern Tasmania?

Prahalad, Vishnu¹; Jones, Jill²

¹*School of Geography and Environmental Studies, University of Tasmania*

²*Natural Resource Management South, Hobart, Tasmania*

Southern Tasmanian coastal saltmarshes form a crucial 'link' between terrestrial and marine systems providing critical ecological functions that support a range of ecosystem services and biodiversity values. Close to a half of these important coastal ecosystems have already been lost or degraded due to mismanagement and neglect. In addition, on-going effects due to climate change and sea level rise leave these ecosystems in a precarious position given that they occupy shores within 1 m of high water. This raises the question: is there a future for coastal saltmarshes in southern Tasmania? In response to this question, this presentation will outline an integrated multi-stakeholder driven ecosystem based management approach for ensuring a future for coastal saltmarshes. The approach includes an inventory framework that informs and guides management action, with a management network to coordinate action on the ground. The proposed management approach aims to advance a more systemic and holistic view of coastal ecosystems where saltmarshes are understood and managed with reference to relevant larger landscape scale processes. The approach acknowledges that the future of saltmarshes is a shared between multiple resource users and cannot be sustained without a shift in focus from the parts to the whole.

Vishnu Prahalad is from the University of Tasmania. His main field of research is on saltmarsh ecology and management in Tasmania. He is interested in ecosystem based management and linking ecosystem services more closely with people's social and economic values.

Monday 25 November

Stream C, Session 1

Roles of genetic specificity and geographic location in photobiont-mycobiont associations in New Zealand *Usnea* spp.

Rafat, Arash¹; Ridden, Johnathon¹; Cruickshank, Robert H.¹; Ridgway, Hayley J.¹ & Buckley, Hannah L.¹

¹*Department of Ecology, PO Box 85084, Lincoln University*

A combination of several factors such as specificity, selectivity, availability, and ecological parameters cause the patterns of association between mycobionts and photobionts in lichens. The aim of this study was to consider the specificity of the mycobiont-photobiont symbiosis for New Zealand *Usnea* lichens across a range of taxonomic and geographic scales. Algal and fungal internal transcribed spacer (ITS) fragments were sequenced for *Usnea* specimens collected from different sites in the North and South Islands, New Zealand. Genetic distance matrices and Bayesian phylogenetic trees were constructed from these data and these were analysed using partial Mantel tests, reconciliation analysis and general mixed Yule-coalescent (GMYC) species delimitation methods to reveal patterns of symbiont association and codiversification. These data provide the first molecular record of the availability of photobionts in New Zealand *Usnea* spp. We report an initial species delimitation based on the fungal molecular data in addition to the results of the algal-

fungal comparative phylogenetics. Results show a co-diversification pattern between the fungal and algal partners that depends on geographic and taxonomic scale. This study has improved our understanding of the association patterns in New Zealand *Usnea* spp. and has implications for their ecology.

Arash Rafat is a PhD student in Molecular Ecology based in the Department of Ecology, Lincoln University, New Zealand working on the molecular ecology of lichens. He has a background in other fields of study such as Agronomy and Plant Breeding, Microbial and Agricultural Biotechnology.

Monday 25 November

Stream D, Session 3

What we need to know about temperate woodland bird decline

Rayner, Laura¹; Lindenmayer, David^{1,2}; Gibbons, Philip^{1,2}; Wood, Jeff¹; Manning, Adrian¹.

¹ *Fenner School of Environment and Society, The Australian National University, Canberra, ACT 0200, Australia*

² *ARC Centre of Excellence for Environmental Decisions, National Environmental Research Program, The Australian National University, Canberra, ACT 0200, Australia*

Declines in Australian woodland bird populations documented over the last 50 years have resulted in widespread public concern and attracted substantial conservation research and funding. However, through a review of the scientific literature, we reveal that quantitative empirical evidence of temperate woodland bird decline remains scant. Existing trend assessments often lacked inferential rigour due to logistic and statistical issues associated with obtaining adequate population data and deriving accurate and reliable population indices. However, conservation science is showing clear signals that it is responding to these issues, with trend assessments becoming more rigorous in recent years. Overall, there is little debate about whether Australian woodland birds have suffered tremendously from the extensive clearing of their native habitat. What we urgently need to know is whether these pressures are ongoing, particularly given substantial increases in vegetative cover throughout much of south-eastern Australia. To address this knowledge gap, we undertook trend assessments for woodland birds in the Australian Capital Territory, where woodland remnants are typically more intact and better protected than anywhere else in Australia. We provide an update on the conservation status of these species based on empirical monitoring records from the last 15 years, capturing population responses to one of the most severe droughts in Australian history. Our results are species-specific and include a number of species commonly identified as 'decliners'.

Laura Rayner is a PhD student at The Fenner School of Environment and Society, ANU. Her research interests include landscape and restoration ecology and ecological monitoring.

Monday 25 November

Stream E, Session 2

Comparison of sight, sound and scent attractants for pelagic fishes to remote mid-water video stations

Rees, Matthew J.¹; Knott, Nathan A.²; Davis, Andy R.¹

¹ *Institute for Conservation Biology and Environmental Management, School of Biological Sciences, University of Wollongong, Wollongong 2522 NSW, Australia.*

² *NSW Department of Primary Industries, Jervis Bay Marine Park, Huskisson 2540 NSW, Australia.*

Patchily distributed taxa represent a significant challenge to adequately census. Near-shore pelagic fishes fit this description; as they are fast swimmers capable of avoiding conventional survey gear, occupy challenging habitats and display high spatial and temporal variation in their patterns of distribution. As a result little is known about the ecology of these fished species over seascape scales within coastal environments. To address this knowledge gap, baited remote underwater video stations (BRUVs) are becoming increasingly used to survey pelagic fishes. However, critical methodological questions, such as the importance of attractant type for these species remain unanswered. This study quantified the abundance of pelagic fishes using remote underwater video stations (RUVs) with 4 different attractant treatments (crushed pilchards, metallic reflectors, baitfish sound and a combination of all attractants) and a control with no attractant on the open coast of Jervis Bay Marine Park, Australia. We tested the hypothesis that the total abundance of pelagic fishes and the abundance of two pelagic fish species were dependent on attractant type. Univariate PERMANOVA detected significant effects of attractant type on the total abundance of pelagic fishes, primarily driven by the abundance of Yellowtail scad. A significant interaction between attractant type and oceanographic conditions was detected for Australia bonito. Attractant type had no effect on Yellowtail kingfish, however their abundance was significantly influenced by oceanographic conditions. In general, greater abundances of pelagic fishes were observed on RUVs containing all attractants and during periods of warm oceanic water. Additionally, Yellowtail scad, Australia bonito and Yellowtail kingfish displayed their highest detection rate on RUVs containing all attractants. Surprisingly bait alone was not an effective attractant. Our findings highlight the importance of attractant type and oceanographic conditions when surveying near-shore pelagic fishes with RUVs.

Matthew Rees is interested in the spatial ecology and conservation of marine assemblages. He is currently completing his PhD at the Institute for Conservation Biology and Environment Management (ICBEM), University of Wollongong.

Monday 25 November

Stream F, Session 1

Challenges in providing habitat for forest birds on a regenerating seabird island

Roberts, Cynthia¹

¹*Department of Conservation*

Rangatira Island, Chatham Islands provides critical habitat for 14 threatened species including forest dwelling birds such as the black robin (*Petroica traversii*) and Chatham Island snipe (*Coenocorypha pusilla*). The island is also home to around 3 million burrowing seabirds. Farming ceased in 1960s, and native vegetation was left to regenerate without significant human assistance. In 2013 I resurveyed forest plots and photopoints established in 2002 to investigate the impact of seabirds on regeneration. Results show that burrow entrance density had increased from 1.19 to 1.76 per m² and understorey ground cover and tree densities had both reduced, suggesting that increased seabird density is impacting on forest regeneration. Photopoints outside of the forest show differing success in establishment of forest species into grassland. At lower altitude on the eastern side of the island, cover of bracken (*Pteridium esculentum*) overtopped with muehlenbeckia (*Muehlenbeckia australis*) vine, which invaded grasslands quickly after farming ceased, have remained static for decades. In addition, some forest margins have succumbed to the weight of the muehlenbeckia. Although black robin numbers have increased on the island, their preference for flatter, lower altitude sites raises concern for their future given that (i) suitable habitat may soon reach carrying capacity, and (ii) the hoped for expansion into old field areas will not happen because muehlenbeckia is suppressing regeneration. Techniques for promoting regeneration within bracken-muehlenbeckia communities will be discussed alongside other options for increasing forest habitat.

Cynthia Roberts, Science Advisor Ecology, Department of Conservation. Research interests include animal plant interactions and vegetation dynamics such as those on seabird islands and marsupial grazing lawn turf communities in Australia; the terrestrial ecology of mangroves.

Thursday 28 November

Stream F, Session 10

Regeneration success in Central North Island mixed podocarp-broadleaved forest – the positive impact of large disturbance

Roschak, Christian¹; Keye, Constanze¹; Norton, David¹

¹*University of Canterbury, School of Forestry, New Zealand*

Podocarp-broadleaved forests represent the most extensive forest type in New Zealand. Due to the value of podocarp timber as well as the demand for productive farmland, they suffered for decades from uncontrolled destructive harvesting and land clearance. Even though short-term effects of destructive harvesting are well studied, little is known about the long-term impacts on the structure and dynamics of these forests. This study focuses on the long-term disturbance effects 57 years after destructive harvesting of podocarps in a 100 ha block of mixed podocarp-broadleaved forest at Pureora in the Central North Island. Less than 1% of podocarps with dbh >20cm were left after harvesting and the forest is now dominated by the mature angiosperms tawa (*Beilschmiedia tawa*) and hinau (*Elaeocarpus dentatus*). But results from our research show vigorous regeneration of the podocarps rimu (*Dacrydium cupressinum*), miro (*Prumnopitys ferruginea*), matai (*Prumnopitys taxifolia*) and kahikatea (*Dacrycarpus dacrydioides*) at this site. Growth rates of advanced podocarp regeneration indicate a strong correlation between the scale of disturbance and regeneration success. The larger the scale of disturbance, the faster the growth of all podocarp species and the better the chance they have of successfully competing with broadleaved species and tree ferns (*Dicksonia* species, *Cyathea* species).

Christian is a forest scientist from Germany and is currently working on his PhD in Forest Ecology at the University of Canterbury. His research focuses on the dynamic nature of gymnosperm-angiosperm relationships in podocarp-broadleaved forest in New Zealand.

Thursday 28 November

Stream A, Session 11

Effects of population reduction on possum movements and habitat use in a New Zealand dryland ecosystem

Rouco, Carlos¹; Norbury, Grant¹; Smith, James¹; Anderson, Dean²

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Brush-tail possum habitats in the southern South Island differ in many respects to those in the rest of New Zealand's high country, such as more abundant rocky outcrops and dense shrubs. This 3-year study investigates movements and habitat selection by possums in dryland habitats, and aims to identify the habitat types where possums aggregate following population control. Possums are controlled in this ecosystem to mitigate their effects on bovine tuberculosis in livestock. We attached GPS collars to 33 possums and supplemented habitat-use information with locational data from peanut butter-infused cards that had been chewed by possums. Possums only marginally expanded their home ranges following a 73 – 87% reduction in possum density. Maximum ranges increased from an average of 17.4 ha to 19.4 ha, but their movements over 24-hour periods within their home ranges increased throughout the year, compared with little seasonality in movements before control. After control, preference for shrubs and rock outcrops increased in all seasons, presumably because the lower density of possums reduced competition for these preferred sites. This increase in mobility

and greater preference for shrubs and rocks is likely to benefit maintenance control because possums will have a higher probability of encountering bait stations when focussed on these particular habitats.

Carlos Rouco is a postdoctoral researcher at Wildlife Ecology & Management Team. Wildlife Ecologist with broad research interests in ecology and wildlife management and disease of small and medium size mammals.

Wednesday 27 November

Stream D, Session 8

Germination in *Eucalyptus*: initial implications for restoration

Ruiz-Talonia, Lorena¹; Reid, Nick¹; Gross, Caroline¹; Smith, Rhiannon¹

¹University of New England, School of Environmental and Rural Science, Armidale.

Direct seeding with precision planters is an attractive option to restore large areas of cleared arable land due to time and economic efficiency, compared with other methods. However before planning any restoration program, seed germination requirements need to be understood. *Eucalyptus* species are keystone species and a priority in many restoration projects in Australia. The objective of this study was to clarify the germination response of 11 *Eucalyptus* species in relation to temperature, to determine suitable sowing seasons for seedling emergence in direct seeding restoration programs. Seasonal temperature regimes of the natural habitat of *E. albens*, *E. blakelyi*, *E. camaldulensis*, *E. chloroclada*, *E. coolabah*, *E. dealbata*, *E. melanophloia*, *E. melliodora*, *E. pilligaensis*, *E. populnea* and *E. sideroxylon* were investigated in north-western New South Wales and matched in germination experiments. These temperatures were simulated in growth cabinets set at 15/5°C, 15/25°C and 25/35°C (12/12 hour day/night regimes) to match winter, summer and autumn/spring temperature regimes, respectively. All species exhibited germination percentages >90% at the 15/25°C, except *E. coolabah* and *E. melliodora* which had poor viability. Ungerminated seeds at the other temperatures were recovered and placed in cabinets set at 15/25°C to test viability. *E. dealbata* and *E. chloroclada* germinated under all temperature regimes; other species performed less well at both extremes. Timing of germination plays a significant role as rate of germination in all species was proportional to temperature.

Lorena Ruiz Talonia is a PhD student at the University of New England. Research interests include: ecology of restoration, habitat fragmentation and its impacts; climate change upon species; population genetics and genetic selection for restoration.

Wednesday 27 November

Stream F, Session 8

Drivers of reptile distributions in disturbed alpine and subalpine environments

Sato, Chloe¹; Lindenmayer, David¹; Green², Ken; Schroder, Mellese²; Michael, Damian¹, Osborne, William³.

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Alpine and subalpine ecosystems are sensitive environments that support a large number of endemic species. These ecosystems are increasingly under threat from human-induced disturbances such as habitat loss due to ski resort development and expansion. However, limited research has investigated the impacts of ski-related disturbances on wildlife, particularly on reptiles.

To address this knowledge gap, we conducted reptile surveys to determine the patterns of lizard distribution and abundance at two Australian ski resorts. Then, using a fully factorial experimental design, we investigated: 1) the influence of temperature and predation in driving observed distributions; and 2) how a common ski resort management practice –mowing – affected thermal regimes and rates of predation on ski runs. We found that the removal of structural complexity through mowing resulted in significantly higher rates of predation on plasticine models, as well as significantly altered thermal regimes. Crucially, mown ski runs had higher maximum ground temperatures that frequently exceeded the recorded critical maximum body temperatures of sympatric lizards. This has the potential to render these areas unsuitable for thermoregulatory purposes for a large proportion of the potential activity period of reptiles.

Together, temperature regimes and rates of predation explain the avoidance of ski runs by lizards. To facilitate the persistence of reptiles in disturbed alpine-subalpine environments, management plans must focus on implementing strategies (such as the retention of structural complexity on ski runs) that reduce the impact of temperature and predation on lizards.

Chloe Sato is a PhD candidate at the Australian National University. She is broadly interested in applied ecology, landscape ecology and biodiversity conservation, particularly in alpine and subalpine environments.

Wednesday 27 November

Stream E, Session 8

Parasitic mistletoes show curiously similar photosynthetic adaptations to aridity as their hosts

Scalon, Marina C.^{1,2}; Wright, Ian J.¹

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Mistletoes are photosynthetic parasitic plants that penetrate the branches of their hosts with their haustorium and steal water and nutrients from the host xylem - they have no root system. Because the unit-cost they pay for nutrients, but particularly water, is far lower than that paid by their hosts then we might expect them to display different optimal balances of water and nitrogen use in photosynthesis, and dampened trends in photosynthetic traits in relation to geographic gradients in aridity and soil fertility. Indeed, some authors have argued that mistletoes have little ability to regulate their resource use. We tested these propositions in mistletoe-host pairs sampled from sites spanning from northern to southern Australia – sites varying widely in climate and soil properties, and associated vegetation types (savanna, desert, woodland, forest). When compared to their hosts, mistletoes showed wildly inefficient use of water in photosynthesis, as well as lower photosynthetic capacity for a given leaf N concentration. However, mistletoes and hosts showed consistent trends in relation to site aridity. At more arid sites they showed (1) stronger control over water loss, reflected in the lower values of stomatal conductance and transpiration at a given photosynthetic rate; (2) higher leaf nitrogen and phosphorus concentrations; and (3) lower photosynthetic capacity for a given nitrogen concentration. That is, both hosts and their mistletoe parasites showed enhanced water conservation strategies in arid environments. Our results suggest that mistletoes can at least partially regulate resources use, and have a coupled response with their hosts to environmental conditions.

Marina Corrêa Scalon is a PhD candidate at Macquarie University (Sydney) interested in understanding relationships among plant functional traits, and how traits and trait relationships vary between different environments and functional groups, particularly focusing on the ecology and physiology of mistletoes.

Wednesday 27 November

Stream E, Session 8

New Zealand-naturalized *Trifolium* species lack root flavonoid diversity

Shelby, Tasha¹; Hulme, Philip¹; Duncan, Richard²

¹Bio-Protection Research Centre, Lincoln, New Zealand

²University of Canberra, Australia

Flavonoids are ubiquitous plant metabolites with vital, co-evolved roles in mutualisms and defence. However, under the novel conditions following plant introduction, some compounds may be rendered superfluous. Thus, opportunistic aliens that dump “baggage” traits from their arsenal may funnel energy toward growth or reproduction – the evolution of increased competitive ability (EICA) hypothesis.

We tested EICA by growing native (Europe) and naturalized (New Zealand) genotypes of five *Trifolium* species in native-range soils in a glasshouse. Using high-performance liquid chromatography, we compared total root flavonoid diversity and concentration as well as the levels of two isoflavonoids -- one involved in defence and another that stimulates mutualistic nitrogen-fixing *Rhizobia*.

The most striking difference was a significant loss of flavonoid diversity among naturalized genotypes. On average, native genotypes had 15.02 (± 0.63 SE) unique compounds, whereas NZ genotypes had only 10.80 (± 0.62 SE) ($P < 0.001$, $F = 23.14$). However, the concentration of individual flavonoids among NZ genotypes was often magnitudes higher. Specifically, the concentration of Biochanin A, an allelopathic compound, was on average 6 times greater in NZ genotypes ($P < 0.004$, $F = 8.687$), suggesting a shift toward generalist defences in the invaded range.

Tasha Shelby is a PhD candidate at the Bio-Protection Research Centre. Her research focuses on the role of adaptation in invasive-plant success, particularly in the context of below-ground interactions and the role of flavonoids in mutualism and defence.

Monday 25 November

Stream E, Session 2

Geckos uncovered: monitoring arboreal geckos in the Auckland region

Sinclair, Su¹; Rixon, Melinda¹

¹Auckland Council

Adoption of a novel reptile monitoring technique in combination with an established and proven method has provided robust results for the Auckland Regional gecko monitoring programme. Artificial refuges on tree trunks as developed by Bell were used in conjunction with night spotting to detect nocturnal arboreal geckos at four separate locations. Detection success varied across locations for each monitoring method, demonstrating that restricting monitoring to a single method would have compromised detectability (and therefore abundance estimates) significantly. Detection per unit effort also varied between methods and locations. Each method has specific inherent logistical or labour resource requirements i.e. daytime vs. night time data collection and skilled vs. non-skilled personnel. Three years of results will be presented and discussed in the context of delivering an optimised programme within local government agency budget and time constraints as opposed to within a research framework.

Su Sinclair (PGDip Sci) is an ecologist at Auckland Council and responsible for managing the Councils kokako recovery programme in the Hunua Ranges.

Monday 25 November

Stream E, Session 2

Basal area from photos.... Is it possible?

Sparrow, Ben¹; Ward, Ben², Thurgate, Nikki¹, Caddy-Retalic, Stefan¹, van den Hengel, Anton² and Lowe, Andrew¹.

¹*Terrestrial Ecosystem Research Network (TERN), School of Earth and Environmental Sciences, The University of Adelaide*

²*The Australian Centre for Visual Technologies, Department of Computer Science, The University of Adelaide.*

This paper describes collaborative work conducted between TERN and ACVT to develop new photopoint collection methodologies. Our photopoint collection methodology incorporates the collection of three sets of overlapping photographs each collected different exposure points within a field site. These photographs are then processed to create a range of products. These photos are seamlessly joined to create a 360 degree high resolution panorama of the site, which is stored with the relevant site data allowing ecologists utilising the data to appreciate the environment in which that data were collected. Point clouds are also calculated allowing a three dimensional view of the site and potentially allowing similar analysis, albeit at slightly lesser precision, to that of terrestrial Lidar systems. Lastly, these three dimensional site reconstructions are used to measure stem diameters and sum these for each site providing a measure of basal area per hectare, with an accuracy greater than that of rapid techniques such as the use of basal wedges/prisms and significantly quicker and cheaper than accurate measures such as measuring DBH for all stems or utilising a terrestrial Lidar. Given that the method allows rapid collection (30 minutes per site) of this information with an accuracy exceeding rapid methods we anticipate that this method will be widely applicable. We look forward to further tests to quantify the accuracy of these methods and to automate the system and deliver it online for ecologist to easily utilise.

Ben Sparrow is currently the Science and Technology Lead for the Multi-Scale Plot Network segment of TERN, and is based at the University of Adelaide. His research interests focus on the utilization of spatial technologies in ecological applications.

Monday 25 November

Stream B, Session 3

Adaptive Significance of Genotypic Sex-Determination (GSD) in Turtles

Spencer, Ricky-John¹; Dormer, Jessica¹; Janzen, Fredric J.²

¹*Wildlife and Aquatic Ecology Group, Native and Pest Animal Unit, School of Science and Health, University of Western Sydney.*

²*Department of Ecology, Evolution, & Organismal Biology, Iowa State University,*

Comparative analyses identify an ancient origin of Temperature-dependent Sex Determination (TSD) in reptiles, suggesting that this trait should be advantageous in order to persist. However, research examining sex-specific variation in offspring phenotype and fitness generated by different incubation conditions has been largely unsuccessful. We posit that, instead, our understanding of the adaptive significance of Sex-Determining Mechanisms (SDMs) in long-lived reptiles may lay with species that have evolved Genotypic Sex Determination (GSD) from TSD. In turtles, GSD evolved from TSD at least five times. We used incubation and common-garden experiments to examine the interactive effects of sex and incubation temperature on post-hatching body size/growth and performance/survival in an Australian turtle, *Emydura macquarii macquarii*, and a North American turtle, *Apalone mutica*, both of which have independently evolved GSD. Eggs were collected from both species and incubated at a range of temperatures. Sex-specific interactions with incubation temperature were examined in a range of traits, including short- and long-term survival and growth, swimming and running speeds, and righting ability. We detected a narrow incubation temperature range where post-hatching body size/growth and performance were optimised, and this optimum was similar between the sexes. Additionally, we found that cool incubation temperatures substantially reduced body size and performance in both species, particularly for males, as well as long-term survival of both sexes in *Emydura*. While our results meet common criteria of models of the adaptive significance of TSD, they also demonstrate that known patterns of TSD in turtles would not be favoured in either species, thus pinpointing GSD as the optimal SDM in both instances.

Ricky Spencer is a Senior Lecturer at the University of Western Sydney and is a founding member of the Wildlife and Aquatic Ecology Group. His research interests include the evolutionary ecology and physiology of reptiles, as well as, vertebrate pest animal ecology and management.

Wednesday 27 November

Stream F, Session 8

Bird community responses to vegetation cover and structural heterogeneity

Stirnemann, Ingrid¹; Ikin, Karen¹; Gibbons, Philip¹; Blanchard, Wade¹; Lindenmayer, David B.¹

¹*Fenner School of Environment and Society, The Australian National University*

Vegetation cover has long been known to be an important predictor of faunal distributions. However, few studies have examined the additional contribution of fine-scale horizontal vegetation heterogeneity for predicting faunal occurrence. Accounting for heterogeneity may provide a more comprehensive picture of the effect of vegetation structure on faunal communities, leading to improved biodiversity management. In this study, we investigated how bird species richness and life-history traits responded to vegetation cover and

heterogeneity in different vegetation types. We found that both fine-scale vegetation cover and shrub heterogeneity were important predictors of bird richness, but the direction of the response to shrub heterogeneity differed between vegetation types. We further investigated these patterns by examining the responses of birds grouped by various ecological traits. Our study is the first to show that bird species with particular traits responded not only to the amount of cover, but also had a preference for (or were restricted by) different levels of vegetation heterogeneity. For example, we found that some bird species with particular life history traits, such as aerial feeders, showed a preference for patchy, heterogeneous micro-habitat. In comparison, bird species with traits such as low mobility and ground feeding exhibited a preference for dense, uniform vegetation cover. Our findings suggest that managing for high levels of vegetation cover, or alternatively managing for high levels of vegetation heterogeneity; will have different effects on the faunal community, with some species responding positively and others negatively.

Ingrid Stirnemann is undertaking a PhD at ANU on the influence of habitat heterogeneity on biodiversity. Ingrid has an international background working on migratory movement patterns and a keen interest in landscape ecology.

Monday 25 November

Stream C, Session 1

Genetic analyses reveal distinct structuring between populations of the endangered Glenelg Spiny Crayfish, *Euastacus bispinosus*, and a lack of genetic diversity in a disjunct South Australian population

Sweeney, Oisín¹; Miller, Adam²; Whiterod, Nick³; van Rooyen, Anthony⁴; Hammer, Michael⁵ Weeks, Andrew^{4,6}

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The Glenelg Spiny Freshwater Crayfish (*Euastacus bispinosus*) is an iconic species endemic to Australia. It is listed as endangered under federal legislation and vulnerable under IUCN. It occurs across a small part of western Victoria and in coastal springs and creeks in south east South Australia, where it is the largest invertebrate in the system and is likely to play an important role in energy transfer via predation and scavenging. We assessed genetic diversity and gene flow from 17 sites using allele frequencies derived from microsatellites and mitochondrial DNA analyses. We found that populations were highly structured with gene flow restricted between sub-catchments. Furthermore, all 12 populations for which analyses were possible were found to have undergone recent bottleneck events. The disjunct South Australian population was found to contain extremely low levels of genetic diversity which may be a result of a small founder population or bottlenecks exacerbated by subsequent genetic drift. These findings support previous work that suggests the species has limited dispersal and colonisation abilities, which may be a consequence of a high degree of habitat specialisation and a long generation time. These life-history traits have likely amplified human impacts such as flow alteration, habitat modification and fishing. Conservation efforts should concentrate on restoring habitat quality and connectivity within and between populations, though genetic rescue may also be required for the disjunct South Australian population to increase genetic diversity and thus resilience.

Oisín Sweeney is a senior habitat ecologist with the Department of Environment, Water and Natural Resources in South Australia. Much of his current role involves on-ground management of threatened species and habitats, though he remains active in research when possible.

Wednesday 27 November

Stream D, Session 8

Fire regimes of the Blue Mountains World Heritage Area, Australia: patterns and ecological impacts

Tasker, Elizabeth¹; Hammill, Kathryn¹; Barker, Clive¹

¹NSW Office of Environment & Heritage

The Greater Blue Mountains World Heritage Area is more than a million hectares and extends over more than 250km north – south. It comprises eight national parks and reserves, including the iconic Blue Mountains National Park. The biodiversity is outstanding with more than 152 plant families, 100 species of eucalypt and 400 species of vertebrates. Fires are an annual occurrence, and – on average – once or twice per decade affect a large proportion of the WHA. Analysis of a 40 year fire history reveals that ~60% of the area has burnt within the past decade, a result of major fire seasons in 2001-02, 2002-03 and 2006-07. For the most part successive fires have burnt different parts of the landscape: over four decades ~20% of the WHA has been burnt by one fire, 33% by two fires, and ~20% by three fires. Only 8% has burnt four or more times. We created fire severity maps from remote-sensed imagery for all major fires of the past two decades. These have revealed for the first time those parts of the landscape that have repeatedly experienced extreme or severe fire. Preliminary analysis of floristic plot data collected from a subset of these areas in wet sclerophyll (eucalypt) forest and rainforest, and stratified by fire severity and number of fires, indicates that the number of fires affects floristic composition more than fire severity. The resulting fire history is among the most extensive and comprehensive in the world, and is the subject of ongoing analysis.

Liz Tasker is Principal Scientist Fire Ecology with the NSW Office of Environment & Heritage, based in Sydney. Her research interests include bushfire ecology and management, understanding animal and plant distribution and abundance, and what makes a really outstanding coffee.

Monday 25 November**Stream F, Session 1****Death on a seabird colony – causes, effect on seabird population growth and ecosystem benefits**Taylor, Graeme¹¹*Department of Conservation, PO Box 10420, Wellington 6143, New Zealand*

Adult, juvenile and nestling seabirds are sometimes observed dead on seabird colonies. Yet the nature and extent of these seabird deaths has seldom been studied nor are the consequences fully understood. This talk will summarise observations obtained over a 25-year study of two small seabird colonies near Auckland, New Zealand. While studying the ecology of four breeding petrel species, I monitored all nests present on each island annually and recorded evidence of all land-based mortality of adult and young petrels. I will show the proportion of deaths that result from inter- and intra-specific competition for nests, as well as from interaction with the island's plant species and from invasive mammalian species. Burrow competition between the different seabird species resulted in mortality of both adults and chicks. The impact of fatal attacks from adult petrels on chicks and fledglings of other species will be compared between the two colonies which have different seabird communities. From these insights the potential effect of colony-based mortality on population growth rates will be assessed. Corpses of seabirds also provide a source of marine derived nutrients for terrestrial ecosystems. The estimated annual biomass of seabird corpses per unit area will be presented in the talk.

Graeme Taylor is a Principal Science Advisor with the Science and Capability Group in DOC's National Office. He specialises in research, monitoring and advice about New Zealand's seabirds, especially petrels, shearwaters and penguins.

Thursday 28 November**Stream C, Session 10****Cascading habitat formation increase biodiversity in New Zealand estuaries**Thomsen, Mads Solgaard¹; South, Paul¹; Schiel, David R¹¹ *Marine Ecology Research Group, School of Biological Sciences*²*University of Canterbury*

Cascading habitat-formation – where primary biogenic habitat-formers facilitate secondary biogenic habitat-formers to indirectly facilitate plant and animal end-users – is important in forests, seagrass beds, mangroves, kelp forests, salt marshes, coral reefs and estuaries. Here we show that cascading habitat-formation in the Avon Heathcote Estuary, Christchurch, increases biodiversity and controls the community structure of invertebrates. More specifically, we quantify spatio-temporal variability in the influence of three co-existing habitat-formers (seaweeds, seagrass, cockles) on invertebrate communities. We then compare our results to cascading habitat-formation in similar ecosystems with different biogeographies (estuaries from different continents) and to different ecosystems inhabited by fundamentally different co-existing habitat-formers (e.g., forests and marshes). Our results show high spatio-temporal variability in indirect facilitation in the Avon-Heathcote Estuary, comparable to the highest and lowest indirect facilitation recorded from similar habitats on different continents and across different ecosystems.

Thomsen, a Research Associate at University of Canterbury, study how invasions, pollution, and climate change impact the structure and biodiversity of coastal ecosystems.

Wednesday 27 November**Stream F, Session 9****Missing pages: filling the gaps in Australia's ecological story**Thurgate, Nikki^{1,2}; Sparrow, Ben^{1,2}; Dormontt, Eleanor^{1,2}; Burns, Emma^{2,3}; Lindenmayer, David^{2,3}; Lowe, Andrew^{1,2,4,5}¹*University of Adelaide*²*Terrestrial Ecosystem Research Network*³*Fenner School, Australian National University*⁴*South Australian Museum*⁵*South Australian Department of Environment, Water and Natural Resources*

Australia contains some of the most ancient, weathered and nutrient depleted soils in the world, yet due to long-term isolation, has evolved a unique and megadiverse ecology. Australian species have adapted to high temperature, variable water availability and frequent fires. A highly variable climate supports globally significant tropical, temperate, alpine and arid ecosystems.

To manage these systems, we must understand their key components, distribution, and the key drivers of ecosystem function and change, both natural and human. We investigate the combined power of the long-term monitoring studies within Australia's Terrestrial Ecosystem Research Network to inform on environmental change at a continental scale. We compare the locations of studies against national bioregional classifications that are regularly used by to make management and policy decisions. We highlight areas of adequate or intensive monitoring, and also areas where there are insufficient monitoring sites to appropriately inform decision-making. We find that the most habitable and/or productive areas, in terms of climate, are those most intensively sampled. Conversely, the majority of the vast arid areas of the continent are most poorly sampled (and thus understood). This finding is not surprising, given the proximity of research institutions to economically important areas, and the logistical challenges faced when accessing arid Australia. However, under-sampled areas, and the vegetation communities that dominate them, constitute the major proportion of our country and are becoming

increasingly economically important. We encourage sustained investment in long-term research in these areas to maximise our capacity to accurately tell a truly Australian ecological story.

A/Prof Nikki Thurgate is a vertebrate ecologist with extensive experience Australian and North American terrestrial ecosystems. She is Director of TERN's Multi-Scale Plot Network, uniting existing and plot networks across Australia for the first time. Nikki is passionate about using ecological science to drive environmental decision making.

Thursday 28 November

Stream C, Session 11

Genetic and recruitment patterns predict biodiversity loss from biodiversity offsetting schemes

Tierney, David¹; Sommerville, Karen²; Gross, Caroline³; Fatemi, Mo³; Tierney, Kate³

¹University of Queensland

²Royal Botanic Gardens and Domain Trust

³University of New England

Understanding the contribution of individual populations to the long-term viability of any given species is critical for both theoretical and practical reasons. For example, recently developed biodiversity offsetting schemes generally assume that populations of species are of equal conservation value. These schemes assume that no net loss of biodiversity will occur if populations are lost or reduced in size in one location, but other populations are established or increase in size. In this study we test these assumptions. Specifically we investigate: 1. Taxonomic status; 2. Genetic structuring, and; 3. Recruitment among populations of the terrestrial orchid *Diuris platichila*. We investigate how the interaction of these factors affects the contribution of individual populations to the viability of this species. Genetic and recruitment differentiation among populations indicate that six studied putative populations of *Diuris platichila* cannot be considered to be of equivalent conservation value. These patterns are not predictable and indicate that enhancement of any given population is unlikely to offset for the reduction or loss of other populations. Issues with past collections from these populations provide further difficulties in assessing the legislated threat status of the studied populations and such issues are not uncommon.

David Tierney suffers from chronic desk phobia and works as a senior ecologist undertaking vegetation surveys, mapping and assessments. He has worked in government, education and consulting roles and undertaken research in areas spanning fire ecology, plant reproductive ecology and evolution.

Monday 25 November

Stream E, Session 2

Linking bioacoustics and ecological condition in a fragmented landscape

Tucker, David¹; Gage, Stuart²; Williamson, Ian¹, Fuller, Susan¹

¹Queensland University of Technology

²Michigan State University

Natural landscapes are increasingly subjected to anthropogenic pressure and fragmentation resulting in biodiversity loss and reduced ecological condition. Surrogates for biodiversity and ecological condition monitoring provide an attractive shortcut for comprehensive surveys; however, the utility of any surrogate is dependent on its scientific validity. Here we have examined whether bioacoustic measures, in the form of acoustic power spectral density, can be used as a surrogate for ecological condition in fragmented forest remnants of South-east Queensland, Australia. The region is noted for its high biodiversity value and increased pressure associated with habitat fragmentation and urbanisation. Ten sites defined by a distinct open eucalypt forest community dominated by spotted gum (*Corymbia citriodora* ssp. *variegata*) were stratified based on patch size and patch connectivity. Each site underwent a series of detailed vegetation condition and landscape assessments, together with avian and bioacoustic surveys. Univariate and multivariate analyses indicated that the measurement of power spectral density reflects avian species diversity and ecological condition, and is dependent on the extent of landscape fragmentation. We conclude that bioacoustic technologies provide a cost effective surrogate for ecological condition, especially in conjunction with established field observations and recordings.

David Tucker is a PhD candidate. He has an interest in surrogacy measures and vegetation patterns has led to a current PhD project researching ecological condition and acoustic indices as surrogates for biodiversity in terrestrial systems.

Thursday 28 November

Stream E, Session 11

Carnivorous Mammals: the Big, the Small and the Giants.Tucker, Marlee¹; Ord, Terry¹; Rogers, Tracey¹¹*Evolution and Ecology Research Centre, School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, Australia, 2052*

Terrestrial carnivorous mammals shift to feeding on larger sized prey when their body size is above 21kg, to meet increasing energetic requirements. What happens to this relationship when marine carnivorous mammals are included as the differences associated with an aquatic lifestyle (increasing body mass and changes to prey types used) may have altered that relationship. We investigate the relationship between predator and prey body mass, in addition to energetic requirements, more broadly, across 107 carnivorous mammals including 51 terrestrial and 56 marine mammal species. We found that marine and terrestrial carnivores have evolved opposing predatory behaviours likely to minimise energy expenditure while maximising energy intake. Despite the high energetic requirements of large body mass, marine carnivores (>12 000kg) feed on small prey up to several magnitudes smaller than themselves. To meet energetic requirements large marine carnivores consume enormous quantities of small prey using specialised feeding apparatus (such as baleen) and specialised behaviours (such as bubble netting) to corral prey schools. We demonstrate that the relationship between prey size and predator body mass is not uniform but differs between marine and terrestrial mammals due to the differences in prey type, predator morphology and behaviour.

Marlee Tucker is an ecology PhD candidate at the University of New South Wales. Her work encompasses macroecological patterns in mammals, specifically changes in patterns and behaviours that have occurred with the colonisation of the marine environment.

Wednesday 27 November

Stream E, Session 8

Assessment of root and litter mediated allelopathic interference of *Phragmites australis* using density-dependent approachUddin, Md Nazim¹; Caridi, Domenico¹; Harun, Md Abdullah Yousuf Al-Hraun¹; Robinson, Randall William¹¹*College of Engineering & Science, Victoria University, Vic. 8001, Australia*

The response of plants to many phytochemicals changes from stimulatory to inhibitory as the concentration of the phytochemical increases. In this paper, a biological response was measured to yield estimates of plant responses to changes in phytochemical concentrations in the case of density-dependent phytotoxicity. The difficulty of distinguishing allelopathy from resource competition among plants has hindered investigations of the role of phytotoxic allelochemicals in plant communities. Considering the complexity we addressed a series of ecological realistic experiments in the laboratory and greenhouse. Experimental plant populations (*Melaleuca ericifolia*, *Rumex conglomeratus*, and *Lactuca sativa*) were grown at varying densities with allelopathy plant, *Phragmites australis* and varying concentrations of aqueous extracts of *P. australis* litter to investigate the potential interacting influences of allelopathy and resource competition on plant response and yield-density relationships. Results showed that phytotoxicity decreased as plant density increased and maximum individual plant weight and some other positive effects on plant traits occurs at an intermediate density. This was attributed to plant 'dilution' of phytotoxins, i.e. the sharing of the available phytotoxin among many plants at high densities. The results demonstrates that either decreasing phytotoxicity with increasing plant density or a reversal in slope of the predicted log yield-log density relationship is proposed as an indication of the allelopathic effect rather than resource competition.

Md. Nazim Uddin is a PhD student in ecology and sustainability, Victoria University, Melbourne, Australia. He is doing research on allelopathy regarding Phragmites australis in wetland. The acquisition of knowledge may provide a rational and scientific basis for wetland management.

Monday 25 November

Stream D, Session 2

Movements and behaviour of free-ranging livestock guardian dogsvan Bommel, Linda^{1,2}; Johnson, Christopher N¹¹*School of Zoology, University of Tasmania*²*Fenner School of Environment and Society, Australian National University*

Livestock guardian dogs (LGDs) offer a non-lethal alternative to lethal predator control. Their use is spreading over the world, and there is increasing evidence that they can protect many types of livestock from many different types of predators. In Australia, LGDs are a relatively new method of livestock protection, but their popularity is increasing. When guarding stock on large properties, LGDs are often unrestricted in their movements, as in most cases they are allowed to range freely and they readily cross stock fences. Their owners usually only check their dogs once a week or less, and the movements and behaviour of these free-ranging LGDs is largely unknown. They can potentially roam over large areas, and this can cause concern for their owners and other members of the community with regard to the safety of the livestock these dogs need to protect, and the activities they might engage in if they leave their stock.

In this research, GPS collars were used to monitor the movements and behaviour of free-ranging Maremma Sheepdogs on three grazing properties in Victoria, Australia. In addition, in order to determine how LGDs' deal with a perceived predator threat, wild dog

incursions were simulated through sound playback and scent application. The Maremmas in this study spent the majority of their time with their livestock, although movements away from stock did occur for a variety of reasons. Their response to a perceived predator threat was consistent with territorial behaviour.

Linda van Bommel has just submitted her PhD thesis, and is currently writing up papers from data that did not make it into the thesis. Her research interests are predator ecology, predator management, non-lethal predator control and human-wildlife conflict.

Wednesday 27 November

Stream E, Session 7

Assessing landscape connectivity values using an expert opinion approach: Slopes to Summit case study

van der Burgh, Cecile¹; Spooner, P.¹

¹*School of Environmental Sciences, Charles Sturt University*

To maintain healthy biotic populations, regional and continental scale connectivity initiatives have commenced worldwide as a key management response to climate change. However, as required biophysical data are often limited, and uncertainty is usually high, expert advice from ecologists and other knowledgeable individuals is often critical for conservation decision making. The aims of our research were to (1) identify and prioritise the information and data needs of experts to rank landscape units for landscape connectivity, (2) assess whether there are differences in landscape connectivity approaches and information needs between different types of experts, and (3) identify which landscape units are important to target for connectivity conservation programs.

A mixed-method survey was developed to elicit the knowledge of 68 experts - researchers, practitioners and land managers – active in the broad field of 'connectivity conservation'. These experts were asked to prioritise selected areas for 'connectivity' in the Slopes to Summit region in NSW Australia, based on scenarios using aerial photographs, and identify the key factors that influenced their scorings.

Respondents identified that road corridors and stock routes were important assets for connectivity, particularly in fragmented and relictual landscapes. When respondents were provided further information for a given scenario, the confidence levels in scoring increased, however individual rankings based on simple air photographs remained largely the same. Our data show that connectivity means different things to different experts and that this may influence information needs and prioritisation.

These results provide important insights for researchers and practitioners interested in connectivity conservation initiatives elsewhere.

Cecile van der Burgh is a PhD Candidate at Charles Sturt University. She is interested in the role of stock routes in maintaining connectivity in Australia's landscapes and in researching differences in approaches between researchers and practitioners in 'connectivity conservation' initiatives.

Wednesday 27 November

Stream A, Session 9

Un-nesting DNA Russian dolls – The potential for rapid construction of food webs using residual DNA in empty aphid mummies

Varenes Yann-David¹; Boyer Stéphane^{1,2}; Wratten Steve D.¹

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Constructing food web assemblages and attempting to analyse their dynamics is historically difficult. For insect-based webs, this usually involves large field collections of prey/hosts followed by labour-intensive rearing of the insects to evaluate rates of parasitism along with morphological identification of the parasitoid species. The aim of this study is to provide a new molecular tool for the retrospective construction of aphid-based food webs, allowing analysis of linkage strengths, among other food-web characteristics.

We hypothesise that parasitoid and hyperparasitoid DNA left inside aphid mummies after emergence of these third- and fourth-trophic level guilds can be amplified and identified using two molecular methods. Two protocols are implemented and compared: (i) amplification of all DNA present followed by electrophoretic separation of amplified fragments; (ii) 454-pyrosequencing. To test our hypothesis, we conducted DNA analyses on laboratory-produced parasitised aphids (mummies) from *Myzus persicae* and *Brevicoryne brassicae* (two globally important aphid pest species) after exposure to the parasitoid *Diaeretiella rapae* and the hyperparasitoid *Asaphes vulgaris*.

This novel approach, based on non-specific DNA amplification allows for the rapid analysis of hundreds of mummified aphids from one site, without the need for rearing and with no a priori knowledge of the local parasitoid and hyperparasitoid fauna. This approach can be particularly useful in assessing the reasons for biological control success or failure, including whether the system analysed involves one or more introduced agents. It could also be applied to investigate the role of introduced pests in an existing natural enemy community.

Yann-David Varenes is a PhD candidate at the Bio-Protection Research Centre, elucidating whether the provision of nectar to parasitoids helps controlling aphid populations. He focusses on ecological factors (species interactions, food-web structure) affecting the success of conservation biological control.

Monday 25 November

Stream E, Session 1

Influence of thermodynamic costs on daily movement decisions and habitat use of the brolga (*Grus rubicunda*)

Veltheim, Inka¹; Kearney, Michael²; McCarthy, Michael³; Cook, Simon¹¹School of Science, Information Technology and Engineering, University of Ballarat, PO Box 663, Ballarat, Victoria 3353, Australia²Department of Zoology, University of Melbourne, Australia³School of Botany, University of Melbourne, Australia

Endotherms produce heat as a result of internal metabolic processes. The core temperature of endotherms is independent of external temperatures within the thermoneutral zone. When external temperatures exceed the upper critical temperature of an animal, it needs to lose heat, which is associated with increased rate of water loss. To maintain core temperature within non-lethal limits, animals may change their behaviour to increase evaporative cooling or shift their location to habitats that provide a thermal environment with lower metabolic costs and reduced water loss. Brolgas (*Grus rubicunda*) forage in open, exposed paddocks and are therefore subjected to external environmental conditions that can result in individuals experiencing heat stress and water loss. These factors are likely to constrain the amount of time available for foraging and influence decisions on when and where to move to maintain water balance and reduce metabolic costs. Daily patterns of habitat use and movements are thus likely to be driven by environmental conditions. We investigated these patterns of behaviour by utilising GPS tracking data to study daily habitat use of brolgas. We then combined location data on habitat use with detailed behavioural observations, weather data and a biophysical model to understand mechanisms behind daily movement decisions of brolgas. Preliminary results indicate that brolgas foraged in paddocks during the cooler part of the day and roosted in wetlands during the hottest part of the day. Movements between the two habitats were triggered by biophysical requirements to reduce heat loss and metabolic costs and to maintain water balance.

*Inka Veltheim is a PhD student at University of Ballarat. Her research interests include animal behaviour, movements and resource use, and landscape ecology. Her PhD focuses on investigating aspects of movement ecology of brolgas (*Grus rubicunda*) in Victoria.*

Wednesday 27 November

Stream A, Session 9

Predicting species grazing responses from lists

Vesk Peter¹¹University of Melbourne

Predicting plant species responses to grazing is important to wise management of grazing lands worldwide. In recent years considerable progress has been made understanding the traits that are associated with grazing responses, post hoc. Yet predictive capacity is still unclear. Correctly predicting the responses of species in a new grazing study would be a strong test of understanding why species respond as they do and converting that understanding into prediction.

I used lists of species responses (decrease/neutral/increase) to grazing from published studies to parameterize a model of grazing response and predict responses in a new trial. These were compared to recorded responses. Then a modification of the model included species traits in the model for the species grazing responses and the same prediction and comparison with observation was made. Third, species responses were predicted to species on the basis of their traits alone, that is, not specifying the species name.

This work showed some capacity to predict grazing responses, but not very strongly. Regardless, it demonstrates an approach to testing the knowledge base we have for use in new situations in a relatively formal way.

BVesk is an ecologist working with plants and other organisms. He is particularly interested in making good use of available knowledge for better environmental management.

Tuesday 26 November

Stream F, Session 6

Challenges in reinstating disturbance regimes for restoration and conservation: an example from a degraded floodplain

Vivian, Lyndsey¹; Godfree, Robert¹¹CSIRO Plant Industry

Reinstating disturbance regimes is an important strategy for restoring and conserving biodiversity in many degraded ecosystems. We investigated whether the reinstatement of semi-natural flood regimes can restore an aquatic floodplain grassy ecosystem at Barmah Forest, south-eastern Australia. River regulation has resulted in the loss of both deep winter floods and summer droughts, leading to the decline of floating vegetation mats dominated by *Pseudoraphis spinescens* (Moira grass), and the encroachment of *Juncus ingens* (giant rush), which forms dense monocultures over 2 metres tall. We used field surveys and experiments to quantify the flood regime required for removing *J. ingens* from its invaded range and encouraging the recovery of *P. spinescens*, and whether such a flood regime could be reinstated using environmental flows. Repeated submergence of *J. ingens* stems for over 2 months, interspersed by drought, resulted in high adult mortality, and a single submergence event of 5 months killed juveniles. Partial submergence, which often

results from shallow environmental flows that promote waterbird breeding, caused rapid *J. ingens* growth. Because of constraints in obtaining and delivering large volumes of environmental water in Barmah Forest, only very small *J. ingens* plants can feasibly be targeted for removal using environmental flows. Surveys showed that despite large floods associated with La Nina in 2010-11, the extent of *P. spinescens* floating mats continues to decline, suggesting that reinstating larger floods may be insufficient for restoring this vegetation type. These results illustrate the ecological, social and policy challenges in reinstating effective disturbance regimes for restoring degraded ecosystems.

Lyndsey is a post-doctoral fellow at CSIRO Plant Industry. She is researching vegetation change in floodplains of the Murray-Darling Basin as part of CSIRO's Water for a Healthy Country flagship.

Wednesday 27 November

Stream F, Session 8

Functional habitat connectivity for the rifleman on Banks Peninsula, New Zealand

Voinopol-Sassu, Ana-Johanna^{1,2}; Bockerhoff, Eckehard³; Hock, Barbara⁴; Barbaro, Luc⁵

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Habitat fragmentation has significant effects on bird diversity in New Zealand. The rifleman *Acanthisitta chloris* is known to respond strongly to forest fragmentation due to its habitat requirements and poor dispersal ability. The aim of this study was to investigate whether there are critically isolated populations on Banks Peninsula and to determine to what extent planted forests can contribute to habitat connectivity for the rifleman metapopulation in the study area. Bird counts were conducted using a modified five-minute bird count

method. This data set was merged with data sets of three other scientific studies and a regional governmental monitoring program. The graph theoretic approach was implemented to investigate functional connectivity. As rifleman occur only in native and planted forests, a graph was constructed with forest patches as nodes weighted by area, while links as Euclidian distances between patches. Integral index of connectivity (IIC), Betweenness Centrality (BC) and Landscape coincidence probability (LCP) were computed with Conefor and analysed statistically with general linear mixed models (GLMM). Habitat connectivity indices did not predict rifleman presence well. A Conefor based GIS analysis demonstrated that planted forests improve habitat connectivity and that connectivity is unlikely to be a limiting factor for rifleman across Banks Peninsula. The studied metapopulation was found to be connected and no truly isolated populations were detected, assuming a dispersal threshold of 1 km across habitats. The study provides an example of how the graph theoretic approach can be applied to New Zealand landcover data such as the Land Cover Database (LCDB).

Ana-Johanna Voinopol-Sassu is a conservation biologist focusing on forest ecology and spatial ecology. Ana-Johanna has a Master of International Nature Conservation, a double degree between Georg-August-Universität Göttingen and Lincoln University. B.Sc.: Nature Conservation and Landscape Planning.

Tuesday 26 November

Stream F, Session 6

Positive interactions in a novel annual plant community

Wainwright, Claire¹; Hobbs, Richard²; Buckley, Yvonne¹; Dwyer, John¹; Mayfield, Margaret M¹

¹The Ecology Centre, The University of Queensland

²Ecosystem Restoration & Intervention Ecology Group, The University of Western Australia

Species introductions often lead to novel species associations and interactions, which in turn affect local community structure in recipient ecosystems. An important goal in modern ecology is to quantify how these novel communities function differently from those they are replacing. Despite widespread acknowledgment that novel communities will become increasingly common under global change, empirical evaluations are still needed to understand their ecological significance.

Using a guild of common annual plants found in a fragmented woodland ecosystem in Western Australia, we explored biotic interactions in native and novel communities containing both native and introduced annuals. We evaluated (by comparing biomass yields) complementarity and selection effects, two components encapsulating patterns of productivity and functioning in multispecies assemblages, and how these components differed between community types.

Both native and novel assemblages tended to overyield due to a combination of positive complementarity and selection effects. Positive complementarity values revealed that species' average yields in mixture were greater than in monoculture, indicative of positive interactions or niche partitioning. Positive selection arose because particular species contributed more to community biomass than predicted by their relative abundance alone, a trend driven by consistent overyielding of a native forb, *Waitzia acuminata*, in multispecies assemblages. Surprisingly, both complementarity and selection effects were more positive in novel assemblages than in native assemblages, and appear to be due to the presence of a diminutive exotic annual grass, *Aira caryophyllea*.

Claire Wainwright is a PhD student working jointly at The Ecology Centre (UQ) and Ecosystem Restoration and Intervention Ecology Group (UWA). She is interested in native plant conservation and the potential for community assembly theory to inform management and restoration.

Wednesday 27 November

Stream A, Session 9

Tailoring hedgerow plants in agroecosystems to maximise beneficial insectsWalker, Melanie¹; Davidson, Melanie¹; Howlett, Brad¹, Mathers¹, Diana, Pyke, Nick²¹The New Zealand Institute for Plant & Food Research Limited, Private Bag 4704, Christchurch, New Zealand²Foundation for Arable Research, PO Box 23133, Templeton, Christchurch 8445, New Zealand

Hedgerows can support populations of pollinators and insect natural enemies, which can provide benefits for farmers by improving arable farm productivity. However, hedgerows can also support detrimental species, such as pest birds and insects. Modern farming techniques have resulted in removal or modification of such habitats. Despite potential benefits, hedgerows have rarely been planted specifically to target and support beneficial animal species. We aim to design on-farm perennial hedgerows and habitats that promote populations of known beneficial insects, while minimising populations of pest species. To do this, we use existing knowledge of host plant-insect associations, as well as an evaluation of insect activity in and around existing field margins (bare fence, pine/macrocarpa or mixed plant species). From the literature we have found that a large number of native plant species support very few arable pests and of these plant species, a high proportion support insect pollinators. Preliminary results from field work reveal that abundant diversity (numbers of individuals of key insects looked for) of beneficial insects was low at all field margin types; overall only 5 beneficial species/orders out of 29 had more than one individual per trap. Numbers of a given species/order varied considerably depending on farm location and field margin type. For example, more March flies and honeybees were caught in traps in mixed margins than other field margins. However the native *Lassioglossum* bee was more abundant in traps from the pine/macrocarpa margins, which may reflect their preference for undisturbed bare ground, a more common feature found with these plant species. The mixed margins we are monitoring generally have only a few individual plants of 1-3 plant species out of the >20 species that literature indicates could be used for improving beneficial insect abundance and diversity. Essentially, the plant assemblages we are looking for do not appear to exist on arable farms, hence the need for this project.

Melanie Walker is a Senior Research Associate in Entomology at The New Zealand Institute for Plant & Food Research Limited, Lincoln. Her areas of research interest include insect biodiversity, insect pollination and integrated pest management of arable and vegetable crops.

Tuesday 26 November

Stream F, Session 4

Is there a cost of adaptation for species as they invade new and increasingly stressful habitats?Wan, Justin¹; Bonser, Stephen¹¹UNSW, Evolution and Ecology Research Centre

Demonstrating a 'cost of adaptation' has been an elusive goal in evolutionary ecology. Many studies had been unable to detect physiological costs related to adapting to stress, and adapting to new environments need not incur a cost. We tested for costs of adaptation in an invasive species moving into new and stressful environments. We used central, range edge and near-edge populations of an introduced perennial (*Plantago lanceolata*) spanning an environmental stress gradient in Australia. These populations have had varying amounts of time to adapt to their environments according to the history of range expansion (i.e. range edge populations are experiencing new environmental stresses). Populations were subjected to nutrient stress in a glasshouse experiment. We found a loss of plasticity in specific leaf area (a key functional trait related to life history in this species) in edge and near-edge stress adapted populations. This observed loss in plasticity is common in both edge and near-edge populations, suggesting costs to adaptation may not diminish over time. Further, range edge populations reproduced later and at larger sizes than central populations. The loss of plasticity in functional traits and related reduction in reproduction rate and larger size at reproduction in stress adapted populations suggest a change to a slower life history, and perhaps a change in invasiveness in range edge populations.

Justin Wan is a 2nd year PhD candidate in plant ecology. My research interests include adaptation, the evolution of species ranges and population ecology.

Tuesday 26 November

Stream E, Session 6

Rainfall drives the structure of flower-visitor networks across space and timeWardle, Glenda¹; Popic, Tony¹; Davila, Yvonne¹¹University of Sydney, Desert Ecology Research Group

The encounters between animals and flowers within a plant-pollinator community can be visualized as a network of species and associated links. Here we ask how the inter-relationships among species change over space and time in a pulse-reserve arid grassland system. We expected that dynamic changes in network composition would likely translate to altered structure of the network. The potential rewiring of the network topology may in turn reveal which properties of the system support coexistence and retention of ecological function as species were gained or lost. To tackle this problem we collected data on visitors to flowers across multiple temporal and spatial scales and constructed 23 flower-visitor networks. Antecedent rainfall was a strong driver of network size and species composition but did not alter modularity. Network size ranged from 23 species to a peak of 118 species with spatial differences

among sites (30km) and locations (1km apart). Higher cumulative rainfall over nine months prior to sampling produced networks with a more nested structure but with fewer connections. However, these changes were mostly accounted for by changes in network size. In contrast, rainfall increased the network-level specialisation beyond that due simply to network size, suggesting that rainfall is an important determinant of specialisation. In conclusion, rainfall-driven pulses in productivity changed network structure directly by altering the size and specialisation of networks with flow on effects of size altering connectance and nestedness. Climate change and pollinator declines pose challenges to retaining this diversity and ecological function into the future.

Glenda Wardle is an Associate Professor in Ecology and co-leader of the Desert Ecology Research Group. Her research explores the dynamics of populations, species and ecological interactions in relation to ecological drivers such as climate, fire and grazing.

Wednesday 27 November

Stream E, Session 7

Promoting succession in retired pastures: can artificial bird perches increase native seed rain?

Warren, Claire¹; Burns, Bruce¹; Stanley, Margaret¹

¹Centre for Biodiversity and Biosecurity, School of Biological Sciences, University of Auckland

Why do some retired pastures adjacent to patches of New Zealand native forest resist forest recolonisation? Given most New Zealand native forest species are fleshy-fruited and bird-dispersed, one ecological limiting factor may be that seed is not arriving into pasture from a forest source. Birds perch between foraging bouts to process seed in the gut and avoid carrying an energetically expensive seed ballast load. At three sites in the Auckland region, we compared seed deposition under artificial and natural bird perches (trees) in pasture at various distances from forest patches. We also identified perch visitors, forest and pasture seed in seed traps, and seed from pasture and forest soil samples. Results indicate that without perches, bird-dispersed seed would not arrive into pastures, and that artificial and natural bird perches mediate the deposition of small-fruited species such as *Coprosma* spp., *Cordyline australis*, *Macropiper excelsum* and *Melicytus ramiflorus*. This is supported by the lack of forest seed germinating in the pasture soil seed bank compared to the forest soil seed bank. Perch visitor identification suggests tui (*Prosthemadera novaeseelandiae*) and fantail (*Rhipidura fuliginosa*) are the primary seed dispersers, however predators such as kingfisher (*Halcyon sancta*) dominate artificial perches. We conclude that ecological restoration projects could be enhanced via the use artificial perches or single trees planted in pasture to promote successional processes. This would reduce reliance on labour-intensive plant propagation and planting strategies. Future research should investigate the modification of artificial perches with cover and/or rewards to attract seed dispersers and deter predators.

Claire Warren is an MSc candidate at University of Auckland with a research interest in plant/animal mutualisms in the context of restoration of ecosystem functioning.

Monday 25 November

Stream D, Session 2

Pyrosequencing of prey DNA in predatory mollusc faeces reveals seasonality and unexpected levels of earthworm diversity

Waterhouse, Benjamin¹; Boyer, Stéphane^{1,2}; Wratten, Steve¹

¹Bio-Protection Research Centre, PO Box 84, Lincoln University, Lincoln, 7647, New Zealand.

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Identifying and understanding predator diets is of high importance in biological conservation, particularly for the introduction, establishment and maintenance of predator populations in newly created or modified ecological communities, such as translocation sites or restored habitats. In the community studied here, the role of earthworms in the diet of the New Zealand endemic predatory land snail *Powelliphanta patrickensis* was evaluated in relation to translocation of this snail to a holding habitat and then to restored sites after mining. Conservation status of predators may not permit captive feeding trials or intrusive gut-content methods, so non-intrusive diet assessment is required, such as faecal analysis. However, earthworms leave no morphological clues suitable for accurately discriminating between species consumed through visual faecal analysis. This study uses non-intrusive molecular methods on earthworm DNA extracted from the faeces of *P. patrickensis*. 454-pyrosequencing data revealed earthworm DNA to be in all samples ($n=60$). Sequences were compared to a DNA library created from published studies of New Zealand's endemic earthworms and online databases, and unidentified earthworm sequences were clustered into molecular operational taxonomic units (MOTUs). 26 species were identified; 17 of these were previously known, and 9 were MOTUs. Similarity indices indicate that there were seasonal differences but similar evenness in the earthworm communities represented in the diets. This type of assessment can be used to inform restoration and relocation programmes throughout the mining process and highlights the importance of including potential temporal shifts in diet analysis studies.

Ben is a PhD student at Lincoln University studying ecological interactions and restoration within an opencast coalmine on New Zealand's West Coast. His main interests are human impacts and ecological interactions at the interface between human and natural systems.

Monday 25 November

Stream D, Session 1

Different trajectories of primary succession after eruption events on Raoul Island, New Zealand?

West, Carol¹¹*Department of Conservation, Wellington, New Zealand*

Raoul Island, in the Kermadec Group north of New Zealand, is an active volcano with a known, recent eruption history. Warm-temperate forest, dominated by *Metrosideros kermadecensis* is the climax vegetation of Raoul Island. Endemism of the principal forest trees and shrubs is high, despite the young age of the volcano (<2 million years). Most volcanic activity in the past century has centred on Green Lake in the central caldera. Each eruptive event has knocked down and buried vegetation within range with ejecta. Between Green Lake and Blue Lake is a ridge, named Devastation Ridge, on which forest succession has been studied. After an eruption in 1964 a stand of *M. kermadecensis* arose that was actively self-thinning until an eruption in 2006 that killed many of those trees and buried the site in ejecta from 0-1 m deep. After the 2006 eruption, vegetation establishing on the site is more diverse and includes fleshy fruited shrubs. In the interval between the two eruptions goats, rats and cats were eradicated from Raoul Island. It is hypothesised that the presence/absence of goats and rats as well as the different nature of the eruptions will lead to different successional outcomes.

Carol West is Manager of Terrestrial Ecosystems Unit within the Science and Capability Group and Stream leader for all biodiversity work in DOC. Research interests include island ecology; impacts of invasive species on native ecosystems and species; plant population dynamics.

Monday 25 November

Stream D, Session 3

Drought intensity alters allometric survival relationships in an extremophile forest-dwelling fish.

White, Richard, S.A¹; McHugh, Peter, A²; McIntosh, Angus, R¹.¹*School of Biological Sciences, University of Canterbury, Christchurch, New Zealand*²*Washington Department of Fish and Wildlife, Olympia, Washington, USA*

Understanding how body size determines survival probability during extreme climatic events will be important for managing the effects of climate change on populations. If larger individuals are disproportionately impacted by extreme events, this could negatively influence subsequent population resilience and persistence. Using Cormack-Jolly-Seber survival models, we investigated how allometric survival relationships (ASR's) in brown mudfish (*Neochanna apoda*), a species well adapted to surviving extreme conditions, were altered by intense drought. Over 800 mudfish from 41 subpopulations were individually tagged in forest-pools varying in depth within Saltwater Forest, South-westland, New Zealand, and monitored during low, moderate and extreme drought periods.

Population ASR's were strongly, and interactively, altered by spatio-temporal variation in drought intensity. During low drought intensity, population ASR's were strong positive power functions of fish length, with no variation between subpopulations occupying habitats varying in depth. However, as drought intensity increased, population ASR slopes flattened, as adult and young mortality equalised; firstly in shallow drought-prone pools during moderate intensity drought, then later, also in deep, drought-resistant pools during high intensity drought. This resulted in strong density dependant population regulation and a 34 percent reduction in total population abundance. These results show that even the most physiologically robust species are susceptible to extreme climatic events, which is indiscriminate of size, thereby threatening population resilience. Moreover, the spatio-temporal variation in subpopulation ASR's and mortality reveals a strong potential for source-sink dynamics, which will determine the long-term population persistence of even extremophile species, such as mudfish, given the increased intensity of droughts expected.

Richard White is an MSc candidate in freshwater ecology at the School of Biological Sciences, University of Canterbury under supervision from Angus McIntosh. He is interested in population biology and macroecology at the boundary of physiology and ecology.

Wednesday 27 November

Stream A, Session 7

Facing the acid test: pH influences the viability of eggs and larvae of the invasive cane toad (*Rhinella marina*)

Wijethunga, Uditha¹; Greenlees, Matthew¹; Shine, Richard¹¹*School of Biological Sciences A08, University of Sydney, NSW 2006, Australia*

The continuing invasion of cane toads (*Rhinella [Bufo] marina*) into southern Australia is exposing the toads to novel challenges – different from the conditions in their native range, and different from conditions in the already-invaded parts of Australia. Although the most obvious abiotic obstacle facing toads on their southern front (in northeastern NSW) is low temperature, measurements of natural ponds in that area show a wide range in pH also. Thus, toads may be faced with both significantly acid and significantly alkaline spawning conditions. To assess whether any of these conditions may hinder reproductive success, we used replicated laboratory

experiments to investigate the effect of various acidic conditions on the embryonic development and performance of cane toads. Cane toad eggs and larvae cannot tolerate extremely high or low pH, but they do have the flexibility to successfully reach metamorphosis over a wide range of pH conditions. Thus, environmental variability in pH in potential breeding ponds in north eastern NSW is unlikely to be a major barrier to further southern invasion or establishment. Nonetheless, variation in pH significantly influenced the 'quality' versus 'quantity' of metamorphs (offspring), and also the rate at which they were able to move through the early phases of their life-history.

Uditha Indeewari Wijethunga, I am currently in the second year of my PhD at Shine lab, University of Sydney. I am interested in several areas of biology with ecology, herpetology and invasion biology.

Monday 25 November

Stream D, Session 2

Quantifying food limitation of redback spiders (*Latrodectus hasselti*) in the field

Wilder, Shawn¹; Simpson, Stephen¹

¹*School of Biological Sciences and the Charles Perkins Centre, The University of Sydney*

Food availability is a key factor affecting the growth, reproduction and survival of animals. Many studies support the idea that spiders are food-limited in nature. However, it has been much more difficult to quantify the degree to which food or nutrients may limit the growth of spiders in nature relative to their needs. We compared the nutrient ingestion of redback spiders (*Latrodectus hasselti*) in the field with a quantitative study of how nutrient ingestion affected growth of spiders in the laboratory to quantify the degree of food limitation of spider growth in the field. Spiders were observed feeding in approximately 10 % of observations in the field. Most prey were relatively small and only provided a few milligrams of nutrients. Larger prey were rare and often more biased in protein than lipid content. In our laboratory study, the ingestion of lipid and protein had large effects on redback growth. Lipid intake affected adult body size while protein intake affected instar duration. Further work with simulation modeling is required to combine field and laboratory data to quantify the degree of food-limitation of redbacks.

Dr. Shawn Wilder is an ARC DECRA Fellow and Lecturer at the University of Sydney who is interested in the nutritional ecology of carnivores and the consequences of carnivore nutrition for communities and ecosystems.

Wednesday 27 November

Stream D, Session 9

Fire futures for a flammable continent

Williams, Richard J¹

¹*CSIRO Ecosystem Sciences, Darwin, Australia*

Australian fire regimes are likely to be affected by climate change. The risks posed by fire to life, property and ecosystems, and society's capacity to mitigate risk, are also likely to change under climate change. For much of Australia, increases in the intensity and/or frequency of fire have been projected as a consequence of warming and drying. However, the nature of change, mitigation of risk to diverse assets, and ecosystem resilience in the face of changing regimes of climate and fire are all uncertain. The direction, magnitude and rate of change will depend on whether key determinants of fire regimes (fire weather, fuel mass, fuel architecture) and post-fire vegetation dynamics (change in relative abundance of seeders and sprouters; intervals between fires required to achieve critical life stages) change synergistically or antagonistically due to climate change. Consequently, ecosystem change may be gradual, within the historical range of variability, or it may be rapid and transformative, leading to novel ecosystems. Finally, the manner in which people manage risks posed by fire at landscape scales (e.g. by increased prescribed burning) will be both challenged by climate change, and may pose risks to conservation values. Case studies from major vegetation types of the highlands of south eastern Australia (open forests, tall-open forests and alpine heathlands) indicate that, depending on these interactions, gradual change or transformative change are both possible outcomes. Knowledge of these possible responses to change will be essential for the development of adaptive strategies to manage ecosystems under future fire regimes.

Dick Williams is a plant ecologist with CSIRO Ecosystem Sciences in Darwin. He works on fire regimes, climate change and biodiversity in the tropical savannas of northern Australia, and the alpine landscapes of south-eastern Australia.

Tuesday 26 November

Stream C, Session 4

Does foliar nutrition explain the success of possums in New Zealand?

Windley, Hannah¹; Ruscoe, Wendy²; Foley, William¹

¹*Australian National University*

²*Landcare Research, New Zealand*

The common brushtail possum (*Trichosurus vulpecula*) poses one of the greatest threats to New Zealand's natural ecosystems. The success of possums as an invasive species has been attributed to the nutritional quality of New Zealand vegetation, since this landscape has not co-evolved with folivorous mammals. We investigated the basis of this claim through chemical analysis of New Zealand foliage, comparisons with existing data for Australian species and measurements of herbivory in the field. We collected 1400

leaf samples from five representative tree species in the Tararua Mountain Range. Samples were analysed using a measure of diet quality known to influence both food choice and reproductive success of possums in Australia; available nitrogen. Preliminary results suggest that the nutritional quality of foliage in New Zealand is on par with eucalypt foliage in Australia; a surprising result. There were also some notable differences between the New Zealand species. *Weinmannia racemosa* foliage is known to be an important staple diet of possums in New Zealand. On average, this species displayed a large effect of tannins on protein availability and thus represented an overall low quality diet. This was in contrast to *Melicactus ramiflorus*, which had the highest protein availability of all the species tested. Using near infrared reflectance spectroscopy we were able to compare these nutritional measurements with a standardised measure of herbivory (the foliar browse index) to draw conclusions about spatial variation in possum browsing in New Zealand and the importance of nutrition for an extremely problematic invasive pest.

Hannah Windley is a PhD student at the Australian National University.

Thursday 28 November

Stream C, Session 10

Using species complementarity to set conservation priorities: which species are most important?

Wiser, Susan K¹; Buxton, Rowan P.¹; Helm, Aveliina²

¹ Landcare Research, Lincoln, New Zealand

² Institute of Ecology and Earth Sciences, University of Tartu, Estonia

The complementarity principle -- defining the minimum site set that protects maximum biodiversity, underpins systematic conservation planning. In NZ, naturally uncommon ecosystems frequently occur outside conservation areas and conservation site prioritisation is needed. Because many naturally uncommon ecosystems are embedded within managed landscapes, the surrounding matrix strongly influences their biota. Many of their inhabitants are of little conservation value, either being exotic or natives derived from disturbed surrounding landscapes.

We focus on selection of priority conservation sites in two naturally uncommon ecosystems: gravel beaches nationally and basaltic outcrops in Banks Peninsula. Across 61 gravel beaches, 51% of the total 350 species were native; of these, 87% represented original diversity i.e. belong to the gravel beach specific species pool and 13% were derived from human disturbed habitats. Across 39 outcrops, 78% of the total 350 species were native; 79% represented original diversity and 21% were derived.

Focussing on original diversity reduced the number of sites required to represent this diversity. For gravel beaches, 87, 57 & 41% of sites represent each of all, native, and original species respectively at least once. For outcrops, 67, 57 & 46% of sites are required respectively. Focussing on original diversity increases the emphasis on cooler, wetter gravel beaches. For outcrops priority sites span the range of composition and environmental gradients regardless of the species set used. For both ecosystems, focussing on original diversity results in selection of more significant sites, potentially resolving the conflict between strategic conservation approaches based on complementarity versus site significance.

Susan Wiser is a plant community ecologist at Landcare Research. Her interests include providing scientific underpinnings to conserve threatened ecosystems, classification of NZ vegetation, and using large datasets to understand vegetation pattern and process to support evidence-based conservation decision making.

Tuesday 26 November

Stream E, Session 4

Facilitation of invasive pines and their ectomycorrhizal fungi through novel mammal associations

Wood, Jamie R.¹; Dickie, Ian A.¹; Bonner, Karen I.¹; Rattray, Gaye¹; Moeller, Holly V.²; Wilmshurst, Janet M.¹

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²Department of Biology, Stanford University, California 94305-5020, USA

Pines (Pinaceae) are major invasive species across the Southern Hemisphere. This invasion is dependent on co-invasion by symbiotic ectomycorrhizal fungi (EMF), but the dispersal strategies of EMF are much less well understood than plant dispersal. We used video monitoring, faecal DNA (454 sequencing) and palynological analyses, and a bioassay experiment, to examine the role of mycophagy by exotic animals (red deer and brush tail possum) in fungal dispersal and seedling mycorrhizal infection. We performed the study in native (*Nothofagus*) and exotic (*Pinus*, *Pseudotsuga*, *Betula*) forest patches at Craigieburn, South Island, New Zealand during autumn 2012. All faecal pellets examined (14 deer, 16 possum) contained EMF DNA, with at least 11 genera (including both native and exotic) represented. When the faecal pellets were applied to seedlings of invasive tree species, those of possum infected 47% of *Pinus contorta* seedlings and 69% of *Pseudotsuga menziesii* with EMF, and those of deer infected 21% and 12% respectively. Only 2, closely-related, EMF genera were identified on infected seedlings (*Suillus* and *Rhizopogon*), both of which are key in conferring competitiveness to the trees as pioneers within their native and invasive ranges. Despite the presence of *Nothofagus*-compatible EMF DNA, we found no mycorrhizal infection of native *Nothofagus* inoculated with dung. The results indicate that introduced herbivorous mammals may play a significant role in facilitating pine and EMF co-invasion in New Zealand. This suggests a tri-partite 'invasional meltdown' with a novel assemblage of taxa from 3 trophic levels and 3 continents (North America, Eurasia and Australia).

Jamie is a palaeoecologist at Landcare Research, with interests in the ecology of extinct birds, ancient DNA, coprolite analyses, prehistoric plant-herbivore interactions, and using palaeoecology to help inform conservation and restoration.

Tuesday 26 November

Stream E, Session 4

Why are some plants rare? Seed supply, safe sites, or soil feedbacks

Wotton, Debra¹; Duncan, Richard²; Lee, William³; Dickie, Ian³

¹*Moa's Ark Research*

²*University of Canberra*

³*Landcare Research*

Globally, many plant species have small populations that are threatened with extinction and will require management if they are to persist. Forty percent of New Zealand's vascular plant species are rare. The mechanisms that influence the abundance and distribution of plant populations are poorly understood and to date have been mostly derived from comparative approaches. Our research aims to understand the underlying causes of rarity in native New Zealand plant species using an experimental approach.

We tested three hypotheses comparing rare and common species. (1) Recruitment of rare plant species is primarily limited by seed availability due to seed production or dispersal constraints. (2) Recruitment of rare species is constrained primarily by the availability of 'safe sites' suitable for seedling establishment. (3) Rare species suffer from stronger negative soil-feedbacks beneath parent plants than away, and consequently are more dependent on seed dispersal. We conducted field and glasshouse experiments using six pairs of co-occurring rare and common congeneric plant species at four sites in Canterbury and Otago, South Island.

Preliminary results indicate no consistent differences in seed limitation, establishment limitation or soil feedbacks among rare and common species. However, when introduced mammals were excluded, rare species had more seedlings but common species did not. We will discuss the implications of our findings for conservation management of rare and threatened plants.

Debra Wotton is an independent ecologist who runs her own company specialising in ecological research for conservation. She has been New Zealand Ecological Society Newsletter Editor since 2010. Her research interests include plant-animal mutualisms, limits to plant recruitment, and rarity.

Wednesday 27 November

Stream E, Session 7

What can we tell about fruit dispersal quantity by looking under the parent canopy?

Wyman, Tarryn E.¹; Kelly, Dave¹; Moltchanova, Elena²; Ladley, Jenny J.¹; Robertson, Alastair W.³

¹*School of Biological Sciences, University of Canterbury*

²*Department of Mathematics & Statistics, University of Canterbury*

³*Ecology, Institute of Agriculture & Environment, Massey University*

There is concern about whether the loss of large frugivores will cause dispersal failure. However, it is difficult to measure dispersal quantity, because fruits are easiest to collect under the parent canopy, but these are presumably biased towards undispersed fruits by an unknown amount. We quantified the relationship between percentage of fruits dispersed and distance from parent tree for three large-seeded New Zealand trees: *Beilschmiedia tawa*; *Elaeocarpus dentatus*; and *Prumnopitys ferruginea*. We used 50 m transect lines run from the base of fruiting trees, and collected all clean (bird-dispersed) and fleshed (undispersed) current-season seeds off the ground. We fitted Bayesian 2Dt kernels to the fleshed and clean seed data, and corrected for the area of each distance band to calculate the total seed crop percent dispersed versus distance from the parent tree. Data from under the canopy were hyper-sensitive to low dispersal. Across 8 years for *tawa* we had variable dispersal percentages below the canopy (yearly means 22-77%), whereas when all seeds to 50 m were included, dispersal percentages were much higher (66%-92%). The overall percent dispersed averaged 81% for *B. tawa*, 75% for *E. dentatus*, and 91% for *P. ferruginea*. Finding only 11-18% clean seeds under the parent tree would indicate an overall dispersal percentage of >50% for all three species tested. Hence, only near-total dispersal failure under the canopy is indicative of whole-crop dispersal failure.

Tarryn Wyman, PhD student in ecology at the University of Canterbury. Studying plant-animal mutualisms, especially seed dispersal, and the effects of the loss of native birds plus introduction of exotic mammals on these ecological processes.

Tuesday 26 November

Stream E, Session 4

New Zealand kauri under threat: consequences for the wider forest ecosystem

Wyse, Sarah¹

¹*School of Biological Sciences, University of Auckland*

New Zealand kauri (*Agathis australis*) is known to influence soil properties and nutrient cycling, lowering pH, available nutrient levels, and modifying soil moisture regimes. Owing to these effects of kauri on its abiotic environment, it could be expected that distinctive plant associations could be found with the species. However, little is known about the potential importance of kauri in shaping habitats, or its influence on its associated plant communities.

By quantifying the composition of the flora associated with mature kauri, compared to adjacent stands of broadleaved species with otherwise similar environmental conditions, I identified a significant effect by kauri on plant community composition. I identified three

groups of plant species: stress tolerant species positively associated with kauri, species negatively associated with kauri, and those with distributions unaffected by the presence of kauri.

The research also explored the mechanisms that may be acting to produce the effects of kauri on its associated flora, including the limited water availability in organic soil horizons during periods of summer drought. To determine whether tolerance to water stress is a characteristic of plants common beneath kauri, I used a dry-down experiment to examine the responses to water stress of six seedling species from the three groups of species previously identified. Comparatively high drought resistance was found to be common to the plants able to establish within kauri stands. This suggests that periodic limitations in water availability beneath kauri could influence the composition of the plant communities able to establish at these sites.

Sarah Wyse is in the final stages of her PhD at The University of Auckland. Her research interests revolve around plant ecology and ecophysiology.

Monday 25 November

Stream E, Session 2

Evaluating camera trap designs to measure feral cat and dingo abundances, Lorna Glen, WA

Wysong, Michael¹; Valentine, Leonie¹; Hobbs, Richard¹; Richie, Euan G.²

¹*School of Plant Biology, The University of Western Australia, Crawley WA 6009*

²*School of Life and Environmental Sciences, Deakin University, Burwood VIC 3125*

In Australia, the largest extant terrestrial mammalian predator, the dingo (*Canis lupus dingo*), occurs sympatrically with feral cats over much of the continent. Recent research suggests that dingoes play an important role in suppressing the abundance and impacts of mesopredators in arid Australia, particularly the red fox. Knowledge on the interactions between dingoes and feral cats remains less clear partially due to the cryptic nature of feral cats that make them challenging to census.

Motion sensitive camera traps can provide information on the activity and relative abundance of many terrestrial vertebrate species that are difficult to survey. In this study, 80 camera traps were placed throughout Lorna Glen, a 244,000 hectare ex-pastoral lease managed jointly by the Department of Parks and Wildlife and the Wiluna Aboriginal Community, to test the effectiveness of four different camera trap designs in measuring the abundance and activity of feral cats and dingoes. Cameras were either active (using an audio bird call lure) or passive (no lure), and placed either on road or 100 m off-road.

To test the effectiveness of cat baiting cameras were deployed 10 days prior to aerial cat baiting, and subsequently redeployed for another 10 days following baiting. The results of this study indicate that certain camera trap designs are more effective in detecting feral cats and dingoes. In addition, a rigorously-designed camera trap study may be an effective tool for conservation agencies to evaluate the effectiveness of their management actions.

Michael Wysong is a second year PhD student at University of Western Australia, School of Plant Biology. His research interests include top-order predators, their impacts on introduced mesopredators, and their use in biodiversity conservation.

Wednesday 27 November

Stream D, Session 8

Regime change: The response of beetle assemblages to altered seasonality and frequency of fire

York, Alan¹; Jellinek, Sacha²

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²*Department of Environment, Water and Natural Resources, Grenfell Street Adelaide South Adelaide 5000*

Mediterranean climate regions are experiencing changes that are projected to have significant impacts on patterns of temperature and rainfall, thereby affecting key ecosystem drivers such as fire regimes. In the sclerophyll-dominated vegetation communities of southern Australia, land managers are responding to increased wildfire probabilities through the use of more frequent low intensity (prescribed) fire. With burning occurring more often throughout the year, plant and animal communities are experiencing shifts in fire regimes; with changes to both frequency and season of burn. The likely consequence of such a regime change on our biodiversity is poorly understood. Is assemblage composition an outcome of stochastic processes or can we develop mechanistic models linking it to fire and subsequent habitat modification?

Here we report on the results of a 30 year study, investigating the effects of fire frequency and seasonality. In each of five locations, five fire treatments were applied: long unburnt, frequent (3 yr) spring, frequent autumn, routine (10 yr) spring, and routine autumn burning. In 2012, a biodiverse and functionally important component of the fauna (litter-dwelling beetles) was sampled; with 9,439 individuals from 215 species collected. Both species richness and assemblage composition varied significantly at the landscape scale. At smaller spatial scales, there was a significant interaction between fire regime components; with frequent spring burns having the greatest impact on beetle assemblages. A model has been developed, incorporating both stochastic and mechanistic components, which provides an improved understanding of likely responses of beetle assemblages to altered fire regimes in these environments.

Alan leads the Fire Ecology and Biodiversity Research Program within the Forest and Ecosystem Science Department. His research group is investigating how fire alters the nature and spatial pattern of resources, and how plants and animals respond to these changes.

Wednesday 27 November

Stream D, Session 9

Re-introducing fire into a long-unburned coastal woodland: changes in stand structure and composition

Zeeman, Ben¹; Lunt, Ian²; Morgan, John¹

¹Department of Botany, La Trobe University

²School of Environmental Sciences, Charles Sturt University

At Ocean Grove Nature Reserve in Victoria, Australia, the stand structure of a long-unburned woodland has been documented in 1971 and 1996. These studies provide evidence that the original *Eucalyptus*-dominated woodland has been largely replaced by *Allocasuarina littoralis* in the long-absence of fire. *A. littoralis* is a fire-sensitive species and hence, the re-introduction of fire may be a valuable management tool to re-instate the woodland structure. This study revisited the woodland in 2012. Since 1996, fire has been re-introduced into a portion of the Reserve (2006 and 2010). This study asked (I) in the continuing absence of fire, has *A. littoralis* continued to increase and *Eucalyptus* continued to decline? And (II) does the re-introduction of fire re-instate the woodland structure and composition? Since 1996, total tree density declined by 42% in the continued absence of fire (*A. littoralis* -34%, *Allocasuarina verticillata* +26%, *Acacia pycnantha* -78%, *Banksia marginata* -73%, *Eucalyptus* spp. -97%), and by 61% following fire (*A. littoralis* -57%, *A. verticillata* -44%, *A. pycnantha* -81%, *B. marginata* -81%, *Eucalyptus* spp. -84%). Total stand basal area declined by 37% following fire. However, in areas that had continued to remain unburned, the basal area of *A. littoralis* increased by 75%, and total stand basal area remained relatively stable. In the understorey, the frequency of prostrate native shrubs had substantially declined over the previous 40 years, while the re-introduction of fire did not lead to their recovery. This study identified the consolidation of *A. littoralis* dominance in the continued absence of fire, where declines in tree density have been compensated for through a substantial increase in basal area. The re-introduction of fire disrupted this process, opening up the woodland structure. However the re-introduction of fire did not reverse changes to woodland composition. The results of the study highlight both the value and limitations of re-introducing fire into long-unburned woodlands.

Ben Zeeman completed honours in the Botany Department at La Trobe University in 2013 in the area of plant ecology.

Monday 25 November

Stream D, Session 3

Evidence-based modelling of diverse plant water use strategies on stomatal and non-stomatal components under drought

Zhou, Shuangxi¹; Prentice I. Colin^{1,2}; Belinda Medlyn¹; Sabaté Santi^{3,4}

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Models disagree on how to represent effects of drought stress on plant gas exchange. Some models assume drought stress affects the marginal water use efficiency (marginal WUE) whereas others assume drought stress acts directly on photosynthetic capacity. A collection of *Eucalyptus* and *Quercus* species derived from different hydro-climate habitats were conducted with drought treatments respectively in Australia and Spain. Measurements included net CO₂ assimilation rate versus substomatal CO₂ concentration curves, fluorescence, and predawn leaf water potential at increasing levels of water stress. The drought effect on leaf gas exchange was analysed with a recently developed stomatal model that reconciles the empirical and optimal approaches on predicting optimal stomatal conductance. The model's single parameter g_1 is a decreasing function of marginal WUE.

The two genera showed consistence on the contrasting response patterns between species derived from mesic and arid habitats, which differed greatly in their estimated g_1 values under moist conditions, and in the rate at which g_1 declined with water stress. They also differed greatly in the predawn water potential at which apparent carboxylation capacity (apparent V_{cmax}) and mesophyll conductance (g_m) declined most steeply, and in the steepness of this decline. Principal components analysis revealed a gradient in water relation strategies from sclerophyll species to malacophyll species. Malacophylls had higher g_1 , apparent V_{cmax} , and g_m values under well-watered conditions, while sclerophylls having a lower sensitivity of g_1 , apparent V_{cmax} , and g_m to drought, and tending to maintain more open stomata and higher apparent V_{cmax} and g_m under dry conditions.

Shuangxi Zhou, PhD student of Macquarie University. Research interest: modelling drought effects on leaf gas exchange in the context of stomatal and non-stomatal components, and its correlation with quantitative plant traits as a basis of a new generation of DGVMs.

Speed Talks

Tuesday 26 November

Stream B, Session 4

Joining the dots: connecting downscaled climate projections, hydrology, ecosystem values, and management frameworks to conserve biodiversity in freshwaters

Barmuta, Leon A¹; Davies, Peter E.¹, Wastson, Anne¹, Graham, Bryce², Read, Martin G.², Warfe, Danielle M.¹

¹University of Tasmania

²Department of Primary Industries, Parks, Water and Environment, Tasmania

We used Tasmania to demonstrate how outputs from downscaled climate models could be integrated with spatially resolved hydrological models and freshwater biodiversity data. In consultation with stakeholders, we quantified how different climate change scenarios could affect the risks to biodiversity assets, the scope and types of adaptation actions, and assessed the strengths and weaknesses of the policy and planning instruments in responding to climate change. We concluded that downscaled climate predictions linked with modelling of catchment and hydrological processes now refines projections for climate-driven risks to aquatic environments. Spatial and temporal hazards and risks can now be compared at a variety of scales via Bayesian Belief Networks, as well as comparisons between biodiversity assets. Uncertainties can be identified and built into adaptation processes. Notwithstanding this progress, we identified the following obstacles to implementation.

Biodiversity data sets need to be improved and updated, and better, spatially explicit information on the contributions of groundwater to surface waters is needed. The bewildering array of adaptation tools available to stakeholders needs to be organised using procedures such as scenario modelling which incorporate explicit tools for comparing costs, benefits, feasibility and social acceptability so that priorities can be set transparently. Formal mechanisms for the uptake of knowledge about identified risks into policy and legislative instruments remain undeveloped. The greatest challenge is to integrate multiple adaptation strategies (sometimes at different scales) to achieve specific adaptation objectives—especially where a mix of water management and non-water management is required.

Leon Barmuta has taught and researched in freshwater ecology for over 25 years. The conservation of imperiled freshwater biodiversity and ecosystems has been a constant interest throughout his career.

Tuesday 26 November

Stream B, Session 4

Data Integration and data quality

Belbin, Lee¹; LaSalle, John²

¹Blatant Fabrications Pty Ltd

²Atlas of Living Australia

The Atlas of Living Australia exposes over 40 million species records, 400 environmental layers and a wide range of tools for discovery and analysis. Aggregations of species observations and specimen records into collections in any museum, herbarium, the Atlas of Living Australia (www.ala.org.au) or the Global Biodiversity Information Facility (www.gbif.org) or similar can propagate errors that were in the original records. Integrating data can also create errors via misinterpreting observations. On the positive side, exposing integrated data will also expose errors that had not been previously detected. For example a geographic outlier of a species is more readily detected on a distribution map that contains most known observations. Agencies such as the Atlas of Living Australia perform extensive data quality checks that may not be applicable to smaller datasets or available to other data providers or collectors (see <http://bit.ly/14v3JWH>). Such data quality checks operate best on large volumes of data and can identify errors that were not previously detected.

Such checks will not however detect all errors in data records. Taxonomic expertise is required to detect and correct naming errors that cannot be automatically detected. Corrections in the form of annotations can be applied by anyone to any field within any data record in the Atlas of Living Australia. Such annotations remain with the record and go back to the data provider for checking and correction. Criticism of agencies such as the Atlas for exposing errors is therefore unhelpful. Agencies such as the Atlas require the support from the ecological and taxonomy community to continually improve the 'quality' of data of Australia's biodiversity data. The Atlas of Living Australia also needs to collaborate with similar agencies worldwide to evolve and standardize methods for improving the quality of online biodiversity data.

Lee currently provides ecological and information management advice to the Atlas of Living Australia. Lee's work interests include biodiversity informatics and project and information management.

Monday 25 November

Stream E, Session 3

Dealing with trade-offs in destructive sampling designs for occupancy surveys

Canessa, Stefano¹; Heard, Geoffrey W. ¹; Robertson, Peter ²; Sluiter, Ian R.K.²

¹*School of Botany, University of Melbourne, VIC 3010, Australia.*

²*School of Science, Information Technology and Engineering, University of Ballarat, Ballarat, VIC 3350, Australia*

Occupancy surveys should be designed to minimize the risk of incorrectly inferring absence when a species goes undetected. This is commonly achieved by increasing replication or the efficiency of single surveys. When using destructive sampling methods such as prizing-open logs or drag netting beds of aquatic vegetation, increasing survey efficiency requires searching higher quality microhabitats. Hence, surveyors can sample more lower-quality microhabitats, resulting in greater financial costs and wider-spread impacts, or they can target high quality microhabitats and risk impacts on the focal species.

We solved this trade-off using a decision-theoretic approach, using as a case study the Millewa skink *Hemiergis millewae*, a cryptic, locally endangered Australian lizard that is best detected using destructive sampling of individual grass hummocks. Using logistic regression models, we found that *H. millewae* more frequently utilises, and is therefore detected in, large hummocks. Hence, targeting these would require less replication.

We calculated the minimum combination of replication (the number of hummocks searched) and efficiency (their minimum volume) that would achieve a given cumulative probability of detecting the species, using weights to reflect the sensitivity of the results to a surveyor's priorities. Minimizing volume to very low values necessitates impractical amounts of replication, whereas emphasis on minimizing replication entails searching very large hummocks, rare and possibly vital for *H. millewae*.

Destructive sampling methods are sometimes necessary. However, it is important to consider the fact that decreasing survey replication may significantly increase ecological impacts. The method we present provides a simple quantitative tool for assessing this trade-off.

Stefano Canessa is a PhD candidate in the Quantitative and Applied Ecology group at the University of Melbourne. His research focused on the application of structured decision making to conservation reintroductions, particularly of amphibians.

Monday 25 November

Stream E, Session 3

Keeping pace with a changing climate: Can Australian plants count on rapid evolution?

D'Agui, Haylee¹; Enright, Neal²; Fowler, William¹; He, Tianhua¹.

¹*Department of Environment and Agriculture, Curtin University, Perth, Western Australia*

²*Environment and Conservation Sciences, Murdoch University, Perth, Western Australia*

The effects of climate change, particularly altered rainfall patterns, are apparent across Australia. In Southwestern Australia, a biodiversity hotspot, decreased annual rainfall is causing concern for the persistence of native flora. The ability of Australian species to rapidly select for drought tolerance in response to decreased rainfall is largely unknown, yet this knowledge is required to develop future management and conservation strategies. This research aims to determine whether seed-banks of selected species can potentially mitigate effects of a drying climate through rapid selection and adaptation. It is hypothesised that the seed-bank of a species can increase resilience to climate change by providing a range of genetic material for rapid selection.

Eight locations where fire was followed by a wet, dry or average winter were identified at Eneabba, Southwestern Australia. At each location, seed was collected from five serotinous, fire-killed species; *Banksia hookeriana*, *Banksia leptophylla*, *Hakea costata*, *Hakea polyanthema* and *Beaufortia elegans*. Seed was germinated, and divided into three drought treatments: 100%, 75%, and 50% mean winter rainfall equivalent. Post-spring, seedlings will be harvested and dry-weight of roots/shoots determined.

A larger proportion of seedlings descended from plants recruited post-fire in dry winters are expected to exhibit tolerance to drought treatments than those descended from plants recruited in average or wet winters.

This experiment is part of a broader study on evolutionary adaptation in Western Australian species, which aims to determine the ability of species to rapidly evolve in response to climate change, and assist in informing approaches to adaptive conservation management.

Haylee D'Agui is currently a PhD student with the Plant Ecology and Evolution Group at Curtin University, Western Australia. Haylee's research interests include ecology and physiology of Southwestern Australian flora, and ability of plants to adapt to a drying climate.

Wednesday 27 November

Stream D, Session 7

A sticky situation: seed dispersal of Cook's scurvy grassDale, Esther¹¹*School of Biological Science, University of Auckland*

Seed dispersal by external attachment to animals is typically achieved using hooked or a sticky seed coating. Seeds with a sticky mucilage coating which develops in contact with water are common in the Brassicaceae and in many cases this facilitates dispersal. Cook's scurvy grass (*Lepidium oleraceum*) is a threatened coastal cress with a clear seabird-associated distribution. It has been suggested that New Zealand coastal cresses, including *L. oleraceum*, may be dispersed through adhesion of a mucilage seed coating to seabirds. I was interested in testing this as a possible dispersal strategy. In order for this to be a viable dispersal mechanism, particularly over long distances, seeds would have to be able to survive repeated immersion in seawater and retain adhesion for extended periods. *Lepidium oleraceum* seeds were soaked in water for differing periods of time then stuck onto a vertical surface to test the period of water exposure required, and the duration of seed attachment. Seeds were soaked in fresh or seawater for zero to four weeks then left to germinate for two weeks to test seed viability following seawater exposure. Mucilage surrounding seeds became sticky after less than 5 minutes contact with water and remained adhered to the surface for extended periods. The proportion of seeds germinated was higher for seeds soaked in fresh compared to seawater, though even in the seawater treatment approximately half of the seeds germinated. Together these results indicate the seed mucilage layer is likely to facilitate external dispersal by seabirds in *L. oleraceum*.

Esther Dale completed her MSc at University of Auckland earlier in the year and is currently exploring options for Doctoral study. Her areas of research interest are forest ecology, plant conservation and plant-animal interactions.

Wednesday 27 November

Stream D, Session 7

The effects of local climatic variation on the fig/pollinator mutualism and its associated parasitesDeGabriel, Jane¹; Sutton, Timothy¹; Cook, James¹¹*Hawkesbury Institute for the Environment, University of Western Sydney*

Figs are keystone species across the tropics and subtropics, providing a vital food source for many species of birds and mammals. The relationship between figs and associated species of pollinating wasps is a classic and well-studied mutualism. However, the potential impacts of predicted climate change on the stability of this species interaction are less clear. Our study aims to investigate the role of local environmental variation on the composition and structure of wasp communities associated with Port Jackson figs (*Ficus rubiginosa*) across a large latitudinal and climatic gradient. We collected ripe fruits from fig trees at five sites around the Sydney region with contrasting rainfall and temperatures at monthly intervals, and recorded the diversity and abundance of pollinating and non-pollinating wasp species that emerged from fruits within 48 hours. We present initial data demonstrating spatial and temporal differences in wasp community assemblages between sites. Our study also investigates how climate influences pollinator biology. We carried out controlled experiments to test whether local environmental conditions impact on the longevity of the pollinating wasp species *Pleistodontes imperialis* exposed to increasing temperature and aridity. Here, we show that wasp longevity decreases strongly with increasing temperature and aridity, and we compare the thermal tolerance curves of *P. imperialis* collected from two sites with contrasting average annual rainfall. We discuss the implications of these results for the stability of fig/pollinator mutualisms in the context of predicted climate change.

Dr Jane DeGabriel, Hawkesbury Institute Research Fellow, impacts of climate change on the evolution and ecology of insect-plant interactions.

Tuesday 26 November

Stream B, Session 4

A test of the Specialization hypothesis using plant populations on an altitudinal gradientFazlioglu, Fatih¹; Bonser, Stephen¹¹*UNSW, BEES and Evolution and Ecology Research Centre*

The Specialization hypothesis was proposed to interpret whether phenotypic plasticity is a by product of natural selection or an active response from plants to environmental variability. The specialization hypothesis predicts that locally adapted (specialized) plants in benign environments have higher plasticity than those specialized in stressful environments. Plant populations in benign habitats can grow vigorously and the variation in growth and fitness related traits are higher and phenotypic plasticity is greater. Under such circumstances, plasticity is a by product of selection. According to specialization hypothesis, low altitude populations will indicate higher plasticity in fitness related traits. In order to test this hypothesis, high (800-1000 m) and low level (20-30 m) populations of *Trifolium repens* (white clover) were collected around Blue Mountains region in New South Wales. Low level populations have relatively more stable and favourable environment when compared to high level populations in terms of temperature, wind and precipitation. In a

common garden experiment, by applying 3 different competition levels, plant responses (i.e shade avoidance) were measured in several functional and fitness traits. In low competition, we found significant difference in fitness traits between low and high level populations. Loss of fitness (plasticity in fitness) was smaller in low level populations since they maintained their fitness with aid of functional traits in low competition treatment. In this sense, our results do not support specialization hypothesis since plasticity in fitness was smaller in low populations between treatments. However, adaptive plasticity and within treatment plasticity values were greater in low level populations.

Fatih Fazlioglu is a second year PhD candidate at UNSW. Research interests are phenotypic plasticity, local adaptation and reproductive strategies in plants.

Tuesday 26 November

Stream B, Session 4

Carbon Stock Variation with Transition Between Wet Sclerophyll Forest and Cool Temperate Rainforest in South-Eastern Australia

Fedriago, Melissa¹; Kasel, Sabine¹; Roxburgh, Stephen²; Bennett, Lauren T.³; Nitschke, Craig, R.¹

¹The University of Melbourne, Burnley Campus, VIC, Australia

²CSIRO, Sustainable Ecosystems, Canberra, ACT, Australia

³The University of Melbourne, Creswick Campus, VIC, Australia

In south-eastern Australia, fire has the potential to influence the transition between wet sclerophyll forest and cool temperate rainforest; however little is known about associated changes in above- and below-ground carbon stocks. Structurally, wet forests are dominated by *Eucalyptus regnans*, whereas cool temperate rainforests are characterised by smaller rainforest trees (*Nothofagus cunninghamii*) and a greater density of shrubs. There are negligible data relevant to the carbon stocks in these communities, particularly in the soils, limiting our capacity to predict changes in the distribution of carbon stocks with changes in fire regimes and climate. In this study, we quantify carbon stocks in above-ground components (standing live and dead trees, shrubs, tree ferns, stumps, coarse woody debris, litter), and in soil (to 30 cm). Our study included 6 sites of each of three communities: wet forest, cool temperate rainforest, and a 'transition' forest characterised by *E. regnans* emergents above a rainforest understorey. Our data provide unique indications of how carbon stocks are distributed between above- and below- ground components in these communities, and how these distributions vary with environmental conditions. Thus, our study markedly enhances the knowledge base for predicting the impacts of biome redistribution on total carbon stocks as it is influenced by changes in climate or fire regimes in these landscapes.

Melissa Fedriago, PhD Candidate at the University of Melbourne, Victoria, Australia. My research interests focus on a multi-disciplinary approach to estimating forest carbon by exploring forest ecology using lidar remote sensing data and traditional techniques.

Wednesday 27 November

Stream D, Session 7

Allelopathy of boneseed (*Chrysanthemoides monilifera* subsp. *monilifera*): a Biochemical Weapon of Invasion

Harun Md. Abdullah Yousuf Al¹; Robinson Randall W.¹; Johnson Joshua¹; Uddin Md. Nazim¹

¹College of Engineering and Science, Victoria University, Melbourne, Vic 8001, Australia.

Natural ecosystems and primary production industries are threatened by invasive species. We studied allelopathic potentiality of boneseed, one of the invasive Weeds of National Significance in Australia and listed on the [National Pest Plant Accord](#) in New Zealand. A series of bioassays compared dose-response to aqueous extract of boneseed as well as the impact of litter and volatile chemicals on model (*Lactuca sativa*) and associated species (*Isotoma axillaris* and *Acacia mearnsii*) with particular reference to biometric and physiological parameters. Germination indices revealed concentration dependent impacts of extract of boneseed organs in the order of leaf > root > stem. There was a significant difference in effect of extract on germination of all species ($p \leq 0.001$). *I. axillaris* was the most susceptible species showing LC₅₀ of only 0.46%, 0.89% and 0.86% against leaf, stem and root extract respectively. Radical length and weight of all species were severely inhibited compared to hypocotyl. Volatile chemicals from boneseed leaf and root were not inhibitory for germination but reduced seed vigour by 22% and 40% respectively of *L. sativa*. Litter incorporated soil exhibited significant reduction of *I. axillaris* germination ($p \leq 0.000$) in varying dosage, and abridged hypocotyl and radical length. Acceleration of electrolytic leakage, hydrogen per oxide, and lipid per oxidation in *L. sativa* with increasing concentration of boneseed extract provide evidence of cellular fragmentation. These findings help to explain the mechanism of invasion by boneseed and emphasize the importance of mitigating the effects of allelopathy by boneseed to protect native species and crop species.

Mr. Harun is an Associate Professor of Environmental Science Discipline, Khulna University, Bangladesh. Currently he is conducting PhD on "Chemoecological Investigation of Boneseed" in Victoria University, Melbourne. Mr Harun has a wide range of research interest including Plant Ecology, Water Management, etc.

Tuesday 26 November

Stream B, Session 4

Modelling kangaroo-vegetation dynamics in semi-arid Australia

Hauser, Cindy E.¹; Lahoz-Monfort, José J.¹¹*School of Botany, University of Melbourne, Parkville Vic 3010 Australia*

In Victoria's Wyperfeld National Park, the kangaroo population is controlled to reduce grazing pressure and enhance the regeneration of pine-buloke woodland vegetation. Over the last 15 years a kangaroo population model has been used to determine cull quotas. Evaluation of the program is hampered because the model does not currently connect kangaroo population control to vegetation regeneration.

We are developing an adaptive management plan for kangaroo control, which will explicitly link kangaroo dynamics to vegetation objectives and condition. In a workshop attended by relevant experts, we elicited objectives and measures of vegetation condition suitable for ongoing monitoring at Wyperfeld. We have gathered expert opinion and research literature to propose a transition model for pine-buloke woodland vegetation under grazing pressure. This model will help identify the likely effectiveness of the control program, current knowledge gaps and future experiments and research directions that have the capacity to improve management of the woodland.

Cindy Hauser is a research fellow at the University of Melbourne. She's a mathematical modeller who develops survey, monitoring and adaptive management plans in collaboration with environmental managers.

Tuesday 26 November

Stream B, Session 4

Patterns of Physical Dormancy Breakdown Along Two Climatic Gradients

Hudson, Alice¹; Ooi, Mark¹; Ayre, David¹¹*Institute for Conservation Biology and Environmental Management, School of Biological Sciences, University of Wollongong, NSW*

In fire prone habitats, one mechanism controlling regeneration is the production of seeds with a hard seed coat (physical dormancy). In certain species, in order for dormancy breakdown to occur, it is the high temperatures generated by the passage of fire that times germination and seedling emergence to coincide with the post fire environment. There have been recent suggestions that the temperature required to break dormancy in such species may be linked to summer temperatures the parent plants experience, and climate change may therefore potentially change these dormancy traits. To test for dormancy variation, seeds of *Acacia suaveolens* (Sm.) Willd. were collected along two climatic gradients in south-eastern Australia, one altitudinal and one latitudinal, each spanning approximately a five degree temperature range. This temperature range is equivalent to estimates of temperature change projected under high emission climate change scenarios. The seeds were subjected to different dry heat temperature treatments to investigate if the temperatures required to breakdown seed dormancy change with home site temperature. It was found that both the initial level of dormancy, and the tolerance to high temperature heat treatments varied between sites of seed collection, with seeds from sites with the highest summer temperatures displaying a greater tolerance to high temperature heat treatments than those from colder sites. These results have consequences for plant population response to future climate change.

Alice Hudson is currently a PhD candidate at the University of Wollongong, researching maternal effects and phenotypic variation in the physical dormancy trait of obligate seeding species from fire prone habitats.

Wednesday 27 November

Stream D, Session 7

Assessing the impact of fox baiting on Tasmanian devils

Hughes, Channing¹; Mooney, Nick²; Dickman, Christopher¹¹*School of Biological Sciences, The University of Sydney*²*Independent wildlife researcher*

The recent introduction of red foxes (*Vulpes vulpes*) to Australia's island state of Tasmania represents a significant ecological and economic threat. In response, the Tasmanian government is conducting a fox eradication program across much of the state, using Foxoff®, a bait containing the poison sodium monofluoroacetate (commonly known as 1080). The bait is potentially attractive to native Tasmanian carnivores as well as to foxes. Of particular concern is the endangered Tasmanian devil (*Sarcophilus harrisii*), which is already at risk from an emergent infectious disease, Devil Facial Tumor Disease.

We report the results of a two-year before-after-control-impact (BACI) study of Tasmanian devil populations at four sites in north-western Tasmania — two poison-treatment sites that were baited midway through the study, and two control sites that were never baited. We monitored the four populations (a total of nearly 400 individuals) through a series of capture-mark-recapture (CMR) surveys. Population size, demographic makeup, and animal condition were compared between treatment and control sites. Preliminary results suggest that fox baiting had no negative impact on devil populations. Final results will be available by the time of conference.

Channing Hughes is a PhD candidate in the School of Biological Sciences at the University of Sydney, conducting a long-term study of the endangered Tasmanian devil in north-western Tasmania.

Monday 25 November

Stream E, Session 3

Using shared phylogeographic patterns to infer the shared threats to an ecto-commensal flatworm and its critically endangered crayfish host

Hurry, Charlotte R.¹; Schmidt, Daniel J.¹; Ponniah, Mark¹; Carini, Giovannella¹; Blair, David² & Hughes, Jane M.¹

¹Australian Rivers Institute, Griffith University, Nathan, Qld, Australia

²School of Marine and Tropical Biology, James Cook University, Townsville, Qld, Australia

Losses to biodiversity are multiplied due to coextinction of closely allied taxa. Comparative phylogeography of species involved in close biotic interactions may show congruent patterns of allied species which share a common history depending on the specificity of the relationship. *Temnosewellia* is a genus of flatworms, members of which live in commensal relationships with host freshwater crayfish. By constructing phylogenetic trees based on mitochondrial COI and 28S nuclear ribosomal gene sequences, this study investigated how evolutionary history has shaped patterns of intraspecific molecular variation in *Temnosewellia albata* and its critically endangered host *Euastacus robertsi* within their narrow, climatically-restricted distribution which encompasses three mountaintops. The genetic data expanded upon previous studies that suggested several vicariance events have led to the population subdivision of *Euastacus robertsi*. Contrary to earlier conclusions, our results showed that limited dispersal has occurred between the mountaintops, these migration events were somewhat congruent for the host and the flatworm. Patterns of divergence differed slightly between the flatworms and their host crayfish. Several hypotheses were proposed to explain this lack of congruence. This study contributes significantly to the understanding of host-commensal evolutionary relationships.

Charlotte Hurry is a PhD Candidate at the Australian Rivers Institute at Griffith University, QLD. Interested in the use of genetics for conservation aims, freshwater ecology and endangered species.

Wednesday 27 November

Stream D, Session 7

The *Varroa* Invasion of Australasia

Iwasaki, Jay²; Barratt, Barbara^{1,3}; Lord, Janice¹; Mercer, Alison²; Dickinson, Katharine¹

¹University of Otago, Botany

²University of Otago, Zoology

³AgResearch Invermay

Social bees are an integral component of agriculture, pollinating the majority of fruiting crops and 15-30% of all food crops worldwide. Honey bees (*Apis mellifera*) in particular are the most important species by virtue of their large colony size, transportability, and effective foraging strategy. European honey bees were introduced for pollination to New Zealand and Australia in the 1800's, and have played a key role in the development of their economies. In the last 50 years, the *Varroa destructor* mite has caused widespread losses of commercial honeybee operations and dramatic losses of feral honeybee populations around the world. New Zealand and Australia were the last major beekeeping countries free of *Varroa* until 2000, when mites were found near Auckland. Since then *Varroa* has caused the same problems in New Zealand as elsewhere, and the effects are on-going as it establishes southwards throughout the country. Australia is as of yet free of *Varroa*, but a near introduction in Sydney in 2012 demonstrates that future infection is likely. In conjunction with *Varroa*, colony collapse disorder and other maladies are affecting honey bees worldwide. However, wild native pollinators have been shown to enhance fruit set independent of honey bee abundance, highlighting the significant potential other bees may have for pollination services. Studying competition between bees and alternative pollination services may lead to insights that encourage redundancy in pollination, enhancing robustness of agricultural systems and incentivising managers to encourage maintaining native insect biodiversity.

Jay Iwasaki is a current PhD student at the University of Otago studying competitive interactions between different species of bees in New Zealand.

Monday 25 November

Stream E, Session 3

Is the MHC class II β gene a single locus in parrots?

Knafler, Gabrielle J.^{1,2}; Fidler, Andrew³; Jamieson, Ian G.^{1,2}; Robertson, Bruce C.^{1,2}

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³Cawthron Institute, Private Bag 2, Nelson 7012, New Zealand

Immunologically important genes of the major histocompatibility complex (MHC) have been characterized in a number of organisms with the general finding that birds display a relatively simple MHC framework compared to mammalian species. A range of non-passerine species which represent early-diverging Neoave lineages have been described as having only one MHC class II β locus potentially leading to the conclusion that this is the ancestral condition. Here we examine the monotypic, early-diverging, critically endangered kakapo, *Strigops habroptilus*, for MHC class II β exon2 allelic variation as part of species recovery efforts. We found 2-4 confirmed alleles per individual and relatively high population diversity given their chronic bottleneck. The only Fiordland-originating kakapo, Richard Henry, contained unique MHC alleles not present in Stewart Island samples. Because gene duplication and loss have served to increase

the number of expressed and subsequent non-functional MHC loci both among and within bird species, it is not surprising that we found evidence for more than one MHC class II β locus demonstrating the questionable nature of the avian ancestral MHC structure.

I (Gabrielle Knafler) am a PhD candidate at the University of Otago in the department of Zoology. My research interests broadly include molecular ecology and population genetics and I am currently working with immunity-related genes (TLRs and MHC).

Monday 25 November

Stream E, Session 3

Gene flow and population structure in the Endangered Nigerian Cameroon chimpanzee in Taraba State, Nigeria.

Knight, Alex¹; Chapman, Hazel^{1,2}; Hale, Marie¹

¹University of Canterbury, Christchurch, New Zealand

²Nigerian Montane Conservation Initiative

The Nigerian Cameroon chimpanzee (*Pan troglodytes ellioti*) is the most recent sub-species of chimpanzee to be recognised and now estimated to be the most endangered. The largest remaining population (est. at 1000-1500 individuals) exists within Gashaka Gumti National Park, Nigeria. In the close vicinity of the park exist remnant forest fragments that still harbour chimpanzee communities. Deforestation in the region is heavy and chimpanzees are hunted for bushmeat so in the foreseeable future communities without any formal protection will likely go extinct. Currently the only fragment outside of the park in Taraba State that is protected is Ngel Nyaki forest reserve, home to the Nigerian Montane Conservation Initiative. Ngel Nyaki consists of two forest fragments located about 10 km south of the national park. We investigated dispersal between the fragments at Ngel Nyaki and the national park using microsatellite markers from DNA in faecal material collected across Taraba State. We found evidence that the fragments at Ngel Nyaki are isolated from the park. More surprisingly the data also suggest that there is little gene flow between the two fragments at Ngel Nyaki despite their close proximity. We also used the genetic data to estimate the population size at Ngel Nyaki to compare it to previous estimates based on nest counts. The results of this study have implications for the long term management of the sub-species and its future in the region.

Alex Knight is an MSc candidate at the University of Canterbury with interests in conservation biology, evolutionary ecology, primatology, population genetics, statistics and GIS.

Tuesday 26 November

Stream B, Session 4

Significant Species and Complex Communities of the University of Canterbury's Cass Mountain Research Area

Lambert, Michelle¹; Young, Laura May^{1,2}; Norton, David²; Pelsler, Pieter¹

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Humans have extensively modified the global environment, which in New Zealand has included burning and conversion to farmland resulting in a decrease in natural forest cover by almost 60%. This has caused a widespread change in vegetation and community structure influencing the diversity of species present. Our research undertaken at the University of Canterbury's 1800ha Cass Mountain Research Area (CMRA), consisted of a vegetation survey which documented the presence, abundance and number of species in 120 10x10m plots. No comprehensive vegetation survey had been previously undertaken in the CMRA, even though the University has owned the land for >100 years. We recorded over 350 plant species (~250+ indigenous and ~100 naturalised), many more than we originally considered and identified eight unique plant communities. A previously unrecorded population of Nationally Declining *Olearia lineata* was discovered, along with new records of species such as *Kunzea ericoides* and *Wahlenbergia ramosa*, not previously recorded in this area. The information from this vegetation survey provides valuable information for the management of the CMRA for teaching and research, enabling future persistence of significant native species and complex communities in the Canterbury high country.

Michelle Lambert and I'm studying towards a Master's of Science majoring in Ecology at the University of Canterbury. My areas of interest are population and community ecology, conservation, evolution, mutualistic interactions and invasive species biology.

Monday 25 November

Stream E, Session 3

Satellite-based tracking of kaka in the Auckland region

Landers, Todd J.¹; Rayner, Matt J.²; Beggs, Jaqueline.²; Clout, Mick²; Perry, George.³; Simpkins⁴; Craig & Dennis; Todd E.⁴

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Parrots (Psittaciformes) are one of the most endangered orders of birds due primarily to habitat loss, illegal capture, and depredation by introduced species. Effective conservation of parrots requires understanding of how fragmented landscapes affect the spatial ecology of populations. This in turn requires knowledge of individual's movements over annual cycles, which can be exceedingly difficult for such highly mobile species. Modern satellite technologies permit collection of tracking data for a wide variety of birds over long periods yet few studies exist for parrots, likely a result of their ability to destroy attached tracking devices. In this study we customised ARGOS satellite transmitters to track the kaka (*Nestor meridionalis*), a large forest parrot (~350 - 690 g) endemic to New Zealand. In the Auckland region these threatened birds occupy core breeding grounds on protected offshore islands but anecdotal evidence suggests some movements to mainland habitats. To quantify the frequency, timing and nature of the animal movement patterns of kaka, we deployed transmitters on 7 individuals on Great Barrier Island in March 2013. Our data reveal a variety of movement strategies including 2 kaka which travelled to the mainland, providing insight into the inter-annual landscape-scale connectivity of this population with mainland New Zealand. Observed movement trajectories of kaka also will be used (in addition to 8 more tracked kaka) to develop spatially-explicit individual-based simulation models that can provide insights regarding what/where are key habitats amongst the fragmented mainland landscape and the location of re-invasion routes to consider in management decisions.

Dr Todd Landers, Scientist, Auckland Council: I am a researcher in avian behaviour and ecology with strong application to species conservation.

Tuesday 26 November

Stream B, Session 4

Impacts of altered precipitation and root herbivory on nutrient cycling in Australian grassland – DRI-Grass experiment

Ochoa-Hueso, Raul¹; Barnett, Kirk¹; Gibson-Forty, Eleanor¹; Tissue, David¹; Nielsen, Uffe¹; Johnson, Scott¹; Power, Sally¹

¹Hawkesbury Institute for the Environment, University of Western Sydney, Locked Bag 1797, Penrith, New South Wales, 2751, Australia.

Current climatic models for Eastern Australia predict an increase in the frequency of deluge rainfall events separated by longer periods of severe drought, which is predicted to influence the structure and composition of local communities as well as to impact on key ecosystem processes such as nutrient cycling and carbon fluxes. Grasslands are found across much of the world where they represent an important global carbon sink. Like many other Australian ecosystems, Australian grasslands are generally nutrient poor (particularly in relation to phosphorus availability), which may make them particularly susceptible to altered nutrient cycling. In addition, changes in the frequency and magnitude of rainfall events can also alter the abundance of root-feeding herbivorous insects in grassland ecosystems and thus the magnitude of their effects on plant communities; the combination of direct and indirect effects of changing rainfall regimes on plants and their associated root herbivores has the potential to drive substantial change in plant community composition and ecosystem processes. Within this broad ecological context, we designed a new field experiment, initiated in June 2013, in which different rainfall regimes (increased and decreased amount and also altered frequency and seasonality) are crossed with a root herbivore treatment (+/-herbivore addition) in a grassland ecosystem in western Sydney (NSW). We predict that reduced precipitation and a reduction in the frequency of rainfall events will alter nutrient cycling and exacerbate soil moisture and phosphorus deficiency, leading to both altered ecosystem function and stoichiometry and ultimately to the alteration of the structure and composition of local plant communities. These changes at the ecosystem scale will also have consequences in terms of reduced ability to sequester carbon above- and below-ground, thus acting as a feed back to global climate change.

Raul Ochoa-Hueso. Research Fellow in Global Change Ecology at Hawkesbury Institute for the Environment. My research centres on the consequences of climate change on ecosystem processes related to the main nutrient cycles and how these impacts determine changes at the plant community level.

Wednesday 27 November

Stream D, Session 7

Invasive Giant African Landsnails in rainforest on Christmas Island, Indian Ocean: little to no evidence of impact

O'Loughlin, Luke S.¹; Green, Peter T.¹

¹Department of Botany, La Trobe University, Bundoora, VIC Australia 3086

In the absence of empirical evidence, invasive species are sometimes assumed to have negative impacts because of their conspicuously high abundance. The Giant African Landsnail (GALS, *Achatina fulica*) is noted as one of the 100 worst invasive species

globally, and although its impact on agricultural systems is well known, its impact in natural ecosystems has not been assessed. On Christmas Island, GALS has become established across large tracts of rainforest mainly because supercolonies of the invasive ant (*Anoplolepis gracilipes*), fuelled by honeydew from non-native scale insects, have locally extirpated populations of red land crabs (*Gecarcoidea natalis*) that are normally effective predators of GALS and prevent them from establishing in intact forest. The density of GALS can be extremely high but their impact is unknown. We conducted an exclusion experiment at a site of high snail abundance (~ 2 snails / m²) to test the hypothesis that this secondary invader has significant impacts on litter dynamics and seedling recruitment. The experiment ran for 6 months during the wet season (December 2012 – June 2013) while the snails were active. By the end of the wet season, leaf litter biomass was greater on the exclusion plots than on control plots ($t = 2.83$, $p = 0.01$) but litter cover did not differ ($t = 1.62$, $p = 0.12$). Further, there was no difference in the number of seedling recruits ($t = -0.19$, $p = 0.85$) or new recruit mortality ($t = -0.10$, $p = 0.92$) between exclusion and control plots. These findings suggest that GALS simply accelerate the decomposition of leaf litter in areas already highly modified by other invaders, and may replace to some extent the role played by native decomposers (land crabs) in this system.

Luke O'Loughlin is a PhD Candidate working on the facilitation of secondary invaders by primary invaders in rainforest on Christmas Island. His main research interests are in novel species interactions and the determinants of invasion success (@OLoughlinLS).

Monday 25 November

Stream E, Session 3

Identification multiplex assay of 19 terrestrial mammal species present in New Zealand.

Ramón-Laca, Ana¹; Linacre, Adrian MT²; Gleeson, Dianne M³; Tobe, Shanan S²

¹EcoGene®, Landcare Research, Auckland, New Zealand

²School of Biological Sciences, Flinders University, Australia

³EcoGene®, Institute for Applied Ecology, University of Canberra, Australia

Problems caused by introduced mammal species in New Zealand comprise predation and competition on native fauna, the modification of plant communities, damage to cultivated areas and the transmission of diseases. An identification assay that allows accurate detection of 19 of the most common terrestrial mammals present in New Zealand (cow, red deer, goat, dog, horse, hedgehog, cat, Tammar wallaby, mouse, weasel, ferret, stoat, sheep, rabbit, Pacific rat, Norway rat, ship rat, pig and brushtail possum) has been developed. This approach utilises a multiplex PCR that targets small fragments of the mitochondrial cytochrome b gene using species-specific primers. Each species is characterised by two distinctive species-specific peaks in a Genetic Analyser, enabling the identification of multiple species simultaneously in DNA mixtures in a self-confirmatory manner. This multiplex assay has shown to be very sensitive, which makes it a very useful tool for degraded and trace samples. The species identification technique featured here can be useful for wildlife management and conservation studies, pest incursion detection, forensic analysis and food quality control purposes in a very simple and cost-effective manner. Examples of how the technique assisted prompt ecological responses to predation events will be presented.

Ana Ramón-Laca is a Research Technician at the Ecological Genetics Laboratory (EcoGene®, Landcare Research). Her areas of interest are wildlife forensics and conservation genetics.

Monday 25 November

Stream E, Session 3

Some Simple Reasons Why Monitoring and Adaptive Management Often Fail in Practice

Reid, Tom¹; Gibbons, Philip¹

¹Fenner School of Environment and Society, The Australian National University,

Here we present a case study illustrating why adaptive management often fails in Natural Resource Management (NRM). Using monitoring data collected as part of a typical private land conservation incentive program, we were unable to find statistically significant links between funded management actions and the intended NRM outcome for several reasons: (1) we could only use data from 22% of the 55 monitored sites because of incomplete data sheets; (2) only three of six variables measured by landholders were strongly correlated with our own field measurements ($r > 0.6$, $p < 0.05$), implying that half of the data collected by landholders were not sufficiently consistent to be used for monitoring; (3) sampling was undertaken in different seasons making it difficult to distinguish change due to management from change due to natural variability; and (4) management actions were defined and recorded at a course scale, so it was not possible to determine whether there were issues with the management actions undertaken *per se*, or the way management actions were implemented on the ground. In order to link management actions with ecological outcomes, appropriate management data must be recorded alongside ecological data at every site, all data must be codified consistently across all sites, control sites must be established and data standards must be maintained across all data providers and through time. If these basic requirements cannot be met then alternatives to monitoring and adaptive management should be employed.

Tom Reid is a research assistant to Dr. Philip Gibbons at the Fenner School of Environment and Society. His research interests are in the areas of effective monitoring for adaptive management of agri-environmental biodiversity programs and this presentation summarises the results of an Honours thesis he completed on this topic.

Wednesday 27 November

Stream D, Session 7

Straddling the divide: den use by brushtail possums (*Trichosurus vulpecula*) in urban parklands.

Ruykys, Laura¹; Carthew, Susan¹; Yanez, B-H².

¹Research Institute for Environment and Livelihoods, Charles Darwin University, Darwin, NT, Australia.

²School of Earth and Environmental Sciences, University of Adelaide, Adelaide, SA, Australia.

The use of urban habitats by brushtail possums (*Trichosurus vulpecula*) remains poorly-researched. This study was conducted in an urban parkland in Adelaide; a setting that represents an intermediary between a fully-urban and fully-natural environment. To determine the factors that influence the presence of hollows in trees, plus their use by possums, the physical characteristics of 240 mature trees in six parks were assessed. To investigate hollow use more comprehensively, 18 possums were also trapped and radiotracked. Tree species and diameter at breast height (DBH) were significant predictors of the presence of hollows in trees. While there was a slight preference by possums for trees with a larger DBH, animals were also more likely to inhabit trees with a single hollow. Possums preferred hollows on the main trunk of the tree and which were a maximum of 350 cm above ground. Animals used hollows with entrance heights and widths of between 5 and 20 cm fairly evenly. There was also no apparent preference for hollow depth. Radiotracked possums used an average of 0.7 dens per week and had an average daytime denning area of 0.08 ha, with no significant difference between males and females in either of these parameters. While hollows were not a limiting resource at this study site, there was a correlation between the number of hollows per hectare and number of possums per hectare ($R^2=0.5$). Thus, altering the number of hollows in a given area would influence the density of possums within it.

Laura Ruykys is currently a Research Fellow at Charles Darwin University. Her research interest lies in wildlife ecology and, more specifically, the conservation of Australian mammals.

Wednesday 27 November

Stream D, Session 7

Spatial and temporal interactions between Dingoes, Cats and Foxes in South Australia's arid zone

Schroeder, Tina¹; Lewis, Megan¹; Kilpatrick, Adam D.¹; Moseby, Katherine^{1,2}

¹School of Earth and Environmental Sciences, the University of Adelaide

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Feral cats (*Felis catus*) and red foxes (*Vulpes vulpes*), two alien mesopredators, have significantly reduced small mammal and reptile populations across most parts of the Australian continent and contributed to recent mammal extinctions. Lately, it has been proposed that the dingo (*Canis lupus dingo*), Australia's top order predator has the potential to act as a biological control agent for introduced mesopredators. Dingo presence may reduce population levels of cats and foxes through interference competition or by changing behavioural patterns of cats and foxes. Those competitive pressures reduce predation risk for small mammals and reptiles, hence dingo presence may benefit threatened species.

This study tested how cats and foxes interact with dingoes by applying static (spatial) and dynamic (temporal and spatial) interaction analyses based on GPS location data of cats, foxes and dingoes recorded every 2 hours during an experiment undertaken in northern South Australia at the Arid Recovery Reserve between 2008 - 2010.

The dynamic interaction analysis showed that dingoes and cats and dingoes and foxes do not associate more or less than expected by chance; however, static interaction analysis detected strong avoidance of high use dingo areas by cats and foxes. This suggests that avoidance patterns are not apparent at short temporal intervals, but do manifest on a larger spatial scale. Competitive pressures are placed on cats and foxes when trying to avoid high use dingo areas and therefore reduce access to resources. This might provide refuge areas for small mammals and reptiles in core dingo areas and ultimately benefit threatened prey species.

Tina Schroeder, Honours Student, University of Adelaide. Areas of research interests are arid zone ecology, conservation biology, landscape connectivity, trophic networks, species interactions, in particular mammalian predator interactions, spatial ecology, animal movements and habitat utilisation.

Wednesday 27 November

Stream D, Session 7

We know what you ate last summer: dung beetles, isotopes and the ocean

Stavert, Jamie¹; Gaskett, Anne¹; Beggs, Jacqueline¹

¹School of Biological Sciences, University of Auckland, New Zealand

Worldwide, dung beetles are recurrently linked to a number of critical ecosystem processes, yet in many regions their ecological role is unknown. Endemic New Zealand dung beetles present an intriguing conundrum; they have evolved on an island archipelago historically lacking terrestrial mammals – the main source of dung for dung beetles elsewhere – but still occur in very high abundance. Considering

the enigmatic nature of endemic dung beetles, stable isotope analysis is an appropriate tool for investigating their function in food webs. We use nitrogen stable isotope analysis to investigate the trophic position of four endemic New Zealand dung beetle species. Additionally, given the historic abundance of seabird colonies throughout New Zealand, we use nitrogen and carbon stable isotope analyses to investigate whether the dung beetle *Saphobius edwardsi* will consume marine-derived carrion. We found that all species were feeding across several trophic levels; *Saphobius* spp. displayed ^{15}N values comparative to detritivores through to carnivores while ^{15}N values of *Boreobius lescheni* were comparative to leaf litter through to detritivores. $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ signatures of *S. edwardsi* provided with decomposed squid were more similar to that of squid than controls. Our findings suggest these species are broad generalist feeders and that *Saphobius* spp. exploit higher quality food resources than *B. lescheni*. Moreover, *S. edwardsi* appear to readily incorporate decomposed squid into their diets, suggesting involvement in nutrient transfer from marine to terrestrial ecosystems. Generalism has probably allowed New Zealand's dung beetles to survive in high abundance despite the loss of many native dung providers.

Jamie Stavert – I am a first year PhD student at the University of Auckland investigating the pollination services provided by native bees. I am interested in the functional role that native insects play in natural and human modified systems.

Wednesday 27 November

Stream D, Session 7

Comparison of habitat selection by an endangered amphibian in a natural and created landscape

Valdez, Jose¹; Stockwell, Michelle¹; Klop-Toker, Kaya¹; Clulow, Simon¹; Clulow, John¹; Mahony, Michael¹

¹*School of Environmental and Life Sciences, University of Newcastle, Callaghan, NSW 2308, Australia.*

With habitat loss and climate change considered the greatest threats for endangered species, habitat creation and translocation projects will be increasingly used methods for conservation management. Achieving successful outcomes requires understanding how species utilize their habitats in their natural environment, and how they respond to active environmental intervention. This study used the endangered green and golden bell frog (*Litoria aurea*) to compare the difference in habitat use patterns between and within a natural and a created landscape. Detection rates were considered to measure whether conclusions would change. Habitat availability was found to differ between both sites. Although habitat utilization differed within both sites, similar selection patterns were found between the sites. Aquatic vegetation, bare ground, and rock piles were selected for more than expected, while terrestrial vegetation was selected less than expected. Open water was utilized more in the created habitat compared to the natural habitat due to differences in pond size and predator numbers. Detection probabilities were found to be similar between the sites and adjusting for them did not alter conclusions. With conservation projects increasing over the next few decades, understanding habitat utilization patterns prior and continuous monitoring should be taken into account.

Jose Valdez is currently a Ph.D. student in environmental science at the University of Newcastle. He is investigating the decline of the green and golden bell frog, which despite being invasive species in some places is threatened in its native Australia. His research interests include conservation, behavioral ecology, and sociality. For fun he enjoys travelling, dancing, drinking quality beers, and playing the ukulele.

Wednesday 27 November

Stream D, Session 7

Dispersal opportunity among Australian alpine plant species

Venn, Susanna¹; Morgan, John¹

¹*Research Centre for Applied Alpine Ecology, Department of Botany, La Trobe University, Bundoora, Victoria, Australia, 3086*

In the face of climate change, long-term resilience strategies of species may involve: *persistence*, whereby species remain on site and rely on inherent characteristics and plastic trait shifts to maintain populations; *adaptation*, whereby species remain on site and rely on genotypic trait shifts to match changing environmental filters; or *dispersal*, whereby species re-locate to suitable sites to avoid unfavourable conditions. Here, we explore the dispersal strategy among plants restricted to the Kosciuszko alpine region, where climate change predictions all point towards a weakening in environmental filters; notably warmer temperatures and less snow. Given these changing conditions and the potential for many alpine species to become locally extinct, we ask: What is their capacity for dispersal? What proportion of this flora is capable of moving from its current location and how far can they go? Which functional or taxonomic groups have better dispersal characteristics in this environment? An understanding of dispersal syndromes and unassisted dispersal capacity is the first step in unravelling whether this strategy might be useful for species migration in future decades.

Susanna Venn is a researcher within the Department of Botany at La Trobe University. Specifically she is interested in how plant species, populations and communities in cold-climate environments will respond to changing environmental conditions over the coming decades.

Tuesday 26 November

Stream B, Session 4

Germination and seedling fitness response to smoke treatment of serotinous species

Yearsley, Emmaline¹; Downes, Katherine¹; He, Tianhua¹

¹ *Department of Environment and Agriculture, Curtin University, Perth, Australia*

Fire plays a key role in many ecosystems across the globe. Often, plants possess functional traits to cope with, or even benefit from fire. Serotiny is a prominent fire-related trait in Western Australia (WA) and roughly half the world's serotinous species occur in this region. Germination and establishment are critical stages of seedling survival and post-fire conditions are optimal for seedling establishment as competition is reduced and nutrient, light, and water availability are increased. Serotiny protects seeds from fire within the canopy and facilitates release into these post-fire conditions. Chemicals within smoke have been shown to enhance germination and seedling fitness.

This study investigates the response to smoke treatment in selected WA serotinous species within the genera of *Petrophile*, *Isopogon*, and *Banksia*. Germination trials assessed total germination and germination rate at various smoke water concentrations. Seedling fitness trials (shoot/root length and dry-weight) evaluated potential fitness benefits from smoke treatment. Interestingly, despite the literature demonstrating smoke response in many other species, the majority of those tested within this study did not show a significant response to smoke treatment. Ultimately, evaluating the response of plants to smoke treatment is a valuable addition to the body of knowledge regarding smoke responsiveness as a fire-related trait, and relating these results to serotinous species can be valuable in broadening the understanding of the combination of traits in fire-prone environments.

Emmaline M. Yearsley, is an honours student with the Plant Ecology and Evolution Group at Curtin University, Western Australia. She is originally from the USA and is particularly interested in pursuing ecology and evolution in both Australia and internationally.

Tuesday 26 November

Stream B, Session 4

A Spatially-explicit Individual-based Approach to Assess the Optimal Perception Range of Foraging Animals

Zhang, Jingjing¹; Perry, George¹; Dennis, Todd¹

¹ *School of Biological Sciences, University of Auckland*

Foraging success is crucial to the survival and fitness of free-ranging animals. Understanding the factors that influence the energy gain of individual animals is fundamental to understanding their movement behaviour and its underlying ecological drivers such as adaptation, competition, and energy flow in and through ecosystems. Inter- and intra-specific differences in perceptual range result in diverse spatially explicit movement decisions, which in turn dictate patterns of movement. For animals that move into previously unexplored locations (such as dispersing juveniles), their movements reflect recognition of important environmental factors. However, it is not yet clear how perceptual ability directly influences movement patterns, and hence uptake of energy at very fine temporal scales. We used a spatially explicit individual-based model to explore the importance of perceptual range in foraging movements. In our model, artificial landscapes of statistically defined structural characteristics were constructed, and then energy-flow ratio distributions were simulated with variable perceptual ranges so that an optimal perceptual range could be evaluated. This approach was repeated across a range of systematically varied landscapes to quantitatively assess relationships between perceptual ability and environmental heterogeneity. Foraging efficiency with different movement rules based on perceptual ability (such as step length, perceptual update rate) also was tested. Our study provides insights into how intrinsic factors such as visual and olfactory sensitivity are involved in when and where animals move, and how interactions between animals and their environments drive patterns of behaviour.

Jingjing Zhang is a Ph.D. candidate in Biological Sciences. Area of interest include using spatial-explicit individual-based model to investigate the role of perception, learning and memory in animal movement behavior and ecology

Poster Presentations

Using stress biomarkers to assess wintering habitat quality in migratory shorebirds

Aharon-Rotman, Yaara¹, Buchanan, Katherine.L, Buttemer, William¹

¹Centre for Integrative Ecology, Deakin University, Waurn Ponds, Victoria, Australia

Migratory shorebird populations are under threat worldwide, but the vast range of locations they use annually makes it difficult to identify where they might be experiencing greatest stress. For shorebirds using the East Asian Australasian flyway, habitat loss at stopover sites in Asia has been identified as a major threat. However, there are populations of Ruddy Turnstones (*Arenaria interpres*) that use this flyway, but winter at different locations in Australia, that have marked differences in their population dynamics. The population wintering at King Island is declining, whereas one wintering along coastal South Australia seems to be more stable. It is possible that differences in levels of anthropogenic disturbance at these wintering sites are contributing to differences in population stability. If this were so, we would expect corresponding differences in levels of stress biomarkers between these wintering populations. We present results from determination of corticosterone (CORT) content in feathers and heterophil:lymphocyte ratios from blood smears, taken from birds at both locations. Because moult is initiated upon arrival at the wintering sites and feathers require several weeks to be regrown, feather CORT content provides an extended and integrated measure of individual stress levels at each site. The leukocyte response also reflects chronic stress, although indicates current, rather than historic conditions, due to the down-regulation of the immune response. Thus, the combined measures of feather CORT and haematological parameters provide a means to test if differences in habitat quality of wintering sites might be contributing to differences in population stability.

Yaara is a 3rd year PhD student in the Center for Integrative Ecology in Deakin University, with a background in geography and ecology from Israel. Her main field of interest includes various aspects of conservation in long distance migrants.

Isolation and characterization of polyaromatic hydrocarbon degrading bacteria isolated from Aseer region, Saudi Arabia

Alamri, Saad A.¹

¹Department of Biology, College of Science, King Khalid University, P. O. Box 10255, Abha 61321, Saudi Arabia.

In this study, thirty five bacterial isolates were obtained from hydrocarbon contaminated soil samples using enrich medium. I tested the ability of these isolates to grow on a mineral salt medium containing anthracene and phenanthrene as the sole carbon source. Only five isolates showed ability to degrade these hydrocarbons. RAPD PCR was carried out for the five bacterial samples and the DNA band pattern revealed that there was no similarity between the examined bacteria, however, the RFLP failed to differentiate between them. The five bacterial isolates were then grown on high concentrations of anthracene & phenanthrene (4% w/v). Two of these bacterial isolates were selected due to their high capability to grow in the presence of high concentrations of anthracene and phenanthrene. The isolates were identified as *Bacillus pumilus* and *Ochrobactrum* sp. using PCR of the 16S rRNA gene. Based on DNA sequences, phylogenetic analysis revealed that the two isolates are new strains. Finally, the ability of these bacterial strains to tolerate and remove different PAHs looks promising for application in bioremediation technologies.

Dr. Saad A. Alamri, Associate Prof. of Microbiology, area of research interest in Microbial Ecology.

Conserving amphibian diversity- gene flow studies in a West African Biodiversity hotspot- Mambilla Plateau, Nigeria

Arroyo-Lambaer, Denise¹; Chapman, Hazel¹; Hale, Marie¹; Blackburn, David²

¹School of Biological Sciences, University of Canterbury, New Zealand¹

²California Academy of Sciences, San Francisco CA, USA

Nigeria's montane forests fall within the Cameroon Highlands Ecoregion and are exceptionally rich in endemic taxa including amphibians. The montane forests on the Mambilla Plateau, Nigeria, are of such limited extent that their small and isolated populations of endemic species are at high risk of extinction. At the Ngel Nyaki Forest Reserve, where this study will be carry out, the main direct threats are habitat loss due to expanding agricultural activities, human settlements, and overgrazing. The expected effect of habitat degradation/fragmentation is the loss of connectivity between populations. Small and isolated populations usually lose genetic variability more quickly than larger and continuous populations, however, the more susceptible species to habitat deterioration are those with restricted dispersal. Such is the case of amphibian species which generally present low dispersal capacities, exacerbating the negative effects of habitat degradation and loss of population connectivity. Therefore, we will use Amplified Fragment Length Polymorphism (AFLP) markers in order to investigate population structure and gene flow of two IUCN threatened frogs species (*Cardioglossa schioetzi* and *Astylosternus rhoepphilus*) to understand its susceptibility to forest degradation and its ability to use corridors for dispersal. Results will help us to place a value on the restoration/conservation of forest as well as small and degraded riparian forests in terms of amphibian conservation. In addition, forceful information generated by this study will be used to model management practices for other African amphibians.

Denise is a PhD Candidate of the School of Biological Sciences, University of Canterbury. She obtained a master degree by the National Autonomous University of Mexico (UNAM). She is interested on the effects of habitat fragmentation on amphibians and reptiles.

Effects of forest fragmentation on plant-bird mutualisms and native plant regeneration

Aubert, Marine¹

¹*School of Biological Science, University of Canterbury*

Human settlement in New Zealand has severely impacted the natural environment by habitat destruction, over-harvesting, and introduction of pests and exotic invasive species. Nearly half the endemic land birds are now extinct, while a considerable proportion of the remainder have been reduced and currently have restricted distributions, sometimes only remaining as small populations in isolated sanctuaries.

Changes in bird density significantly influence bird foraging behaviours, food preferences and competition mechanisms. Consequently, some native plants may suffer from insufficient bird visits and subsequent regeneration failure. Because of the unusually high importance of birds for plant regeneration compared to other temperate countries, the extensive loss of native birds is of particular concern in New Zealand. Along with the significant impact of habitat destruction, seed predation and herbivory, the loss of plant-bird mutualisms is threatening the regeneration ability of native bird-pollinated and fleshy-fruited species.

Most lowland native forests in New Zealand are now highly fragmented, embedded in predominantly farmed landscapes, and often consist of post-disturbance, secondary vegetation. For years, increasing biodiversity conservation efforts have been promoted, from the management of large natural reserves to the protection of small forest remnants on private landholdings. My research aims to evaluate whether native plant regeneration is failing in small isolated forest patches below some threshold size and isolation level, because of the lack of pollination and/or dispersal with current bird densities within a heterogeneous fragmented mosaic landscape. This will quantify the sustainable limits in bird and plant populations that may allow for long term species persistence.

Marine Aubert, 1st year PhD student at the University of Canterbury, inaugural recipient of the Queen Elizabeth II National Trust Brian Molloy Scholarship. Ecology, habitat fragmentation, plant-bird mutualisms, and conservation of native biodiversity.

Drought, deluge, and “downunder” grazing: grassland ecosystem responses to rainfall variability and root herbivory

Barnett, Kirk¹; Johnson, Scott¹; Power, Sally¹

¹*Hawkesbury Institute for the Environment, University of Western Sydney*

Climate models for the Australian continent predict more variable rainfall patterns as a result of climate change. In SE Australia, this includes reduced annual rainfall amounts, particularly in winter and spring, and longer periods between rainfall events. Plant community responses will depend on component species' shifts due to rainfall patterns and associated changes in competition. Additionally, root herbivory could alter the effects of extreme rainfall changes by removing root tissue needed to support the water demands of plants during periods of drought. Grassland soil surveys established that the majority of herbivores were Soldier Flies (Diptera: *Inopus* sp.) (82%), weevils (Coleoptera: Curculionidae) (9%), and scarabs (Coleoptera: Scarabaeidae) (3%). In order to investigate the effects of precipitation and root herbivory we established a large scale rainfall manipulation experiment at the University of Western Sydney's Hawkesbury campus using rainout shelters. Irrigation regimes simulated rainfall patterns predicted by current climate models. Treatments consist of drought, reduced frequency of rainfall, and ambient rainfall. Root herbivores were applied to half of the plots. We predicted that plant groups will respond contrastingly to rainfall manipulation, and will be further altered by the addition of root herbivores. For example, C₄ plants will be able to outcompete C₃ plants in drought conditions, however, root herbivores will reduce differences between the two plant groups. Legumes will suffer doubly under drought and root herbivory due to reduced nodule activity and root damage. Here, I present the findings from the first year of the field experiment and complementary glasshouse experiments.

Kirk Barnett is a PhD student at the Hawkesbury Institute for the Environment at the University of Western Sydney. His previous work includes ecological effects of invasive plants species and trophic interactions of herbivorous insect larva in hardwood forests.

A new species of lizard: just a stone's turn away?

Barr, Ben¹; Mitchell, Cathy²; Mitchell, Peter²; Ball, Olivier¹.

¹*NorthTec, Whangarei*

²*Bream Head Conservation Trust*

The distribution and densities of many endemic lizards have undergone significant declines within mainland New Zealand, mainly due to introduced predators and habitat loss. The vast majority of lizard habitat in New Zealand is unmanaged and historically there has been a lack of lizard surveys undertaken. Furthermore, New Zealand lizards are difficult to detect, difficult to identify and thus new or important discoveries may be overlooked. Community groups are increasingly becoming involved with conservation on private and public land and novel herpetological finds are being reported more frequently. This is due to a massive search effort increase by citizen scientists, and possibly due to behavioural and numerical responses of lizards to predator control. After three years of intensive predator control, the Bream Head Conservation Trust made one such discovery in Bream Head Scenic Reserve, Whangarei Heads in February, 2013. Three individuals of a previously unidentified taxon were located during routine lizard monitoring. Preliminary molecular analysis indicates that

the taxon is closely related to the brown skink (*Oligosoma zelandicum*), which is distributed in the lower North Island and the upper South Island. This discovery either represents a significant range extension for the brown skink or a recent speciation event. We present an initial phylogeny and outline research plans to clarify the taxonomy, distribution and habitat preferences of this taxon.

Ben Barr is a conservation lecturer and NorthTec, Whangarei. He has a particular interest in lizard ecology and conservation.

Reproductive ecology of Mānuka (*Leptospermum scoparium*) under various fire regimes

Battersby, Paul¹; Perry George¹; Wilmshurst, Janet²; McGlone, Matt²; Curran Tim³

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Globally, fire is an important driver of ecological processes. However, across most of the Holocene fire activity in New Zealand was extremely low, although charcoal records suggest increased fire frequencies in the last 3000 years. Irrespective, human arrival approximately 750 years BP radically altered the natural fire regime, reducing return times to approximately 7-14 years. Mānuka (*Leptospermum scoparium*) is one of the few members of the New Zealand flora to show fire adaptations, most notable serotiny, defined as retention of seeds in the canopy over consecutive seasons. Previous studies have investigated geographical variation in serotiny in mānuka as an indicator of past fire regimes, but they have not incorporated known fire histories from palaeocharcoal records. Serotiny was assessed at thirty sites throughout NZ after being placed into four categories of fire exposure; long (10 000BP-700), medium (700-300BP), late (300BP-present) and no fire. Environmental characteristics (i.e. vegetation cover, altitude) were recorded for each site. Mānuka is weakly serotinous with a bimodal distribution of closed capsules between and within populations and weakening as latitude increases. While we found an association between serotiny and fire history, environmental factors such as altitude are more important in driving serotiny in Mānuka in New Zealand.

Paul Battersby is an MSc student in the School of Environment at The University of Auckland, supervised by Associate Professor George Perry. Research interests include plant ecology, aquatic ecology and restoration ecology.

Does the temporal stability of plant community composition vary along a soil moisture gradient in upland swamps?

Benbow, Chantel¹; Keith, David²

¹*Australian Wetlands, Rivers and Landscapes Centre, The University of New South Wales*

²*NSW Office of Environment and Heritage*

Upland swamps are a type of peat-forming mire locally restricted to coastal plateaus of south-eastern Australia. Upland swamps provide important hydrological services and are noted for their high plant species richness. Spatial turnover in plant community composition is largely correlated with a hydrological (soil moisture) gradient that transitions from dry margins to a waterlogged core. This gradient corresponds with availability of plant resources including soil oxygen and nutrient content. The aim of this study was to examine variation in community stability across the soil moisture gradient. We quantified changes in species composition using a time series of vegetation surveys (1984, 2004/05 and 2013) for two upland swamps in Dharawal Nature Reserve, NSW, to test support for three alternative hypotheses: i) there is no difference in community stability across the moisture gradient; ii) community stability is greater in wetter parts of the gradient where waterlogged conditions limits the number of species able to persist in these conditions; or iii) stability is greater in drier parts of the gradient where drought may similarly act as a filter for species persistence. Preliminary results suggest support for hypothesis (ii). This suggests that enhanced understanding of the dynamics of swamp margins, rather than the core, may contribute most to improved management to promote maintenance of diversity in these important ecological communities.

Chantel Benbow is an honours student in the Australian Wetlands, Rivers and Landscapes Centre at The University of New South Wales. She is interested in plant ecology and developing her plant identification skills.

Investigating the role of tree ferns in forest succession

Brock, James¹

¹*School of Biological Sciences, University of Auckland, Auckland, New Zealand*

New Zealand's forests are fragmented, and losses to indigenous vegetation cover are ongoing. These fragments are experiencing plant diversity loss, in part due to the failure of species to successfully establish, and the long-term viability of these ecological islands is decreasing. Effective stewardship and positive management of degraded habitat, along with biodiversity restoration, mitigation and habitat creation projects, requires an understanding of the process of succession and the ecosystem engineers that influence this process. Therefore, identifying ecosystem engineers and understanding their mechanisms of action are critical steps in our ability to restore biodiversity and recreate natural communities. In New Zealand natural forests, tree ferns are a common component of the understory and early successional habitats yet little is known of their roles in influencing overstorey composition, density, basal area, productivity and overall species diversity. In particular the role of tree ferns in succession and regeneration has not been examined as a function of the forest communities. Given the age and ubiquitousness of this group of species, it is considered likely that they will function as keystone species within forest communities.

The poster presentation will outline my initial PhD research examining the ecology of New Zealand tree ferns; the focus of the research is the functional role of these species in secondary succession within native forest. The presentation will highlight the research to date which will include: macro-scale assessment of tree fern distribution and habitat/species associations; gametophyte establishment conditions, and field studies of a chronosequence of sites dominated by *Cyathea medullaris*.

James Brock, PhD Candidate at the University of Auckland: My research interests are epiphytes of tree ferns, successional trends within forests, and restoration ecology and conservation management. I also have strong interests in habitat creation, biodiversity offsetting and sustainable development.

Quantifying the relative effects of snow disturbance on a mixed *Nothofagus* forest, at Boyle River Flats, New Zealand

Carter-Brown, Ross¹; Curran, Timothy¹

¹Department of Ecology, Lincoln University, Canterbury, New Zealand

Snowfall is a common feature in *Nothofagus* forests at higher altitudes and trees can be damaged when large amounts accumulate on crowns and stems. Although New Zealand's *Nothofagus* forests have been well studied, very little work has been done on the mechanisms of snow damage, or on species specific traits or stand characteristics that determine their response to snow events. Research was carried out in June 2013 at Boyle River Flats in the Lewis Pass in the South Island of New Zealand, to quantify the response of mixed *Nothofagus* forest to a significant snow event in the previous winter. The forest is located at ~600m A.S.L. and consists predominantly of *Nothofagus fusca* and *N. menziesii* with some isolated pockets of *N. solandri*. International studies have shown that snow damage can vary based on wood density, tree size, position in the canopy, crown asymmetry, and height/diameter ratio. We asked the questions: 1) How do snow disturbances affect different *Nothofagus* species, relative to each other, in a mixed beech forest? 2) How do *Nothofagus* stand characteristics effect the amount and type of damage from snow disturbances? Twenty-two 20x20m plots were set-up and surveyed for damage. In total 1049 stems were sampled. Preliminary results show that there was a mortality rate of 16.01% and significant differences between the types of damage sustained between the canopy and sub-canopy trees. Further fieldwork is being carried out to measure wood density and crown asymmetry of *N. fusca* and *N. menziesii* in the area.

Ross Carter-Brown is an undergraduate student currently completing a B.Sc. Conservation and Ecology at Lincoln University. Ross' professional interests include disturbance, succession, and ecological restoration (with a focus on improving ecosystem function, and plant/soil interactions).

The influence of fire and climate on the community dynamics of heathy-woodland shrub species

Chick, Matthew¹; Cohn, Janet¹, York, Alan¹, Nitschke, Craig¹

¹Department of Forest Ecosystem Science, University of Melbourne

Climate change has the potential to alter wildfire regimes through a shift in the temporal (seasonality and frequency), spatial (area and patchiness), and magnitude (intensity, severity, and type) components. This in turn is increasing threats to both human assets and forest ecosystems. Throughout Victoria these threats are being met through increasing both the temporal and spatial components of prescribed burning; meaning that the frequency has been increasing, and the seasonality and severity altering. This is resulting in a diverse and constantly changing fire regime throughout the landscape. Furthermore, as this landscape covers a diverse range of geographical locations, and therefore climatic conditions, it is apparent that the response from these burns will correspond to the region for which they are implemented. Considering these factors, this research will be focusing on the ecological responses of shrubs in the heathy-woodland community to time since fire, the season (spring versus autumn) and severity of fire, and how these responses vary geographically across a precipitation gradient within Victoria, Australia. This will occur: retrospectively through the assessment of time since last fire (TSLF) shrub species dynamics; presently through building predictions of community responses when prescribed fire is introduced to these different TSLF dynamics; and into the future through modeling community responses to alternate seasons of prescribed fires with the use of fire scenario modeling. Through this research better understanding of the relationship between climate, fire regimes and shrub dynamics in heathy-woodland will be developed.

Matthew Chick is currently completing a PhD in Forest and Fire Ecology with the University of Melbourne. He is researching the ecological responses of Australian heathy-woodland to different seasonal timings of fuel reduction burning in interaction with climate change.

Landscape supplementation of introduced predators

Clarke, Dean A.¹; Smith, James²; Norbury, Grant²; Wilson, Deborah J.¹

¹Landcare Research, Private Bag 1930, Dunedin

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Landscape supplementation of unwanted species abundance can threaten the persistence of indigenous biota. For example, in North America, timber harvesting and agriculture favour moose or white-tailed deer, supporting more cougars or wolves, which in turn leads to fewer woodland caribou or mule-deer through increased predation. We studied an effect of landscape supplementation on indigenous

fauna in a New Zealand grassland ecosystem. We used ink footprint tunnels, faecal pellet plots and camera traps to detect introduced species across this landscape. Short, intensively-grazed, fertilised pastures, adjacent to refuge habitat (indigenous tussock grassland and shrubland) for indigenous fauna, favoured introduced rabbits and the top-order introduced predators (cats and ferrets) that rely on rabbits as primary prey. These top predators are very mobile and move freely between the rabbit-prone improved pasture and the refuge habitat. This overflow of predators reduces the efficiency of predator control programmes in refuge habitat. While extending predator control, or rabbit control, beyond the target area is a way to mitigate landscape supplementation, we argue that a more sustainable and long-term solution is to include a buffer of dense vegetation that does not favour rabbits around the target area. Ecosystem management that is cognisant of ecological context and addresses both *in situ* and *ex situ* threats is more likely to achieve conservation goals.

Dean Clarke is a Senior Research Technician. He has a strong interest in drylands ecosystem research and mammalian pest ecology.

Microbial diversity and ecosystem functioning: boundaries of sustainability in a changing world

Colombo, Federica¹; Macdonald, Catriona¹; Powell, Jeff¹; Singh, Brajesh¹

¹Hawkesbury Institute for the Environment, University of Western Sydney, Richmond, NSW, Australia

Biodiversity loss is among the major drivers of ecosystem change. Understanding the consequences of loss of biodiversity on the functioning of the ecosystems is of paramount importance in order to assess the sustainability of a system. Microbes are the most abundant organisms on Earth and they are responsible for many ecologically important ecosystem processes. Despite this, the knowledge about their role in ecosystem functioning and sustainability is still incomplete. This research aims to investigate the consequences of decline in soil microbial diversity on ecosystem functioning. Here we experimentally manipulated the soil microbial community using the dilution approach to analyse the functional consequences of biodiversity loss. The preliminary results of this study demonstrate that a loss of microbial diversity affects not only specific functions, such as the decomposition of less labile compounds, but it can also have an impact on widespread functions such as community respiration, contrarily to what previously assessed. These results suggest that the functional redundancy of microbial communities may be not as prevalent as generally thought. These findings have consequences for predicting the effects of biodiversity loss on ecosystem functioning.

Federica Colombo is a PhD candidate at the Hawkesbury Institute for the Environment (UWS). Her research interests focus on understanding the contribution of biodiversity to ecosystem functioning and environmental sustainability, particularly in systems experiencing environmental change.

New Zealand mangroves as a model system for studying water and carbon relations

Cusens, Jarrod¹; Alfaro, Andrea¹; Gillman, Len¹; Leuzinger, Sebastian¹

¹Institute for Applied Ecology New Zealand, School of Applied Sciences, Auckland University of Technology

The stomata of plants are the gatekeepers of carbon entering and water leaving terrestrial ecosystems. Trees are of particular importance because they are dominant carbon sinks and sources of water to the atmosphere in terrestrial ecosystems. Changing climate will undoubtedly influence tree survival and hence affect the ability of forest systems to store carbon and cycle water. Despite the described importance of trees there are several key questions regarding carbon and water relations that remain unanswered. A principal barrier to addressing these questions is the logistical difficulty of studying large mature trees in complex systems. Here we propose using New Zealand mangroves as a model system for studying water and carbon relations in trees. New Zealand mangroves are an ideal outdoor laboratory for investigating tree carbon and water relations for several reasons. Firstly, tidal inundation with salt water induces periodic and therefore predictable stress conditions. Secondly, their canopies are easily accessible even when trees are mature. Lastly, New Zealand mangrove forests are monospecific (i.e. no interspecific competition), which removes a classic confounding factor in ecological experiments. We will use a combination of established (e.g. sap-flow and stomatal conductance) and newly developed tools (e.g. point dendrometers and leaf patch-pressure clamps) linked to an online continuous monitoring system. The combination of these state-of-the-art sensors will provide an unprecedented and complete understanding of water and carbon relations in mangrove trees, with the potential to apply our findings to the ecophysiology of terrestrial forest ecosystems.

Jarrod is a PhD candidate with broad ecological interests including community and functional ecology. He has previously worked on the productivity-diversity relationship. This has led to interest the specific factors that influence and limit productivity and tree growth.

The influence of dead material on flammability in common gorse (*Ulex europaeus*)

Dent, Jennifer¹; Buckley, Hannah¹; Curran, Timothy¹

¹Department of Ecology, PO Box 84, Lincoln University, Canterbury, New Zealand.

Fire is an important disturbance in many ecosystems worldwide. A key determinant of local fire behaviour is the flammability of constituent plants. Common Gorse (*Ulex europaeus* Fabaceae) is an invasive weed in many countries and is known to be very flammable due to its characteristic accumulation of dead biomass. The aim of this study was to experimentally quantify the nature of this relationship between dead fuel accumulation and flammability. Shoots of *Ulex europaeus* with varying proportions of dead material were ignited in a purpose-built plant-burner. Samples were assessed in terms of three components of flammability: sustainability (flame

duration), consumability (proportion burnt biomass) and combustibility (maximum temperature). All three components of flammability were shown to increase in relation to the proportion of dead material. While sustainability and consumability had a linear relationship with the proportion of dead material, combustibility was best modelled by a non-linear regression which suggested that maximum temperatures plateaued at 721°C, at approximately 65% dead material. All three flammability components were reduced to a single variable using principle components analysis and the relationship between this and proportion of dead biomass was also shown to be linear. These results have important implications for the control and risk management of gorse populations. They suggest that a trade-off between fire hazard and the effectiveness of control burns.

Jennifer Dent is an Honours student at Lincoln University and is interested in plant physiology and animal behaviour. This research was conducted as part of a research placement course in late 2012.

The effectiveness of reforestation techniques in restoring mammal communities in the Wet Tropics of Australia

Derhé, Mia^{1,2}; Menendez, Rosa¹; Murphy, Helen²; Preece, Noel³

¹ Lancaster Environment Centre, Lancaster University, UK

² Ecosystem Sciences Division, CSIRO, Australia

³ School of Earth & Environmental Sciences, James Cook University, Australia

⁴ Research Institute for the Environment & Livelihoods, Charles Darwin University, Australia

Extensive clearing of tropical forests is a major driver of global biodiversity loss and decline, with many countries now running out of large areas of primary forest due to rapid anthropogenic forest change. Ecological restoration is therefore becoming regarded as a major strategy for increasing the provision of ecosystem services and reversing or mitigating biodiversity losses, particularly in tropical rainforests. Effective restoration programs require an understanding of how ecosystems and communities respond to restoration efforts. This project investigates faunal community and ecosystem function responses to ecological restoration over time, using chronosequence data. The study location is in the Wet Tropics of Australia, which contains the oldest continually surviving tropical rainforest on earth and is one of the world's biodiversity hotspots. However, regrowth and replanted forests now make up around a third of rainforest and wet sclerophyll forest growing on freehold land in the region. In this poster we examine the response of mammal communities on the Atherton Tablelands to forest restoration, and demonstrate that mammal assemblages in reforested sites show convergence with those of mature rainforest sites, with increasing age. Although there have been several studies looking at the success of reforestation practices in restoring biodiversity in the region, there are to date no published studies looking at how mammal communities respond to reforestation over time on the Atherton Tablelands. The implications of these results are discussed in relation to current reforestation techniques in the region, as well as more widely.

Mia Derhé, PhD student. My research looks at reforestation approaches in the Wet Tropics ecoregion, focussing on the responses of soil invertebrate, dung beetle and mammal communities and the important ecological functions that they provide.

Next Generation Biodiversity Assessment

Dickie, Ian¹; Holdaway, Robert J.¹; Wood, Jamie R.¹; Orwin, Kate H.¹

¹ Landcare Research, Lincoln, New Zealand

Biodiversity underpins critical ecosystem services but New Zealand has an information void concerning biodiversity criteria that can be used as indicators of ecosystem function in productive landscapes. To facilitate "green growth", criteria must be developed from reliable, comprehensive data and will require cost-effective monitoring. Current methods for measuring terrestrial biodiversity rely on costly surveys and scarce professional labour and focus on a few species (plants, mammals, birds). Soil biodiversity, critical for nutrient cycling and carbon sequestration, is neglected. We outline a novel biodiversity assessment method that integrates traditional plot-based biodiversity monitoring with state-of-the-art molecular techniques to provide rapid and thorough assessment of biodiversity and ecosystem function in both indigenous and productive landscapes. Our methods use DNA extracted from a single pooled soil sample to assess the diversity of 12 taxonomic groups, including plants, fungi, bacteria, birds, mammals, micro- and macro-invertebrates and other animals. We address the question of how to set environmental criteria using our cost-effective DNA-based metrics of terrestrial biodiversity and ecosystem function. We link these metrics to ecosystem function (carbon storage, nutrient cycling, and soil resilience to disturbance) within a model catchment. The response of these metrics to land use intensification will be used to produce an evidence-based minimal set of measures to set biodiversity criteria. We will also identify the least amount of biodiversity information needed to effectively determine change in the criteria. We envisage that our rapid, cost-effective techniques and quantitative criteria will be incorporated into existing monitoring by the productive sector, Regional Councils, and the Department of Conservation, bringing a step change in the efficiency and completeness of biodiversity assessment, and providing the evidence base needed for policy to support 'green growth' within environmental limits.

Ian Dickie is a ecosystem ecologist at Landcare Research working on the interaction of above and belowground biodiversity in ecosystem services and biodiversity across gradients of plant invasion and land-use intensification.

Tri-trophic interactions in a warmer world with elevated CO₂: results from an above/belowground case study

Facey, Sarah¹; Ellsworth, David¹; Staley, Joanna²; Wright, Denis³; Johnson, Scott¹

¹The Hawkesbury Institute for the Environment, University of Western Sydney (UWS)

²The Centre for Ecology & Hydrology, UK

³Imperial College London, UK

Linkages between above- and belowground systems are increasingly acknowledged as drivers of ecosystem processes. Little, however, is known about how climate change will affect these. Moreover, few climate change studies examine more than two trophic levels in addition to multiple abiotic factors. This experiment used the well-studied *Brassica-Plutella xylostella* system to address these issues. We determined the effects of increased temperature and atmospheric CO₂ on the development of *P. xylostella* caterpillars reared on plants, with and without belowground herbivores (scarab larvae). Plants were grown under elevated and ambient CO₂ (640ppm/400ppm) and temperature (30°C/26°C) in a fully factorial design. Larval performance (development times, pupal weights, plant material consumed), plant growth, photosynthetic rates and above-/belowground biomass were quantified. Specific leaf weight, C, N and glucosinolate content were also determined. Caterpillars reared under elevated temperature had faster development rates compared with those reared under ambient conditions, even when plant quality was reduced as a result of elevated CO₂. Belowground herbivores had no measurable effect on aboveground herbivore performance, despite differences in foliar traits caused by root herbivory. The results of this study suggest that *P. xylostella* will be able to compensate for altered plant nutritional quality under future climate scenarios and this could have associated pest control implications.

Sarah Facey is a PhD candidate at UWS researching the effects of climatic change on tri-trophic interactions. Previously, Sarah has worked in the UK on projects looking at the effects of climate change on insect phenology and crop pollination.

PLANTS IN SPACE! Functional traits meet biogeography.

Gallagher, Rachael V.¹; Wright, Ian¹

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Biogeography is the study of where species live and why – their distribution across geographic space and through geological time. Over the past century, thousands of biologists have used biogeography to address fundamental questions about life on Earth (e.g. *why do more species live in the tropics than the poles? How does species diversity differ between continents, and why?*). However, amid questions comparing diversity and richness at the *species* level, biogeographers have rarely considered functional traits. These are the physical, chemical and even molecular-level characteristics which determine how organisms ‘make a living’ - how they grow, compete for resources and reproduce. This omission is seriously problematic because it is the functions organisms perform – determined by their traits, not their taxonomic identity – which gives us vital information about how ecosystems work. Functional traits have rapidly become the new, empirical currency of plant ecology. The last decade has seen a meteoric rise in the application of functional trait approaches in ecology and an exponential increase in the availability of plant trait data. However, we still lack an integration of the disciplines of functional trait ecology and biogeography; one which provides a comprehensive understanding of how traits vary across landscapes at continental scales, and why. We address this challenge by combining trait data for the Australian flora with information on their distribution from Australia’s Virtual Herbarium. By mapping the distribution of plants, grid cell by grid cell, together with information on their functional traits this research delivers a ‘functional biogeographic’ understanding of the Australian flora.

Rachael Gallagher is a Macquarie University Research Fellow who spends most of her time thinking about plant functional traits and strategies, and how to use spatial analysis to depict ecological patterns in nature.

Variable trap morphology in the carnivorous plant genus *Utricularia*

Gardiner, Corin¹; Gaskett, Anne¹; Adamec, Lubomir²

¹University of Auckland

²Institute of Botany AS CR

Utricularia is a carnivorous plant genus whose members occupy water-logged terrestrial, epiphytic and fresh water aquatic habitats. The terrestrial habit is basal with derived aquatic clades having multiple, independent origins. All *Utricularia* spp., regardless of lifestyle, catch prey with complex suction traps whose external surfaces are adorned with trichomes (bristles) and more developed protuberances called ‘appendages’. Appendages among one wholly aquatic section, section *Utricularia*, are morphologically conserved, taking the form of two dorsal, branched, antennae-like structures and are supplemented by lateral and dorsal bristles. The removal of these appendages results in reduced rates of prey capture. Coupled with observations of some prey taxa feeding behaviour, this indicates these structures have evolved as lures to enhance the probability of a prey encounter by exploiting the innate feeding preferences of phytophilous prey. Species from section *Utricularia* vary their investment in carnivory (proportion of biomass allocated to traps or carnivorous shoots in the case of shoot dimorphism) depending on environmental factors, including light intensity, nutrient levels and prey availability. I predict this variable investment in carnivory will extend to the expression of appendages due to their function in prey capture. I will cultivate *Utricularia gibba* (Section *Utricularia*) under a range of contrasting environmental conditions, quantifying appendage expression as a proportion of total trap dry biomass and make comparisons between treatments. I will also conduct classical morphometric analysis on a variety of trap characters for comparison with previous studies on trapping investment.

Corin Gardiner is in the 2nd year of his Ecology & Evolution PhD candidacy at Auckland University. He has an academic background in classical studies, criminology, mathematics and conservation biology. His interests include sculptural installation, film theory and sharks.

Monitoring the cumulative effect of small scale vegetation change in the Waitakere Ranges, Auckland

Goldwater Nick²; Bishop Craig¹; Landers Todd¹

¹Research Investigations and Monitoring Unit (RIMU), Auckland Council

²Wildland Consultants, Auckland

Worldwide, one of the primary drivers of species and ecosystem extinctions is habitat loss. The cumulative effect of numerous small scale vegetation clearances (i.e. 'death by 1000 cuts') on the ecological values of a specific district or landscape, and the inability of the Resource Management to manage and account for these clearances, is a commonly cited environmental 'problem' in New Zealand. This problem is regarded as being particularly important in peri-urban or city fringe landscapes where development pressures are usually more severe and land tenure is highly fragmented. This paper presents data on vegetation change within the Waitakere Ranges Heritage Area from 2001 – 2012. Rates of habitat clearance were measured using two methodologies: (1) desktop analysis of changes in aerial photographs followed by field checks, and (2) change between LCDB2 and LCDB3. Aerial photo analysis detected a loss rate of 0.03% of all indigenous habitats per year, (or 1.5% reduction of indigenous ecosystems over 50 years). This rate was almost 10x the annual rate of loss detected using LCDB2 vs.LCDB3 comparisons for the same area (c. 0.003%/ per annum). However, irrespective of which method is used to measure change, the overall impact of current vegetation clearance rates on biodiversity values within the Waitakere Heritage Area is likely to be relatively small, provided the cleared habitats do not include significant or uncommon ecosystems or habitat for threatened species.

Nick Goldwater is an ecologist at Wildland Consultants. He has worked with Auckland Council on a range of projects involving biodiversity monitoring and data collection. Nick is a co-author on the Waitakere Ranges Heritage Area state of the environment report.

Manage the Damage - practical goat impact assessment for South Australia's Arid Ranges.

Haby, Nerissa¹; Brandle, Robert¹

¹Natural Resources, SA Arid Lands, Department for Environment, Water and Natural Resources

Goats present a major threat to palatable perennials in South Australia's arid ranges. Traditional plot based methods for assessing impacts and monitoring response post goat control are impractical for monitoring impacts at landscape scales, primarily because of the resources required to adequately sample affected perennial species with sparse, patchy distributions and erratic episodic recruitment. These problems can be overcome by focussing on species preferentially grazed by goats, the effect of browse intensity on their development (growth form) and their population age structure within sample areas. By focusing on species and sampling target numbers, the sample area in any location is determined by species density and avoids the common issues of high species variation, low numbers of palatable species and need for large numbers of sites to gain interpretable datasets. Using browse concepts developed by Keighley (1997) and adapted for semi-arid conditions by McDonald and Brandle (2009), a browse intensity assessment method has been developed to provide timely feedback to managers on the effectiveness of current goat control activities at landscape scales. The data contributes to a current browse index for each site which averages the intensity of browse across the samples area. Identified management triggers are an important aspect of the assessment procedure and will be used to indicate where current control activities are effective and where they need to be intensified.

As the Senior Ecologist for South Australian Arid Lands NRM region, a key role is to develop methods and tools that inform managers about their effectiveness and enable the region to report on the state of its natural resources.

Powelliphanta land snails: an assessment of the current monitoring technique

Hamilton, Mark^{1,2}

¹Lincoln University

²MBC Contracting Ltd

There are currently no proven techniques for monitoring populations of land snails in the genus *Powelliphanta*. The Department of Conservation has developed a method for establishing an index of abundance. Although this method is routinely used, its reliability remains unclear. Many *Powelliphanta* species and sub-species are currently listed as threatened. Improving estimates of population trends and assessing the effectiveness of conservation management is therefore critical. The main aim of this research is to improve the techniques used for assessing and monitoring populations of these animals. The study is split in to three main parts: an assessment of the current monitoring technique, a description of a newly developed mark-recapture technique, and an analysis of the ancillary data that can be collected when utilising a mark-recapture method, which may provide vital information to conservation managers. This poster presentation relates to part one of the study: an assessment of the current monitoring technique.

Mark Hamilton, postgraduate student at Lincoln University and General Manager at MBC. Main area of interest is the management of flora & fauna, particularly in the mining sector. Particular interests include the management of Powelliphanta land snails, with specific reference to survey and monitoring techniques and translocations.

Investigating the effects of elevated temperature on carbon, nitrogen and phosphorus cycling in soils under *Eucalyptus tereticornis* growing in whole-tree chambers

Hasegawa, Shun^{1,2}; Power, Sally²; Macdonald, Catriona²

¹Department of Life Sciences, Imperial College London

²Hawkesbury Institute for the Environment, University of Western Sydney

Despite the geographic and economic importance of native Australian *Eucalyptus* woodland, relatively little is known about their responses to predicted global warming. Elevated temperature (eTemp) may stimulate plant growth and increase soil microbial activity, both of which can potentially change the availability of soil nutrients and rates of nutrient cycling. My PhD study investigated the effects of eTemp on soil N and P availability, pool size, turnover rates and leaching losses in soils planted with *Eucalyptus tereticornis* seedlings in whole-tree chambers (WTC). Six ambient and six eTemp (ambient + 3 °C) WTCs ($\phi = 3.25$ m, $h =$ c.a. 9 m) were installed in Western Sydney, Australia. Temperature treatments started in December 2012, and *Eucalyptus* seedlings were planted in to the chambers in February 2013. In the first two months of the experiment without plants there were no significant effects of eTemp on soil nutrient cycling. Substantial within-chamber variation in nutrient concentrations was apparent, particularly in the rooting zone (10-15 cm). Results from the first nine months of temperature treatments will be presented in this poster.

Shun Hasegawa. PhD Life Sciences Research, Division of Ecology and Evolution, Department of Life Sciences, Faculty of Natural Sciences, Imperial College London. Area of research interest includes forest ecology, biogeochemistry, soil chemistry, nutrient cycling.

Beech and *Pinus contorta* seedling establishment following wilding pine control

Howell, Clayson J.¹; McAlpine, Kate G.¹

¹Department of Conservation, Science and Capability

Pinus contorta (lodgepole pine) is an invasive species of major concern in New Zealand. We investigated the consequences of felling and poisoning closed canopy stands on subsequent seedling regeneration. 192 seedling plots were established in felled, poisoned and untreated stands in the Kaweka Forest Park. A seed mix containing lodgepole pine, mountain beech (*Nothofagus solandri* var. *cliffortioides*) and red beech (*N. fusca*) was added to half of the plots. Wire cages were also added to half of the plots to exclude seed and seedling predators such as rats, possums, and deer. One year after treatments were applied, felled sites showed much greater establishment of lodgepole pine seedlings while poisoned sites strongly favoured beech. Addition of seed to plots made no significant difference for lodgepole pine but was required for beech establishment. Excluding predators increased the number of lodgepole pine seedlings in most plots. Beech seedling recruitment was highest where beech seed had been added and predators excluded. Felled lodgepole pine stands are likely to require greater levels of follow-up control than stands that are poisoned. The moderate light levels measured under poisoned stands appear to be more favourable for beech establishment than untreated or felled stands. Needle loss from poisoned trees is incomplete after only one year; we expect light levels to increase in subsequent years. Early seedling establishment data are promising enough to contemplate broader seeding of beech under poisoned wilding conifer stands.

Clayson Howell is a science advisor in the threats team within Science and Capability at the Department of Conservation. This work is part of research programme into the ecology of wilding conifers and their management for positive outcomes.

Climate change mediation of predator-prey interactions

Hunt, Sophia K.¹; Wootton, Katherine L.¹; McIntosh, Angus R.¹

¹University of Canterbury

Global environmental change drivers such as climate warming and biotic invasions are altering natural ecosystems at increasing rates and can interact, generating unexpected outcomes for biological communities. Higher water temperatures and greater potential to dry are predicted for freshwater habitats, and these altered conditions will likely mediate interactions between predators and prey, especially the effect of any invader on communities. Warmer temperatures and drier habitats will likely affect short term predator-prey interactions by increasing metabolism, activity levels and prey densities (due to decreased habitat size). To evaluate the potential for such interactions we ran two pond microcosm experiments. Firstly we tested the influence of water temperature on dragonfly predation on chironomids, and secondly, how prey density affected predation by damselflies on mosquitoes. Higher water temperatures resulted in a linear increase in prey consumption, caused by increased predator movement. There was a non-linear increase in prey consumption associated with a prey density threshold. This work suggests that drying will affect the impact of an invader on local communities due to altered predation rates associated with greater consumption rates in warmer habitats, but depending on critical thresholds. Greater consumption of invasive mosquitoes by predators may result in smaller invasive populations in the short term, but long term responses will depend on both population and evolutionary responses over time. We are now examining how aquatic warming and habitat drying will affect predator-prey interactions influencing mosquito populations, and comparing short and long-term responses by using both experimental and modelling approaches.

Sophia K Hunt is a Masters student at the University of Canterbury examining how interacting global change drivers impact communities.

Plant traits and their role in determining forest community structure along a soil fertility gradient

Jager, Melissa¹; Laughlin, Daniel¹

¹University of Waikato

Two dominant processes have been proposed to influence community assembly along environmental gradients. Environmental filtering increases functional similarity of species within a community resulting in trait convergence, whereas limiting similarity assumes that competitive exclusion of functionally similar species will lead to the coexistence of functionally dissimilar species leading to trait divergence. We sought to determine the relative importance of each of these antagonistic processes in the context of a species-rich old-growth kauri forest. We surveyed intra and interspecific variation in leaf, wood and whole-plant functional traits of 31 tree species (across 765 individuals) along a soil fertility gradient in Puketi Forest, Northland. Mature leaves were collected using telescopic pole pruners, a shotgun and a slingshot. Wood samples were collected using increment borers. We quantified SLA, LDMC, leaf thickness, leaf nitrogen and phosphorus concentrations, nutrient resorption efficiency, wood density, bark thickness, height, and diameter on each tree. Forest overstorey community composition was determined using forty permanent, 400 m² plots that spanned the full gradient in soil properties and topographic variation. At each permanent plot, we obtained data on soil pH, soil total nitrogen and phosphorus, cation exchange capacity, and several other important chemical soil properties. Preliminary regression analysis indicates that SLA, leaf nitrogen and leaf phosphorus are positively correlated with pH, topographic index and total soil phosphorus, and wood density is negatively correlated with these environmental variables ($p < 0.05$). Large variation within the data indicates that there is important niche differentiation among species within each site.

Melissa Jager has a BSc in Biological Sciences from the University of Waikato. She is now in her final year of a Master of Science program at Waikato where she is pursuing her interest in plant ecology.

The agony of choice, selection and performance of ecosystem attributes for biodiversity offset models

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World-wide, ecologists are being challenged in choosing the most appropriate ecosystem attributes for use in biodiversity offset models. Attributes ought to represent the key biodiversity features at a given site, be quantifiable, easy to measure, reliable and sensitive to management actions. Attributes are important for calculating the offset model, for monitoring progress in implementing the offset, and for reporting back to stakeholders and consent authorities on the results of this implementation. But, biodiversity is complex and not easy to describe or measure, especially in the context of offsetting. Determining which attributes are the most appropriate for this task is currently compromised by the lack of a theoretical framework and as a result most offset projects have made their own decisions on attribute selection. In this paper, a conceptual framework for attribute selection focusing on forest ecosystems is presented. Attributes commonly applied in forest biodiversity assessment have been investigated and a set of attributes which appear to be most suitable for application in biodiversity offsets has been identified. Using this framework, I test the performance of selected attributes at two New Zealand case study sites. Both represent different restoration techniques commonly applied in biodiversity offsets. The overall aim of this research is to help develop a robust and sustainable system for biodiversity offsetting in New Zealand.

Constanze is a forest scientist from Germany currently undertaking her PhD at the University of Canterbury in New Zealand. Her research interest focuses on forest ecology and restoration of degraded forest ecosystems.

Long-term trends in distribution of invasive plants along the road network in the Andrews Forest, western Oregon, USA

Kim, Kee Dae¹

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Roads provide corridors for plant dispersal and establishment, thus aiding exotic plants in overcoming barriers to expansion. Roads can act as the initial point of entry into a landscape for exotic plants. Studying patterns of distribution over many years can give a broader perspective of change at the landscape level. This study aims to examine how the distribution of invasive plants has changed along roads over time (from 1994 through 2005 to 2013), and to explain the environmental factors that might have influenced increases or decreases in abundance of these species. The study site, the Andrews Forest is situated in the western Cascade Range of Oregon, and covers the entire drainage basin of Lookout Creek. Road survey of the presence/absence of 11 target species and relative abundance of 4 target species were conducted on 104 km of roads in the Andrews Forest and an additional 50 km of roads in the surrounding area. The presence/absence of 11 exotic plants was noted along each 0.16 km segment of the road survey in 2013. Data from the 1994, 2005, and 2013 road inventories were used to evaluate the change in exotic plant distributions over time. Spatial analysis of the distribution patterns of exotic plants was conducted of the HJ Andrews and Deer Creek areas using ArcGIS. This study showed that exotic species distributions have changed over time through the process of dispersal along road corridors associated with traffic and other factors promoting spread (wind, water movement and change in light associated with canopy closure).

Kee Dae Kim, presenting author is associate professor of Korea National University of Education, Republic of Korea. He is teaching candidate teachers on ecological education. He is interested in biological invasion focused on exotic invasive plants.

How does hydrological regime structure riparian plant communities? A functional trait approach.

Lawson, James¹; Leishman, Michelle¹

¹Macquarie University

The structure and composition of riparian plant communities result from abiotic and biotic processes operating within a dynamic geomorphic template, with one of the main abiotic drivers thought to be hydrological regime. Surprisingly little is known about the strategies that riparian plants use to cope with or take advantage of hydrological conditions. These strategies can be investigated by looking at functional traits: the phenotypic manifestations of an organism's response to its environment.

In this study I use a functional trait approach to examine key axes of variation in trait composition between riparian vegetation communities that are exposed to different hydrological regimes. Five sites from each of three flow regime classes (*sensu* Kennard et al. 2010) were selected along gauged rivers in eastern NSW. These sites were chosen for their intact native vegetation and geomorphic condition, and minimal anthropogenic catchment modification. Structural characteristics of riparian vegetation communities were measured at each site, and plant species occurring at each site were identified and their abundance visually assessed. Individual plants were sampled to obtain data on specific leaf area and wood density. Additional data on growth form, longevity, seed mass, dispersal mode, rooting habit and reproductive modality were collated from field measurements, online databases, field guides and floras.

Hydrological regimes are predicted to change at a regional-scale under future climates. This study will identify patterns of vegetation structure and trait variation in relation to hydrological regime that can be used to directly inform predictions of riparian vegetation change in response to climate change.

James Lawson is a PhD student at Macquarie University. He is interested in the complex interplay between vegetation, fluvial geomorphology, and accelerating environmental change. His research investigates how riparian vegetation communities might respond to changing hydrological conditions under future climates.

Variation in physical dormancy temperature thresholds at the intra-population level

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Differences in levels of physical dormancy (the dormant vs non-dormant fraction) are often found between individuals within populations. However, difference in response to dormancy-breaking treatments has rarely been tested. In fire-prone ecosystems, it is more relevant to understand variation in response to temperatures required to break dormancy because heat from the passage of fire determines the proportion of seeds germinating and initial dormancy levels are uniformly very high. In this study, we focused on the intra-population variation of dormancy thresholds of four physically dormant Fabaceae species from fire prone south eastern Australia. Seeds were collected from between four and seven individual plants of *Dillwynia floribunda*, *Viminaria juncea*, *Bossiaea heterophylla* and *Aotus ericoides*. Three replicates of seeds from each individual were treated for 10 minutes at 60°C and 80°C. After treatment, seeds were incubated for six weeks at 25°C/ 18°C along with untreated seed samples from each individual as a control, and germination recorded. Seed weight, viability, the proportion of viable seeds germinating and T_{50} were compared between individuals. Response to heat treatments varied significantly between individual plants. Extreme differences were found for *V. juncea* at 60°C with two individuals showing >80% germination and three <10%. In contrast, individuals of *B. heterophylla* displayed quite similar responses. Variation in dormancy thresholds between individual plants may provide a mechanism for population persistence in fire prone ecosystems because of the inherent variability of the fire regime. This heterogeneity could result from genetic or environmental factors however further studies are required to clarify this.

Ganesha Liyanage is a PhD candidate at the University of Wollongong. Her main research interests are seed ecology and ecophysiology. Her PhD research is focused on physical dormancy variation in native Australian plant species.

Individual based modelling of a predator's hawk-dove strategy in a closed bottle (in prep)

Malishev, Matthew¹; Kooi, Bob²; Kooijman, Sebastiaan²

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²Faculty of Biology, Vrije Universiteit, De Boelelaan 1087, 1081 HV Amsterdam, The Netherlands

We study the propagation of aggressive behaviour in a population of consumers feeding on producers. Besides direct consumption of the producers, consumer individuals also fight for captured producers. Fighting of two individuals is modelled with rules that mimic classical game theory. The products produced in all metabolic processes, assimilation, maintenance, growth, and fighting are recycled instantaneously. This food chain exists in a closed environment and thus yields full mass conservation. We use the framework of the Dynamic Energy Budget theory (Kooijman 2010) to explicitly consider costs and gains of increased feeding rates. We use the model for the producer and consumer populations as described and analysed in Kooijman et al. (2004) and Kooijman et al. (2007).

A stochastic model will be used to formulate an individual based model (IBM) in the IBM platform Netlogo. The IBM, where the consumer population consists of a finite number of individuals, aims to replicate results from population-based analysis using a bottom-up approach.

Matthew Malishev is a Ph.D. student. I use individual based modelling and energy budgets to model individual foraging strategies in space and time. The mechanisms driving movement on fine time scales using energetics hold answers to complex questions of species distribution and predator-prey interactions.

Density and assemblage influences on the species richness-productivity relationship in Australian dry sclerophyll forest species

Mallett, Ruth¹; Hovenden, Mark

¹University of Tasmania

At any given site, a more species-rich community is thought to be more productive than a species-poor community, although this understanding comes largely from grasslands. We aimed to determine the nature of the species richness-productivity relationship in a southern-hemisphere sclerophyll forest system given its importance from a basic, theoretical perspective as well as for applied ecology. Using three levels of sowing density and three different species assemblages, the impacts of these variables on productivity, plant density and plant biomass were investigated. In each assemblage a different dominant tree species from local forest was grown as a monoculture and included in every subsequent level of species richness. Communities were grown in a glasshouse pot experiment for four months, harvested and above-ground biomass measured. We found no general species richness-productivity relationship in the early-stage communities studied. There were no overall increases in productivity as species richness increased; in most cases the productivity of communities with 4 and 8 species was lower than monocultures of the dominants. 15 species mixtures were equal to or exceeded the biomass of monocultures, primarily due to the addition of another highly productive species. Density influenced the way richness affected productivity and this effect was dependent upon assemblage, indicating species identity is a key determinant of productivity. These results demonstrate important ecological principles in a novel system, regarding the impact a factor such as density has on the species richness-productivity relationship, suggesting the generally believed relationship between richness and productivity may not exist universally in terrestrial plant ecosystems.

Ruth Mallett is in her first year as a research assistant in the school of Plant Science at the University of Tasmania. Research interests include community ecological processes and the importance of biodiversity in the context of changing climates.

Investigating invasion potential of blackberries in native vegetation in Australia using species distribution modelling (SDM) techniques

Marshall, John¹; Whalen, Molly A.¹; Mackay, Duncan A.¹

¹School of Biological Sciences, Flinders University, Bedford Park, South Australia.

In Australia, European blackberry (*Rubus fruticosus* L. aggregate), is a Weed of National Significance (WONS). This study focuses on the invasion biology and ecology of individual species in this aggregate using field data, GIS, and species distribution modelling methods. It provides valuable information for the management of individual species in the aggregate.

Field surveys suggest five species in particular are likely to invade native vegetation in the Mt. Lofty Ranges (MLR) of South Australia. We assess the potential invasive distributions of these five species across Australia, using different combinations of bio-climatic variables using five modelling techniques in the *Dismo* package of R. This modelling work has shown significant variability among the five species with respect to their potential invasive ranges. *Rubus anglocandicans*, for instance, which exists over a broad area of Southern Australia, is likely to expand its range primarily in marginal local areas. In contrast, *Rubus erythrops*, the second most common species in the surveys of native vegetation in the MLR, has a more limited range in Victoria, South Australia and Tasmania but modelling indicated a capacity to expand its range to areas in West Australia and New South Wales where it is currently absent.

Interestingly, *Rubus leucostachys*, which is widespread in Eastern Australia, did not strongly associate with native vegetation in the field surveys above.

John's research for his PhD on invasion ecology and biology of individual species of European blackberry, using field techniques and a variety of species distribution models, increases the understanding of the risk they pose at a species level.

Diffuse mutualism along a geo-environmental gradient of relationship in an Ant-*Acacia* system.

Martinez-Bauer, Angelica Elizabeth¹

¹*School of Biological Sciences, Monash University*

A popular and thoroughly studied case of an interdependent mutualistic relationship is that of the American swollen-thorn *Vachellia* spp (formerly known as *Acacia* spp.) and their ant inhabitants (Janzen, 1966). Whether such interactions exist amongst Australian *Acacia* spp. remains unknown, despite the fact that they represent one of the most abundant and speciose groups of vascular plants on the continent. Ants are remarkably diverse in Australia, widespread, can act as generalist predators, and are frequently seen feeding on *Acacia*'s extrafloral nectaries. We conducted ant- and pollinator-exclusion experiments on *Acacia myrtifolia* at four sites varying in moisture, temperature and fragmentation from western to eastern Victoria, asking 1) whether the presence of ants produces favorable outcomes for the plants across a longitudinal gradient and 2) what is the combined impact of ants, herbivores, pollinators and seed dispersers on the plant's fitness. The exclusion of ants did not enhance herbivory damage or increase fruit set. Ants have significant short temporal-scale effects on diaspore characteristics and seedling survival, and long temporal-scale effects on growth. There is a strong suggestion of a geographical and environmental gradient in ant community composition, seed-dispersing ant assemblages and some of the variables related to plant fitness (bud number, growth, seed weight, and seedling growth). The composition of ant guilds attending *A. myrtifolia* appears to affect the degree of benefit plants derive from this diffuse mutualism. In relating multiple interactions we gain an insight into the evolution of complex net interactions and the result of different trade-off decisions.

Angelica Elizabeth Martinez-Bauer is PhD candidate from the School of Biological Sciences, Monash University. Her areas of research include Evolutionary Ecology, Ecology (interactions) and Pollination.

The provision and flow of ecosystem services in response to land management interventions

Maseyk, Fleur¹; Mackay, Alec; Possingham, Hugh; Buckley, Yvonne

¹*Environmental Decisions Group, University of Queensland; The Catalyst Group, New Zealand*

The concept of ecosystem services has been researched from a wide range of disciplines (e.g. economics, planning, ecology, agricultural science, forestry), and for diverging purposes such as conservation planning, poverty alleviation, resource management, decision making, justification for public spending, and optimisation of production. The literature reflects the growing interest in the importance of recognising ecosystem services within natural resource management decision making. However, the legacy of disparate ideas, terminology, frameworks, and topology within the literature has served to obscure a clear and workable pathway for the mainstreaming of the ecosystem services concept into policy and decision making.

Conceptual frameworks are useful when the components are explicitly defined and relationships between components clearly stated. When components are ill-defined, drivers of change ignored, or linkages blurred, conceptual frameworks add little value to on-the-ground land management practices.

Critical for managing for sustained provision and flow of ecosystem services in agroecosystems is the recognition of natural capital stocks as the component most subject to impact as a result of land management actions. However, commonly referenced ecosystem services classification systems rarely explicitly acknowledge natural capital stocks. This is a major limitation to our ability to incorporate ecosystem services into decision making.

This research illustrates how application of a framework that clearly recognises natural capital stocks and the interactions between land management, ecological processes, and ecosystem services can substantially increase the relevance of the ecosystem services concept for natural resource management and decision makers.

Fleur Maseyk: Practice Leader - Ecology and PhD candidate. My research interest is focussed on the quantification and valuation of changes in ecosystem services in agroecosystems as a result of management intervention and integrating this information into policy and decision making.

Microbial Response to Urbanisation and Earthquake Damage

Moffett, Emma¹; Kevin Simon¹; Jon Harding²

¹*The University of Auckland*

²*University of Canterbury*

Anthropogenic land-use has dramatically increased bioavailable nutrients in streams globally, likely altering the identity and magnitude of limiting nutrients. Microbial organisms play a pivotal role in stream nutrient cycling; therefore, they are important to understand if we are to manage nutrient pollution effectively. The aim of our study was to determine how urbanisation influences microbial nutrient limitation in New Zealand streams. Nutrient limitation was assessed in Auckland and Christchurch over Spring and Summer using three commonly used methodologies: 1) organic and inorganic biofilm response to nutrient addition, 2) sediment extracellular enzyme activity (EEA), and 3) inorganic water chemistry ratios. Nutrient limitation demonstrated a clear switch from N (nitrogen) to P (phosphorus) limited at 30% urbanisation. Limitation also roughly aligned with the Redfield ratio with breakpoints evident. Christchurch provided a unique opportunity address earthquake disturbance in an urban system, we found microbial nutrient suppression and low DIN:SRP molar ratios common in

impacted streams. In urban streams limitation predicted by sediment EEA suggested a predominance of N-limitation and did not align with limitation inferred from water chemistry which frequently suggested P-limitation; however enzyme activity did vary with catchment urbanisation suggesting this could be a promising bio-assessment tool. Differences in nutrient limitation between stream compartments indicate that microbes are reliant on the water column N and P to different degrees owing to variations in their access to resources. Our results demonstrate that urbanisation and earthquake damage have had a noticeable effect on nutrient limitation which is evident across the various methodologies.

Emma Moffett, Masters student, Freshwater ecology.

Restoring the Headlands - Black Beech Re-establishment Trial in Abel Tasman National Park (Project Janszoon)

Moore, Simon¹

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Project Janszoon is a collaborative initiative between a privately funded trust and the Department of Conservation. It is committed to ecological restoration in Abel Tasman National Park over a period of 30 years. One element of the project involves the establishment of black beech 'nuclei' on Adele Island and, if successful, on the mainland in parts of the park which have been burned in the past and have lost their beech component.

The two key objectives for re-establishing beech nuclei are:

1. To promote the regeneration of beech forest ecosystems in parts of the park where natural recruitment from existing beech margins would take decades, if not centuries. This would provide habitat for wildlife which is currently restricted in these areas because of the paucity of floristic diversity;
2. To assist in shading out, in the long term, invasive weeds which occupy the dry, depauperate coastal headlands, ridges and shoulder slopes and which are impractical to remove either mechanically or by poisoning (e.g. needle-leaved hakea, willow-leaved hakea, gorse).

Adele Island is an ideal place to trial the techniques around beech establishment to achieve these objectives. It contains burned ridges and shoulder slopes similar to those on the mainland, it is free of the confounding effects of herbivores, and it is visited by DOC biodiversity staff regularly so that there are logistical advantages around gathering results. The planting trial would have the added advantage of boosting beech forest restoration on Adele Island.

Simon Moore is a Technical Advisor specialising in plant ecology with the Department of Conservation, based in Nelson, New Zealand. He works mainly in the fields of indigenous plant restoration, inventory and monitoring, and ecological assessments.

Varying effects of fire exclusion on grassland composition along a soil texture gradient

Moxham, Claire¹ & Dorrough, Josh²

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Fire is a major driver of grassy ecosystems throughout the world. Excluding fire from savannah grasslands and woodlands is predicted to have the greatest effects on vegetation composition when primary productivity is high. In these circumstances shading and competitive exclusion by dominant grass species constrain small inter-tussock plants. To test this prediction, we examined the effects of ten years of fire exclusion in paired sites along a soil texture and productivity gradient in south-eastern Australia (Gippsland Plain, Victoria).

The cessation of frequent burning had significant effects on vegetation composition, but effects on major ground cover attributes (the perennial tussock grass *Themeda triandra*, bare ground and cryptogamic crust) varied with soil texture. Although there was strong evidence that the soil texture gradient is associated with changes in tree cover, species composition and species richness, for most variables there was not strong support that the effects of fire exclusion varied across the landscape. Few native plant species appear to be favoured by an absence of fire, and significant declines in some native species were observed. While total native plant cover only declined in response to fire exclusion on the more productive finely textured sites, this did not correspond with similar variation in species richness or diversity which declined regardless of soil texture. The results suggest that maintaining frequent burning, regardless of soil texture, is important for conserving the native plant communities in these remnant grassy ecosystems.

Claire Moxham is a Senior Scientist at the Arthur Rylah Institute for Environmental Research. Her research interests include grasslands and grassy woodlands, fire, grazing, semi-arid ecosystems and landscape ecology.

Interactive effects of habitat loss and rainfall decline on insect species networks

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Terrestrial ecosystems are threatened by multiple drivers of global change, including habitat loss, nutrient enrichment, invasive species, and climate change. Acting together, multiple drivers can have unanticipated effects on ecosystems, which may be more important than single-driver impacts. Greater knowledge of such 'higher order' effects on biodiversity, ecological networks, and ecosystem function is needed. This study helps to address this knowledge gap by investigating the impacts of two major drivers on insect communities. Specifically, the interactive effects of habitat loss and declining rainfall on Hymenoptera in fragmented woodlands of the WA Wheatbelt are being examined. Insect sampling is taking place in 48 Eucalypt woodlands spatially distributed across landscapes of varying vegetation cover and rainfall change. Pollinator diversity is being assessed using coloured UV-reflective vane traps, and species networks constructed using data on cavity-nesting bees and wasps from wooden trap nests. To date, vane trap sampling has yielded many thousands of specimens, and trap nests have successfully reared at least 20 taxa (bees, wasps, parasitoids). Taxonomic identification will be achieved using both morphological and molecular approaches, and trophic interactions established for host-parasitoid, predator-prey, and plant-pollinator networks. Biodiversity and network structure will then be compared across woodlands. Predictions include that diversity may be lower and networks more 'simplified' in woodlands with higher landscape habitat loss, and that these effects may be exacerbated in areas with recent rainfall declines. This work will generate much-needed data on the ecological impacts of global change, and should inform future ecosystem management in a rapidly changing world.

Mark Murphy MSc, PhD Candidate, School of Animal Biology, University of Western Australia. Research interests include Hymenoptera, predators and parasitoids, food-web ecology, ecological networks, insect-plant interactions, woodlands and forests, vegetation assessment and mapping, global change, landscape ecology, and restoration ecology.

Detection probabilities for improved ship rat management

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²Department of Statistics, University of Auckland

³Landcare Research, Lincoln

The ability to detect pest animals is fundamental to conservation practice. Detection methodologies are used to monitor changes in population indices, estimate occupancy, determine probability of eradication success and detect incursions on pest-free areas. The results may influence important decisions, such as whether to modify existing pest control strategies or whether deployment of contingency responses to a new invasion is necessary. Yet, factors affecting the probability of successful detection are poorly understood. Effective detection requires animals not only to encounter detection devices, but also to interact with them. Factors influencing encounter rates may include pest density and device spacing, whereas rates of interaction may be more influenced by the attractiveness of baits and lures or an animal's previous experiences. Our research investigates the partitioning of P_d (probability of detection) into its constituent components of P_e (encounter) and P_i (interaction) using the ship rat (*Rattus rattus*) as a model species. We aim to determine factors influencing these probabilities and methods of manipulating these to maximise rat detection. Models predicting optimum choice and landscape distribution of devices will be generated using a simulation study. The models will be informed by data from a field study using marked rats, motion detector cameras and radio-frequency identification (RFID) loggers to determine rates of interaction with devices given an encounter. An optimum control model will be chosen and tested for validity at an alternative field site to determine the general utility of the model for informing rat control programmes across New Zealand.

Helen Nathan is a PhD student at the University of Auckland. Her research interests are the behaviour and management of invasive species, particularly rodents.

Moving house: examining how Southern hairy-nosed Wombats (*Lasiorhinus latifrons*) respond to translocation.

O'Brien, Casey¹; Sparrow, Elisa²; Taggart, David¹

¹University of Adelaide

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In South Australia (SA), the distribution and abundance of Southern hairy-nosed wombats (SHW) varies greatly. Some populations are highly fragmented and threatened (e.g. Yorke Peninsula), whereas others are overabundant (e.g. Far West). To ensure the long term survival of this species, an integrated management approach is required, taking into account the needs of both overabundant and threatened populations. Translocation has been suggested as one potential management tool. Translocation of animals between populations has the potential to enhance genetic diversity. However, the influence of translocation on the survival and behaviour of SHW's is currently unknown. We aim to address this knowledge gap, by determining how translocation affects the survival, health and ranging behaviour of SHW's. To do this we are comparing results from SHW's translocated to a release site near Swan Reach, South Australia with a control group resident to the release site. All wombats used in the study are given a health check upon capture and fitted with either a GPS, or VHF collar. Animals have been tracked regularly since the commencement of the study, and opportunistically caught to assess their condition. Preliminary results have shown that following an initial establishment period, translocated animals

do not move far from their release site. Additionally no significant differences have been observed between translocated and control wombats for the number of warrens used, or the distances travelled between them. These preliminary findings suggest that translocation may be a viable management option to aid in the conservation of the Southern hairy-nosed wombat.

Casey O'Brien, PhD student, University of Adelaide - My primary research interests are reintroduction & translocation biology, human-wildlife conflict and species conservation and management.

Nitrogen deposition reduces biological soil crust and shrub abundance in a semiarid shrubland in Spain

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Biological soil crusts, of enormous importance for the structure and correct functioning of arid and semiarid ecosystems, are regarded as very sensitive to the ongoing global environmental change. One of this global change factors is nitrogen (N) deposition which, along with an increasing demand for fossil fuels and food, has significantly peaked in the last few decades. This study focused on the effects of increased N deposition on biological soil crust (including cyanobacteria, mosses and lichens) and shrub abundance and cover in a semiarid Mediterranean shrubland in central Spain after 5 years of N application. 6 experimental blocks with 4 plots each (corresponding to 0, 10, 20 or 50 kg N ha⁻¹ yr⁻¹) were selected within the shrubland. Lichen and shrub cover decreased up to 50% and 40%, respectively, with N fertilization after 5 years of study. However, these changes were only statistically evident when evaluated from a temporal perspective. Cyanobacteria abundance and soil pigment concentration, which were only measured once after 5 years, were more related to soil physicochemical characteristics. However, given the close relationship between cyanobacteria abundance and soil parameters (mainly pH and certain micronutrients), we hypothesised indirect effects of N deposition on this group via N-driven soil chemistry alterations, which was ultimately confirmed by both covariance and multivariate analyses. Finally, in this study we have shown the high sensitivity of key elements of semiarid Mediterranean shrublands to N deposition and suggest the importance of evaluating and monitoring changes from a temporal and multivariate perspective.

Raul Ochoa-Hueso. Research Fellow in Global Change Ecology at Hawkesbury Institute for the Environment. My research centres on the consequences of climate change on ecosystem processes related to the main nutrient cycles and how these impacts determine changes at the plant community level.

What does 20 years of monitoring reveal about the distribution and abundance of *Astelia australiana*?

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¹Department of Forest and Ecosystem Science, University of Melbourne

²Department of Environment and Primary Industries, State Government of Victoria

Astelia australiana, Tall *Astelia* (J.H. Willis) L.B. Moore is an endemic perennial typically associated with Cool Temperate Rainforest in the Central Highlands and Otway Ranges of Victoria. *Astelia australiana* was formerly more widespread but has undergone significant decline in its distribution and abundance leading to it being classified as Threatened under the *Flora and Fauna Guarantee Act 1988* and Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*. A monitoring program for *Astelia australiana* across its 15 known populations was established in 1993 and reassessed in 1995, 1998, 2008, and 2013. We quantified the spatial and temporal changes in abundance and distribution of *Astelia australiana* and found that majority of populations are in decline, including some populations that no longer exist, although there has been an increase in abundance of some populations. Investigation into possible casual factors of this decline including drought, fire, browsing and infection by *Phytophthora cinnamomi* is on-going.

Linda Parker is a PhD student at the University of Melbourne. Her research aims to explore changes in the distribution and abundance of *A. australiana* and to address knowledge gaps surrounding the ecology of the species.

Getting on the same page: what is a woodland bird?

Pearson, Hannah¹; Garrard, Georgia²; Rumpff, Libby¹; Hauser, Cindy¹; McCarthy, Michael¹

¹University of Melbourne

²RMIT University

We live in an age of pressing ecological problems; associated with habitat destruction, introduced species and climate change. The multitude of studies investigating these problems increase our ability to deal with them, but only if each study builds on those before it.

Consistent definitions, measures and methods are needed to make different studies comparable so that they most effectively add to the accumulation of knowledge. Inconsistency in these areas slows progress towards solving the important problems. In Australia, many studies have been conducted investigating the decline in woodland birds. Unfortunately researchers have not agreed upon which bird species to consider as woodland-dependent. Different suites of species are regarded as woodland birds in different papers and, as a result, it is difficult to justify drawing conclusions from multiple studies.

A systematic review of the literature provided a comprehensive collection of studies classifying lists of species as woodland birds. Analysis of these lists revealed substantial disagreement regarding which birds to include in this classification. The reasons for the high level of uncertainty about woodland bird classification were explored through expert elicitation. The consequences of inconsistently classifying woodland birds are examined in the context of habitat fragmentation impacts, emphasising the importance of researchers getting on the same page.

Hannah Pearson is a PhD candidate, studying in the quantitative and applied ecology lab at the University of Melbourne. She is interested in understanding and resolving uncertainties regarding managing ecological systems.

Molecular ecology of New Zealand lichens in the genera *Usnea* and *Ramalina*

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Lichen symbiosis is a complex ecological interaction based on a mutualistic relationship between a fungal and algal partner. In order to understand the factors affecting the geographical distribution of lichen partners, specimens of two genera of lichens, *Usnea* and *Ramalina*, were collected from a number of sites across New Zealand. DNA sequences were obtained from the nuclear internal transcribed spacer (ITS) of the fungal and algal partners and used to construct genetic distance matrices and phylogenetic trees for each partner. These were compared with each other and with the geographical distances between the sites where they were collected in order to reveal the relative importance of phylogenetic and geographical factors. The results are complex and suggest that different factors are important at different spatial scales.

I'm a 3rd year undergraduate student majoring in Conservation and Ecology at Lincoln University. My area of research interest includes molecular ecology, biogeography, phylogenetic analysis, spatial and community ecology.

Ecological Thresholds as Constraints to the Growth and Survival of Woody Tree Species in Degraded Grassland in the South Island's Dryland Zone

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New Zealand's dryland zone is one of the country's most endangered ecosystems and also the least protected (< 1.2% under legal protection). Natural regeneration of the native forest and shrubland species is inhibited by several environmental and anthropic factors that affect the establishment and growth of seedlings. This research is focusing on understanding how some of these factors limit regeneration and growth of native woody species. Five sites from North Canterbury to the Mackenzie Basin were chosen, all of which were previously farmed and are now dominated by a rank growth of exotic grasses or and weeds. At each site we have set up a replicated experiment using several treatments (mulch, cultivation, herbicide, shade cloth, fencing and irrigation) to better understand the factors limiting growth of native woody seedlings. Seedlings of two native woody tree species were planted at each site in December 2012, and their growth will be followed for two years, along with a continuous monitoring of soil moisture content and physiological data.

The preliminary results show low survival rate for seedlings (<5 cm tall at planting) on all sites (12-35%), whereas taller plants (20-40 cm tall) have higher establishment success (75-91%). Since December/2012, plants have grown between -8.84 up to 96.15%, and seedlings have had an increment of 7.5 up to 139.5%, in average. Plants growing on the exotic rank grass sites have shown higher growth rates compared to those on the degraded short tussock grasslands. Physiological responses seem to vary as a factor of treatment and site.

Anna Paula Rodrigues, Brazilian, Forestry BSc and Master's. Currently pursuing a PhD degree in Forestry. Interested in conservation, landscape and restoration ecological studies of dryland and savannah ecosystems, resembling those found in Central-Brazil.

Oral vitamin E administration attenuates potassium dichromate induced hepatotoxicity

Shati, Ali A.¹

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This study investigates the protective role of orally administered vitamin E against potassium dichromate (K₂Cr₂O₇) induced hepatotoxicity. This study was carried out between February and May 2013 at the laboratories of the biology department at King Khalid University, Abha, KSA. Twenty four adult male rats (*Rattus norvegicus*, weighing 150-180g) were used and divided into 4 groups

(n=6): Control group received distilled water; sham group received Vitamin E (100 mg/kg b.w); model group received K₂Cr₂O₇ (8 mg/kg b.w) and treated group received K₂Cr₂O₇&Vitamin E. All treatments were given orally on a daily basis for 6 weeks. Cr levels were measured in the serum and livers of rats. DNA content, TBARS, GSH content and SOD activity were measured in liver homogenates. In addition, the liver tissues were examined histologically and glycogen, protein and DNA contents were detected by histochemistry. In comparison to control or sham group, K₂Cr₂O₇ treated rats exhibited significant increases in TBARS levels and significant decreases in GSH content and SOD activity. Their livers showed major histological alterations such as severe necrosis and increased lymphocytic infiltration. Furthermore, Glycogen, protein and DNA content were significantly decreased. Oral Vitamine E concomitant administration with K₂Cr₂O₇ could ameliorate all these changes and resulted in normal hepatic histological and cellular contents. In conclusion, Oral administration of vitamin E has a hepatoprotective role against K₂Cr₂O₇ induced toxicity in rats.

Dr. Ali A. Shati, Associate Prof. of Ecological Physiology, area of research interest in Ecological Physiology.

Conservation of Afromontane Trees: *Lovoa trichilioides* and *Cordia* sp.

Thia, Joshua¹; Hale, Marie¹; Stouffer, Daniel¹; and Chapman, Hazel¹

¹School of Biological Sciences, University of Canterbury.

Afromontane forests are one of the most threatened habitat-types due to climate change and anthropogenic pressures. Furthermore, Western African habitats are of a conservation concern because they are less well characterised in terms of their species diversity and ecology relative to other geographic locales in Africa. The study-site for this project, Ngel-Nyaki, is a western Afromontane forest. In this forest, two locally rare tree species, *Lovoa trichilioides* (Meliaceae) and a *Cordia* sp. (Boraginaceae), have been selected to understand ecologic and genetic processes affecting Afromontane trees in a disturbed landscape. The research goals are to quantify (1) genetic diversity of each species, and (2) factors that may influence regeneration (e.g. seed predation rates, seed and seedling shadows), for the sake of a between species comparison. A further objective, (3) is to use molecular tools to understand the taxonomic significance of the Ngel-Nyaki *Cordia*, whose characteristics are unlike that currently described for other West African species.

Joshua Thia is a current MSc student in evolutionary biology at the University of Canterbury, and this project constitutes his thesis work. His main area of interest is in molecular ecology.

Determining the influence of seabird derived nutrients on terrestrial and coastal marine food webs.

Thoresen, Joshua¹; Towns, Davids^{1,2}; Leuzinger, Sebastian¹

¹Institute of Applied Ecology New Zealand (AENZ), School of Applied Science, Auckland University of Technology (AUT)

²Department of Conservation (DOC)

The impacts of agricultural nutrients on terrestrial, freshwater and marine ecosystems have been well studied. However, less is understood about the natural inputs of nutrients into these systems via seabirds. Before the arrival of Polynesians and invasive mammals, New Zealand's terrestrial fauna and flora was influenced by extraordinarily high densities of seabirds on the mainland. As a result, high inputs of nutrients into watersheds and coastal marine systems would have existed. This seabird fauna has now largely been lost from mainland New Zealand, but the nutrient input is still apparent via farming. Seabirds provide highly concentrated sources of nutrients that can be tracked as stable isotopes of nitrogen and carbon through trophic systems. Research has focused on the effects of seabird-derived nutrients on terrestrial ecosystems on a broad scale, but little is understood about how it affects small scale terrestrial and marine food webs due to the destruction of most seabird populations by introduced predators. Populations of seabirds have, however, survived on some offshore islands and are now spreading on others as predators are removed. This study will for the first time investigate nutrient fluxes within and from islands, and the ways that these nutrients influence plant growth and food webs within and adjacent to an island ecosystem. The study will further aid the understanding of how terrestrial and marine ecosystems in New Zealand manage high nutrient inputs and will serve to gain knowledge in where, or if, and how excessive nutrients are stored in an ecosystem.

Joshua Thoresen, a PhD student at AUT. My first love is reptiles but I have always been fascinated with the complexity of ecology, especially food webs. I am never satisfied with studying single species I want to know everything.

Physiological flexibility to climate warming declines from temperate to tropics within widely distributed Eucalypts

Tjoelker, Mark G.¹; Drake, John E.¹; Aspinwall, Michael J.¹; Ghannoum, O.¹; Pfautsch, S.¹; Rymer, Paul. D.¹; Crous, Kristine Y.¹; Tissue, David T.¹; Reich, Peter B.^{1,2}

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As rapid climate warming creates a mismatch between forest trees and their "home" environment, the capacity of trees to cope is critically dependent on their ability to physiologically acclimate to increased temperature. In widespread species, trees in cooler "home" climates should exhibit greater physiological flexibility to warming than their counterparts in warmer climates that approach thermal

limits. We tested this prediction with a “climate shift” experiment in widely distributed *Eucalyptus tereticornis* and *E. grandis*, using provenances originating along a ~2,500 km latitudinal transect (15.5 to 38.0 °S) in eastern Australia. We grew 21 provenances in conditions approximating temperatures at seed origin (“home”) and warmed temperatures (home +3.5 °C) using a series of climate-controlled glasshouse bays. Consistent with our hypothesis, we observed a marked biogeographic cline in physiological flexibility in photosynthesis and growth responses to 3.5 °C warming that declined at the highest mean annual temperatures and lowest latitudes of origin among taxa. Warming increased light-saturated leaf photosynthesis (A_{sat}) by ~60% in the cold-origin provenances, but reduced A_{sat} by 20-40% in the warm-origin provenances of the two species. Likewise, cold-origin taxa increased drymass growth by ~60%, while warm-origin tropical taxa showed reduced growth by ~20% with climate warming. Measures of photosynthesis at saturating CO_2 concentration indicated that responses were underpinned by changes in photosynthetic capacity. These findings suggest that climate warming effects vary predictably across the geographic range of widely distributed tree species from photosynthesis and growth increases in temperate regions to marked declines in the tropics.

Mark Tjoelker is leader of the Ecosystem Function and Integration Theme at the Hawkesbury Institute for the Environment, University of Western Sydney. He studies the impacts of environmental change on ecosystems and the physiological ecology and biogeography of forest trees.

Ecosystem processes within a *Phytophthora* Taxon Agathis (PTA) affected kauri forest.

van der Westhuizen, Willem D.¹; Althuizen, Inge¹; Macinnis-Ng, Cate¹; Perry, George^{1,2}; Waipara, Nick³; Schwendenmann, Luitgard¹

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The novel *Phytophthora* species *Phytophthora* Taxon Agathis (PTA) kills kauri seedlings and trees of all ages and is present in many of the remaining kauri stands throughout Auckland and Northland. We investigated carbon and nitrogen stocks and fluxes in a kauri stand afflicted by PTA in the Waitakere ranges. Since March 2013, we have measured litter fall, tree growth, soil CO_2 efflux and microclimatic parameters fortnightly in the vicinity of trees grouped into two infection ‘classes’: (1) healthy to minimally infected and (2) medium to highly infected. Soil samples were taken from both the organic layer and mineral soil (to a depth of 70 cm) to determine pH, texture and to quantify carbon and nitrogen density. The amount of litter collected between March and June was considerably lower under highly infected trees than under minimally infected trees. Only slight differences were found in soil CO_2 efflux with respiration in the vicinity of highly infected trees being lower. An understanding of the consequences of PTA for ecosystem processes is crucial to improve our understanding of pathogen related disturbances and to inform future management decisions.

Willem Donald van der Westhuizen is an Environmental Science Masters student at the University of Auckland. He has a background in a range of ecological disciplines including conservation ecology and biosecurity.

Do mice matter? Impacts of mice alone on the invertebrate fauna of Maungatautari Ecological Island

Watts, Corinne¹; Thornburrow, Danny¹; Innes, John¹

¹Landcare Research, Hamilton

The advent of predator-proof fences, accompanied by advanced techniques for eradication and subsequent surveillance, has enabled multi-species eradications of mammals from large areas on the New Zealand mainland. However, house mice (*Mus musculus*) have proved difficult to eradicate and at a number of sanctuaries around New Zealand they are now the only exotic mammal present. But are the impacts of mice ecologically important? We examined the impact of mice on the invertebrate fauna at Maungatautari Ecological Island by comparing two sites where: (1) mice have been kept at low levels with poisoning (-Mice), and (2) mice have been allowed to increase to high densities (+Mice). Invertebrates were sampled in both blocks using pitfall traps and leaf litter samples. Interim results from the first three years of the study show that significantly more invertebrates, including beetles, spiders and weta, were caught in pitfall traps in the -Mice block than in the +Mice block. Beetles and weta sampled from the +Mice block were on average half the size of those collected from the -Mice block. Litter samples have shown similar results to the pitfall trap data. These interim results suggest that the invertebrate community sampled from Maungatautari is adversely affected by mice that reduce invertebrate abundance and selectively prey on larger individuals. We plan in the next 2 years to monitor invertebrate responses to the reversal of the ‘mouse treatment’ between blocks, i.e., mouse eradication in +Mice block and mouse increase in -Mice block.

Corinne Watts, Invertebrate Ecologist. Restoration and monitoring of invertebrate communities and threatened insect species management.

Dama wallaby research opportunity – What we know we don't know!

Williams, Dale¹; Bailey, Brett²; Knill, Katrina³

¹Bay of Plenty Regional Council

²Waikato Regional Council

³Department of Conservation

Dama wallabies (*Macropus eugenii*) were liberated in the Bay of Plenty, New Zealand in 1912. Since then their feral range has expanded to cover approximately 180,000 ha. Wallabies pose a significant threat to New Zealand's indigenous plant species that have evolved in the absence of browsing mammals. In 2006 the Department of Conservation, along with the Bay of Plenty and Waikato Regional Councils, implemented a management plan for dama wallabies and formed a multi-agency Wallaby Management Team. This team faces significant knowledge gaps around wallaby behaviour, particularly with regard to identifying factors that drive dispersal. This poster reviews some recent results gained from deploying a wallaby indicating dog and digital trail cameras, as surveillance tools and highlights some potential research topics that could assist the Wallaby Management Team in their quest to halt further expansion of the wallaby feral range. In Australia dama wallabies are confined to a handful of populations and have largely disappeared from the Australian mainland. Considerable scope exists to gain a greater understanding of wallaby behaviour that could assist the management of dama wallabies as a vertebrate pest in New Zealand and a threatened species in their native homeland of Australia.

Dale Williams is a Land Management Officer with the Bay of Plenty Regional Council. He's worked as a technical advisor with the Regional Council, Department of Conservation, Mannaki Whenua and the Forest Research Institute and has presented a number of papers on dama wallaby management.

Mice in the sanctuary: how many and who cares?

Wilson, Deborah J.¹; Innes, John G.¹; Barker, Gary M.²; Bartlam, Scott¹; Fitzgerald, Neil B.¹; Frogley, Kelly³; Johnston, Peter R.¹; Padamsee, Maj¹; Smale, Mark C.¹; Thornburrow, Danny¹; Watts, Corinne¹

¹Landcare Research

²G. M. Barker & Research Associates

³University of Otago

Many wildlife sanctuaries in New Zealand are fenced to exclude exotic mammals. House mice (*Mus musculus*) remain in many sanctuaries, however, and sometimes become abundant after other mammals are removed. Whether these mice have important impacts on native species is unknown. We estimated changing mouse population densities and measured a range of biodiversity attributes at Maungatautari Ecological Island since 2011. We compared two sites where (1) the mouse population has been allowed to increase inside a separately fenced block (+Mice), and (2) mice have been controlled with poison to prevent a population increase (-Mice). In the +Mice block, mouse population densities were similar to estimates in forest and alpine ecosystems after masting events, and mice were often detected in trees, up to 11 m high. Mice quickly found and ate small bird eggs placed in experimental nests on the ground. In the -Mice block, mice were undetectable at the beginning of our study, but have gradually increased in density since poisoning stopped in 2012. Some invertebrate taxa were more abundant and had larger individuals in the -Mice block compared with the +Mice block (see our companion poster, Watts *et al.* 2013). We did not detect effects of mice on land snails, seedlings or fungal fruiting bodies, although all are likely minor diet items. The next step in this ongoing study is to reverse the experimental treatments, by eradicating mice from the +Mice block (planned for August 2013) and letting the mouse population continue to increase on the -Mice block.

Deb Wilson. Ecologist. Population dynamics of small mammals and their prey species; impacts of invasive mammals and habitat change on native species.

Assessing the methodology for measuring wood density

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Wood density is a fundamental plant functional trait which has been associated with many aspects of the life history of woody plants, such as successional status, disturbance response and growth rate. It is also vital for calculations of forest carbon budgets. Therefore, accurate estimates of wood density are critical for our understanding of forest structure and dynamics and global efforts to assess carbon stocks. However, a recent paper criticized the methods ecologists have used to measure wood density, raising concerns regarding the part of the tree from which wood was sampled and the temperature at which samples were dried. This project seeks to examine these issues for a suite of native and exotic tree species found in Canterbury. Specifically it addresses the questions: 1) How variable are wood density measurements derived from sampling different locations on a tree; i.e. from branches of varying angle to the horizontal and from different radial parts of the trunk? 2) What effect does oven drying temperature have on the moisture content and density estimate of wood? This research will be useful in developing a better understanding of how differences in the methodology for wood density might affect measurements of this fundamental trait and will also provide data from New Zealand species to add to the growing global wood density database.

Monique Wright is currently doing her BSc Honours at Lincoln University. She is broadly interested in plant functional ecology.

Notes

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