



timetable and abstracts

16 - 20 november

school of biological sciences
university of auckland

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Conference Organising Committee

Dianne Brunton
Sandra Anderson
Ji Weihong
Stuart Parsons
Joanne Peace
Marleen Baling

Important Information

Getting Help

The registration/information desk, in the foyer of the Engineering School, will be open for the duration of the conference. If you need assistance with any conference-related matters, please ask at the desk.

Oral Presentations

Two concurrent sessions will be running for the majority of the conference. Talks will take place in lecture theatres ENG439 and ENG401. Both theatres are clearly marked. The student day will take place within the Old Biology Building, School of Biological Sciences, 5 Symonds Street, Auckland Central. Presentations will be given in the BLT100 lecture theatre.

Both ENG439 and ENG401 will have a member of the organising committee on-hand to assist presenters with loading talks, and can provide instructions for using of the electronic lectern (e-lectern). The e-lecterns are running Windows XP, but Macintosh and Windows laptops can be connected as “guest” computers. However, this should be avoided to minimise delays between presentations. Presenters are asked to load their talks as early as possible to prevent delays. Please check that your presentation is compatible with the e-lectern by first running it in the preview lecture theatre, room ENG402. If you think you will have a problem loading or running your presentation on the e-lectern, please seek help early. Speakers wishing to use photographic slides, overhead transparencies, or show video/DVD presentations, should also seek advise well before their session begins. Laser pointers and microphones will be provided in each lecture theatre.

Poster Presentations

The poster evening is being held on Monday 17 November, starting at 5:45PM in the foyer of the Engineering School. All posters should be mounted on the display boards well before the start of the session. Poster presenters are expected to be available at their poster to answer questions. Space on the display boards will be allocated on a first come, first serve basis. Mounting pins and velcro are available from the registration/information desk.

Food

The cost of the wine and cheese evening and morning and afternoon teas is included in your conference registration fee. All catered events, with the exception of the conference dinner, will be held in the foyer of the Engineering School. Lunches are not provided, but a number of excellent eating establishments are located near to the conference venue. See the Map of Key Locations to locate a selection of nearby cafes.

Conference Dinner

The conference dinner is being held at the Coast restaurant, 7th floor, Hewlett Packard Building, Princes Wharf on Wednesday 19 November. The restaurant is about 20 minutes walk from the conference venue, and its location is noted on the Map of Key Locations. Please be at the restaurant by 7:00PM. Dinner is from 7:30PM, with dancing following from 9:30PM.

Field Trips

Field trips will be held on Wednesday 19 November. Buses to Tawharanui and Miranda will leave from outside the Thomas Building, 3A Symonds Street. Please be at the departure point no later than 8:45AM, for a prompt 9:00AM departure. People going to Tiritiri Matangi Island should meet at the Ferry Building, Quay Street (see Map of Key Locations) at 8:45AM, for a prompt 9:00AM departure. We are using a commercial ferry service that will not wait for late-comers.

Conference T-Shirts and Coffee Mugs

T-shirts and coffee mugs showing the logo of the conference are available for ordering in the foyer of the Engineering School. Stocks are limited so order early to avoid disappointment.

Map of Key Locations



1. Coast Restaurant and Bar
2. Ferry Building
3. Doshiers Bar – Good for a relaxed ale.
4. High Street cafes – great for lunch.
5. Internet cafe.
6. Village Cinemas.
7. School of Biological Sciences.
8. Bus stop meeting point for field trips.
9. Alfred Street bus stop for city circuit
10. Slurp Bar and Café.
11. Techspresso – coffees, muffins, seat in the sun.
12. Cafes, Subway.
13. Viaduct basin – restaurants and bars.
14. Old Biology building.
15. Engineering School

CONFERENCE TIMETABLE

Day 1	16 November (Student Day)
	Level 1, Biology Building, School of Biological Sciences, 5 Symonds St, Auckland City
0800 – 0930	Registration & student speaker preparation
0930 – 0945	Joanne Peace Introduction
0945 – 1005	Darryl Jeffries (University of Auckland) Prickly problems in the Pingao: hedgehog impacts in dunes
1005 – 1025	Jawad Abdelkrim, Michel Pascal, Claire Calmet & Sarah Samadi (Muséum National d'Histoire Naturelle; Institut National de Recherche Agronomique) The introduced Norway rat on Brittany islands (France): molecular genetic studies as a tool for management of invasive populations and consequences of its eradication
1025 – 1045	Sarah Robbins (Victoria University of Wellington) Foraging interference by <i>Pteropus scapulius</i> (Megachiroptera: Pteropodidae) management implications
1045 – 1115	MORNING TEA
1115 – 1135	Clare Brown (Massey University) Can dogs be used to detect native reptiles for conservation work?
1135 – 1155	Paulette L. Dewhurst & Ben D. Bell (Victoria University of Wellington) Population and survival estimates from a mark-recapture study for a translocated population of the Maud Island frog, <i>Leiopelma pakeka</i>
1155 – 1215	Carryn Hojem (University of Auckland) The ecology and ethology of captive Archey's frog (<i>Leiopelma archeyi</i>)
1215 – 1235	Kevin L. Woo, Nicola J. Nelson, Maree Hunt, David Harper, Charles H. Daugherty & Ben D. Bell (Victoria University of Wellington) Sensory perception and acquisition learning in tuatara (<i>Sphenodon</i>)
1235 – 1255	Joanne Peace (University of Auckland) Ecology of the rainbow skink (<i>Lampropholis delicata</i>) in New Zealand
1255 – 1355	LUNCH
1355 – 1415	S. May, J. Ogden & J. L. Craig (University of Auckland) Restoring forest: should theory or biota dictate management options?
1415 – 1435	Hazel Gatehouse (Lincoln University) Predicting the rate and extent of spread of naturalised plants in New Zealand
1435 – 1455	Kelly Gravuer (Lincoln University) Determinants of the introduction, naturalisation, and spread of <i>Trifolium</i> species in New Zealand
1455 – 1515	Craig Bishop (University of Auckland) A case study of a sharp vegetation boundary in a natural system: frost flat heathland-forest ecotones in the central North Island
1515 – 1545	AFTERNOON TEA
1545 – 1605	Jeremy Corfield (Auckland University of Technology) Acoustic identification of individual North Island Brown Kiwi and its use as a conservation tool
1605 – 1625	Sarah Withers (University of Auckland) Composition and function of Hihi (<i>Notiomystis cincta</i>) song in relation to social behaviour and resources
1625 – 1645	Rose Thorogood (University of Auckland) Determining the effects of food availability on the reproductive behaviour and success of hihi (<i>Notiomystis cincta</i>): an experiment in progress
1645 – 1705	Julia Chen (University of Auckland) The effect on the reproductive success of little blue penguins (<i>Eudyptula minor</i>): Human impact on foraging behaviour, population demographics, and ectoparasite infestations
	Common Room, Thomas Building, School of Biological Sciences, 3A Symonds St, Auckland City
1715 – 2100	Student Day Party & Quiz – drinks & pizza provided

Day 2		November 17th	
	Engineering School, 20 Symonds Street		
8:00	Registration/information desk opens		
	Room ENG439		
9:00-9:20	OPENING & President's welcome		
9:20 -10:00	Award Speaker: Phil Cowan (Landcare Research): What do we really know about possums?		
10:00-10:40	MORNING TEA		
	SYMPOSIUM Endangered Species Management: Theories and Applications		
10:40-11:20	Steven R. Beissinger (University of California, Berkeley): Theory and Practice of Recovering Threatened Species: Paradigms Lost and Found.		
11:20-11:40	Doug P. Armstrong, Yvan Richard and Rebecca Boulton (Massey University): Integrating two paradigms for understanding broad-scale declines of native species.		
11:40-12:00	Ian G. Jamieson (University of Otago): Effects of breeding and loss of genetic variation in population viability: do we really understand the processes and consequences?		
12:00-12:20	Paulette L. Dewhurst & Ben D. Bell (Victoria University of Wellington) Population and survival estimates from a mark-recapture study for a translocated population of the Maud Island frog, <i>Leiopelma pakeka</i>		
12:20-1:40	LUNCH		
	Room ENG439	Room ENG401	
	SYMPOSIUM Bio-invasions	SYMPOSIUM Behavioural ecology	
1:40-2:00	Nod Kay (NZFRI): What constitutes a host for invasive defoliators?	Dianne Brunton ¹ and Isabel Castro ² (¹ University of Auckland ² Massey University) Implications of differential sex allocation for endangered species management.	
2:00-2:20	H. M. Harman, K. F. Armstrong, S. P. Worner and P. Syrett: Small propagule size, genetic diversity and invasion success.	Isabel Castro ¹ , Karen M. Mason ¹ , Doug P. Armstrong ¹ & David M. Lambert ² (Massey University): Effect of extra-pair paternity on effective population size in a reintroduced population of the endangered hihi, and potential for behavioural management.	
2:20-2:40	Craine, J.M. ¹ , Lee, W.G. ¹ , Bond, W.J. ² , Williams, R.J. ³ , Johnson, L.C. ⁴ (¹ Landcare Research; ² University of Cape Town; ³ CSIRO Sustainable Ecosystems, PMB 44 Winnellie, NT, 0821, Darwin, Australia; ⁴ Kansas State University): Is there a global relationship among leaf and root traits? – results from an intercontinental grassland comparison.	Richard P. Duncan (Lincoln University): Why do southern hemisphere birds lay smaller clutches? Using introduced birds to test Ashmole's hypothesis.	
2:40-3:00	Margaret Stanley and Darren Ward (Landcare Research): Do willows provide resources for native fauna? The influence of landscape context on the impact of an invasive weed.	*Emma Marks (The University of Auckland): The Ecstatic Display calls of the Adélie penguin (<i>Pygoscelis adeliae</i>): the importance of being honest.	
3:00-3:20	*Christopher Berry, Richard Duncan, Glenn Stewart (Lincoln University): Post-dispersal seed predation by introduced mammals: Does it really matter?	*Emily King (Victoria University of Wellington): From mainland beech to island hardwood habitat: challenges of translocating mohua (<i>Mohoua ochrocephala</i>) to Nukuwaiata,	
3:20-4:00	AFTERNOON TEA		
	SYMPOSIUM Bio-invasions	SYMPOSIUM Behavioural ecology	
4:00-4:20	Alice Miller ¹ , Richard Duncan ¹ , Jon Sullivan ¹ , Susan Wisser ² and Claire Newell ² (¹ Lincoln University; ² Landcare Research): Do creeks serve as focal points for the invasion of <i>Hieracium lepidulum</i> into Canterbury catchments?	Burns, K.C. Caching behaviour in New Zealand robins (<i>Petroica australis</i>).	
4:20-4:40	Carol J. West (Department of Conservation): Distribution and management of weeds in coastal Fiordland.	Ji Weihong (University of Auckland): The social life of possums: implications for disease transmission.	

4:40-5:00	Duane A. Peltzer ¹ , Chad Hershock ² , Radka Wildova ³ and Deborah E. Goldberg ² (¹ Landcare Research, Lincoln, NZ; ² Department of Ecology and Evolutionary Biology, University of Michigan, USA; ³ National Institute for Botany, Prague, Czech Republic): Variation in the success and abundance of exotic plants along natural soil fertility gradients.	*Rebecca Lewis (Massey University): Can artificial nests be used to assess predation pressure on natural nests.
5:00-5:20	John Parkes (Landcare Research): The role of eradication of vertebrate pests within the Homogocene era.	Mark E. Hauber (University of California, Berkeley): Patterns and coevolutionary consequences of repeated brood parasitism.
5:45-7:00	POSTER SESSION (WINE AND CHEESE EVENING)	

Posters

Bassett*, I. (The University of Auckland): Cabbage Tree Seedling Responses to Soil Compaction: Implications for Ecological Restoration
Bockett, F. (Department of Conservation): Operation Hope: Conservation in South Westland.
Boswijk, G. (The University of Auckland): Tree-ring analysis of late Holocene 'swamp kauri' from the Waikato Lowlands.
<u>Duthie</u> *, C. & Burns, K.C. (Victoria University of Wellington): Are Weta legitimate dispersers of New Zealand plants?
<u>Eyfe</u> *, J. & Burns, K.C. (Victoria University of Wellington): Fruiting and flowering patterns of New Zealand plants and their importance to conservation.
Chard*, J. (The University of Auckland): Wai Care: How Successful is it? An investigation into urban water quality and community groups
<u>Hartley</u> ¹ , S., Harris ² , R., & Lester ¹ , P. (¹ Victoria University of Wellington, ² Landcare Research): Predicting the potential global distribution of the Argentine ant, <i>Linepithema humile</i> .
Hartley, S. & Lester, P. (Victoria University of Wellington): A degree-day model for the development of the Argentine ant, <i>Linepithema humile</i> , with implications for range limits in New Zealand.
Heiss-Dunlop*, S. (The University of Auckland?): Planning for success: an integrated management approach towards restoration of Motuihe Island, Hauraki Gulf.
Hojem*, C. (School of Biological Sciences, University of Auckland): The ecology and ethology of captive Archey's Frogs (<i>Leiopelma archeyi</i>)
Lee ¹ , D.E., Scadden ² , P., & Lee ³ , W.G. (¹ University of Otago; ² Institute for Geological and Nuclear Sciences; ³ Landcare Research): Late Pleistocene and Holocene paleogeography of the New Zealand region.
<u>Li</u> *, X., Flenley, J., Rapson, J., & McLachlan, R. (Massey University): Testing vegetation dynamics around Spongy Swamp and Tiniroto Lakes - a numerical analysis.
Lux*, J. (University of Auckland): Early Polynesian burning and vegetation change at Waipoua Forest, Northland, New Zealand.
Mckechnie*, S. (University of Otago): The reliability of an infra-red burrowscope for detecting occupants of Sooty Shearwater (<i>Puffinus griseus</i>) burrows.
Merrett, M. & Burns, B. (Landcare Research): What causes low fruit set in native shrubs? Case studies of two species with different reproductive strategies.
<u>McHardy</u> *, P. & Burns, K.C. (Victoria University of Wellington): Environmental predictors of vascular plant species richness on an island archipelago, South Wellington Coast, Wellington, New Zealand.
Minor, M. (Massey University): Latent heat flux in evapotranspiration and fossil energy inputs as two predictors of biodiversity: a pilot study with soil invertebrates.
<u>Mariette</u> *, M.M., Armstrong, D.P. & Innes, J.G. (Massey University; Landcare Research): Movements of Tui across the forest-urban gradient, and implications for conservation.
<u>Parkes</u> , J., & Norbury, G. (Landcare Research): Ecological effects of rabbit haemorrhagic disease in New Zealand 1997 – 2003.
Rapley, K. (The University of Auckland) Woodhill Forest: a case study in Ecosystem Management and sustainability.
Robbins*, S. (Victoria University of Wellington): Foraging interference by <i>Pteropus scapulatus</i> (Megachiroptera: Pteropodidae): management implications.
Shanahan, D. (University of Otago): New and improved! Satellite imagery in fine-scale habitat use studies.
<u>Siva</u> , A. & Burns, K.C. (Victoria University of Wellington): Long-term forest dynamics of Otari-Wilton's bush: Effects of possum control.

<u>van Horik*</u> , J., Bell, B. & Burns, K.C. (Victoria University of Wellington): Ecological and behavioural constraints to the breeding success of the North Island Kaka.
<u>Woo*</u> , K.L., Nelson, N.J., Hunt, M., Harper, D., Daugherty, C.H. & Bell, B.D. (Victoria University of Wellington): Sensory perception and acquisition learning in tuatara (Sphenodon).
*Denotes student poster. Presenting author is underlined.

Day 3		November 18th	
8:30	Registration/information desk opens		
	Room ENG439		
	SYMPOSIUM Use of Population Models in Conservation Biology		
9:20 -10:00	David Fletcher (University of Otago): Population Modelling: Theory and Practice in Conservation		
10:00-10:20	Marti Anderson (University of Auckland): Multivariate models for monitoring and environmental impact assessment		
10:20-10:40	MORNING TEA		
	Room ENG439	Room ENG401	
	SYMPOSIUM Use of Population Models in Conservation Biology		
10:40-11:00	Ian J. Payton ¹ , Peter N. Beets ² , James P. Barton ³ , Claire Newell ¹ , Sarah Beadel ⁴ (¹ Landcare Research, ² Forest Research, ³ NZ Climate Change Office, Ministry for the Environment, ⁴ Wildland Consultants Ltd): Every cloud has a silver lining: a biodiversity upside to the Kyoto Protocol.	Eckehard Brockerhoff A test of the biodiversity-stability theory: a meta-analysis of tree species diversity effects on insect pest infestations, and experiences from New Zealand's planted forests	
11:00-11:20	Spencer N. and Wiser S. (Landcare Research): Globalising vegetation data management.	Nicholas Martin (NZ Institute for Crop & Research Ltd): Testing a new way to measure the biodiversity of indigenous, invertebrate herbivores.	
11:20-11:40	Stephen Hartley ¹ , Phil Lester ¹ & Richard Harris ² (¹ Victoria University of Wellington, ² Landcare Research): Two contrasting modelling approaches for predicting the future range of an invasive species: the Argentine ant in New Zealand.	Astrid C. Dijkgraaf and Bill E. Fleury (Department of Conservation): Aerial Foliar Browse Index monitoring of forests.	
11:40-12:00	*Mandy Barron (Lincoln University): The application of population models for quantifying the impact of two exotic parasitoids on red admiral butterfly (<i>Bassarid gonerilla</i>) abundance	Lora Peacock & Sue Worner (Lincoln University): Extending the climate matching concept for feature extraction from databases of global invasive insect species distribution.	
12:00-12:20	Tadashi Fukami (University of Tennessee): Ecosystem size and assembly history interact to affect species diversity: experimental evidence	Ian Westbrooke (Department of Conservation): Alternatives to hypothesis tests - some conservation examples.	
12:20-1:40	LUNCH		
	SYMPOSIUM Fragmentation & Restoration	SYMPOSIUM Bio-invasion	
1:40-2:00	*Robert Ewers and Raphael Didham (University of Canterbury): Large-scale invertebrate responses to forest fragmentation.	Janet M. Wilmshurst ¹ & Thomas F.G. Higham (¹ Landcare Research): Dating the arrival of the Pacific rat (<i>Rattus exulans</i> or Kiore) and humans in New Zealand.	
2:00-2:20	*Charlotte Hardy and Robert Hoare (The University of Auckland): Conservation lessons from forest edges in the Rodney district.	*Jawad Abdelkrim ^{1,2} , Michel Pascal ² , Claire Calmet ¹ , & Sarah Samadi ¹ . (¹ UMR 7138, Systématique, Evolution et Adaptation - Département de Systématique et Evolution du Muséum National d'Histoire Naturelle 43 rue Cuvier – 75005 Paris – France. ² Institut National de Recherche Agronomique, Département Hydrobiologie et Faune Sauvage, Equipe "Gestion des Populations Invasives", Campus de Beaulieu, 35042 Rennes, France): The introduced Norway rat on Brittany islands (France): molecular genetic studies as a tool for management of invasive populations and consequences of its eradication.	

2:20-2:40	Susan Walker ¹ , Catherine G. Rufaut ² , Geoffrey M. Rogers ³ and William G. Lee ¹ (¹ Landcare Research, ² 25 Frances Street, Broad Bay, Dunedin, New Zealand ³ Department of Conservation): Effects of fragmentation on alluvial floodplain forest ecosystems.	*Ian Johnston (Massey University): Testing the applicability of tracking tunnels for indexing rodent abundance and the efficacy of removal trapping as a tool for calibration, Tongariro National Park, New Zealand.
2:40-3:00	I.L. Power and M.B. Dodd (AgResearch): Establishment of native tree species into hill country pasture by oversowing.	*Olivia Holland ^{1,2} Dianne Gleeson ² (¹ . The University of Auckland; ² . Landcare Research): Molecular Ecology of Stoats in New Zealand.
3:00-3:20	Mark C. Smale ¹ , Craig W. Ross ² , Gregory C. Arnold ³ (^{1,2} Landcare Research; ³ Massey University): Vegetation recovery in rural kahikatea (<i>Dacrycarpus dacrydioides</i>) forest fragments in the Waikato region, New Zealand, following cessation of grazing.	*Michael Perry (Massey University): The browsing impact and abundance of European brown hares (<i>Lepus europaeus</i>) in the Central North Island, New Zealand.
3:20-4:00	AFTERNOON TEA	
	SYMPOSIUM Fragmentation & Restoration	SYMPOSIUM Bio-invasion
4:00-4:20	*Alisha Birkett (University of Auckland): Effects of habitat fragmentation on the Otago skink: population monitoring and management from a genetic perspective.	Adrian Monks and Murray Efford (Landcare Research): Selective browsing of southern rata with respect to leaf age by brushtail possums.
4:20-4:40	Bruce Burns ¹ , Liza Gorkiewicz ² , and Donna Worthy ¹ (¹ Landcare Research, Private Bag 3127, Hamilton, New Zealand; ² Northern Michigan University, Marquette, Michigan, USA.): Effect of tree ferns on forest regeneration at Mt Pirongia: inhibition or facilitation?	*Blackie, H.M and Dennis, T.E. (The University of Auckland): Daily movements and activity patterns of the brushtail possum (<i>Trichosurus vulpecula</i>), characterised using global positioning devices
4:40-5:00	*Sarah McLean Local adaptation of the <i>Phormium tenax</i> (New Zealand flax) to microsites	*James Haw (The University of Auckland): Effects of Argentine ant (<i>Linepithema humile</i>) on arthropod fauna in New Zealand native forest
5:45	Book Launch “Ecological Context of Development” by Stephen Knight. Special presentation by Dr Morgan Williams. Refreshments provided.	
6:00-7:30	AGM	

Day 4	November 19th
Field Trips	
Trip 1 Tiritiri Matangi Island: Trip departs from city ferry terminal, Quay Steet, Auckland City.	
Trip 2 Tawharanui Peninsula: Trip leaves from outside the Thomas Building, School of Biological Sciences.	
Trip 3 Miranda Coast: Trip leaves from outside the Thomas Building, School of Biological Sciences.	
Please be at your departure point by 8:30AM for a prompt 9:00AM departure. The boat for Tiritiri Matangi Island stops at Gulf Harbour (Whangaparoa Peninsula) on the way to the Island. The boat departs Guld Harbour at 9:45AM. All trips should return by approximately 4:00PM. Lunch is provided. Hats and sunblock are highly recommended.	
7:00PM until late: CONFERENCE DINNER “THE COAST” RESTAURANT, Level 7, Hewlett Packard Building, Princes Warf, Auckland City.	

Day 5		November 20th	
08:30	Registration/information desk opens		
	Room ENG439		
	SYMPOSIUM Fragmentation & Restoration Ecology		
9:20 -9:40	Monica Tomosy (U.S. Geological Survey): Biological Research at the U.S. Geological Survey		
	Room ENG439	Room ENG401	
	SYMPOSIUM Fragmentation & Restoration	Contributed papers	
9:40-10:00	Daniel Rutledge ¹ , Craig Miller ² (¹ Landcare Research; ² Macquarie University): Landscape indices and fragmentation: is there pattern in the process?	Jacqueline R. Beggs ¹ , Brian J. Karl ² , David A. Wardle ^{3,4} and Karen I. Bonner ³ (¹ University of Auckland, ² Landcare Research, ³ Landcare Research, ⁴ Department of Forest Vegetation Ecology, Swedish University of Agricultural Sciences): Honeydew beech forests – the ultimate sugar fix.	
10:00-10:20	*Carol Curtis: Coarse wood and direct transfer maximise invertebrate diversity in restoration of forest.	Lisa Berndt and Ecki Brockerhoff (Forest Research): Native beetles in an exotic landscape: investigating the conservation value of plantation forests	
10:20-10:40	*Marleen Baling, Dianne Brunton (The University of Auckland): Habitat preference of captive chevron skinks: applications to the wild.	Cynthia M. Roberts, Richard P. Duncan, Kerry-Jayne Wilson (Lincoln University): The effect of burrow-breeding seabirds on forest regeneration, South East Island (Rangatira), Chatham Islands.	
10:40-11:00	Morning Tea		
	SYMPOSIUM Fragmentation & Restoration Ecology	Contributed papers	
11:00-11:20	Daniel Rutledge and Graham Sparling (7 Fox Street, Hamilton 39 Levey Lane, Katikati): New Zealand sustainability: halting the denial.	Harshi K. Gamage ¹ , Linley K. Jesson ¹ , Donald R. Drake ^{1,2} (¹ Victoria University. of Wellington, ² University of Hawaii): Leaf anatomy and stomatal conductance- Do foliar responses determine the shade-tolerance of homoblastic and heteroblastic seedlings?	
11:20-11:40	Sandra Anderson, Dave Kelly, Alistair Robertson, Jenny Ladley and Marilyn Merrett (The University of Auckland): Maintaining the empty museum – pollinator limitation and the sustainability of mainland NZ forest ecosystems.	*Mark Hamer (Massey University): The influence of nutrients on stream algal biomass and invertebrate communities.	
11:40-12:00	Dave Kelly, Alastair W. Robertson, Jenny J. Ladley, Sandra H. Anderson, and Robert J. McKenzie (University of Canterbury): The relative (un)importance of introduced animals as pollinators and dispersers of native plants.	*Anthony C Keen (The University of Auckland): Spatial and temporal patterns of plant succession in freshwater wetlands on the Tawharanui peninsula.	
12:00-12:20	Ralf Ohlemüller ¹ , Susan Walker ² , J. Bastow Wilson ¹ (¹ University of Otago; ² Landcare Research): The role of local vs. regional factors in determining native and exotic plant species richness in indigenous forest fragments in eastern Otago.	*Yanbin Deng, John Ogden*, Mark Horrocks*, Sandra Anderson (University of Auckland, Auckland): Vegetation succession in estuarine wetlands on Great Barrier Island, northern New Zealand, Since c. 7500BP	
12:20-1:40	LUNCH		
	SYMPOSIUM Monitoring	Contributed papers	
1:40-2:00	*Rhonda M. Pearce, Adrian M. Paterson, Richard P. Duncan (Lincoln University): Patterns of range contraction in native New Zealand passerine birds.	*Craig Bishop (The University of Auckland): The nature, cause and stability of frost flat heathland-forest ecotones in the central North Island.	
2:00-2:20	*Smith, A. N. H. & Westbrooke, I. (Cantebery University): Comparing historical and recent bird counts in Pureora Forest.	Phillip Dawson (Massey University): The population structure and pollination of <i>Pimelea arenaria</i> , a declining native dune plant.	
2:20-2:40	Lynette Hartley (Department of Conservation): Tell me about your five minute bird counts.	S. May An evluation of vegetation patterns and management strategies at Shakespear Regional Park: Will they achieve ecosystem goals?	

2:40-3:00	Darryl I. MacKenzie (Proteus Research & Consulting Ltd.): Tips on designing monitoring programs for the proportion of area occupied by a species.	*Josh Guilbert (The University of Auckland): Bat relocations in New Zealand: The long and the short of it.
3:00-3:20	AFTERNOON TEA	
	Contributed papers	Contributed papers
3:20-4:00	Murray Williams (Department of Conservation): Competition and hybridisation between indigenous grey duck and introduced mallard in New Zealand.	
4:00-4:20	Timothy J Martin (University of Auckland): Warm, wet and wild: the ecology of <i>Ascarina lucida</i> and some implications for the interpretation of palynological records. (Check: no registration)	
4:20-4:40	Alex Lautensach (The University of Auckland): The values of ecologists.	
4:40-5:20	Prizes Ceremony (Student prizes and the Royal Society of New Zealand Science and Technology Medal will be awarded to John Parkes)	

Guest speakers



Professor Steven Beissinger is currently Chair of the Division of Ecosystem Sciences, University of California, Berkeley. Professor Beissinger's current research examines basic processes and problems in conservation biology, and behavioural and population ecology, particularly of birds. He works in tropical ecosystems in South America and the Caribbean, and in California wetlands, marine environments, and forests. Steve's research also makes extensive use of the development of demographic models on computers that link ecosystem or other management options to risks of extinction for threatened and endangered species. This has included models of Everglades water management and Snail Kite population viability, Marbled Murrelet demography in the Pacific Northwest, sea turtle nest protection programs, and demographic criteria for evaluating California Condor reintroduction success. Current work is examining spatial variation in parrotlet meta-population processes



Dr Dave Fletcher is a researcher in the Mathematics and Statistical Department of the University of Otago. His research work arises from collaboration with ecologists, particularly those working in conservation biology and marine science. Recent work has included development of new mark-recapture models for estimating survival rates of Hector's dolphins — a species found only in New Zealand. In conjunction with this, he has become interested in population viability analysis, in which demographic models are used to assess the risk to a species. He is currently involved in carrying out this type of analysis for Hector's dolphins, as well as using it to assess the sustainability of the harvesting of Titi (muttonbirds) by Maori on Stewart Island. Dave asserts that the emphasis (and satisfaction!) in much of this work is in providing new methods of analysis that are readily understood by ecologists who do not regard themselves as expert statisticians.



Dr Marti Anderson is a research in the Statistics Department of the University of Auckland. She is an ecological statistician or a statistical ecologist and her work centres on the use and development of statistical methods for ecological applications. Marti states that "This is why statistics is so important for ecology. We need to quantify, estimate and make rigorous probabilistic statements about these stochastic systems where absolute determinism is simply impossible ... I take an inter-disciplinary approach as an applied statistician and a practicing field ecologist to tackle these issues. ... Ecological data require special statistical methods!" Much of the practical work that Marti does is in marine ecology, at the University of Auckland's Leigh Marine Laboratory. She is actively involved in ecological and environmental consulting and also develops computer programs that implement the newest statistical methods and techniques available.



Ms Monica Tomosy is currently working in the Washington Office's Endangered Species Program in the Division of Conservation and Classification. Her primary focus is to develop a prioritization system for the backlog of listing actions; an effort that has involved staff and managers from every Region of the FWS, as well as a wide array of stakeholders and scientists. Previously Monica held a position with the U.S. Fish and Wildlife Service practicing wildlife and habitat management at the Salton Sea and Tijuana Slough National Wildlife Refuges. She worked again for the Service's "Region 8" stationed in the El Yunque rainforest of Puerto Rico where I conducted nest-watching protection and behavioral studies of the critically endangered Puerto Rican parrot. Monica's experiences in natural resource conservation include: wildlife management at the Bureau of Land Management's Medford District, and spotted owl research on the Siskiyou National Forest for the Forest Service's Redwood Sciences Laboratory.

Abstracts: Student Day (alphabetical by surname)

The introduced Norway rat on Brittany islands (France): molecular genetic studies as a tool for management of invasive populations and consequences of its eradication.

Jawad Abdelkrim^{1,2}, Michel Pascal², Claire Calmet¹, & Sarah Samadi¹.

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Islands are a major challenge for biodiversity conservation as they represent hotspots of endemism and are very sensitive to introduction of exotic species. Furthermore, while they often exhibit limited areas, usually highly isolated, they represent a realistic place for eradication programs. Two main questions are of first interest once eradication has been conducted. The first is, “is it viable in the long term. This depends on how the focused area is isolated from potential sources of re-infestation. To answer this question, studying genetic structure of targeted populations and neighbourhood ones in order to evaluate gene flow between these local populations of the focused species is of particular interest. The second question is “What are the consequences of the alien population eradication on the ecosystem functioning?” To provide pertinent evaluations, a comparison of the situations before and after eradication using a standardised methodology is needed.

The Norway rat, *Rattus norvegicus*, has been introduced into many islands and is highly detrimental to native species. A genetic study using nine microsatellite markers was conducted on eradicated populations of *R. norvegicus* over twenty islands from five archipelagos. This study revealed a high population structure between the different archipelagos and a low insular allelic diversity. Furthermore, for inter-island distances greater than one hundred meters, the island populations of each archipelago are highly differentiated. This suggests the lack of effective gene flow between distant islands or between islands and the continental mainland. As soon as invasion pathways such as human transportation are effectively controlled, colonisation probability is supposed to be low. Nevertheless, after eradication, rats have been observed on one of these insular systems. The genetic tool allowed identifying them as survivors of the eradication campaign, and probably not as newcomers.

Furthermore, a comparison between before and after the eradication was conducted on one of these islands, which is of particular interest regarding its local avifauna. The number of nesting pairs of all the terrestrial avifauna species was established annually from 1996, before the eradication operation, until 2001. Between the 1996 reproductive season and the 2001 one, the number of nesting pairs of the Dunnock (*Prunella modularis*), the Wren (*Troglodytes troglodytes*), and the Rock Pipit (*Anthus petrosus*), increased by an estimated factor of 1.7-2.0, 2.2-2.7 and 5.5-7.0 respectively. Many biological facts converged to identify the rodent disappearance as the major driving factor of these increases.

This study illustrates the benefits of combining ecological and genetic approaches to make such management programs more efficient.

A case study of a sharp vegetation boundary in a natural system: frost flat heathland-forest ecotones in the central North Island.

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Sharp boundaries between communities, and vegetation mosaics in an apparently uniform environment, have been of interest to ecologists since quantitative censuring of plant associations began. Clements (1905) was the first author to describe these sharp boundaries as ecotones. Ecotones are defined as 'zones where spatial or temporal rates of change in ecological structure or function are rapid relative rates across the landscape as a whole'. Plant ecotones have been defined at many spatial scales. The current study seeks to identify the cause and dynamics of a sharp, landscape scale ecotone - between frost flat heathland and surrounding vegetation - at four sites in the Central North Island. More specific questions included: Is the FFH/forest ecotone a 'true' boundary between two different communities, or does it represent the distributional limit of one structurally obvious component of the surrounding forest association? What is the cause of the vegetation boundary? Is it the result of an abrupt environmental/physical variable, such as temperature or geology, or due to the operation of a vegetation switch? Is the current boundary stable? Or does it represent a moving colonisation front as forest replaces FFH by facilitation succession? If the boundary is unstable at what rate is it moving? If it is stable is this situation likely to persist in the short-medium (5-50 years) term?

Can Dogs Be Used to Detect Native Reptiles for Conservation Work?

Clare Browne

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Finding endangered animals can be one of the most time-consuming parts of a conservation program. Although trained dogs have been used in New Zealand conservation for many years to locate, track and help capture a range of protected native species (predominantly birds), I believe they are under-utilised in this field, and could potentially be used to assist with the conservation of many other species.

The aim of my research is to determine if dogs can detect native reptiles in an experimental situation; if they can differentiate between different sources of scent from the same animal (i.e. skin, scats, and gland secretions); and if they can detect reptile scent that has been exposed in a natural bush setting for an extended period of time.

My research involves using approximately 20 dogs belonging to members of local dog training clubs (already trained for scent work), running a series of trials testing their abilities to detect different reptile scents. Because the reptiles I am studying are protected species, I use a range of materials from the animals with the dogs: paper towels that the reptiles have been sitting on (containing gland secretions), scats, and skins.

The results I have already obtained indicate that dogs can very successfully detect New Zealand reptiles. The potential benefits of this research to the field of conservation could be immense. Many reptile species are rapidly diminishing, and having a tool such as a dog to quickly establish their presence in an area would assist efforts to protect them immeasurably.

Nest Attendance and Counts in Little Blue Penguins (*Eudyptula minor*)

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The little blue penguin (*Eudyptula minor*) is found throughout coastal New Zealand and several offshore islands. They come ashore on Tiritiri Matangi Island (Hauraki Gulf, Auckland) from May, staying for the breeding cycle from June to December, and the moulting period from January to March. This study will investigate the nest attendance and some of the major factors influencing the population count of *E. minor*, in relation to: (1) human impact on their foraging behaviour, and (2) environmental variables. The methods employed in this study include boat transect, mark-recapture and radio telemetry. As the Hauraki Gulf supports heavy recreational and commercial use by a large human population, and the sea area nearby Tiritiri Matangi Island is subject to increasing sewage and industrial pollution, this study will also compare the density and distribution of the little blue penguins at the sea area surrounding a non-marine reserve (Tiritiri Matangi Island) and a marine reserve (Goat Island). The data will be analysed statistically to quantify the breeding success of little blue penguins, and how it is affected by the parent foraging trips over the breeding season. The significance of this study is to help management and conservation of this species, provide baseline data of the penguin foraging behaviour, and to use penguins as the monitors of the marine environment for the implementation of the proposed marine reserve surrounding Tiritiri Matangi Island.

Acoustic identification of individual North Island Brown Kiwi and its use as a conservation tool

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North Island Brown Kiwi (*Apteryx australis mantelli*) are found in the upper third of the North Island. Currently, the population size stands at 70,000 birds and is declining at a rate of 5.8% per year due to trapping, poisoning and predation from introduced mammals such as mustilids, cats, and dogs. Kiwi produce a variety of social vocalisations, including 'territorial' calls. Male and female pairs share a territory and these calls are used to maintain contact with one another, and advertise their presence to other kiwi nearby. The Department of Conservation (DoC) survey for kiwi each year by listening for territorial calls. Although male and female birds produce easily distinguished calls, it is not possible to reliably identify individuals using this technique and it cannot give precise information on the exact number of kiwi present. Nor can it provide information on the loss or gain of birds from or to known populations.

The aim of this research is to produce a detailed description of the territorial calls of kiwi and develop a method for identifying individual birds from their calls. The method will subsequently be used to investigate behavioral patterns and explore opportunities for this method to be used in future management and research efforts.

Kiwi calls are being recorded from 5 regions in the North Island, including managed kiwi reserves at Rarewarewa and Hodges Bush north of Whangarei. Calls are recorded using a Sennheiser microphone connected to a Sony DAT recorder (TCD-D8). Calls are digitized to computer and subsequently analysed using the software packages Raven v1 (Cornel Laboratory of Ornithology, Ithaca, USA) and Sound Analysis v3 (City College of New York, New York, USA). Preliminary results show that male and female kiwi can be easily distinguished, there is a high degree of variability between calls of different males, there is low variability within calls of individual males, and if the call of a male is a duet with its mate then variability increases. Further analyses are planned that will investigate the usefulness temporal and spectral call features, analysed using multivariate statistical techniques and artificial neural networks, for distinguishing between the calls of individual birds.

Assessing the success of a trial translocation of the threatened Maud Island frog, *Leiopelma pakeka*

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The native endangered Maud Island frog is restricted to two islands, Maud Island and a translocated population on Motuara Island, both in the Marlborough Sounds, New Zealand. Nearly 20 years ago, the first translocation of this species was undertaken within Maud Island. One hundred frogs were moved 0.5km to Boat Bay in two separate translocations, one year apart. Monitoring has been carried out on both the translocated and source populations at least annually since.

Studies of the Boat Bay population are providing information on the success of the translocation. An intensive one-off survey was carried out in 2002 to better determine the current population and survival estimates. Morphological comparisons between the translocated and source populations were also carried out to establish how well the transferred population was faring.

Fifty-eight captures of 42 frogs were made over 20 nights, 70% of these were founder members. Ten were of frogs that had not been previously captured, indicating they were recruits into the population. Frogs were found to have moved up to 26m to alternative habitat sites outside of the permanent grid, including both founder members and frogs recruited into the population.

The results of this study suggest an optimistic future for the Maud Island frogs in Boat Bay, with important implications for future native frog translocations in New Zealand.

Predicting the rate and extent of spread of naturalised plants in New Zealand

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Over 20000 exotic plant species have been introduced to New Zealand so far. Of these, more than 2000 have already naturalised. Of these, about 500 are causing problems by impacting on primary production and/or native biodiversity. Twelve new species are naturalising regionally per year. Defence of the border is estimated at \$60m and loss of production due to naturalised species is estimated at \$40m.

The aim of my project is to understand the factors affecting the rate and extent of spread of naturalised plant species in New Zealand. The two key questions are: (1) Why are some species more widespread? Over 30% of species are currently found in only 1 region, around 15% are found throughout New Zealand. (2) Why do some regions contain more species? Some regions have more than 1000 species but other regions have less than 500 naturalised species.

I will produce a globally unique database which will reconstruct the spread and current distribution of all naturalised species in New Zealand. I will be able to identify parts of the country that are most susceptible to these species, and identify the most successful spreading species. I will derive statistical models describing the patterns and rate of spread of species as a function of key attributes of the species, features of the region of origin, history of introduction and attributes of the regions of New Zealand.

These models will allow us to assess the risk of spread posed by species that have not yet arrived, are still only in cultivation or are in the early stage of spread.

I am eight months into this three year project. This talk outlines my proposal and I look forward to feedback from outside my department.

Determinants of the introduction, naturalisation, and spread of *Trifolium* species in New Zealand

Kelly Gravuer
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Over two thousand plant species are naturalised in New Zealand, and up to one quarter of these may have detrimental impacts on natural or productive ecosystems. Although New Zealand employs the best available science to screen and manage problematic species, gaps in understanding of invasion biology leave much room for improvement of these models. Two promising approaches are the stage-based framework, in which the introduction, naturalisation, and spread stages of invasion are examined separately, and the congener comparison approach, in which ecological traits of congeneric species with varying degrees of invasiveness are contrasted. I am combining these approaches to identify key determinants of the introduction, naturalisation, and spread of *Trifolium* (clover) species. Historical information is available for *Trifolium* because of its economic importance, and the 24 species naturalised in New Zealand provide an ideal system for statistical investigation. I have identified which of the world's approximately 230 *Trifolium* species have been introduced to New Zealand, which of these have naturalised, and the current geographic range of each naturalised species in New Zealand. Potential predictors of each stage have been collected from published literature, including native range attributes, estimated date of introduction and naturalisation, introduction effort (e.g., planting records), climatic suitability, weediness elsewhere in the world, and biological traits. In addition, I have performed a common garden study of 15 naturalised annual species. Traits measured for each species included growth rate, height, leaf area, phenology, biomass allocation, and fecundity. I will present my preliminary results. These approaches suggest promising avenues for future screening and management of *Trifolium* species that may apply to other genera. The unique ability to document and account for the history of species introductions in New Zealand will improve global understanding of early stages of invasion, and the relative importance of human and biological influences at each stage.

The Ecology and Ethology of Captive Archey's Frogs (*Leiopelma archeyi*)

Carryn Hojem and Dianne Brunton
School of Biological Sciences, University of Auckland

The conservation of New Zealand's four endemic frog species (genus *Leiopelma*) is crucial, as the threat from many factors (including chytridiomycosis [a disease caused by *Batrachochytrium dendrobatidis*], habitat loss, introduced species and temperature changes) pose a serious risk to their survival. *Leiopelma* species are unique in that they show primitive features. These features include the presence of nine vertebrae in front of the sacrum (modern frogs have eight) and tail wagging muscles in adults, the absence of webbing between their toes, external eardrums, the ability to croak and the absence of a tadpole stage (froglets possessing tails emerge from eggs and in Archey's frogs (*Leiopelma archeyi*) and Hamilton's frogs (*Leiopelma hamiltoni*), these froglets are cared for by the male, riding on his back). Archey's frogs are found in three main populations (Moehau and Coleville Ranges on the Coromandel Peninsula and the Whareorino forest, west of Te Kuiti). Evidence of the chytrid fungus was found in September 2001 in the Coromandel and since then, in all three populations, with recent surveys of the areas showing reduced numbers of the frogs. These indicators show that the species is faced with potential extinction and this has prompted a captive breeding programme of the frogs by the Auckland Zoological Park. This programme will involve the sourcing of approximately 60 individual Archey's frogs (theoretically 20 from the three different sites) in late 2003. They will then be used in establishing a breeding population that can be utilised for future reintroductions back into the wild. My study is evolving and will potentially involve accessing different factors and features of the individual frogs and their breeding behaviours, in order to determine the optimum conditions (including aspects such as density, sex-ratios, body size, feeding and temperature) for successful breeding.

Prickly problems in the Pingao: hedgehog impacts in dunes.

Darryl Jeffries, Mick Clout, and Dianne Brunton

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Early European settlers introduced the European hedgehog (*Erinaceus europaeus*) into New Zealand around the late 1800's. It has since become established nationwide, even abundant in some areas, which is a concern, as they can compete with native species for food, carry human and stock infections, and are potentially a significant threat to native invertebrates and ground-nesting birds. While earlier studies of hedgehogs have revealed information about their behaviour and biology in New Zealand, until recently there has been little knowledge of, or research into, their impacts on local wildlife. To accomplish this project, coastal study sites in the North Auckland region were selected, from which hedgehog diet will be analysed to identify their prey in these habitats. A number of threatened ground-nesting native bird species nest in coastal sand dune areas within this region. To determine available hedgehog prey species, pitfall traps were used to identify and monitor ground invertebrates present in each study area over two years. Additionally, radio-tracking and mark-recapture methods were used to study hedgehog demographics and movement patterns over space and time in the relevant habitats. Together this data will provide information on the hedgehogs' behaviour and use of sand-dune habitats, and the potential impacts they may have, which is important if any future management is to be executed efficiently and effectively.

Restoring Forest: Should Theory Or Biota Dictate Management Options?

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The restoration management of native plant communities in New Zealand has been relatively ignored and poorly resourced. Frequently, legal protection and fencing is seen as the endpoint of the conservation of plant communities. Management strategies often rely on nursery crops such as manuka *Leptospermum scoparium*, broom *Cytisus scoparius* and gorse *Ulex europeaus* to enhance the natural succession of primary successional species to mature canopy. This study evaluates the effectiveness of these techniques at Shakespear Regional Park, Auckland, New Zealand in order to assess whether current management practises require modification. Indirect gradient analysis Decorana was used to determine the successional relationships between different vegetation associations throughout the landscape by interpreting the age and dynamics of existing stands in relation to dominant environmental variables. Results indicate that vegetation at Shakespear has undergone substantial modification since human clearance. Although the landscape is gradually reverting to forest, the nature of the progression was found to be complex due to spatial and temporal dynamics working together to influence the rate of succession. Fences enhance regeneration of species within remnants, but are not helping species expand into the surrounding matrix. Reasons for this failure were attributed to dense mats of pastoral grasses on the margins of forest remnants, and also to the lack of regeneration beneath dense manuka canopies, as a consequence of poor avian seed dispersal. Managers are urged to adopt an active management approach to short cut the successional process.

Ecology of the rainbow skink (*Lampropholis delicata*) in New Zealand

Joanne Peace, Dianne Brunton, and Neil Mitchell

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Rainbow skinks (*Lampropholis delicata*) are New Zealand's only introduced reptile that has successfully established out of captivity, and they have been present in this country since an accidental introduction from Australia in the early 1960s. Currently they are well established in the greater Auckland area, the Coromandel Peninsula, Tauranga, and Te Puke. However to date little, if any, ecological research has been conducted on them in New Zealand, and there is no indication of how they may be affecting our native fauna.

This project focuses on three main areas which are necessarily addressed when the invasiveness of a species is considered: distribution, ecology, and behaviour in its new environment. It aims to achieve three key objectives.

- 1) Clarification of the environmental variables restricting the distribution of rainbow skink in Australia to allow the inference of their potential distribution in New Zealand.
- 2) Estimation of population density, investigation of habitat use, and examination of reproductive biology of rainbow skinks at sites in the Auckland region.
- 3) Examination of interactions between a maximum of 50 rainbow skinks, and 40 copper skinks (*Cyclodina aenea*) in custom-built enclosures under controlled laboratory conditions.

By meeting these objectives a large step forward in our knowledge of the rainbow skink, and what its presence in New Zealand means, will have been taken.

Determining the effects of food availability on the reproductive behaviour and success of hihi (stitchbird, *Notiomystis cincta*): an experiment in progress

Rose Thorogood¹, Dianne Brunton¹ and Isabel Castro²

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Hihi are an endangered endemic honeyeater (Melaphagidae), and are an excellent species with which to research the relationships between food and reproduction. This study aims to determine the role food availability plays in influencing parental and chick behaviour, and reproductive success, and to enhance conservation and management.

Food availability for the population present on Tiritiri Matangi Island (109 individuals) will be experimentally manipulated in breeding territories using supplemental feeders. Nests greater than 100m from feeders will be used as controls.

The response of parental behaviour to food, and the effect this has on their breeding behaviour, will be measured. Maternal decisions regarding the sex allocation of her brood are of interest. Chick growth, survivorship, and behaviour will also be measured. The hypotheses this experiment will test include:

- 1) do hihi mothers manipulate the sex ratio of their brood prior to egg lay?
- 2) does food availability affect this decision?
- 3) do incubation times vary when food is more readily available?
- 4) does food availability affect nest visitation rates for males and females?
- 5) is chick development, behaviour, and mortality affected by parental access to food?

Composition and function of Hihi (*Notiomystis cincta*) song in relation to social behaviour and resources

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Research on bird song has tended to focus on the Northern Hemisphere and work on the function of male song has predominated. New Zealand represents a particularly interesting location for bird song analysis, with several species in which both males and females sing. The proposed research aims to analyse the function of song in an endemic New Zealand species, the Hihi or Stitchbird (*Notiomystis cincta*). The proposed research will determine the structure of both male and female song, using sonogram analysis of recorded vocalisations. Recordings from Tiritiri Matangi Island, Mokoia Island and Little Barrier Island will be compared for inter-population differentiation in song types, song structure and song context. Fine scale analysis of bird song within the Tiritiri Matangi population will focus on a comparison of male and female song structure, repertoires, calls and song types, to determine the function and context of Hihi song. Research on avian vocalisation has consistently found that different song types function for territorial display or for mate attraction and retention. An analysis of both the social and non-social context of song will be focussed on, in order to determine the function of particular song types in Hihi. Variation in song will be tracked temporally and related to temporal changes in resources, using measurements of resource quality and quantity within territories. This research will represent the first in depth song analysis on Hihi, and will be one of few studies that focus on the function of song in both males and females.

Sensory perception and acquisition learning in tuatara (*Sphenodon*).

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Scientific investigation of the sensory world and behaviour of the tuatara (*Sphenodon*) has been very limited. However, this study incorporates both ecological and psychological theories to test discrimination and sensory perception. Tuatara were trained under an operant conditioning procedure to respond to various discriminative stimuli (S^+). Preliminary results have shown discrimination of flicker fusion rates (2.65-25.06 Hz) in visual stimuli. Subjects have also demonstrated learning capabilities. We intend to proceed with other aspects of visual discrimination as well as audition, and establish the basic groundwork for chemoreceptive studies in reptiles. The results of this study may aid in determining what aspects of visual stimuli are important to tuatara (i.e., predator/prey/kin recognition, mate selection, background versus foreground discrimination, and communication). The study aims to generate and establish a reliable method that can be used to far more depth psychophysical experiments to further access perception and learning all reptiles as well as providing some initial data on the visual perception of tuatara.

Abstracts: Main Conference (alphabetical by surname)

The introduced Norway rat on Brittany islands (France): molecular genetic studies as a tool for management of invasive populations and consequences of its eradication.

***Jawad Abdelkrim^{1,2}, Michel Pascal², Claire Calmet¹, & Sarah Samadi¹.**

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Islands are a major challenge for biodiversity conservation as they represent hotspots of endemism and are very sensitive to introduction of exotic species. Furthermore, while they often exhibit limited areas, usually highly isolated, they represent a realistic place for eradication programs. Two main questions are of first interest once eradication has been conducted. The first is, “is it viable in the long term. This depends on how the focused area is isolated from potential sources of re-infestation. To answer this question, studying genetic structure of targeted populations and neighbourhood ones in order to evaluate gene flow between these local populations of the focused species is of particular interest. The second question is “What are the consequences of the alien population eradication on the ecosystem functioning?” To provide pertinent evaluations, a comparison of the situations before and after eradication using a standardised methodology is needed.

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Furthermore, a comparison between before and after the eradication was conducted on one of these islands, which is of particular interest regarding its local avifauna. The number of nesting pairs of all the terrestrial avifauna species was established annually from 1996, before the eradication operation, until 2001. Between the 1996 reproductive season and the 2001 one, the number of nesting pairs of the Dunnock (*Prunella modularis*), the Wren (*Troglodytes troglodytes*), and the Rock Pipit (*Anthus petrosus*), increased by an estimated factor of 1.7-2.0, 2.2-2.7 and 5.5-7.0 respectively. Many biological facts converged to identify the rodent disappearance as the major driving factor of these increases.

This study illustrates the benefits of combining ecological and genetic approaches to make such management programs more efficient.

Multivariate models for monitoring and environmental impact assessment

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Monitoring and assessment of environmental impacts are of great importance in conservation management and ecologists need appropriate tools for analysing the responses of whole sets of species in ecosystems simultaneously. Here, I give a summary of some of the most recently developed multivariate statistical tools that have been specially designed to deal with “misbehaving” ecological data sets. These methods are flexible in that they allow any relevant dissimilarity measure to be used as a base for the analysis, yet they provide a way of rigorously assessing particular multivariate hypotheses with minimal assumptions. Next, I will provide particular examples of their use to answer current interesting ecological questions. Where and when are fish assemblages of the Great Barrier Reef being impacted? Can we come up with models of the “health” of soft-sediment benthic intertidal ecosystems in the Auckland Region? Can the biodiversity of kelp holdfast assemblages provide a good monitoring tool for New Zealand’s subtidal marine systems? Can physical information about a habitat inform or predict biological assemblages? How can we model large-scale patterns of variation in biodiversity? We have a long way to go towards developing good predictive models for ecosystems, but these are some very solid first steps.

Maintaining the empty museum – pollinator limitation and the sustainability of mainland NZ forest ecosystems

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Reduced native honeyeater densities throughout mainland New Zealand appear to be the primary cause of low pollinator visitation and reduced seed set in a variety of native flowering plants. This study presents additional evidence for pollinator limitation in two bird-visited species, the canopy tree *Dysoxylum spectabile* and the shrub *Clianthus puniceus*, and attempts to review the situation for the thirteen plant species investigated to date. We use as an index the level of pollination service, with hand-pollinated flowers representing maximum service (100%) and bagged flowers minimum service (0%). Pollination service was inadequate (index less than 50%) at approximately half the mainland plant populations monitored. Eight plant species (62%) were pollen-limited to some extent at mainland sites. Of the remaining five (38%) which did not suffer pollination failure at any site, two species were capable of autonomous self-pollination. The results suggest widespread failure of bird-pollination mutualisms on the New Zealand mainland; the inevitable consequence of avifaunal decimation and the ‘empty museum’ status of mainland forests as highlighted by Glasby (1991). Although factors other than seed production may limit population size for some plants, other species are entirely reliant on reproduction by seed. Due to the long lives of most native plants, the effect of reduced seed production is not immediate but can ultimately lead to major shifts in vegetation composition.

Pollination services may be restored on the New Zealand mainland if the key bird species can be increased. In the last decade, intensive control of introduced mammalian pests has frequently increased bird numbers, including tui and bellbird. Despite their low biomass per hectare, these native honeyeaters are crucial for continued ecosystem function, and their protection is probably necessary to prevent large-scale, long-term changes in the surviving native forests of New Zealand.

Integrating two paradigms for understanding broad-scale declines of native species

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In 1994, Graeme Caughley noted that two distinct paradigms had emerged for understanding extinctions of single populations: the small population paradigm and the declining population paradigm. He argued that recovery programmes would be more effective if the paradigms were integrated. This integration has largely been achieved at the population level, but another dichotomy has emerged at the landscape scale. Numerous papers have been published in the last decade on factors accounting for broad-scale patterns of extinction among multiple populations. However, these studies usually follow either a “habitat paradigm”, where declines are explained in terms of habitat factors like predation or vegetation type, or the “metapopulation paradigm”, where stochastic extinctions and isolation are invoked. Both paradigms lead to predictive models that can generate recommendations for species recovery, but the recommendations will depend on which paradigm is followed. To achieve effective species recovery at the landscape scale, it is vital to integrate the two paradigms so that the relative importance of habitat and metapopulations factors can be assessed. This is not trivial, however, and we discuss 6 problems that need to be overcome. We argue that the two paradigms can only be integrated if detailed demographic data are collected in multiple locations, and outline a research programme using this approach involving North Island robins in the central North Island.

Habitat preference of captive chevron skinks: applications to the wild

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The endangered chevron skink (*Oligosoma homalonotum*) has been a focal species of conservation management on Great Barrier Island in the recent years. Management of this species has included habitat conservation, which places emphasis on understanding the habitat preferences and also the general behaviour of the chevron skink. This study concentrates on the behavioural ecology, particularly habitat use and refuge use of chevron skinks in captivity. Three individuals were introduced into separate outdoor enclosures supporting two habitats (vegetated and unvegetated areas) supplied with ground and arboreal refuges. Daily activity and macro and microhabitat use of the skinks was recorded between August to October 2002. Due to the small sample size, data were analysed separately for each individual. Each skink showed varied preferences for macro and microhabitat, which can be explained by individual differences. However, results do indicate that the high site fidelity after refuge selection consequentially determined the primary type of macro and microhabitat used for each skink. Skinks were found to utilise arboreal refuges, but none of the artificial ground refuges provided. All captive skinks had the highest frequency of being seen during mid-day, and the varied individual emergence time from refuge is likely to be influence by sun. The results supports other studies conducted in the field, where similarity of captive behaviour to the wild suggests a positive role of captive studies and this opens possibilities of detailed observation studies or testing new techniques in captivity before applying them in the wild.

The application of population models for quantifying the impact of two exotic parasitoids on red admiral butterfly (*Bassaris gonerilla*) abundance.

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A common problem in ecology is estimating changes in species' abundance when there are data only on present-day abundance and there are no historical data apart from anecdotal accounts. This is the situation for the endemic New Zealand red admiral butterfly, *Bassaris gonerilla* (F.): anecdotal evidence suggests populations have declined but there are no data to verify this. The possible decline in *B. gonerilla* numbers has been linked with the introduction of two generalist pupal parasitoids, *Pteromalus puparum* (L.) and *Echthromorpha intricatoria* (F.), in the early 1900s. *P. puparum* was deliberately introduced for the biological control of the cabbage white butterfly (*Pieris rapae* (L.)), whilst *E. intricatoria* was an adventitious arrival from Australia. In the absence of historical data on *B. gonerilla* abundance, population models were used to estimate any changes in their populations likely to have been caused by the parasitoids. First, a population model for *B. gonerilla* was constructed based on a detailed autecological study of populations on the Banks Peninsula, South Island, New Zealand. The mortality caused by the parasitoids was then removed from the model to give an estimate of *B. gonerilla* abundance in the absence of pupal parasitism. This retrospective model suggested that *P. puparum* has had little impact on *B. gonerilla* populations but that *E. intricatoria* has reduced *B. gonerilla* populations on the Banks Peninsula.

Honeydew beech forests – the ultimate sugar fix.

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We estimated the annual production of honeydew per unit land area of beech (*Nothofagus* spp.) forest by measuring the amount of honeydew produced in 24 h by scale insects (*Ultracoelostoma* spp.) (Hemiptera: Margarodidae) every month for 2 years. We used exclosures to prevent animals (notably *Vespula* wasps) removing honeydew, and we compared the standing crop of honeydew inside permanently closed exclosures with that outside exclosures. The surface area of trees infested with scale insects was estimated using allometric regression relationships between tree diameter and total surface area of tree trunk and branch material. These estimates were combined with measurements of tree diameter in 10-m radius circular plots to give a production estimate of between 3500 and 4500 kg dry weight honeydew ha⁻¹ year⁻¹. Honeydew production and the number of honeydew droplets was highly variable between individual trees, tree type, position on tree, and, exclosure type, and within and between years. Sugar composition also varied between tree type and between years. Honeydew scale insects provide large amounts of biologically available carbon in the form of soluble sugar. It is a crucial resource for the above-ground system, and probably also for the below-ground system. We conclude scale insects have the potential to function as keystone species in these forests.

Theory and Practice of Recovering Threatened Species: Paradigms Lost and Found.

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The growth of conservation biology over the past two decades has been concomitant with the growth of extinction theory and “tests” of that theory through repeated field applications with threatened species, especially with birds. Two paradigms shape the way conservation biology analyzes the risks, agents of decline, and recovery options for threatened species. The Small Population Paradigm is characterized by the role of population size and stochasticity (PVA), while the Declining Population Paradigm attempts to identify and reverse the factors causing declines. The Small Population Paradigm is based on theory but testable hypotheses are difficult to create and falsify, while the Declining Population Paradigm has little theory but more avenues to develop and test hypotheses. For the latter paradigm, the potential for development of theory is linked to evaluating factors that affect fitness responses to disturbance or life history perturbation. I identify 6 approaches for diagnosing causes of declines and illustrate how to employ the most general approach, Multiple Competing Hypotheses, in conjunction to determine causes of decline of the Marbled Murrelet. This seabird nests in coastal old growth forests and is threatened by multiple factors. I conclude by examining how these paradigms are being used or ignored in other high profile, endangered bird recovery programs in the United States.

Native beetles in an exotic landscape: investigating the conservation value of plantation forests

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The Canterbury Plains of the South Island are a highly modified landscape, with most of the land in pasture and crop production. Many parts of the Plains used to support kanuka low forest and shrubland, but now less than 100 ha of this habitat remains. Invertebrates that originated in this forest type may therefore be under threat due to loss of habitat. Plantation forestry may help alleviate this threat, as these exotic forests are able to support populations of many native plants and animals, including some threatened species. In this study we compare the carabid beetle fauna of kanuka forest, pine plantation, pasture and gorse shrubland, and investigate the effect understory vegetation in the plantation has on this fauna. Pitfall traps were used to sample the beetles over three summers between 2000 and 2003. Sampling was conducted in Eyrewell Forest, a 7000 ha *Pinus radiata* plantation, and neighbouring habitats, including Eyrewell Reserve, a nearby patch of kanuka forest. Native carabids were found in all habitat types, although the species composition differed between habitats. The open habitats (pasture and young pine plantation) were dominated by exotic species. A threatened species, *Holcaspis brevicula*, was found in the pine plantation. We conclude that mature pine plantation does provide a suitable habitat for many native carabid species that inhabit kanuka forest, and is of more benefit to these beetle communities than pasture.

Post-dispersal seed predation by introduced mammals: Does it really matter?

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It is widely accepted in New Zealand that introduced mammals have the potential to alter plant community structure through seed predation. When studying post-dispersal seed predation most researchers, both here and overseas, focus on estimating rates of seed loss to predators. While this information is useful, the actual impact of seed predation on plant recruitment depends on the degree to which the plant population is seed- or microsite- limited. Seed predators will have a greater impact on plant recruitment when plant populations are strongly seed-limited.

We established a seed sowing experiment to investigate the factors limiting seed germination and to determine the impact of mammalian predators on seedling establishment at Peel Forest, Canterbury. Seeds from three hardwood species (determined to have similar mammalian predation levels) were sown at three densities. Replicates were randomly allocated protection from mammalian seed predators and seed germination was recorded over 12 months. Mammal predation significantly reduced seedling establishment in one but not the other two plant species studied.

This experiment highlights the importance of considering abiotic factors and the degree to which plant populations are seed- or microsite limited when investigating the relevance of seed predation to plant recruitment.

Effects of habitat fragmentation on the Otago skink: population monitoring and management from a genetic perspective.

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The impact of agricultural development on native habitats around the world is well documented. Increasingly, the effects of habitat fragmentation on the population dynamics of inhabiting species are being investigated indirectly, using genetic markers as tools to track dispersal and genetic connectivity between populations. The tussock grasslands of Central Otago are one example of the dramatic changes following human development. The past 150 years of pastoralism in areas like Macraes Flat have seen native tussock grasslands burnt and oversewn with pasture to make way for grazing and farming. Endemic to the Central Otago area is the Otago skink, *Oligosoma otagense*, now restricted to only 8% of its former range. A proposed factor in this decline is the increasing fragmentation of the habitat surrounding rock tors, on which small groups of the lizards live. There is some evidence that conversion to pasture is negatively impacting dispersal between groups, and thus may be decreasing gene flow and genetic variation within the population. This work takes advantage of microsatellite markers now available for New Zealand skinks and statistical tools such as assignment tests to investigate the genetic structure of this species. The results of this work can then be considered when planning management strategies to maintain metapopulation structure and genetic diversity in the future.

Daily movements and activity patterns of the brushtail possum (*Trichosurus vulpecula*), characterised using global positioning devices

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Global positioning devices (GPDs) and geographic information systems provide an innovative tool for collecting and analyzing spatial and temporal information on a wide range of animal species. This presentation will describe the first successful deployment in the world of these devices on small mammals.

Miniaturised GPDs were attached to brushtail possums in a lowland mixed beech forest, in order to collect data regarding daily movement and activity patterns. Position fixes were obtained at fifteen-minute intervals, allowing estimation of multiple life history characteristics including home range size, habitat preferences, patterns of activity, and intersexual differences.

Results clearly showed several important trends. Possums repeatedly commuted from den sites within the forest up to 1.3km away to feed on either improved pasture or floodplains. All possums returned to den sites within the forest interior nightly. Over 95% of possum activity occurred between the hours of 6pm and 2.30am. Daily home ranges were linear in appearance and overlapping was common. The average distance traveled by males was significantly greater than that traveled by females.

These results demonstrate that by utilising GPDs in the field we can greatly increase our knowledge of possum behaviour and ecology. Better information on movement and activity patterns will lead to an increase in the efficiency of eradication.

A test of the biodiversity-stability theory: A meta-analysis of tree species diversity effects on insect pest infestations, and experiences from New Zealand's planted forests

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The diversity-stability hypothesis, which proposes that species-rich populations and communities are more stable than those of low species diversity, remains controversial. We present new evidence of a diversity-stability relationship in forest ecosystems, based on a world-wide quantitative review of studies comparing measures of insect herbivory on trees growing in mixed or single-species stands. A meta-analysis revealed that insect abundance or damage were overall negatively related to stand diversity, although the outcome was strongly dependent on the degree of insect host specificity and on the qualitative and quantitative composition of the tree mixture. These findings have important implications for the management of forests, especially planted forests which are expanding in many countries. Contrary to some predictions, New Zealand's plantation forests remain remarkably healthy and have so far experienced few significant insect pest problems. The indigenous looper *Pseudocoremia suavis* has occasionally caused considerable defoliation in *Pinus radiata* plantations in the past. We tested the hypothesis that pine stands with an understorey of indigenous shrubs have lower pest populations than stands with few understorey plants. Preliminary results from pine stands in Eyrewell Forest, North Canterbury, indicate that there appears to be a negative relationship between the abundance of *P. suavis* and the diversity of understorey shrubs. This may be related to effects of an indigenous understorey on the habitat quality required by natural predators and parasitoids of this defoliator.

Implications of differential sex allocation for endangered species management.

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Supplemental feeding has become a method of increasing reproductive productivity for several of New Zealand's threatened species. However, recent studies have suggested that the provision of supplementary food may result in skewed sex ratios particularly for polygynous species. Current research has shown that females are able to alter primary sex ratios and potentially increase their individual fitness. Advances in molecular sexing techniques have seen a large number of observational studies examining female sex ratio manipulation and results have been variable. Very few studies have tested experimentally for facultative control of primary and fledging sex ratios in free-living populations. In this study we examine sex allocation in hihi (*Notiomystis cincta*) using empirical data from supplemental feeding experiments. We measured primary and fledgling sex ratios, and chick survivorship and growth rates in relation to the provision of food and maternal age. Support for two hypotheses that explain adaptive deviations from a 1:1 sex ratio are evaluated. Feeders were provided to breeding female hihi on selected territories on Mokoia Island, Lake Rotorua. Molecular techniques were used to determine the sex of eggs/chicks. Primary sex ratios tended to be male biased under poorer conditions. However, fledging sex ratios for both treatments tended to be male-biased. This shift in sex ratio bias was the result of differential survival rates for males and females under the different treatments; in particular male offspring survived significantly better when raised on territories with supplemental food. Chick survival was also influenced by the sex composition of broods. Females in same sex broods had higher survivorship than females in mixed broods, whereas males in mixed sex broods had lower survivorship than males in same sex broods. Finally, while male and female offspring had different growth rates these were not influenced by food provisioning. Our results emphasise the importance of considering impacts of supplemental feeding on a variety of life history traits.

Effect of tree ferns on forest regeneration at Mt Pirongia: inhibition or facilitation?

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Tree ferns are a characteristic feature of northern New Zealand forests in which they are abundant in subcanopies and understoreys. As well as being a substantial component of developed forest, they often establish in tree fall gaps, after disturbance events, and on forest edges. Tree ferns therefore have the potential to markedly influence the trajectory and rate of forest development and secondary succession. We are examining the mechanisms whereby tree ferns could inhibit or facilitate the success of woody seedlings of different species on Mt Pirongia. Tree fern trunks are formed from woody rhizomes encased by a thick layer of adventitious rootlets, making them suitable as surfaces for establishment of woody seedlings. In forests of Mt Pirongia, tree ferns (mostly *Cyathea dealbata*, *C. smithii*, and *Dicksonia squarrosa*) provide 0.06-0.20 ha of trunk surface area per ha of forest area. Woody species epiphytic on these tree ferns represent a subset of the available woody flora; 93% of seedlings were *Geniostoma rupestre*, *Weinmannia racemosa*, *Quintinia serrata*, or *Melicytus ramiflorus*. These species are mostly characterised by having small wind-dispersed seeds in comparison with the larger bird-dispersed seeds of those species that are available but do not establish as tree fern epiphytes. Most tree fern epiphytes were small (< 30 cm tall) and occurred in the lowermost 2 metres of the trunk. There was no relationship between seedling height and height of the epiphyte on the trunk, nor did the presence of a frond skirt in *C. smithii* significantly reduce the number of epiphytes present on its trunk in comparison with its non-skirted congener *C. dealbata*. Dead tree fern fronds covered one third of the forest floor on average, and their distribution and abundance influenced the presence and abundance of woody seedlings. Our study suggests that tree ferns do affect forest regeneration processes mostly through interference and inhibition of woody seedling development.

Caching behaviour in New Zealand robins (*Petroica australis*)

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Food caching is an important component of the life history of many animals, yet the dynamics of caching behaviour are poorly understood. I developed a simple model that describes caching behaviour as a trade-off between storing food externally (in caches) and internally (through consumption). The model predicts that when faced with an over-abundance of food, birds should maximize caching rates only when competition for food is low. This prediction was then tested in an experiment with New Zealand robins (*Petroica australis*). Robins are monogamous birds that are territorial year-round; however males are competitively dominant to females. Two grams of mealworms were presented to both male and female robins, either when they were alone or with their mates. Results were generally consistent with theoretical predictions. Birds cached a higher percentage of worms when they were alone, and males had slightly higher caching percentages than females. Behavioural differences observed between sexes during trials could account for weaker differences between males and females. Although physically dominant, males often lost caches to females who stole and sometimes re-cached food originally stored by males. Overall results indicate that robin caching behaviour represents a trade-off between internal and external food storage, with caching being the preferred storage mechanism in less competitive environments.

Effect of extra-pair paternity on effective population size in a reintroduced population of the endangered hihi, and potential for behavioural management

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We collected genetic and behavioural data on hihi (*Notiomys cincta* an endangered New Zealand bird) reproduction after reintroduction to Mokoia Island to assess the effect of the hihi variable mating system on effective population size (N_e), and investigate the potential for increasing N_e through behavioural management. DNA fingerprinting revealed that 46% of chicks (n=188) resulted from extra-pair paternity, and 82% of broods (n=61) had at least one extra-pair chick. Of the extra-pair young, 34% (n=90) were from unpaired males, and the remainder were from paired males. Variance in reproductive success (VRS) among individuals changed between years. The relative variance among males and females depended on the sex ratio. VRS increased over longer time scales, the variance in recruits being three times higher than the variance in the number of hatchlings. This caused a decrease in our estimates of N_e/N (e.g. 0.29-0.39 among years for recruits). Extra-pair copulation increased variance in reproductive success by 150% in one year and decreased it by 30% in another year but this only caused a 4% decrease and 8% increase respectively to N_e/N . While there is potential to manage VRS in this species through behavioural management, a more important factor is adult lifespan which is the main correlate of lifetime reproductive success as well as the determinant of generation time. The high annual mortality rate in Mokoia hihi (females = 64%, males = 52%) has prevented the population from growing, so the key factors limiting N and N_e/N are the same.

What do we really know about possums?

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Because of their pest status in New Zealand, possum are one of the world's most researched marsupials. Despite decades of research, some aspects of possum ecology and behaviour critical to understanding their impacts and their current and future management remain poorly known. I will explore this issue using examples from recent research on the genetics of possum populations, possum population dynamics, possum impacts, possum dispersal, and possum parasites.

Coarse wood and direct transfer maximise invertebrate diversity in restoration of forest

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Invertebrate colonisation is a significant, but often overlooked, component of ecosystem restoration strategies, which tend to focus on establishing vegetation. Three restoration techniques were trialed at Waitakere Quarry, West Auckland: conventional planting into mixed overburden, conventional planting with added coarse woody debris, and direct transfer of live vegetation and 1.5 m tall stumps with attached underlying soil. Three controls were included: unrestored gravel overburden, cutover forest adjacent to the quarry, and Matuku Reserve. Invertebrates were pitfall trapped from January to July, 2002. Terrestrial invertebrate groups Acari, Collembola, Coleoptera and Orthoptera were assessed as potential bioindicators of habitat restoration success.

Direct Transfer had the highest invertebrate diversity of the restoration techniques, probably because insects were introduced in intact soil and litter on root plates which also provided refugia. Conventional planting with added coarse woody debris (CWD) also exhibited high diversity, attributed to the CWD providing refugia. This treatment had the greatest number of invertebrates and the highest vegetation cover, indicating the importance of vegetation in moderating humidity. Coleoptera and Cryptostigmata (Acari) had the most potential as bioindicators, as they occupy a wide variety of ecological niches and many individuals survive the translocation process. Direct Transfer is recommended for restoring invertebrate habitat, with supplementary planting of vegetation to maximise cover. Where direct transfer is not possible, CWD should be used with planting.

Is the sand daphne *Pimelea arenaria* suffering a regeneration problem and are mice (*Mus musculus*) contributing to this?

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My research investigated the declining native sand dune plant *Pimelea arenaria*, with the aims of (1) determining whether the plant is suffering a recruitment failure, (2) whether this failure, if found, is due to the plant being unable to produce viable fruit, and (3) if viable fruit is produced, then how does the introduced house mouse (*Mus musculus*) contribute to its decline.

Line transects through existing patches of *P. arenaria* found no seedlings and individual plant height measurements also showed an adult-biased population, suggesting a recruitment failure.

Both female and hermaphrodite plants are able to produce viable fruit. Hermaphrodite flowers produced twice as many fruit following natural pollination than female flowers. Only the hermaphrodite plants are able to autonomously self and so able to produce nearly 100 % fruit. Hand out-crossing increasing proportions of fruit set in female flowers, but not in hermaphrodite flowers, suggesting female flowers are naturally pollen limited.

Mice are known to eat the fleshy fruits of several native plants as well as the seed of some dune plants. A feeding trial was conducted with 16 lab mice left for 13 hours with *P. arenaria* fruit as the only food source. 96 % of the fruit presented was destroyed.

So there is a regeneration failure in *P. arenaria* populations despite individuals being able to produce viable fruit, the results of the feeding trial suggesting that mice may be a causal factor in this recruitment failure. Management strategies and further research needs are discussed.

Vegetation Succession in Estuarine Wetlands on Great Barrier Island, Northern New Zealand, Since c. 7500BP

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This paper is based on 18 pollen profiles from estuaries at Great Barrier Island. The driving factors of hydrosere were assessed and compared between a modern estuary (Whangapoua) and several buried before human impact (Awana-Kaitoke). The palynological results indicate that the Forsythes' Paddock, Kaitoke Swamp, and Awana sites were estuaries or open embayments c. 7500 cal. yr BP. *Avicennia* and Restionaceae pollen, and the low amounts of Cyperaceae pollen suggest inundation by sea water and little flow of freshwater. The period from c. 6000-1000 cal. yr BP was characterized by gradual freshwater intrusion into the swamps. By c. 6000 cal. yr BP, the Awana sites had become freshwater wetlands; Kaitoke made the transition at c. 4000 cal. yr BP, and Forsythes' Paddock c. 2300 cal. yr BP. The transition is evidenced by higher Cyperaceae/*Gleichenia/Leptospermum* pollen values, as a result of the local environment becoming drier. During the last millennium, the decline of forest pollen taxa and increase in *Pteridium* spores coinciding with a peak in charcoal indicates extensive anthropogenic deforestation. Successional shrubland and swamp forest declined. *Typha* swamp spread in the Awana-Kaitoke system. The whole vegetation from mangrove to freshwater swamp occurred within this phase in the Whangapoua Estuary. The hydrarch successional routes interpreted from the pollen sequences, show the early marine succession was linear, while subsequent freshwater succession routes were multiple. Disturbances (natural and human), interacting with autogenic factors (peat-forming plants), have been the driving factors of vegetation succession from estuarine to freshwater wetland on Great Barrier Island ever since sea levels stabilised c. 7500 yr BP. The results show that the intensive impact (mainly burning) during Polynesian times had a much greater effect on estuaries and swamps than the pre-Polynesian natural processes, greatly accelerating plant succession.

Population and survival estimates from a mark-recapture study for a translocated population of the Maud Island frog, *Leiopelma pakeka*.

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A population of the endemic Maud Island frog *Leiopelma pakeka* has been studied by mark-recapture techniques since an initial intra-island translocation on Maud Island, Marlborough Sounds in 1984-85. One hundred individuals were released at the same position in a small regenerating forest in Boat Bay from a remnant forest 0.5km away. Annual monitoring of both this and the source population typically involved a capture session of three to five nights duration. An intensive 20-night mark-recapture session was undertaken in 2002, which provides a comparative case study to the ongoing monitoring.

Program MARK was used to obtain population and survival estimates. There were 58 captures of 42 frogs made over the 20 nights. Ten of the 42 frogs were unmarked, representing local recruitment. The short-term consecutive nature of the study allowed use of Huggins' Closed Population Estimation for the population estimate, and Cormack-Jolly-Seber for obtaining survival estimates. The results are within the 95% confidence intervals of those from 19 years' recapture history.

The mark-recapture studies have also provided information on movement of frogs to other habitat areas within Boat Bay and morphological comparisons between the translocated population and the source population.

Aerial Foliar Browse Index monitoring of forests

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One of the roles of the Department of Conservation is to protect conservation values in areas managed by the Department. This includes reducing the threat from introduced mammalian species, such as possums, to native biodiversity. The Department uses various methods to reduce possum populations and the effectiveness of this control needs to be monitored to ensure that desired outcomes are attained. Often, the desired outcome for forests is a reduction of foliage damaged by possums and an increase in the health and productivity of the forest canopy.

Payton et al developed the Foliar Browse Index method ; a ground-based assessment of plant species to measure impacts of possums on forests and vegetation responses to possum control. The method uses permanently marked trees to measure trends in canopies and possum damage to leaves and stems. It was initially used in Wanganui Conservancy but was difficult and costly in inaccessible and remote terrain. The method has been modified by using a helicopter from which to view indicator species. The modifications to the Payton method are explained, and data are presented comparing ground-based and aerial monitoring.

Why do southern hemisphere birds lay smaller clutches? Using introduced birds to test Ashmole's hypothesis

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One of the best known, but least understood, life-history patterns is that the average clutch size of birds increases with increasing latitude in both the northern and southern hemispheres. Furthermore, this rate of increase appears to be greater in the north, so that at equivalent latitudes the clutch sizes of southern hemisphere birds are smaller than their northern counterparts. Ashmole's hypothesis argues that birds lay larger clutches in more seasonal environments, where lower survival during harsher winters results in an over-abundance of resources relative to the number of birds entering the breeding season. In addition to explaining the latitudinal gradient, this hypothesis could explain clutch size differences between hemispheres because southern hemisphere land masses are generally smaller, have a more strongly maritime influenced climate and are consequently less seasonal. To test this, we compared seasonal variation in the clutch sizes of eleven species of introduced passerine birds breeding in New Zealand with their counterparts in Britain, using the available nest record cards from both countries. Mean clutch sizes were significantly smaller in New Zealand for 9 of the 11 species. Mean clutch sizes also varied less throughout the breeding season in New Zealand than in Britain for most species. This pattern implies that birds perceive the New Zealand environment to be less seasonal. This result, along with the smaller clutch sizes observed in New Zealand, provide support for Ashmole's hypothesis.

Large-scale invertebrate responses to forest fragmentation

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We present results from the Hope River Forest Fragmentation Project which is the largest scale study of its kind, comparing fragmentation effects on invertebrates over a far greater range of fragment sizes and far longer edge gradients than previously attempted. A total of 233 flight interception traps were used to investigate area effects in forest fragments spanning six orders of magnitude in size and edge effects over a 2,048 m gradient. Species-specific responses to edge effects were discovered, with even closely related species exhibiting contrasting patterns. Responses of some invertebrates occurred over a very large spatial scale, with edge effects on species abundance patterns still in evidence at distances of more than one kilometre into forest. An undescribed species of *Megadromus* sp. was found only within the forest control, providing an extreme case of edge avoidance. Edge effects were significantly correlated with fragment area, as invertebrates responded strongly to edges in large fragments, but weakly in small fragments. A fragment area of one hectare is postulated as a threshold size for the detection of significant edge effects, and is supported by examining the responses of several species that displayed contrasting edge responses. The threshold effect is explained by referring to the prevalence of multiple edges and differences in habitat structure of small fragments.

Population Modelling: Theory and Practice in Conservation

David Fletcher

In this talk I will provide an overview of some important issues in the use of population models in conservation. In particular, I will consider:

- . Use of sensitivity analyses
- . Simulation or mathematics?
- . Important new methods of parameter estimation

I will illustrate the issues using examples from my own experience in providing management advice for species in New Zealand.

Ecosystem size and assembly history interact to affect species diversity: experimental evidence

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Although species diversity is often correlated with ecosystem size in a consistent manner, mechanistic explanations of whether and how diversity is related to size remain a central topic of ecological research. Rarely considered in understanding size-diversity relationships is the potential role of the history of community assembly. I conducted a laboratory microcosm experiment with freshwater protists and rotifers to test for interactive effects of assembly history and ecosystem size on diversity. The experiment used a two-way factorial design with four assembly sequences and four ecosystem sizes as treatments. Community dynamics were monitored for approximately one hundred generations. The results show that the assembly x size interaction can occur and that, through this interaction, assembly history can influence whether and when a significant relationship between ecosystem size and species diversity is observed. These results were most clearly demonstrated when diversity was measured as biomass-based Simpson diversity. The results also show that transient dynamics can last for such a long period compared to the generation times of the species involved that assembly history can play a significant role even in the absence of multiple stable states. Overall, this study suggests that assembly x size interaction may shape natural size-diversity patterns.

Leaf anatomy and stomatal conductance--Do foliar responses determine the shade-tolerance of homoblastic and heteroblastic seedlings?

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Heteroblastic plants by having markedly different growth habit, leaf size and shape between juvenile and adults, may have evolved in response to differences in light environment experienced at different life stages. We hypothesized that heteroblastic species, by having a fixed leaf morphology as seedlings would be more shade-tolerant than to homoblastic seedlings (plants that have slight changes in morphology between juvenile and adults). An array of leaf anatomical and stomatal responses influences the shade-tolerance of a species. We expected that in shade, seedlings of heteroblastic species would possess relatively more shade-adapted leaf anatomical attributes (thinner leaf blade, cuticle, palisade mesophyll, and greater stomatal density and stomatal area index = SAI) and lower stomatal conductance than homoblastic seedlings would. Four congeneric pairs of homoblastic and heteroblastic seedlings (*Aristotelia*, *Hoheria*, *Pseudopanax*, *Meliocope*) were grown in full sun (R:FR = 1.25) and deep shade (2% of full sun; R:FR = 0.25) for nine months. In shade, heteroblastic *A. fruticosa* and *M. simplex* had thicker leaf anatomical attributes but lower stomatal conductance relative to homoblastic congeners. However, with the exception of SAI, heteroblastic *H. sexstylosa* and *P. crassifolius* had thinner leaf anatomical attributes and lower stomatal conductance than homoblastic congeners. In full sun, heteroblastic seedlings were greatest in both leaf anatomical attributes and stomatal conductance. We conclude that the foliar responses of heteroblastic seedlings are more efficient than homoblastic seedlings under high irradiance, but vary in response to low irradiance.

Bat relocations in New Zealand: The long and the short of it

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The long-range navigation sense of bats is poorly understood. Studies of the short-range navigation senses of bats, and general navigation studies on other animals, infer that vision, sound and sight alone do not fit the requirements of long-distance navigation. The magnetic sense has been shown to play an important role in long-distance navigation in birds, and possibly fish. However, its use by bats has never been investigated. Magnetite, the element required for the magnetic sense to work, has been found in bats but its function (if any) is still unknown. This study aims to investigate the role of the magnetic sense in the homing ability of a small Vespertilionid bat, *Chalinolobus tuberculatus*. Adult male bats will be relocated outside of their natural home ranges, and their homing abilities studied. The role of the earth's magnetic field will be assessed using studies of release orientation behaviour pioneered at the University of Auckland.

The forced relocation of bats is unfortunately a common. Habitat loss is a global problem with many species being pushed towards extinction. When habitat is lost, either by intention or accident, little effort, if any, is made to relocate affected fauna. When attempts are made they often end in failure when relocated animals return, sometimes over great distances. The development of relocation protocols, based on a sound understanding of navigational abilities, would greatly increase the number of relocation attempts, and their ultimate success.

The influence of nutrients on stream algal biomass and invertebrate communities.

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High nutrient inputs have generally been identified as being responsible for the degradation of lowland rivers and lakes in New Zealand and internationally. Nutrients have been shown to influence algal community growth rate and composition. In turn algae can have strong effects on invertebrate communities (density, richness, composition, distribution, structure and function). The effect of nutrients on algal biomass and higher trophic levels was investigated to determine the importance of nutrient loading on stream ecosystems.

Twenty six agricultural streams were surveyed in the Manawatu region in February, 2002. Algal biomass was greater in streams with higher nitrate levels. Invertebrate communities differed in terms of the quantitative macroinvertebrate community index (QMCI), Ephemeroptera, Plecoptera and Trichoptera (EPT) individuals and taxa between sites with high and low algal biomass. Regression analysis was used to relate the "quality" of the invertebrate community to stream algal biomass. At 13.2 $\mu\text{g}/\text{cm}^2$ of chlorophyll a there was a dramatic shift in invertebrate community composition to more pollution tolerant taxa. Sampling of algal biomass should be included in state of the environment monitoring by regional councils.

Conservation lessons from forest edges in the Rodney district.

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The Rodney district of northern New Zealand was once extensively forested. Despite widespread habitat fragmentation and increasing dominance of agriculture and development it remains a valuable resource for biodiversity. The variation in remaining habitat dictates a strong management framework. In a study conducted in the forest edges of four remnant sites in the district it was found that both mobile and ground dwelling insect fauna exhibited a significant edge effect. How strongly this effect was exhibited depended on ecological and biological characteristics at the family group and species level. Moths in the study showed a positive or negative edge preference. This may be partially explained by differential degrees of mobility and or habitat host plant specialisation in individual species. Diversity within a site was as great or higher than diversity between sites, highlighting the problems of adequately monitoring or sampling fragmented habitats for conservation purposes. Relevance of this edge effect study extends to conservation applications for the less common moths in the region and a consideration of the impact exotic Lepidoptera may have on native forest. Given recent concerns about invasive insect fauna it is important we understand the processes of colonisation already occurring in our native forests. Data are separated on this basis and the extent to which exotic species have colonised these sites is discussed.

Small propagule size, genetic diversity and invasion success

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Genetic diversity provides material for adaptation to a changing environment. Both theoretical and empirical studies show that a loss of genetic variability may occur as a result of a founder event. The smaller the size of the founding population the more genetic diversity is likely to be lost as a consequence of sub-sampling from the source populations. Propagule size for a species invading a new environment is often small, especially when colonisation is at a great distance from the source populations. Broom twig miner (*Leucoptera spartifoliella*), a European moth accidentally introduced to New Zealand at least 50 years ago, is believed to have established from a small propagule size. It has, however, successfully colonised its introduced host plant, broom (*Cytisus scoparius*) in a wide range of environmental conditions throughout the country and is proving to be an effective biological control agent. The amplified fragment length polymorphism (AFLP) technique was used to compare the genetic makeup of populations from New Zealand with those from Europe to test the hypothesis that long-distance colonisation events have reduced the genetic diversity in New Zealand populations relative to those from the native range. Although New Zealand populations showed losses of genetic variability in comparison with the European populations, this was mainly due to losses in less frequent alleles, and overall genetic diversity was still high. This retrospective analysis of a self-introduced species reinforces the concept that small propagule sizes of insects may establish and become abundant without significant losses of genetic variability.

Tell me about your five minute bird counts

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Researchers have been doing five minute bird counts in New Zealand forests for nearly 30 years as a way of monitoring bird populations. The method has been used for everything from monitoring the impacts of logging and the effects of 1080-poisoning operations to a way of choosing which forests to protect for their importance to birds.

Between now and June 2004 I am compiling a catalogue of summary information on five minute counts that have been collected since the method was recommended by David Dawson and Peter Bull in 1975. I will also be investigating the need for assembling a database of historical counts. This paper is a call for researchers to contact me if they have any counts in their possession or know where they might be.

I will talk about the history of the technique and why it is used so much despite acknowledged limitations. Some of the counts from the 1970s and 1980s are very large and becoming increasingly valuable with time. It is hoped this project will generate interest in documenting this information before it is lost. I will discuss the value of five minute bird counts and talk about recent studies that have tapped in to historical data and the potential for doing more.

Two contrasting modelling approaches for predicting the future range of an invasive species: the Argentine ant in New Zealand.

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Predicting the future spread of invasive species, and the limits to their expansion, are important tasks for the applied ecologist. We illustrate two contrasting modelling approaches to this problem using the Argentine ant (*Linepithema humile*) in New Zealand, as a case study. The first approach is a degree-day model based on the temperature-dependent physiology of development, the second approach is a logistic regression model based on correlations between current distribution and climate. We discuss the strengths and weaknesses of each approach, including the problem of model validation. Both models predict greater suitability of northern sites, although running the degree-day model with data on soil temperatures suggests several sites in the South Island are also 'at risk' of invasion.

Patterns and coevolutionary consequences of repeated brood parasitism

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The lack of adaptive host responses to virulent parasites and pathogens is paradoxical. We demonstrate non-random spatial and temporal patterns of brown-headed cowbird (*Molothrus ater*) parasitism in three populations of two host species and hypothesize the existence of a relationship between individual hosts' experience with brood parasitism and the delayed appearance of egg-ejection strategies in exposed host populations. Using an explicit analytical model we show that higher rates of repeated parasitism of individual host females decrease the relative benefits of rejecter strategies when parasitism is particularly costly, thus potentially contributing towards the counterintuitive patterns that more vulnerable cowbird hosts are less likely to reject parasitic eggs. These results also imply that evolutionary equilibrium or lag are not always clear alternative paths to explain the non-evolution of parasite resistance.

Effects of Argentine ant (*Linepithema humile*) on arthropod fauna in New Zealand native forest

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Although the Argentine ant (*Linepithema humile*), a highly invasive ant species, has been in New Zealand over the past > 10 years, little is known about its invasion. Increasing spread and establishment of populations throughout New Zealand is disturbing because of the devastating impacts documented on native invertebrate biodiversities overseas. The primary aim of this study was to determine the impacts of Argentine ants on arthropods in native forest habitats in West Auckland. Pitfall traps at invaded and uninvaded sites were used to quantify ant and non-ant arthropod faunas. Argentine ants adversely affected native host ant communities. However, two ant species were found to be resistant to invasion. Argentine ant invasion reduced the abundances of a few orders of invertebrates while several taxa were more abundant in the presence of Argentine ants. Distribution and abundances of Argentine ant populations were monitored in this study from 2000-2003. Also, rate of spread was investigated to evaluate whether native forest habitats would be at risks from invasion. Measurements of foraging ant trails on monitored tree trunks revealed seasonal distribution patterns involving high activity in summer/autumn and low activity in winter/early spring. Argentine ants were found to be established primarily along the edge of the forest and did not invade into the interior of the forest during the study period. The results of this study are significant in assisting with the development of future research and management plans for this ant.

Molecular Ecology of Stoats in New Zealand

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New Zealand is home to three introduced mustelid species, the stoat (*Mustela erminea*), weasel (*M. nivalis vulgaris*) and ferret (*M. furo*). All of these species, especially stoats, pose significant risks to native species as they are extremely effective predators. Monitoring and control are also difficult because population densities fluctuate significantly between seasons and years.

This study is aimed at determining the population genetic structure of stoats in New Zealand in order to evaluate the utility of genetic approaches to estimating population densities in the field. These results will assist in developing monitoring methods that will greatly improve the efficacy of current and future control strategies.

Recently developed genetic markers (microsatellites) allow significant amounts of information to be gained about individuals by determining their genotype. Both mitochondrial (D-loop) sequences and microsatellite genotypes have been used to determine genetic variability from 19 populations throughout New Zealand. Mitochondrial DNA revealed only a single haplotype throughout the North Island, while four haplotypes were present in the South Island. In contrast, microsatellite loci display high levels of variability, indicating they will be of use in population monitoring. Temporal sampling results from two regions (Otago Peninsula and Coromandel) indicate there is little variation in the genetic structure of these populations at different times of the year. These results, along with preliminary results using microsatellite markers to assign parentage of blastocyst samples, will be presented.

Effects inbreeding and loss of genetic variation in population viability: do we really understand the processes and consequences?

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New Zealand conservation biologists have tended to downplay the importance of inbreeding in isolated populations, not only because there are more pressing concerns such as controlling introduced predators, but also because there are observational and theoretical reasons for thinking inbreeding depression might not be as costly in New Zealand populations as it is elsewhere. This is in contrast to 'overseas' literature where inbreeding depression is seen as a serious limitation to population recovery of small fragmented populations. Recent documented cases of isolated and declining populations suffering severe inbreeding depression are not representative of the situation in New Zealand. As long as introduced predators or pests are intensely controlled or eradicated, small relict populations in New Zealand show the capacity to increase dramatically without any introduction of new genetic stock. However, the existence of populations that have increased after genetic bottlenecks is not evidence that inbreeding is not harmful. One needs to know how many other populations went extinct, declined, or had their growth significantly limited because of inbreeding depression – data that are sorely missing for New Zealand populations. This paper examines the relationship between bottleneck size and recovery rates in isolated populations and tries to reconcile how populations can exhibit inbreeding depression and still grow and persist.

Social life of possums – implications for disease transmission

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Information on the contact behavior of wild animals is difficult to obtain for cryptic species but is important for understanding their social and mating systems. Such information is critical for understanding disease transmission in wildlife and for efficient biological control that depends on animal contacts to spread the control agent. This study reports the results of the first field trial of a newly developed proximity data logger, for measuring contacts between individual wild animals. The trial was conducted on brushtail possums (*Trichosurus vulpecula*). The trial focused on detecting contacts between female and male possums. The results indicate that such contacts are brief and rare outside breeding season. Contacts over 1 minute long happened episodically during the breeding season, at intervals coinciding with the estrous cycle of female possums. A female can have contact with up to 4 males during a breeding season. This may indicate promiscuity of female possums, which may facilitate spread of biocontrol agents that depend possum contacts. The data logger developed for and tested in this research has many potential applications for other studies of animal behavior in the wild.

Reassessment of the tracking tunnel index for rodents: its applicability and ‘calibration’.

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Ship rat (*Rattus rattus*) tracking rates of footprint tracking tunnels were compared with density estimates generated by removal trapping on three replicate removal grids in Tongariro National Park, New Zealand. The correlation of tracking rates to estimated density varied across the three sites but tracking rates were significantly correlated to density when data from the replicates were combined. The results obtained here compare well to those found in previous, geographically distant studies. To test the efficacy of removal trapping as a tool for the calibration of tracking tunnels, reinvasion of the removal trapping areas was assessed by ear clipping rats outside removal grids before removal trapping, and with analysis of the concentric catch pattern of rodents on the trapping grids. Little immigration was detected during removal trapping and density estimates were considered to be accurate. The findings highlight the importance of employing replicate treatments to incorporate variation in the index into the results. The applicability of the tracking tunnel index to different seasons and habitat types requires further investigation. Also, a standard protocol for the ‘calibration’ of tracking rates needs to be implemented so that reliable comparisons can be made between studies.

What constitutes a host for invasive defoliators?

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There has been a steady increase in the establishment of exotic forest insects in New Zealand. In the past, Lepidoptera, especially from the Northern Hemisphere, have been notably absent from the record. However, over the last decade four polyphagous moths, from families absent or poorly represented in the indigenous invertebrate fauna, have established and been the subjects of intensive eradication, or management, programmes. This gennulectory response to their arrival is partly driven by the accepted, but largely untested, ecological theory of island invasiveness.

Even polyphagous insects are constrained by diet and the high level of floristic endemism in New Zealand may well act as a defence for the indigenous flora. However, the standard tests of plant palatability, which support the decision making for incursion response programmes, often record a degree of acceptance of novel hosts plants. The assessment of the risk posed by this acceptance comes down to a reconciliation of both the physiological character, and the ecological context, of the potential host plant.

The results of the host-testing of three recent incursives, the white spotted tussock moth, the painted apple moth, and the gypsy moth, are evaluated to in an endeavour to address this reconciliation.

The relative (un)importance of introduced animals as pollinators and dispersers of native plants

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We review the importance of various native and introduced animals for pollination and dispersal mutualisms of New Zealand native plants, based on species lists and frequency of visitation to flowers or fruit. Introduced bird species make up 31% of the species lists of visitors to native fruits and flowers, but only make 5% of all visits. The most important introduced birds at native flowers (house sparrow) and fruits (blackbird) make only 3-4% of visits, about the same share of total visitation made by endemic stitchbirds and saddlebacks, despite these rare endemics being absent from 80-90% of our sites. Four natives (silvereye, bellbird, tui, kereru) make 89% and 84% of all bird visits to flowers and fruit respectively. The major shift since human arrival in New Zealand is not towards exotic birds, but towards reliance on the recently-arrived native silvereye, which makes 38% of all fruit visits and 31% of flower visits to native plants and has become the single most frequent bird visitor to native plants. For flower and fruit visits combined, silvereyes are 35% more important than bellbirds, twice as important as tui and more than three times as important as kereru. Introduced species are more important among flower visits by invertebrates (29% of visits), with *Apis*, *Bombus* and *Vespula* about equally important. However, more study is needed on the effectiveness of various flower and fruit visitors. Some visitors may not effect pollination or dispersal, and some plants may be reliant on a subset of visitors for effective service.

Spatial and temporal patterns of plant succession in freshwater wetlands on the Tawharanui peninsula.

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As part of research on the ecology of predominantly freshwater wetland ecosystems, patterns of plant succession were investigated at two scales: spatial and temporal. The study site was on the Tawharanui peninsula, 90 km northeast of Auckland. The vegetation was sampled at 5 sites on the peninsula with a total of 44 plots being surveyed. Monitoring of several environmental variables including water depth, hydro chemistry & soil aeration, was carried out at the main site, Hubbard's bush. Relationships between the measured environmental variables and the current vegetation were investigated with the intent of understanding present day zonation of the wetland vegetation and also the processes of succession and disturbance that have facilitated the development and in some instances loss of wetland on the peninsula.

The wetlands on the Tawharanui peninsula have been subjected to impacts from both natural processes including changes in climate and subsequent sealevel and more recently human impact by both Maori and European. Deforestation, drainage and wetland conversion to farming have all been contributing factors to the development of the present day landscape we see at Tawharanui.

Patterns in wetland vegetation were interpreted using TWINSPLAN classification and DECORANA ordination analysis. Through this analysis key community associations were identified and a probable pathway of wetland succession was formulated. A palaeoecological investigation, which included pollen analysis, sedimentology and C¹⁴ dating, provided a chronology of local environmental change back to c.6559 yrs B.P.

From mainland beech to island hardwood habitat: challenges of translocating mohua (*Mohua ochrocephala*) to Nukuwaiata, Marlborough Sounds

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In recent years stoat (*Mustela erminea*) and rat (*Rattus rattus*) numbers have increased due to a combination of heavy beech masts followed by mild winters. Many of the isolated mohua (*Mohua ochrocephala*) populations on the mainland have declined rapidly, highlighting the importance of establishing and maintaining translocated safety net populations on predator free offshore islands. In 1999 four mohua were translocated from Mt Stokes to Nukuwaiata, Marlborough Sounds. In 2001 this population was supplemented with a transfer of 27 mohua from the Dart Valley, Fiordland.

These two translocations provide an opportunity to study the adaptation abilities of mohua in a different habitat type, as they were transferred from beech forests to a hardwood/podocarp forest. Preliminary results show that only two of the original four Mt Stokes birds survived, having produced a total of three offspring over two breeding seasons. Of the 27 mohua translocated from the Dart Valley, only four now survive and none have bred. Data on habitat use, collected using time budgets, indicated that there were no differences between Mt Stokes and Dart Valley mohua in either the types of behaviours or the stratum layers used. Mt Stokes mohua spent proportionally more time in miro (*Prumnopitys ferruginea*), kohekohe (*Dysoxylum spectabile*) and hinau (*Elaeocarpus dentatus*), whereas Dart Valley birds preferred manuka (*Leptospermum scoparium*), miro and kohekohe. Preliminary invertebrate indices showed that the greatest abundance of invertebrates was found in miro, kohekohe, manuka, and rata (*Metrosideros* spp.). Therefore it appears that mohua allocate more time to tree species that have more abundant food resources.

The values of ecologists

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The popular stereotype of ecologists appears somewhat at odds with the ideal of the objective, detached, morally disinterested researcher. But to what extent and in what respects are ecologists 'greener' than their fellow scientists from other fields? I have analysed over fifty randomly selected publications of ecologists for explicit and implicit value statements. The analysis revealed an abundance of value statements. However, no bias was evident towards a conservationist or ecocentric environmental ethic such as suggested by the stereotype. I will suggest several alternative explanations for these results that take into account the ecologist's professional situation.

Is there a global relationship among leaf and root traits? – results from an intercontinental grassland comparison.

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Uncertainties regarding the relationship between how leaves and roots are constructed has impeded an integrated understanding of plant evolution and the efficient parameterisation of ecosystem models. To examine relationships between leaf traits, root traits, and climate across grassland regions that differ in their evolutionary history and ecosystem state factors, roots and leaves were collected 293 grasses at 77 sites in four grassland regions of the world: the temperate South Island of New Zealand; the tropical Northern Territory of Australia, sub-tropical eastern South Africa, and the temperate central grassland region of North America. For fine roots (<1mm) and leaves we measured six sets of corresponding traits that relate to resource acquisition and ecosystem carbon and nitrogen dynamics: root diameter/leaf thickness, tissue density (mass per unit volume), N concentrations, N¹⁵, lignin concentrations, and the soluble cell content fraction. Within regions there is a consistent set of relationships among leaf and root traits along nitrogen supply gradients. Sites with higher N supplies have higher N concentrations in leaves and roots, lower leaf lignin concentrations, and higher leaf tissue density than sites with lower N supplies. Seasonally freezing soils in New Zealand and North America may be responsible for lower root tissue density, lower lignin concentrations, and higher root N concentrations while N-limitation most likely causes less enrichment of plant ¹⁵N and finer root diameter than grasses from South Africa and Australia. A major classification of grasses (C3 and C4) does not substantially differentiate leaf or root traits. This study shows that a small set of environmental variables may explain the major global patterns of evolution and/or expression of leaf and root traits and can be used to increase the sophistication of global ecosystem models.

Can artificial nests be used to assess predation pressure on natural nests.

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The use of artificial nests to assess the predation pressure on natural nests has shown inconsistent results and thus has resulted in a lack of confidence in this method as a monitoring technique. This study was designed to test the validity of using artificial nests as a method of monitoring natural nest success. This large scale study involved 9 reserves located around the North Island New Zealand. Reserves ranged in size from 25-4000ha and had either a presence or absence of predator control. 30 artificial nests each containing two eggs (both real and artificial) were placed in each reserve for an exposure period of 21 weeks. Nests were placed at 75 meter intervals along transects which ran from the edge to the centre of each reserve. Predators were identified by teeth and beak marks left on the artificial eggs. For natural nest success the North Island Robin (*Pertioica australis longipes*) was used as the model species.

The known fate method (programme MARK) was used to calculate the artificial nest success estimates, losses associated with predator type (rats, birds and all predators) and the effect of using artificial vs real eggs in artificial nests for each reserve. Natural nest success was estimated for each reserve with Stanley, T R (2000) programme. Correlation analysis was used to look for a relationship between artificial and natural nest success estimates for each predator type. Monte- Carlo simulation was then used to test the strength of the correlation within the limits of the standard error.

The results of this study have shown that with the right technique artificial nests can provide an accurate index of the predation pressure on natural nests.

Tips on designing monitoring programs for the proportion of area occupied by a species.

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Monitoring the proportion of an area occupied by a target species may be a low-cost surrogate to estimating the species population size. Typically, in order to estimate abundance it is necessary to identify individuals so that the number of animals encountered once, twice, thrice, etc. can be determined. In some cases, the associated cost of collecting the appropriate information (e.g. marking and resighting animals) may be prohibitively expensive. Alternatively, recording whether a species is present at a monitoring site may be collected relatively cheaply as it is not necessary to identify individual animals. However for most species, there may be a reasonable chance of not detecting the species even when it is present at the monitoring site, i.e., there is a reasonable chance of recording the species as falsely absent. Methods have recently been developed that enable unbiased estimation of the proportion of an area occupied given that the species may be detected imperfectly. A requirement of these techniques is that sites must be surveyed multiple times within a reasonably short time period so that the probability of detecting the species can be estimated. In this talk some handy tips are given on how to efficiently conduct the multiple surveys, drawing upon simulation results and consulting experiences.

Seminar title: Local adaptation of the *Phormium tenax* (New Zealand flax) to microsites

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Local adaptation of plant populations requires heritable variation to occur among plants in response to specific environmental factors. To assess differentiation of plant responses to microsite conditions, I contrasted germination and seedling establishment characteristics of *Phormium tenax* from different populations and maternal families (i.e. offspring from different plants) in a common garden environment. Seed families from five populations throughout New Zealand were sown in three substrate types (clay, sand, and soil) and two moisture regimes (low and high), giving a total of six treatment combinations. I recorded percent germination and seedling emergence rate and after six months, percent survival, total seedling mass, shoot mass, root mass, the root to shoot ratio and seedling height. Populations were genetically differentiated for all seedling traits and significant variation was found among maternal families for both germination and establishment characteristics. There were also significant interactions between populations and the moisture level for seedling height and survival and between populations and the substrate type for root to shoot ratio. Maternal families varied in response to the moisture level for germination and seedling emergence and the substrate type for seedling size. These findings provide evidence of both heritable variation and local adaptation of *Phormium* to specific microsite conditions.

The Ecstatic Display calls of the Adélie penguin (*Pygoscelis adeliae*): the importance of being honest.

***Emma Marks and Dianne Brunton**

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Adélie penguins (*Pygoscelis adeliae*) are monogamous breeders, and as such must communicate effectively in the noisy environment of the colony. Mate recognition in extreme Antarctic environmental conditions is crucial for breeding success. The Ecstatic Display call consists of a chain of short staccato syllables followed by a longer rasping final syllable and, although recognised as a male territorial display, also serves to attract females during early pair formation. This study looks at the importance of the male Ecstatic display call in Adélie penguin mate attraction/pair-bonding and the role factors such as arrival time and nest quality/location play in this process. The research is based on the following hypotheses: that male body condition will be reflected in the Ecstatic call (an honest signal); that seasonal change in body condition will be reflected in a change in male Ecstatic call; that females are attracted to male Ecstatic calls and use them as a measure of fitness; that quality of nest location and nest quality may also be used as measures of fitness; and that male quality will be reflected in breeding success. Models of honesty based on Zahavi's handicap principle, have shown that costly signals are likely to provide the receiver with honest information regarding the condition of the signaller, because only superior individuals can afford to employ them. Data was collected during the 2000/2001 and 2002/2003 summer seasons on Ross Island in Antarctica. Results indicate that several of the Ecstatic call parameters are effected by changing male body condition and that arrival time, male condition and nest quality all play a role in breeding success. This suggests that the Ecstatic Display call could indeed be an honest signal of male condition and that females may critically assess potential mates using this call.

Testing a new way to measure the biodiversity of indigenous, invertebrate herbivores

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Insects are the most diverse group of organisms in the world and it is estimated that there are 20,000 species in New Zealand, most of which are indigenous. Surveys of the biodiversity of habitats, including monitoring the impact of changes in habitat management and progress in restoration projects, should include estimates of insect biodiversity. Up to now, the numbers of species and the difficulty of distinguishing them, has meant that only skilled entomologists could do this. Even so, in practice, estimates of insect biodiversity have been restricted to particular insect groups, such as butterflies, carabid beetles or ants.

Crop & Food Research have developed a new method that can be used by non-experts. It assesses invertebrate herbivores (insects and mites) that cause distinctive plant damage or invertebrates that have a distinctive appearance on their host plant. This paper reports the results of a pilot study to test the new method in an Auckland forest remnant and the subsequent development of this tool, now named Plant-SyNZ™.

Warm, wet and wild: the ecology of *Ascarina lucida* and some implications for the interpretation of palynological records.

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Ascarina lucida is a small tree species endemic to New Zealand. The species is uncommon in the North Island occurring as small, scattered populations. *A. lucida* was formerly abundant in the early Holocene, and has become increasingly rare over the past 7000 years. This decline in abundance is often attributed to climate change.

The distribution of *A. lucida* suggests an inability to survive severe frosts or droughts. Therefore, periods of abundance of this species in pollen records have been interpreted as periods of mild and moist climatic conditions. Recent research has experimentally confirmed the sensitivity of this species to climatic extremes. However, vegetation disturbance is also a major factor influencing its' distribution. A case is made for *A. lucida* being a pioneer species that regenerates following forest disturbance. Periods of *A. lucida* abundance were probably characterised by a warm, wet climate with periodic forest destruction caused by cyclonic winds. Peaks in the abundance of *A. lucida* therefore need to be interpreted with regard to both climatic variability and disturbance regime.

Restoring Forest: Should Theory Or Biota Dictate Management Options?

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The restoration management of native plant communities in New Zealand has been relatively ignored and poorly resourced. Frequently, legal protection and fencing is seen as the endpoint of the conservation of plant communities. Management strategies often rely on nursery crops such as manuka *Leptospermum scoparium*, broom *Cytisus scoparius* and gorse *Ulex europeaus* to enhance the natural succession of primary successional species to mature canopy. This study evaluates the effectiveness of these techniques at Shakespear Regional Park, Auckland, New Zealand in order to assess whether current management practises require modification. Indirect gradient analysis Decorana was used to determine the successional relationships between different vegetation associations throughout the landscape by interpreting the age and dynamics of existing stands in relation to dominant environmental variables. Results indicate that vegetation at Shakespear has undergone substantial modification since human clearance. Although the landscape is gradually reverting to forest, the nature of the progression was found to be complex due to spatial and temporal dynamics working together to influence the rate of succession. Fences enhance regeneration of species within remnants, but are not helping species expand into the surrounding matrix. Reasons for this failure were attributed to dense mats of pastoral grasses on the margins of forest remnants, and also to the lack of regeneration beneath dense manuka canopies, as a consequence of poor avian seed dispersal. Managers are urged to adopt an active management approach to short cut the successional process.

Do creeks serve as focal points for the invasion of *Hieracium lepidulum* into Canterbury catchments?

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Understanding how the spatial structure of the landscape influences patterns of invasion is important for understanding the spread of invasive species. Field observations indicate that the invasive weed *Hieracium lepidulum* is abundant in naturally disturbed habitats such as creek sides and landslide scars. These habitats are predicted to be more susceptible to invasion than relatively undisturbed habitats like forest and grassland. Since these disturbed habitats are sparsely distributed in the landscape, they tend to be missed from usual surveys. Nevertheless, they may be particularly important in serving as focal points for invasion and subsequent spread into adjacent less-disturbed habitats. To evaluate the hypothesis that creek sides are acting as focal points for the invasion and subsequent spread of *H. lepidulum* into surrounding vegetation, we surveyed the density of *H. lepidulum* in creek sides and in adjacent beech forest and alpine vegetation in the central Canterbury high country. The density of *H. lepidulum* was higher in creeks, and density declined with increasing distance from the creek into the forest, but not into the alpine vegetation. The density of *H. lepidulum* in creeks was positively correlated with *H. lepidulum* density in the immediately surrounding forest and alpine vegetation. These results support the hypothesis that creeks are acting as a source habitat for *H. lepidulum* invasion into both forest and alpine vegetation. The lack of a relationship between distance from creek and density of *H. lepidulum* in alpine vegetation may reflect a lack of dispersal barriers, such as those provided by a forest edge, that allows seed to disperse more evenly throughout alpine areas.

Selective browsing of southern rata with respect to leaf age by brushtail possums

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Young leaves are often higher in nutrients and more easily digested by herbivores than older leaves. In the absence of significant chemical deterrents in young leaves, herbivores should selectively browse younger leaves in order to maximise their nutrient intake. We identified the proportion of young (<1 yr), 2 yr and old (> 2 yr) rata leaves in the diet of brushtail possums (*Trichosurus vulpecula* Kerr) by applying the n-alkane method to stomach samples collected from Patterson Inlet, Rakiura. Availability was assessed from the relative biomass of each leaf age class on branches sampled from southern rata (*Metrosideros umbellata*) trees. Young rata leaves were higher in nitrogen, phosphorous, potassium and lignin than older leaves. Young leaves were also highly preferred by possums (Chessons selectivity index 0.87), comprising 88.7% of the rata diet on average, but only 39.5% of the standing leaf biomass. These data suggest that when modelling possum-plant dynamics, the foliage population should be structured by age.

The role of local vs. regional factors in determining native and exotic plant species richness in indigenous forest fragments in eastern Otago

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In order to understand the determinants of plant community structure in fragmented habitats, both local and regional parameters need to be considered. Species richness, for example, has often been investigated and explained either with factors operating at small scales, or with factors operating at larger scales, but rarely has their relative importance been assessed together.

We compared the ability of local (soil, tree stand structure) and regional (climate, surrounding land cover) parameters to explain variation in the species richness of native and exotic vascular plants at the plot level in forest remnants in coastal Otago. In order to identify important variables, we used Generalised Linear Models (GLMs) and a criterion-based, forward and backward stepwise variable selection procedure, with adjustments for multicollinearity. Despite several limitations inherent in this approach, we demonstrated that there may be quantifiable differences in the ability of local and regional factors in explaining patterns of richness in different groups of plant species.

The models explained between 28 % (herbaceous plants) and 54 % (trees) of the variation in species richness. Climate explained only 5 % of the variation in native species richness across all plots; however, in only the most undisturbed plots, this value was 40 %. Woody species richness was mainly explained by regional parameters, whereas the richness of non-woody species groups was explained by local factors to a large extent. The abundance of *Nothofagus menziesii* in the plots had a highly significant negative effect on the richness of some groups (total and tree species) but not others (fern and woody species). Exotic species richness was highest in small forest fragments in warmer areas.

The role of eradication of vertebrate pests within the Homocene era

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Regional and national ecosystems have become more homogenous as human activities break down barriers to the movement of biota. In New Zealand and Australia the largest risks of establishment of new vertebrate pests come from escaping pets, rather than from deliberate introduction as in the past. Excluding fish, Australia has 59 exotic vertebrates in the wild and 624 in captivity, while New Zealand has 70 in the wild and an unknown number in captivity. Which species currently in captivity should be removed or banned and should we know what we have? Eradication of established pests requires three obligate conditions to be met, and many risks and constraints overcome. This paper will talk about one obligate condition and one risk. The obligate condition is that all animals must be at risk. I will use predator-prey theory to explore how animals in refugia of different sorts might be put at risk. The paper will also address one risk factor – that survivors (or recent immigrants) should ideally be detectable. Detection probabilities and search theory will be explored using two strategic approaches to rodent eradication.

Every cloud has a silver lining: a biodiversity upside to the Kyoto Protocol

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Once the Kyoto Protocol is ratified by sufficient countries for it to become a legally binding document, developed (or Annex 1) countries are committed to collectively reduce their greenhouse gas emissions to 5 percent below 1990 levels by 2012. New Zealand's agreed target over this period is a reduction to levels pertaining in 1990. Countries unable to meet the required reductions have the option of purchasing credits from those who exceed their targets. To demonstrate compliance with the terms of the protocol each signatory is required to establish systems to monitor greenhouse gas sources and sinks. In this paper we report on the development of a nationwide network of permanent plots that is being established to estimate carbon stocks in New Zealand's indigenous forests and shrublands, and to monitor their change through time. When complete, the network will consist of approximately 1400 plots on an 8km² grid across the main islands of New Zealand. Sampling protocols are based on the standard 20mx20m forest plot, with additional measurements to calculate carbon estimates. The use of an existing biodiversity-based methodology is providing a wealth of data on the structure and composition of forests and shrublands, and has the potential to form the basis for a national-scale monitoring system for these communities. We conclude by suggesting that this plot network will provide opportunities for monitoring other elements of the New Zealand biota.

Extending the climate matching concept for feature extraction from databases of global invasive insect species distribution.

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An important part of the risk assessment of unwanted polyphagous insect species entering New Zealand is to identify global regions and analogous climates from which such species could invade. Process orientated models are often used to predict the potential geographical distribution of invasive species using climate parameters that describe the species observed distribution. Usually, a single species is modelled. More basic approaches to the determination of the likelihood of establishment, is simply to match the climates of where the species is normally found with that of the region where it is unwanted. We extend the concept of climate matching to extract important features from a database of the known distributions of 104 phytophagous insect pests. The match index function of a process orientated model, CLIMEX, was used to identify global regions that have a similar or analogous climate to Auckland, New Zealand. Published global distribution maps of insect pests of plants were used to record the presence or absence within these global analogous climates of the insect species that have established in New Zealand. The analysis showed that New Zealand shares most of its phytophagous insect invaders with South Eastern Australia (90%) and Western Europe (78%). Such an analysis provides additional information for an assessment of pathways of entry. It indicates that if a phytophagous insect species invades South Eastern Australia it is highly probable that it will invade New Zealand. In addition, close examination of those species that are established in these two analogous climates but have not yet established in New Zealand, would provide further information on the probability of invasion.

Patterns of range contraction in native New Zealand passerine birds

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Since human arrival, the range sizes of most native bird species have contracted, although by differing amounts, and some parts of the country have lost more species than others. The aim of this study was to identify factors underlying this variation by studying patterns of range contraction in 20 native New Zealand passerine species. We collected data on the distribution of these species in the 75 Ecological Regions of New Zealand using subfossil records (indicating presence pre-human or during Maori occupation), historical European records (indicating presence at some stage during European occupation) and present day records. From these data we identified the regions from which species had contracted during the two periods of human colonisation of New Zealand (Maori and European), and developed statistical models to identify: (1) what features of the regions were associated with greater or lesser amounts of range contraction, and (2) what attributes of the species could explain differences in the degree of range contraction, during both Maori and European colonisation. Regions that suffered the greatest loss of species tended to be those impacted more heavily by both Maori and European arrival. The strongest predictors of range contraction were the extent of deforestation during Maori occupation, and population size and the amount of cropping land during European occupation. Species that suffered the largest range contractions during both periods tended to be large-bodied species with low reproductive rates. Our results suggest that the patterns of range contraction reflect both variation in the severity of human impacts throughout the country and the differential susceptibility of species to those impacts.

Variation In The Success And Abundance Of Exotic Plants Along Natural Soil Fertility Gradients

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There is growing interest in understanding the success and subsequent impacts of invasive exotic plant species in ecosystems. However, no general framework has emerged for predicting which species will become invasive from morphological or other traits, or which systems are prone to invasions despite a large literature on the topic. An underutilised approach is to consider how the success and abundance of invasive species varies along natural productivity-stress gradients. We carried out surveys in calcareous fens which are characterised by natural soil fertility gradients from unproductive, marl-dominated substrates to more productive, peat-dominated substrates. Across all fens surveyed, the presence of exotic plant species strongly increased with soil organic matter (i.e., soil fertility) and the abundance of tussocks, but declined with total plant abundance. The abundance of exotic species was predicted by these same factors, but the sign of their effects was opposite to that observed for presence-absence (i.e., factors that were negatively associated with the presence of exotics, were positively associated with the abundance of exotics). Path analyses further revealed that increasing soil organic matter influenced exotic abundance mostly via enhanced litter and plant cover; after statistically controlling for these effects, native plant diversity significantly decreased the abundance of exotics. These results show that invasion success and abundance varies strongly along natural soil fertility gradients, but that biological effects, including the abundance of litter, tussocks and native plant diversity, can modify invasion success and abundance. These results suggest that disentangling the factors regulating establishment from subsequent population growth of invasive plants is necessary.

The browsing impact and abundance of European brown hares (*Lepus europaeus*) in the Central North Island, New Zealand

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The browsing impact and abundance of hares were investigated at several sites in the Central North Island, New Zealand. While the impact of hares on high altitude vegetation has generally been considered to be an issue of low conservation priority, they are now considered to be the main grazers in many alpine systems and there is large shortfall in knowledge.

The suitability of the cleared plot pellet counts for assessing hare abundance, habitat use, and biomass consumption was investigated was found to produce precise, easily obtainable results. It was found that hares numbers varied regionally and locally with habitat type, and season. Hare impact was assessed using a variety of techniques including the utilization of existing exclosures, the construction of new exclosures, and selected monitoring of preferred browse species. The long-term exclosure plots (although limited in number) indicated that hares were having no noticeable effect on any aspect of vegetation composition, either native or exotic in the Moawhango region. Conversely hares were having a significant effect upon the vegetation in Manson region of the Kaweka ranges. There, hare browsing appeared to be benefiting native species through the suppression of exotics grass species. In contrast, targeted monitoring of preferred browse species in Tongariro National Park showed that hares there browse heavily upon a range of native plant species. These results suggest that the degree to which hares impact native vegetation is dependent upon the level of exotic species present, and the landscape studied. Where exotic species are present (particularly grasses), they are the preferred browse species. Where exotic species are not readily available, or competition is high, hares then subsist at lower densities by browsing native vegetation. In some areas this browsing may have a significant detrimental effects on native biodiversity.

Establishment of native tree species into hill country pasture by oversowing.

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Planting native trees as seedlings is a popular and effective method of restoring indigenous vegetation to pasture-dominated systems. However, this approach can be expensive, and the development of low-cost alternatives is desirable for achieving biodiversity policy goals in production landscapes. Oversowing is a common method of pasture renewal, but revegetation of pastures with native tree seeds is viewed as ineffective. This paper reports on the germination and establishment of *Coprosma robusta*, *Hebe stricta*, *Cordyline australis*, *Dacrycarpus dacrydioides*, *Kunzea ericoides*, *Leptospermum scoparium*, and *Pittosporum tenuifolium* in a hill country pasture by oversowing. All seven species were sown in spring and autumn into pasture plots which had been sprayed with glyphosphate. Half of the plots were treaded with sheep after sowing to ensure seed-soil contact, while half the plots were left untreaded. After two months only the *C. robusta* and *H. stricta* had any germination success with little or no germination for the other tree species. The spring sown plots had significantly greater initial germination in the treaded plots than the untreaded plots, with no effect of treading on germination for the autumn sown plots. Germination of *C. robusta* and *H. stricta* in the spring sown plots was more rapid than the autumn sown plots, but the autumn sown plots had higher initial germination and greater seedling survival after 12 months.

The effect of burrow-breeding seabirds on forest regeneration, South East Island (Rangatira), Chatham Islands.

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South East Island (218 ha) supports >3 million seabirds and 5 endangered forest bird species. Burrowing and trampling by seabirds may negatively impact seedling regeneration, with implications for the viability of the forests. We surveyed the forests in order to: (1) describe the main forest communities, (2) to examine the impact of seabirds on seedling establishment (3) to examine the importance of canopy gaps for forest regeneration. Five forest communities were described using cluster analysis from forty 10 m² plots randomly located in forests across the island. Increment cores indicated that most of the present forest had regenerated after farming ceased in the 1960s. Exclosures (0.25 m²) to exclude seabirds were established in 30 of the forest plots. After nine months the number of woody seedlings was significantly higher in the exclosures than in the adjacent control plots, showing that seabirds inhibit seedling establishment. A canopy gap survey identified 14 small canopy gaps (0.73% of the 6 ha sample area). Seedling density was significantly higher in gaps than in adjacent non-gap plots but burrow density was significantly lower in gaps. These results suggest that canopy gaps allow forest regeneration despite the negative impacts of seabird burrowing.

Landscape indices and fragmentation: is there pattern in the process?

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We present data on current work examining the use of landscape indices in the study of fragmentation. Landscape indices have been developed over the past 10 years to quantify various aspects of ecosystem fragmentation including patch statistics (size, shape) and landscape pattern (contagion, interspersed/juxtaposition). First we review the development of those indices and the current thinking on them. Second we present preliminary results from our current review of approximately 1800 papers related to fragmentation over the past 5 years. Initial results indicate a fairly distinct dichotomy between remote-sensing/GIS studies-based studies and field-based studies. The former tend to use a large number of landscape indices describing all aspects of pattern and usually focus little on process. Field-based studies typically make use of two primary indices: patch size and patch isolation. Most studies delineate patch boundaries based on broad vegetation or land cover classes, e.g. forest, wetland, agricultural, etc. Studies involving distance measurements assume that patches are “isolated” without much additional insight into what that means, although they do attempt to link to the process of dispersal. Landscape indices should receive less emphasis as an end unto themselves. Instead, we should characterise the effects of pattern on specific process, e.g. population viability, gene flow, or nutrient flows. Understanding the interaction of pattern and process will ultimately prove more useful to conservation and restoration efforts.

New Zealand Sustainability: Halting the Denial

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We examined some current trends of the New Zealand economy and lifestyle with a particular emphasis on the ecological footprint. The ecological footprint attempts to measure sustainability by converting our activities such as resource use, consumption patterns, and waste generation into common units (area) and reflects commendable actions such as recycling and use of public transport. We calculated our personal footprints using the Ministry for the Environment footprint calculator. We also compared our personal footprints with national trends in key sustainability indicators.

Our own ecological footprints were larger than desirable, but we appear not to be unusual, because national trends in such indicators as energy consumption, use of fossil fuels, declining water quality, increasing population, loss of indigenous biodiversity or expenditure on consumer goods all suggest that New Zealand society as a whole is not sustainable. The numerous organisations promoting sustainability have had success in some areas (e.g. more recycling) but appear to have had little impact on bigger issues. We must develop indicators at a range of scales that quantify how long current levels of resource use, consumption and waste generation will last. More importantly, we must develop the individual and collective will to make hard and unpopular decisions about how much we extract, use, and throw away. Only then will we begin the transition to a truly sustainable economy and lifestyle.

Vegetation recovery in rural kahikatea (*Dacrycarpus dacrydioides*) forest fragments in the Waikato region, New Zealand, following cessation of grazing

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Vegetation was sampled in rural kahikatea (*Dacrycarpus dacrydioides*)-dominant forest fragments on similar soils but with different recovery periods (time since grazing ceased) in the Waikato region, North Island, New Zealand. Changes in vegetation were modelled against recovery periods ranging from 0 to 74 yrs and in relation to position (edge or interior). Indigenous species richness increased and adventive species (mostly pasture herbs) richness declined with recovery period; small tree and sapling density and seedling ground cover increased. Edge plots had higher adventive species richness, lower basal area (~biomass), more established seedlings, lower litter cover and higher grass ground cover, than interior plots. Some indigenous species, e.g., *Laurelia novaezealandiae* and *Myrsine australis*, increased with recovery period while some adventive species, e.g., *Solanum pseudocapsicum*, declined. The relative basal area of *Alectryon excelsus* increased significantly with recovery period at edges and of *Melicytus ramiflorus* everywhere. Twenty years represents a turning point in the recovery period, with the end of the loss phase of adventive pasture species, the start of the re-establishment phase of native ground layer and understorey species, and significant recovery of population structures of major species. In relatively non-weedy rural environments, retirement from grazing may alone be sufficient to ensure a return to near-natural states in 40-50 years.

Comparing Historical and Recent Bird Counts in Pureora Forest

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Using data from the large-scale five-minute bird count survey that was done in 1978-1981 in Pureora Forest Park, and a further survey in the same area in 1997-1998 which differentiated sites on the basis of pest control, we were able to compare bird count levels over this time period. The results suggest a dramatic decline over time (irrespective of pest control) in many small native insectivores, including the grey warbler, pied tit, fantail and rifleman, and some interesting patterns of increases in the larger birds. The study shows the value of historical bird count surveys for assessing long-term changes in bird populations, and suggests a need to make similar data sets from around New Zealand more readily available to researchers.

Globalising vegetation data management

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Growing volumes of ecological research data, and the need to use this data in new ways, push the boundaries of many initial options employed for data management. Current solutions such as solutions, such as standalone personal databases, spreadsheet data capture and even text-based systems, while mostly meeting restricted project scale goals will be limiting when scaled to national and global levels. Fragmented and potentially inconsistent data sets can develop, limiting their ability to interact with and contribute to global data sets in addressing large-scale questions.

To overcome these problems ecologists need to develop and adopt standard data structures, standard dataset descriptions, and data interchange formats to maximise the availability and usefulness of their data. One way to achieve this is to make use of organised data repositories, which are developing worldwide. Data repositories can accommodate both data sets collected in a structured way and those that are semi-structured or non-conforming. The critical aspects of such systems are their accessibility, data descriptions, support of data standards, and data exchange abilities. These facets allow global scale research to be conducted. Examples from the New Zealand Carbon Monitoring System project will be given to highlight these issues.

We present our experiences during ongoing developments of a long-term vegetation databank managed at Landcare Research. The National Vegetation Survey databank (NVS) (<http://nvs.landcareresearch.co.nz>) is New Zealand's largest archive for plot-based vegetation data. Structured data management and standard protocols allow NVS data to contribute to an increasing number of questions at national and international scales. Current activities include the development of a standards based general vegetation data model supporting a wide range of data types. Through interaction with similar international efforts, e.g. VegBank, data interchange will be possible allowing comparisons that contribute to ecological research and environmental reporting at a global scale, e.g. climate change and global biodiversity.

Do willows provide resources for native fauna? The influence of landscape context on the impact of an invasive weed

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Native animals often respond negatively to invasive weeds. This is because animals are often associated with resources that are plant specific. However, the surrounding landscape is also likely to have a strong influence on native fauna and their use of resources. Crack willow (*Salix fragilis*) has been used extensively for erosion and flood control in New Zealand and is now an invasive weed, particularly in riparian zones. There has been no attempt to quantify the benefits of willows to native fauna in terms of the resources willows provide. This study aimed to quantify the use of willow trees as a resource to birds and invertebrates and to determine whether willow use by fauna is dependent on landscape context. We examined bird and invertebrate communities associated with willow or kanuka (*Kunzea ericoides*) trees in riparian zones surrounded by either native forest or pasture. Bird and invertebrate communities responded differently at different spatial scales. Invertebrates responded strongly at the level of tree species; landscape context appeared to have little influence on invertebrate abundance, richness and composition. Lower invertebrate abundance and richness were associated with willow trees. Bird communities associated with native forest contained more native and endemic birds than those associated with pasture. Although birds were influenced by the landscape context, native and endemic birds within the native forest landscape were strongly associated with kanuka, while bird communities associated with willows in native forest were composed mainly of introduced species.

Biological Research at the U.S. Geological Survey

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The United States Geological Survey (USGS) Biological Resource Discipline (BRD) is the leader for biological research in the US Department of Interior. The mission is to provide the scientific understanding and technologies needed to support the sound management and conservation of biological resources in the United States. Following are the BRD Programs:

- Terrestrial, Freshwater, and Marine Ecosystems – This program guides the design and evaluation of scientifically based strategies to manage and restore ecosystems and landscapes.
 - Status and Trends - This program integrates monitoring programs that track the abundance distribution, productivity, and health of plants, animals, and ecosystems at the landscape, community, population, and genetic levels, and develops inventory and monitoring techniques and statistical methods applicable to resource management.
 - Fisheries: Aquatic and Endangered Resources - This program is focused on the study of fishes, fisheries, aquatic invertebrates, and their water-based or water-dependent habitats.
 - Wildlife: Terrestrial and Endangered Resources – This research is conducted on waterfowl, songbirds, large mammals, terrestrial plants, amphibians.
 - Contaminant Biology – This program investigates the effects and exposure of environmental contaminants to living resources.
 - Invasive Species – This program focuses on efforts to combat invasive species through early detection and assessment of newly established invaders, monitoring, improving understanding of the ecology of invaders and factors in the resistance of habitats to invasion, and development and testing of prevention, management and control methods.
 - Biological Informatics – The focus of this program is to develop and apply innovative information technologies to the management of biological data, information and knowledge resulting from worldwide research.
 - Cooperative Research Unit - This university-based program is a creative partnership with the USGS and State natural resource agencies to provide graduate education, research, and technical assistance.
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Distribution and Management of Weeds in Coastal Fiordland

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Coastal Fiordland forms part of Te Wahipounamu - South West New Zealand World Heritage Area and Fiordland National Park. Between 1996 and 1998 introduced plant species were recorded from 98 sites, from Milford Sound in the north to Puysegur Point in the south. The data are compared with surveys of 27 of these sites undertaken between 1969 and 1979. There are no consistent trends in species diversity – at some sites diversity has increased, at others decreased and, interestingly, at a few sites diversity has not changed at all over a 25–30 year period. A total of 79 weed species were recorded. Weeds were not present at 24.5% of the 98 sites examined. Not surprisingly, the locations with the greatest diversity of weeds are those that have had prolonged and extensive human settlement, e.g., Milford, Deep Cove, Puysegur Point. Aside from Milford and Deep Cove, Preservation Inlet is the weediest part of Fiordland. Yorkshire fog (*Holcus lanatus*) was the most widespread species, occurring at 40% of the sites. Weeds are dispersed through coastal Fiordland by water, deer, birds, wind and people. Management focuses on two widespread, sea-dispersed species: marram (*Ammophila arenaria*) and gorse (*Ulex europaeus*). Both species are capable of significantly altering this internationally significant natural area and are being controlled to zero-density. Annual surveillance and spraying are undertaken to keep these species at zero-density. Eradication is not possible because propagules are regularly dispersed from the heavily infested West Coast.

Alternatives to hypothesis tests - some conservation examples

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The use of hypothesis testing is widely criticised in the ecological and statistical literature and beyond, with papers like *The Insignificance of Statistical Significance Testing* (Johnson, D.J. 1999, *J Wildlife Management*, 63(3):763-772), and websites such as <http://www.indiana.edu/~stigtsts/> <<http://www.indiana.edu/~stigtsts/>> which have page upon page of criticisms from eminent statisticians. However, much as they are criticised, hypothesis tests remain pervasive, and referees often insist on them.

I will briefly review the pros and cons of hypothesis tests from a statistician's viewpoint, then concentrate on some practical examples where alternatives were more useful. Often, we are interested in the range of values for parameters of interest that are consistent with the data, but a hypothesis test only tells whether that range includes a particular value, e.g. zero. Estimating the size of a parameter, for example a treatment effect, along with a confidence bound or interval, will often have more practical value than a test - for example when making conservation management decisions. I present some examples, including how we analysed and presented the impact on tomtits of using carrot or cereal baits for 1080 possum control operations; the possible effects of transponders on a native snail; and the impact of an aerial brodifacoum poison drop on Little Spotted Kiwi on Kapiti Island.

Competition and hybridisation between indigenous grey duck and introduced mallard in New Zealand

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Three hypotheses – demographic ascendancy, genetic assimilation, and habitat destruction and disturbance – have been advanced to explain the demise of grey duck and the rise of mallard subsequent to the mallard's introduction to New Zealand one century ago. We developed models of relative population change over the past 60 years based mainly on hunters' diaries and used these to help evaluate the competing hypotheses. We concluded mallard's higher survival, fecundity and productivity, its physical dominance, and its willingness to exploit novel feeding opportunities, especially in proximity to human activity, have contributed to its significant numerical and competitive advantage. An apparently extensive hybrid swarm may be dominated by the mallard phenotype but evaluation of genetic exchange based upon phenotype alone remains problematic. Grey ducks and the grey duck phenotype may soon disappear from New Zealand, and a repeat of this process of displacement is possible in parts of south-eastern Australia

Dating the arrival of the Pacific rat (*Rattus exulans* or Kiore) and humans in New Zealand

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The Pacific rat or kiore (*Rattus exulans*) dispersed throughout the Pacific with human voyaging, and reached New Zealand in this way. Therefore the earliest evidence of rat presence also denotes the first human contact. Archaeological evidence and Maori oral tradition indicate New Zealand was discovered and settled in the 13th century. However, radiocarbon bone dating of the Pacific rat (*Rattus exulans*, or kiore) has challenged this conclusion by controversially placing the arrival of New Zealand's first introduced predator more than 1000 before initial human settlement. The early dates have been contested in the literature for numerous reasons.

The rapidly breeding and dispersing omnivorous kiore would have had a profound and immediate effect on the naïve native flora and fauna. Past direct impacts on the fauna are difficult to observe, as most prey items are either easily biodegraded and not preserved, or do not reveal cause of death. Most faunal declines observed before human settlement based on fossil bone frequency can only ever be circumstantially linked with rat predation. However, immediate effects on the flora can be measured. It is implausible that a fast-breeding, rapidly dispersing omnivorous rodent could persist in a predominantly forested environment for 1000 years and leave no sign of seed predation.

Woody seed cases of native trees preserved in peat deposits showing distinctive incisor gnaw-marks provide a reliable and unequivocal proxy for past kiore presence and an independent test of the time of kiore arrival in New Zealand. Rat-gnawed seeds offer many advantages over dating rat bone directly; rats regularly consume the seeds of widely distributed forest trees, seeds are produced in abundance and tend to be well preserved in peat and buried flood deposits. We present radiocarbon dates of rat-gnawed seed cases from two coastal peat deposits on opposite coasts of the North Island, which challenges the early rat invasion hypothesis.

Abstract: Poster Presentation (alphabetical by surname)

Cabbage Tree Seedling Responses to Soil Compaction: Implications for Ecological Restoration

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Cabbage trees are widely used in ecological restoration, often on retired riparian areas in farmland. However, in these areas soil compaction may inhibit plant growth. This study investigated the effects of soil compaction on establishment and growth of cabbage tree seedlings. A growth cabinet experiment tested responses of pre-germinated seeds to three levels of soil compaction in Brown and Ultic Soils. Increasing compaction reduced the number of seedling radicles penetrating the soil surface and decreased the speed of penetration. Root length of established seedlings decreased with increasing compaction. After 34 days mean shoot height was 35mm in the uncompacted treatment, 16mm in the intermediate, and 7mm in the high compaction treatment. Both root and shoot growth were significantly and negatively related to soil strength, being severely restricted above 0.6Mpa (Fig. 1). Grazed pastures in Tawharanui Regional Park had penetration resistances >3 MPa at nominal field capacity. Soil strength appears likely to reduce cabbage tree establishment and growth in pasture sites such as those at Tawharanui, thus impairing natural regeneration. The effectiveness of restoration using seeds or small seedlings may also be reduced at such sites until uncompacted soil develops in the absence of grazing.

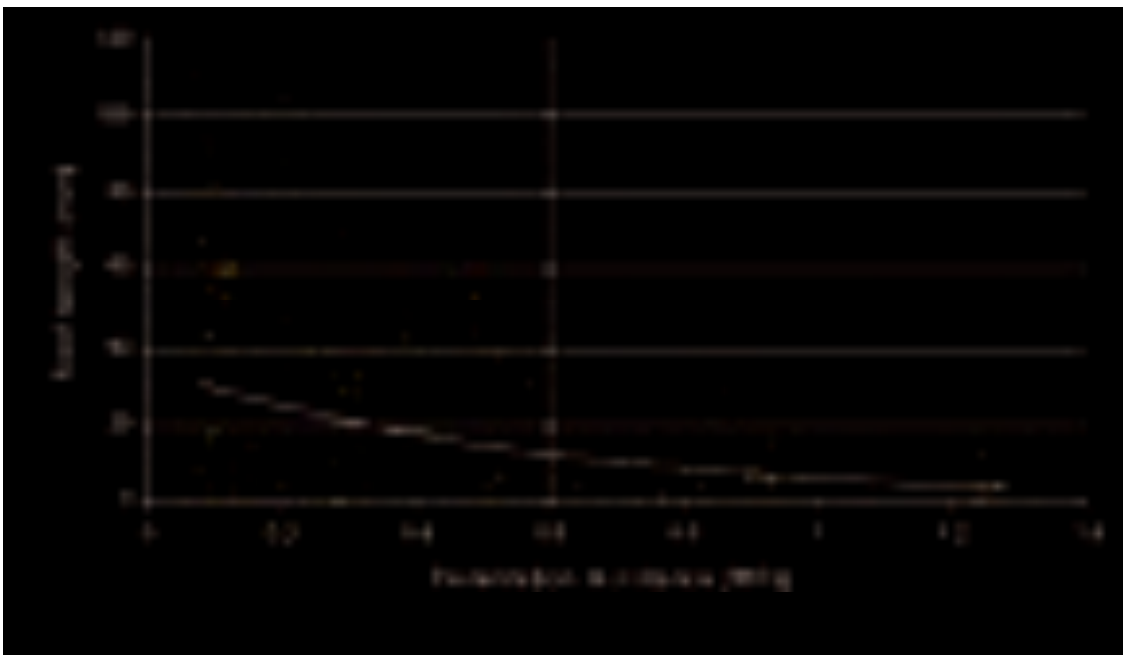


Figure 1. Cabbage tree seedling root length as a function of soil strength. Root length = $3.56e - 1.75P$ where P = penetration resistance. $R^2 = 0.22$

Operation Hope: Conservation in South Westland

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Parts of South Westland have until recently held some of the last remaining possum free forest within mainland New Zealand. Recent surveillance however has confirmed that these last few areas are now being colonised by possums, completing the final spread of this highly successful marsupial throughout the New Zealand landscape. Numerous pieces of research have shown that the majority of possum impacts occur as possums colonise an area and build up to peak levels. Thus it is far more effective to control possums before they reach peak levels than to try to restore ecosystems after possum populations have peaked. South Westland remains a national stronghold for threatened species such as the beech mistletoe *Peraxilla colensoi* and South Island kaka, with some of the highest kaka densities on the New Zealand mainland being recorded from this area. A substantial causal effect has been identified between possum colonisation and the decline of both these species. The importance of maintaining some representative areas of South Westland in a state unmodified by possums has been recognised by the Department of Conservation in the development of its possum control strategy. Operation Hope has been instituted by the Department's South Westland Area Office to maintain forest health within the Hope Valley, an area as yet unmodified by possums. The results of baseline monitoring and survey are described and the long-term objectives of the programme outlined along with results predicting the outcome of no management from similar areas colonised earlier along the possum invasion front.

Tree-ring analysis of late Holocene 'swamp kauri' from the Waikato Lowlands

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A significant rise in kauri pollen in palynological records from sites in the Waikato Lowlands after ca. 3000 BP has been attributed to the expansion of kauri onto the drier edges of bogs and lakes. Loose connections have been drawn between palynological evidence and the remains of preserved kauri stumps and logs in peat. However, little (if anything) is known about the actual age, structure and longevity of these 'swamp kauri' forests. As modern kauri commonly attains ages upwards of 600 years, and can exceed 1000 years, the expansion of kauri on to marginal environments may represent only a few generations. This poster presents a new multi-millennial sub-fossil kauri tree-ring chronology from the Waikato lowlands, derived from kauri recovered from two swamp sites near Huntly, Waikato and dated to ca. 3700 – 1700 BP. Germination, age and mortality trends evident in the dendrochronological record are explored for a period that is contemporary with expansion of kauri elsewhere in the Waikato Lowlands.

Are Weta Legitimate Dispersers of New Zealand Plants?

***Duthie, C & Burns, K.C.**

Victoria University of Wellington

Weta are a group of large, omnivorous insects endemic to New Zealand, which in the absence of native mammals are thought to perform similar ecological functions. As such, they might be expected to be important seeds dispersers. However, there are no documented cases of insects consuming fleshy fruits and dispersing seeds after gut passage (i.e. endozoochory). This study presents preliminary evidence that weta are legitimate seed dispersers of fleshy fruits. Fruits of a variety of plant species with different fruit and seed characteristics were presented to weta in captivity. Seeds excreted intact after consumption were placed in incubators, and their germinability was compared to seeds extracted from pulp. Seeds of many small-seeded plant species passed through weta in viable condition, and surprisingly, some subsequently had higher germination percentages relative to controls. Results therefore provide the first evidence of insect endozoochory, and suggest weta may be important seed dispersers in a variety of New Zealand plant communities. Future work will investigate the existence of a weta seed dispersal “syndrome” by 1) comparing their seed dispersal effectiveness to avian and reptile seed dispersers, and 2) evaluating the morphology of fruits and seeds dispersed by weta to those dispersed primarily by other dispersers (i.e. birds and reptiles).

Fruiting and flowering patterns of New Zealand plants and their importance to conservation

***Fyfe, J. & Burns, K.C.**

Victoria University of Wellington

New Zealand’s islands are often viewed as the last strong hold for many native bird species and are frequently used to manage their conservation. The availability of food resources on these islands is crucial for the survival and reproductive success of such species. Whilst New Zealand has no obligate frugivorous bird species, many terrestrial bird species are dependent upon fruit for their survival. Thus a thorough understanding of the abundance and timing of presentation of fruits on offshore islands is vital. This study will follow the fruiting and flowering phenologies of common bird dispersed fruiting trees on three offshore islands and one mainland island to determine temporal and spatial changes in fruit resource abundance. Foraging observations will also be conducted to document interspecific differences in diet. This information will be used to determine times of resource scarcity. These times of scarcity will be useful in determining which species could be successful if translocated to islands and to guide revegetation efforts to enhance the natural fruit food resource of a particular island.

Wai Care: How Successful is it? An investigation into urban water quality and community groups

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Community involvement in monitoring the ecological and physical health of urban waterways is an increasingly popular and undeniably valuable tool for natural resource management. As a result many partnerships are currently being forged between councils and communities concerned for the health of their local catchments.

Correspondingly it is becoming increasingly important to consider how we can measure the outcomes of these programmes in terms of their ability to help achieve positive environmental benefits through raising awareness and providing good quality monitoring data, in order to obtain maximum benefit from them.

This research focuses on the Wai Care programme, which resources and supports community groups and schools in monitoring an urban stream or water body of their choice on a regular basis in the Auckland Region. Some of these groups are motivated by involvement in Wai Care or otherwise, to restore habitats in their local catchment with the aim of restoring stream values such as biodiversity and general water quality. How we can encourage more groups and individuals to get involved in acting for their local environment in this fashion is another important question considered here.

This poster outlines results to date, including the criteria for success for the Wai Care programme as defined by stakeholders in Wai Care and relevant literature.

A degree-day model for the development of the Argentine ant, *Linepithema humile*, with implications for range limits in New Zealand.

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The Argentine ant, *Linepithema humile*, is an invasive species with the potential to cause significant economic and ecological damage in New Zealand. Pre-existing data from the literature were used to parameterise cumulative degree-day models for each developmental stage of the Argentine ant. A summary model was also developed, which suggested that approximately 445 degree-days above 15.9°C are required for complete development from egg to adult worker. Meteorological records of accumulated soil and air temperatures indicate that many parts of New Zealand fulfil this minimum temperature requirement on an annual basis, although it is cautioned that thermoregulatory behaviour, microclimatic considerations, biotic interactions and dispersal opportunities will also be important in determining the precise range limits of the Argentine ant.

Predicting the potential global distribution of the Argentine ant, *Linepithema humile*.

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The Argentine ant, *Linepithema humile* (Mayr), is a major pest species that has successfully invaded many parts of the world, including recent new records from New Zealand (1990) and Japan (2000). Because of the many adverse economic and biodiversity impacts of the Argentine ant, there is considerable interest in predicting how much further it might spread. We used existing records of the Argentine ant's worldwide distribution and global climate data (temperature and rainfall variables at a 0.5° latitude×longitude, resolution) to predict the potential geographic range of this species. Logistic regression was used for the modelling. Our "best" model showed a concordance probability of 0.93, between observed and predicted distributions. Statistical confidence in the predictions was assessed both at the level of model specification (i.e. using different subsets of the predictor variables) and through geographical partitioning of the data into multiple test and training sets (cross-validation). Results suggest that much of New Zealand (particularly North Island), central Madagascar, parts of Asia and a number of small Southern Hemisphere islands are climatically suitable for the Argentine ant, and vulnerable to future spread and/or invasion.

Planning for Success: an Integrated Management Approach towards Restoration of Motuihe Island, Hauraki Gulf

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The ecological restoration of islands as a conservation management tool offers a unique opportunity to ensure the long-term survival of New Zealand's rapidly declining biodiversity. It also provides an opportunity for people to become involved in community projects with the potential to raise awareness and an appreciation of issues surrounding conservation practices in New Zealand. Motuihe Island, located in close proximity to Motutapu and Waiheke Islands in the inner Hauraki Gulf is the latest island to undertake a community-based restoration initiative. The significant heritage and natural values of Motuihe Island provide the potential to successfully fulfil a wide range of conservation, social and recreation objectives.

The overall aims of this research are to develop a planning process for restoration within the framework of sustainability and to raise awareness of alternative options to sustaining conservation initiatives. Sustainability models, alternative paradigms, funding options and conservation legislation are examined in the context of planning for successful restoration outcomes.

Motuihe Island has had a long history of human presence and pastoral farming reflected in highly modified landscapes. The remaining fragmented vegetation remnants have been severely impacted upon by grazing stock, rabbit browse and weed infestations. The main objectives of this research are to determine past vegetation patterns through pollen core sampling in order to assist revegetation planning; to identify potential weed threats via seed rain analysis from starling roost sites; to establish consensus among various stakeholders for management; and to make recommendations towards an integrated management approach for the long term sustainability of the restoration of Motuihe Island.

Late Pleistocene and Holocene paleogeography of the New Zealand region

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The extent and configuration of terrestrial environments in the New Zealand region over the past 21,000 years has changed considerably in response to eustatic sea level fall and rise. Determining the shape and amount of land at different time intervals in late Pleistocene/Holocene has been frustrated by the potential unreliability of regional bathymetric maps. The advent of satellite altimetry, however, has allowed the inference of bathymetry from derived gravity maps and crustal modelling. The resulting bathymetry models provide good estimates of the average water depth of 2-minute squares, especially where local soundings are available for control. These maps give the broad outline of the New Zealand region and the position of islands at past sea levels, exclusive of tectonic and isostatic changes.

Based on this approach, a series of new paleogeographic reconstructions are presented for three different times (ca. 21,000 yrs BP, ca. 120m below present MSL; ca. 12,000 yrs BP, ca. 50m below present MSL; and ca. 6000 yrs BP, ca. present MSL) to show the distribution of land and the degree of inundation around the current coast of New Zealand including offshore islands. At the last glacial maximum (LGM), based on the 120-metre isobath, terrestrial environments covered ca. 438,000 sq kilometres, nearly double their current extent. North, South, and Stewart Islands were linked, as were all the Hauraki islands, with the exception of the Three Kings. Substantial land areas to the south of Stewart Island reduced the distance between subantarctic islands and the mainland, while at least one large island on the Chatham Rise abridged the distance to the much-enlarged Chatham Islands. Low-lying coastal plains were widespread along the southern and eastern South Island, along the west coast of the North Island, and around northern New Zealand. To the north, Norfolk Island was at least 50 times its present area during the LGM.

These maps have important implications for the terrestrial (and marine) ecological biogeography of the New Zealand region. They potentially provide population divergence times for vicariance events, identify likely terrestrial dispersal routes, and assist the categorization of ancient from modern islands on the continental shelf. Similar alternations in land connections occurred cyclically throughout the Quaternary.

Testing vegetation dynamics around Sponge Swamp and Tiniroto Lakes—a numerical analysis

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Recent research in community ecology has recognized the prevalence of non-equilibrium in vegetation dynamics. Nonequilibrium dynamics at the scale of 10^4 years has been validated by numerous pollen studies. However, the dynamics at shorter scales, 10^3 or 10^2 years, may be system dependent and controlled by local disturbance regime.

In order to test the vegetation dynamics at shorter scales, and examine the role of disturbance in this process, two sites with different backgrounds of disturbance are chosen. Sponge Swamp, located in Haast, southern Westland, is selected as the undisturbed site, contrasting with Tiniroto Lakes, Gisborne, as the site subjected to both volcanic and fire disturbance. Dryland pollen preserved in stratified sediment at both sites is used as a proxy measure of population of dryland trees around the sites.

Ordination analyses (PCA and RDA) were performed on pollen data to test the change pattern within each data set and to try to interpret this change with environment variables. The sample scores of the first PCA axis were examined for stationarity with autocorrelation analysis.

The result of this study indicated that nonequilibrium characterized the vegetation dynamics in both sites, in which vegetation composition is continually changing through time. The main variance of species data on the two sites might have been resulted from different mechanisms. Long term climate change, from warm and wet to cooler and drier, is probably the main reason responsible for the nonequilibrium dynamics on vegetation around Sponge Swamp, while the long time succession modified by catastrophic disturbance played an important part in vegetation dynamics around the Tiniroto site.

Apart from the trend brought about by the chief environmental gradient, vegetation dynamics around Sponge Swamp basically depended on the temporary permutation of rather small scales; but vegetation around the Tiniroto site is mostly explicable as being derived from its own immediate precursor on c.100 year time scale. Catastrophic disturbance, which could change the vegetation composition substantially, thus controlled the vegetation dynamics.

Ordination methods and time series analyses are confirmed as a useful tool in detecting vegetation dynamics from pollen data at short time scales.

Early Polynesian burning and vegetation change at Waipoua Forest, Northland, New Zealand.

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Pollen and sediment analyses throughout New Zealand show that Polynesian burning from ca. 800yrs BP to the time of European settlement resulted in half the islands' forests being cleared. Drier, fertile, lowland coastal areas underwent widespread burning, while in the wetter upland forest, burn sites were smaller and maintained by regular firing. Extensive archaeological evidence shows that Te Iwi O Te Roroa had major settlements near the coast, and their oral history tells that ancestors used inland forest clearings (or *waerenga*) for hunting kiwi. Using tree-ring and pollen analyses, Ogden et al. (2003) determined the date of initial burning at a clearing within the Waipoua Forest Sanctuary (named Tarahoka) to be ca. AD 1460, followed by 300 years of regular burning until ca. 1900. Although this finding was in agreement with oral history the authors concluded that 'the postulated sequence of formation, use and abandonment of the clearing requires confirmation by investigation of similar nearby sites using the same combination of methods'. This study will further investigate the nature and chronology of clearance at the same site and two others (Omaia and Tamahinetahi), using dendroecology, palynology, vegetation survey and oral history to reconstruct vegetation change both pre- and post-clearance. A comparison of pollen cores from forest interior and coastal sites will also be carried out.

The reliability of an infra-red burrowscope for detecting occupants of Sooty Shearwater (*Puffinus griseus*) burrows.

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Estimating the population size and studying the breeding biology of burrow-nesting seabirds can be difficult due to a lack of accurate methods for detecting burrow occupants. Traditional methods are often subjective, inaccurate or lack precision. The development of infra-red burrowscopes has overcome many of these problems, however several indications suggest that burrowscopes also consistently miss an unknown proportion of occupants. Features of burrow geometry such as corners and divisions, burrow substrate and adult birds can all prevent entire burrow systems from being revealed. This paper reports the results of a study that assessed the precision and accuracy of an infra-red burrowscope in detecting occupants of Sooty Shearwater (*Puffinus griseus*) burrows. Thirteen plots on three islands were burrowscoped by two sets of observers before being partially excavated to reveal true occupancy. Accuracy was consistent between islands at 83.79, 85.00 and 84.19 % on The Snares, Bench Island and Putauhinu respectively. Inaccuracy was largely due to missing occupants, although a proportion of occupants on The Snares and Putauhinu were double counted. A correction factor based on the aspects of burrow geometry that predict detectability of occupants was developed, and will be applied to data obtained during sooty shearwater population monitoring.

What causes low fruit set in native shrubs? Case studies of two species with different reproductive strategies.

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Alseuosmia macrophylla, from Maungatautari Mountain and the Mamaku Plateau, is a multi-stemmed shrub that produces fragrant, cabernet-red flowers in spring, and occurs in conifer-broadleaved forest, sometimes as a dominant component of the shrub layer. The flowers are hermaphrodite, self-incompatible, and pollination experiments indicate it is pollen limited at these two sites. Bellbirds have been observed nectar feeding from the flowers, and are likely to be a major pollinator. *Alseuosmia* spp. are highly palatable to deer and goats, and occasionally to possum. Although not severely browsed at either of the study sites, the loss of pollinator/s seems the most likely cause of poor reproductive output and, in the long-term, may have a negative impact on population viability.

Melicope simplex is a small-leaved, single-stemmed dioecious shrub growing to approximately 6 m tall. It occurs on the margins or in light-wells of native forest, including in fenced kahikatea remnants in the Waikato region, although often in small numbers there. *M. simplex* appears to be one of the native species that has benefited from forest fragmentation during the last century, by taking advantage of the increase in edge habitats. *M. simplex* produces small, cream flowers in spring, and at two geographically separated study sites in the Waikato (Pukemokemoke Bush Reserve and Gordon Gow Scenic Reserve), pollination experiments have shown it to be pollen limited at both sites. Interestingly, both populations are dominated by female plants. Poor reproductive output may be the result of inequitable gender distribution, or may be the result of inadequate pollinator activity. Loss of male plants, canopy closure, and/or alteration in edge characteristics that reduce light levels are potential factors that may cause vulnerability in small populations.

Environmental predictors of vascular plant species richness on an island archipelago, South Wellington Coast, Wellington, New Zealand

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The theory of island biogeography predicts that species richness on islands varies as a function of island area and isolation. However, little is known about how other island attributes, such as susceptibility to disturbance, influences species richness. This study investigated 45 islands on the South Wellington Coast, Wellington, New Zealand, to determine which of five abiotic variables best predicted vascular plant species richness. A census of each island was conducted on foot, revealing 63 species of vascular plants. "Wave disturbance", area, elevation, isolation from the mainland, and isolation from the nearest island inhabited by vascular plant species, were measured. Multiple regression revealed that area was the primary predictor of species richness, while "wave disturbance" was marginally related to species richness. When large islands were removed from analyses, the ability of "wave disturbance" to predict species richness increased. Overall results suggest that disturbance is an important process in determining species richness on small islands.

Latent heat flux in evapotranspiration and fossil energy inputs as two predictors of biodiversity: a pilot study with soil invertebrates.

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Several hypotheses relate the sustainable carrying capacity of a region to the ratio of imported (fossil) energy and natural energy flows. This “energy investment ratio” can be thought of as a macro-measure of development – regions with low investment ratio have more services provided by the natural environment, while regions with high investment ratio have significant human impact. A ratio of fossil energy inputs and latent heat flux (i.e., evapotranspiration) can be used as an indicator of degree of disturbance, and possibly as predictor of biodiversity. I investigated the relationship between fossil energy inputs, evapotranspiration, and diversity of soil invertebrates (Acari: Oribatida) in several temperate land use systems. The diversity of Oribatida is a robust indicator of environmental stress at the same scale as humans perceive it – with their long adult life (1-3 years), slow development, low fecundity, low metabolic rates, and low dispersal abilities, these tiny saprophages and mycophages are most diverse in stable and well-structured soil environments.

Fossil energy inputs were estimated from literature data and field measurements. Actual daily evapotranspiration was modelled using remote sensing data (Landsat 7), meteorological data, and field measurements. Soil Oribatida were sampled in replicated sites representing selected land use systems.

The model showed that the diversity of soil Oribatida was negatively correlated with the energy investment ratio. It is possible that the ratio of fossil energy inputs and latent heat flux in evapotranspiration can serve as a variable integrating both biomass productivity and degree of disturbance in large-scale biodiversity analyses.

Movements of Tui across the forest-urban gradient, and implications for conservation.

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Habitat restoration can counter habitat loss provided that habitat selection and dispersal processes of affected species are understood. Tui, *Prosthemadera novaeseelandiae*, a New Zealand honeyeater, typically breeds in native forest remnants, then appears in the urban/rural landscape in winter where it feeds mainly on introduced plants. Conservation of tui is important because it is one of the few endemic species regularly observed in urban areas and because of its critical role in pollination and seed dispersal. However, tui long distance movements and their implications for conservation are not well understood. In Hamilton, planting of native species in lowland areas has been proposed to conserve honeyeaters. We are studying tui movements to determine if planting could be used to increase the tui population. This involves addressing three questions: (1) Who moves and why? In addition to food variability, models of tui distribution should include social constraints and inter-individual variability. (2) Would planting increase the tui population and if so, how should it be done? Data are needed to determine whether tui leave bush fragments because of local food scarcity. Moreover, movement patterns should be characterised to decide where to plant. (3) What are the limits of urban planting as a conservation strategy? Tui movements between bush and urban areas could increase weed spread and decrease native plant dispersal. Also, planting in urban areas may merely enhance tui conspicuousness rather than abundance. To answer these questions, we will observe reproductive success, movements and diet of colour banded individuals in and outside the bush fragments.

Ecological effects of rabbit haemorrhagic disease in New Zealand 1997 – 2003.

John Parkes, Grant Norbury

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Rabbit haemorrhagic disease has persisted at most places in New Zealand and generally suppressed rabbit populations. We describe the benefits of fewer rabbits in terms of increased vegetation biomass, fewer predators and lower control costs. However, removing most of the dominant herbivores from grassland systems in New Zealand also has ecological costs with a diet shift among the surviving predators, more weeds, and more competing animals such as hares and possums.

Woodhill Forest: a case study in Ecosystem Management and sustainability

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Ecosystem management recognises that even scientifically derived management decisions are value based and require the consideration of both ecological and social factors. Woodhill Forest, a multiuse forest in close proximity to Auckland, offers economic, recreational, spiritual and ecological benefits to a large variety of people. The potential for implementing an Ecosystem Management approach to the contentious management issues related to conservation areas and fallow deer (*Dama dama dama*) is assessed. 1. The susceptibility and response of the native vegetation to deer browse was assessed by combining a browse index and a seedling ratio index. The sub-canopy was found to be dominated by unpalatable / browse resistant species. 2. The fallow population was assessed by indirect sampling (browse and faecal pellet indices) and computer modelling. Both deterministic and stochastic models suggested that zero growth of the population is highly unlikely and that culling of more females most significantly affected growth. 3. An anonymous postal questionnaire was distributed to stakeholders. Opinions related to deer, conservation and management responsibilities were diverse. Desired outcomes and management options were identified. In keeping with the objectives of Ecosystem Management the options recommended include protecting the biological reserves, reducing but sustaining the fallow population, consultation facilitated by Carter Holt Harvey and the establishment of a committee that ensure good information sharing and communication between stakeholder groups.

New and Improved! Satellite Imagery in Fine-Scale Habitat Use Studies.

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The Mackenzie Basin, South Canterbury, contains the nesting place of the world's rarest wading bird; the black stilt, or kaki. Trapping has been carried out in the basin to protect kaki and other ground nesting braided river birds for 20 years with limited success. Nests are still lost, predominantly to cats, ferrets and hedgehogs. One potential reason for this is the lack of knowledge of fine-scale habitat use by predators. This information could improve trap placement, and therefore catch rates. This study investigates the use of very high resolution satellite imagery in the study of fine-scale habitat use by ferrets and hedgehogs in the Mackenzie Basin. The satellite image was obtained from a new commercial satellite, IKONOS, and has a resolution of 4 metres. Hedgehogs and ferrets are tracked using the spool and thread technique. This method provides data of an accuracy high enough to match the resolution of the satellite image. These tracks are overlaid onto a habitat map created from the image, and analysed within Geographic Information System (GIS) software to determine patterns of habitat use.

Long-term forest dynamics of Otari-Wilton's bush: Effects of possum control

***Siva, A. & Burns, K.C.**

Victoria University of Wellington

Otari-Wilton bush is a 75-hectare reserve dedicated primarily for the preservation of New Zealand's native flora. It consists of a remnant stand of broad-leaf Podocarp forest, which once dominated the Wellington peninsula. Possums have been identified as a serious threat to New Zealand's forests. They were introduced to the Wellington area in the 1880s, but no major control efforts were undertaken in the reserve until 1993. Our research investigates the effect of possum control on the temporal changes in forest structure. We aim to resurvey six plots (30 x 30 m) that have been periodically monitored for nearly a century (1934, 1984, 1992). These plots were last surveyed in 1992, just prior to the control of possums with a long-term poisoning program. These plots will be expanded in 2003-2004 (50 x 50 m), all plants taller than 1m and height will be permanently tagged and seedling densities will be measured within 1 m² subplots. Canopy measurements from 1932, 1992 and 2003-2004 will be compared to identify the changes in recruitment of canopy trees over the past century. Densities of seedlings, saplings and adults will also be compared among census intervals to investigate changes in the relative abundance of common tree species. Results will hopefully generate a better understanding of long-term effects of possum eradication on broad-leaf Podocarp forests.

Ecological and behavioural constraints to the breeding success of the North Island Kaka.

***van Horik, J., Bell, B. & Burns, K.C.**
Victoria University of Wellington

Predation is the primary threat to the survival of Kaka (*Nestor meridionalis*); however predator free mainland islands and off shore islands continue to exhibit low breeding success. I plan to investigate limitations to the breeding success of Kaka by investigating several potential social and ecological constraints to breeding success. I will monitor nest sites on Kapiti Island and the Karori Wildlife Sanctuary comparing productivity in post-eradication habitats with pre-eradication data. Fruit abundance and vegetation structure will be sampled to determine potential ecological constraints to breeding success. Preliminary observations have shown that groups have social hierarchies with dominants being more reproductively successful. Less dominant animals might cooperate with more dominant members to rear offspring. Helpers in return may learn valuable foraging strategies and improve their social status, thus increasing their chance of gaining a high quality territory for future breeding. Vocalizations utilized to explore dominance hierarchies via manipulations of context specific playbacks. An understanding of ecological constraints and social structure will be an important conservation tool when maintaining populations via translocations and will increase our understanding of the breeding behaviour of one of New Zealand's threatened parrots.

Sensory perception and acquisition learning in tuatara (*Sphenodon*).

***Kevin L. Woo, Nicola J. , Maree Hunt, David Harper, Charles H. Daugherty & Ben D. Bell**
Victoria University of Wellington

Scientific investigation of the sensory world and behaviour of the tuatara (*Sphenodon*) has been very limited. However, this study incorporates both ecological and psychological theories to test discrimination and sensory perception. Tuatara were trained under an operant conditioning procedure to respond to various discriminative stimuli (S^+). Preliminary results have shown discrimination of flicker fusion rates (2.65-25.06 Hz) in visual stimuli. Subjects have also demonstrated learning capabilities. We intend to proceed with other aspects of visual discrimination as well as audition, and establish the basic groundwork for chemoreceptive studies in reptiles. The results of this study may aid in determining what aspects of visual stimuli are important to tuatara (i.e., predator/prey/kin recognition, mate selection, background versus foreground discrimination, and communication). The study aims to generate and establish a reliable method that can be used to far more depth psychophysical experiments to further access perception and learning all reptiles as well as providing some initial data on the visual perception of tuatara.

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