CONFERENCE BOOK

Biodiversity NOW

29 JUNE to 3 JULY 97

The 1997 joint annual conference of

New Zealand Ecological Society (Inc.)

The Entomological Society of New Zealand (Incorporated)

SYSTANZ
Association for the study of biodiversity

Supported by

Ministry of Research, Science and Technology
Te Manatu Putaiao

Department of Conservation
Te Papa Atawhai

TE PAPA
OUR PLACE

CENTRE FOR CONTINUING EDUCATION
Te Whare Pukenga

VICTORIA UNIVERSITY OF WELLINGTON
Te Whare Wananga o te Upoko o te Ika a Maui

Biodiversity Now Conference Book

Biodiversity Now The joint annual conferences of the New Zealand Ecological Society, Entomological Society of New Zealand and SYSTANZ Systematics Association of New Zealand. An opportunity for scientists, policy makers and managers to discuss issues that surround the preparation of the New Zealand Biodiversity Strategy.

Biodiversity Now - from Sunday 29 June-Thursday 3 July at Victoria University of Wellington, Maclaurin Lecture Theatre

Biodiversity Now - Conference Organising Committee:
Paul Blaschke, Tony Cairns, George Gibbs, Kath Dickinson, John Holloway, Fran Kell, Mary McIntyre, Wendy Nelson, Don Newman.

Published by the Conference Organising Committee June 1997

STUDENT POSTER AWARD
The Victoria University of Wellington School of Biological Sciences, as host to the conference, is pleased to offer a prize for the best student poster presentation ($100 and merit award $50). Please place a red sticker (available at registration desk) at the top right hand corner of your poster to indicate that this was work done as a student.

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The Conference Organising Committee gratefully acknowledges the generous support of the Museum of New Zealand Te Papa Tongarewa for the production of this Conference Book.

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	Peter Bridgewater, Environment Australia
11:55	*Managing New Zealand's biodiversity: Identifying the priorities and widening the options.*
	Ian Atkinson, Ecological Research Associates of New Zealand

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	Strategy and policy session: General issues
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	Chris Richmond, Department of Conservation
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Tuesday 1 July - Concurrent sessions - Systematics

Venue : Maclaurin 2

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9:30	*Molecular Systematics of the Orange Fronted Parakeet* **Wee-Ming Boon**
9:50	*Conservation implications of cryptic diversity in the black mudfish, Neochanna diversus.* **D Gleeson et al**
10:10	*The evolution of feeding behaviour in carnivorous snails: Phylogenetic evidence from Wainuia.* **Murray Efford & Dianne Gleeson**

10:30 Morning tea

	Chair: **Jessica Beever**
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11:20	*Flower biology of Geniostoma ligustrifolium* **Phil Garnock-Jones & Mary Endress**
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12:30 - 1:30 **SYSTANZ AGM in Maclaurin 2**

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Venue : Maclaurin 3

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9:30	*Provenance variation in fuchsia and in relation to palatability to possums* **P Sweetapple & G Nugent**
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10:30 Morning tea

Chair: **Judith Roper-Lindsay**

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12:20 - 1:30 Lunch

12:30 - 1:30 **SYSTANZ AGM in Maclaurin 2**

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Biodiversity Now Symposium - Part B - Assessment

Tuesday 1 July Venue : Maclaurin 3

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2:45	*Biodiversity and ecosystems: grasslands, islands, and afterlife effects* **David Wardle, Manaaki Whenua Landcare Research**
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3:35	*Systematic ecological entomology: mutalism in studies of system diversity* **J A Hutcheson, Forest Research Institute**
4:05	*Setting priorities for ecosystem conservation management* **T Stephens, Department of Conservation**
4:30	*Marine biodiversity, conservation, and sustainable development: from invasions, and sedimentation impacts on marine environments to bioprospecting and sustainable development of marine resources* **C Battershill, National Institute of Water and Atmospheric Research**
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	Conference Dinner at The Skyline restaurant **Upland Road, top of the Cable Car**
6:30	**Predinner Drinks - Cash Bar**
7.30	**Dinner served**

Biodiversity Now Symposium - Part C - Management

Wednesday 2 July Venue : Maclaurin 3

Chair: **Don Newman, Department of Conservation**

8:30	*Unit of biodiversity management: A review of species concepts* **Charles Daugherty & Michael Tracy,** **Victoria University of Wellington**
8:55	*Genetic diversity in fisheries research and management* **Peter Smith,** **National Institute of Water and Atmospheric Research**
9:20	*Hybridisation: how, or should it be managed?* **Murray Williams, Department of Conservation**
9:45	*The organisation and rationale of domestic livestock conservation* **Hugh T Blair, Massey University**

10.10 Morning tea

Chair: **Susan Timmins, Department of Conservation**

10:40	*The ecological re-juvenation of Matiu/Somes Island* **John Sawyer & Peter de Lange, Department of Conservation**
11:05	*Ecosystems frameworks for addressing biodiversity management* **Di Lucas, Landscape Planner**
11:30	*Management of ecosystems in the rural landscape* **Liz Wedderburn, AgResearch**
11:55	*Community attitudes to biodiversity management* Victoria Froude **~~Marg O'Brien~~, Department of Conservation**
12:20	*Summary comment on the symposium*

12:30 - 1:30 Lunch

12:40 - 1:30 Slide show Maclaurin 3
Southern Connection Congress II, Valdivia, Chile, 1997

Wednesday 2 July - Concurrent sessions - Plant Ecology

Venue : Maclaurin 2

Chair: **Ross Beever, Manaaki Whenua Landcare Research**

1:30	*Environmental corelates of tree alpha-diversity in New Zealands's primary forests* **J Leathwick**
1:50	*Biodiversity now...and then: Pollen diversity in pre- and post-Taupo sediments* **J Ogden & M Horrocks**
2:10	*Peat bog antiquity and resistance to environmental change* **J Shearer**
2:30	*Climatic effects on Sphagnum wetland dynamics* **Jill Stanley et al**
2:50	*Ecology and management of red (copper) tussock (Chionochloa rubra ssp. cuprea) grassland in southern NZ* **C Bycroft**

3:10 Afternoon tea

Chair: **Carol West, Department of Conservation**

3:40	*Structure and stand development of kahikatea forest remnants in the western Waikato* **B R Burns**
4:00	*Disturbance of successional vegetation on the shoreline of Lake Waikaremoana: Effects of lake level management* **C Ward**
4:20	*Management of the Phormium yellow-leaf phytoplasma* **R E Beever et al**

4:45 Presentation of awards and close of conference

Venue : Maclaurin 3

7:30-9:00 PUBLIC SEMINAR

The Future Eaters: Lessons from the past
Tim Flannery

Venue : Maclaurin 3

Wednesday 2 July - Concurrent sessions - Animal Ecology

Venue : Maclaurin 3

Chair: **Kerry-Jayne Wilson, Lincoln University**

1:30	*Biodiversity of freshwaters: Status and threats* **I K G Boothroyd & B J Smith**
1:50	*Roost selection and social structure in long-tailed bats (chalinolobus tuberculatus): Limiting factors and implications for population viability* **Jane Sedgeley & Colin O'Donnell**
2:10	*Assessing the suitability of Mokoia Island for hihi* **John Perrott et al**
2:30	*Colour preferences in weka* **Lynette Hartley et al**
2:50	*Preliminary results - Costs and benefits of aerial 1080 possum poisoning operations to North Island robins in Pureora Forest Park* **Ralph Powlesland et al**

3:10 Afternoon tea

Chair: **Gary Bramley, The University of Waikato**

3:40	*Surviving brodifacoum: effects of rodent eradication on morepork* **B Stephenson & E Minot**
4:00	*A pilot study of the impacts of pollard 1080 baits on forest invertebrates* **Greg Sherley et al**
4:20	*Predation on lizards by small mammals at Pukerua Bay, Wellington* **Colin Miskelly**

4:45 Presentation of awards and close of conference

Venue : Maclaurin 3

7:30-9:00 PUBLIC SEMINAR

The Future Eaters: Lessons from the past

Tim Flannery

Venue : Maclaurin 3

Wednesday 2 July - Concurrent sessions - Entomology

Venue : Maclaurin 1

Chair: **Allen Heath, AgResearch**

Molecular biology for insect control

1:30 *Introduction : New, environment-friendly insecticides*
Regine Blattner

1:50 *Endocrine strategies for arthropod control and ecdysteroid receptors*
S Huang & A Heath

2:10 *Experiences with sick and wobbly possums: searching for the unknown in the unexplored, and finding the unexpected*
J O'Keefe

2:30 *Transgenic insects : a new means for pest control?*
M Scott

2:50 *Strategies to use single gene products for pest management*
J Christeller

3:10 Afternoon tea

Applied entomology

3:40 *Incidence of woolly apple aphid in a genetically diverse apple planting*
Peter Alspach & Vincent Bus

4:00 *Host plant refugia for managing pest resistance to transgenic brassicas and potatoes*
P J Cameron et al

4:20 *The establishment of fruit crop arthropod pests: and their natural enemies in NZ: from way back to the future*
J G Charles

4:45 Presentation of awards and close of conference

Venue : Maclaurin 3

7:30-9:00 PUBLIC SEMINAR

The Future Eaters: Lessons from the past
Tim Flannery

Venue : Maclaurin 3

The Future Eaters: Lessons from the past

Tim Flannery
Australian Museum

Venue : Maclaurin 3

Wednesday July 2, 7.30pm-9pm

The Future Eaters has been one of the most discussed scientific books over the last few years. The author, Tim Flannery, gives a challenging comparison of evolution in the four regions of Australia, New Guinea, New Caledonia and New Zealand. He seeks to understand the reasons for similarities and differences in their biota before human impact, then studies the impact of the first indigenous peoples and then of Europeans. The book seeks to find the truth, rather than just the acceptable conclusion. Tim Flannery will outline his main ideas and then four New Zealand researchers will comment from their area of interest. The programme then has time for audience questioning.

Tim Flannery's visit made possible by

Manaaki Whenua Landcare Research

PUBLIC SEMINAR

ABSTRACTS OF PAPERS PRESENTED AT BIODIVERSITY NOW

Incidence of woolly apple aphid in a genetically diverse apple planting

Peter Alspach &Vincent Bus
HortResearch

Over a four year period from 1991 to 1994 apple seedlings derived from 500 mainly open-pollinated families of diverse origin throughout the world, including *Malus sieversii* from Central Asia, were planted at three sites in New Zealand. The aims of this project are to establish and maintain biodiversity within the *Malus* germplasm for genetic studies and cultivar development. It is expected that such a population will provide sources of mono- and multigenic resistance to a wide range of pests and diseases.

Data collected to date on Woolly Apple Aphid (*Eriosoma lanigerum*) infection on one sub-population at one site provide evidence for both monogenic immunity and multigenic resistance. The interpretation is complicated by the non-random spatial distribution of the pest. This distribution is investigated using a statistical technique which is widely applicable in ecological point pattern investigations.

Biodiversity management - setting NZ priorities

Ian Atkinson
Ecological Research Associates of New Zealand

Six priorities are identified for the future management of New Zealand's biological diversity. These are the need for a wider understanding of what the nation's biodiversity includes, the need to involve a wider sector of society in protecting and enjoying biodiversity, the need to develop a genuine ecosystem approach to the management, increased efforts to control invasive species, more rigorous programmes for restoring biodiversity, and a change in the attitude towards the application of scientific research and technology to biodiversity problems. There are opportunities to increase options with all these priorities.

New, environment-friendly insecticides

Regine Blattner
Industrial Research Limited, Gracefield Research Centre, P O Box 31 310, Lower Hutt, New Zealand

The Carbohydrate Chemistry Team at Industrial Research Limited became interested in insecticides as the result of extensive work with glycosidase inhibitors which included the chitinase inhibitor allosamidin, a microbial fermentation product. Chitinase inhibitors have insecticidal activity due to their ability to interfere with the moulting process. The novelty and selectivity of this mode of action makes them attractive alternatives to the traditional nerve poisons.

Whereas allosamidin was discovered overseas and reported in the literature, several other new natural products with interesting pesticidal properties have been isolated and characterized in New Zealand.

The practical application of these products as agrochemicals is however precluded by the limited amounts available from the natural source on the one hand, and the complexity of their structure which prevents efficient chemical synthesis on a large scale, on the other. We are therefore using them as lead compounds in an effort at simplifying their structures without concomitant loss or conceivably even with a gain in activity and selectivity.

Marine biodiversity, conservation and sustainable development: from invasions, and sedimentation impacts on marine environments to bioprospecting and sustainable development of marine resources

Chris Battershill
National Institute of Water and Atmospheric Research, Wellington, New Zealand

There is probably no section of coastline or continental shelf, globally, which has not been influenced by human activities. At small scales and over relatively short terms, point source discharges or accidental pollution events impact local marine environments with immediate and usually obvious effects. Over large spatial scales and time periods, sediment runoff exacerbated by human activity on land, has possibly already caused substantial change to marine biodiversity. Whether these impacts have been casual or catastrophic remain unknown. Between these extremes are other impacts associated with increasing use of seas by shipping and aquaculture, where introductions of foreign marine species can potentially cause major restructuring of communities. A summary of recent work from New Zealand is presented to examine these issues.

Additionally, marine resources are becoming increasingly sought after as food or for applications such as drugs and industrial biocides. Commonly, the species concerned are either important in characterising habitats or fill top trophic levels. Alternatively, they are rare. Bioprospecting and sustainable development of new marine resources can be intimately linked with principles in marine conservation. An example is provided where development of new pharmaceutical and marine industry is coupled with fundamental marine ecological research and biotechnology. Here, maintenance of marine biodiversity is central to future industry based on marine natural products.

Management of the *Phormium* yellow-leaf phytoplasma

R E Beever[1], L W Liefting[2], M A Andersen[3], P W Sutherland[3], R L S Forster[3]
[1]*Manaaki Whenua Landcare Research, Private Bag 92170, Auckland*
[2]*School of Biological Sciences, University of Auckland*
[3]*HortResearch, Private Bag 92169, Auckland.*

Phytoplasmas (mycoplasma-like organisms, MLOs) are obligate plant-inhabiting prokaryotes which cause a variety of lethal and non-lethal plant diseases, including many so-called 'yellows' diseases. They occur within the phloem sieve tubes and are vectored by phloem-feeding insects such as planthoppers and leafhoppers. *Phormium* yellow-leaf (PYL) disease was first recognised in 1908, and subsequently became an important limiting factor for the fibre industry based on *Phormium tenax.* The flax planthopper *Oliarus atkinsoni* was implicated as a vector of the disease in 1951, and it was concluded at that time that the causal agent was an endemic virus. However, the demonstration of phytoplasma profiles in affected plants - using electron microscopy in 1969 - implicated a phytoplasma as the cause. Sequence studies of 16s rRNA demonstrate that the PYL phytoplasma falls in the aster yellows group. It is very closely related (if not identical) to a phytoplasma associated with grape disease in Australia, raising the possibility that it is an exotic rather than indigenous organism. Symptoms include intense yellowing of older leaves and vascular damage in the rhizome, followed by plant collapse and death. PYL is known from both *P. tenax* and *P. cookianum*, and has been recorded from both the North and South Islands. Widespread death of plants associated with PYL is usually associated with ecosystem disturbance, including wetland drainage; in recent years it has caused death of *P. tenax* planted in restoration projects. Possible management options include removal of sources of infection, control of the vector using pesticides and through habitat management, and use of resistant flax selections. The desirability or otherwise of attempting to manage the disease will be discussed.

Social wasps vs native caterpillars - can we even the odds?

Jacqueline Beggs
Manaaki Whenua Landcare Research, Nelson
Email: BeggsJ@landcare.cri.nz

Introduced common wasps (*Vespula vulgaris*) can reach very high densities in beech forests containing honeydew-producing scale insects. We used an experimental approach to test whether reducing the abundance of wasps increases the survival rate of native invertebrates. Kowhai moth caterpillars *(Mecyna maorialis)* were placed out on potted plants in each of four sites at Nelson Lakes National Park, and their rate of removal was measured. We reduced wasp numbers in two of the sites by poison baiting for 4 years, and achieved a 55% to 70% reduction per annum. Caterpillar survival rate in the poisoned sites increased in comparison to the non-poisoned sites. Large caterpillars had a lower survival rate than small caterpillars. Predation rates were high - for instance only about 20% of large caterpillars survived for 3 hours in the peak of the wasp season. The implications for caterpillar populations and the level of wasp control required will be discussed.

The organisation and rationale of domestic livestock conservation

Hugh T Blair
Department of Animal Science, Massey University, Palmerston North

Each year, domestic livestock contribute some 40-50% of New Zealand's export earnings from the sale of produce based on meat, milk and fibre. While this figure has steadily declined in recent decades, it is clear that our economy is heavily dependent on livestock production. In the 1970s, concern was voiced, internationally, regarding the perceived narrowing of the genetic base from which animal production was being generated. The pig and poultry industries were already dominated by a small number of international companies who provided breeding stock to commercial producers. At the same time, the American Holstein dairy cow was beginning to dominate the international dairy herd. For mammalian farmed species, this dominance was assisted by improvements in reproductive technologies such as artificial insemination and embryo transfer, which enabled the rapid global dissemination of genetic material.

In an attempt to halt the loss of livestock breeds, a number of national and regional domestic livestock conservation groups were established such as the Rare Breeds Survival Trust (UK), Pro Specie Rara (Switzerland) and the Rare Breeds Conservation Society (NZ). Currently, there are some tens of organisations internationally and many of them have had to learn their modus operandi by trial and error. In 1991, Rare Breeds International (RBI) was founded in an attempt to provide an umbrella group that could provide advice to fledgling conservation groups. RBI wish to provide a non-government parallel to FAO which represents governmental interests in livestock conservation. RBI have also made approaches to become affiliated to IUCN under the Species Survival Commission. The importance of domestic livestock diversity was also identified in the Convention on Biological Diversity, to which New Zealand has become a signatory. Under this Convention, a number of countries will have to resolve the, often significant, conflict of interests between conserving exotic livestock versus indigenous fauna and flora.

In general, conservation organisations were founded by "grass-roots" people who were concerned at the loss of individual breeds. Typically, they did not dwell on the rationale behind their actions. It has only been more recently that some scientists have challenged the belief that livestock breeds should be saved on the expectation that their genotypes will become important at some time in the future. Aside from the genetic insurance rationale, there are other reasons as to why rare breeds may be conserved. The most important of these is saving breeds for historical-cultural-religious reasons. This author believes that the conservation of most western-based domestic livestock breeds will eventually be justified on the basis of historical importance, rather than genetic insurance. Given that there are some 1100 million cattle in the world, it is difficult to argue they are rare! However, there is need for quantitative study of several issues in domestic animal conservation to clarify the previous statement. These include genetic distances between breeds, and as to whether it is quicker to modify currently popular breeds to some new standard by within-breed selection or whether genes should be introgressed from "unimproved' rare breeds into currently popular breeds.

Molecular systematics of the orange fronted parakeet

Wee Ming Boon
Institute of Molecular Systematics, School of Biological Sciences, Victoria University of Wellington

Parakeets of the genus *Cyanoramphus* occur in the South Pacific from the tropics to the subantarctic. The Orange Fronted Parakeet *(C. Malherbi)* belongs to the genus described above. It is currently very rare and occurs only in the North Canterbury region of New Zealand. It did once occur in the Stewart Island and may have been present on Auckland Island. Due to high degree of subspeciation that has occurred on isolated islands, some forms of Cyanoramphus have very limited distributions and thus very vulnerable to extinction; the Orange Fronted Parakeet being one of them. There are 3 or possibly 4 extant species and numerous subspecies in the genus *Cyanoramphus.*

The Orange Fronted Parakeet has had a confusing taxonomy since it was first described in 1857 but pre 1900 records on them have been rather confusing and unsubstantiated. The Orange Fronted Parakeet is now considered a colour morph of the yellow crowned parakeet and has been relegated synonymy with *C. auriceps auriceps.* Morphological and allozyme work in the past has not reached a consensus on the specific status of the bird.

Currently, the specific status of the Orange Fronted Parakeet is still unresolved. This paper reports the early stages of DNA analysis of the Orange Fronted Parakeet from sequencing of the mitochondrial cytochrome b gene.

Biodiversity of freshwaters: status and threats

I K G Boothroyd & B J Smith
National Institute of Water and Atmospheric Research, PO Box 11-115, Hamilton

Despite the use and demands placed on freshwater ecosystems in New Zealand, little attention has been given to biodiversity. With the exception of fish and aquatic macrophytes, we have a very poor knowledge of the New Zealand aquatic biota, and as a result a poor understanding of the loss of biodiversity. The status of taxonomic knowledge of many groups is little understood and/or the literature is often fragmented so as to make taxonomic resolution difficult. This is highlighted through an examination of the taxonomic base for the major aquatic biota and the taxonomic resolution in the published literature. Distributions of many freshwater species can be very localised and many taxa therefore remain unknown or little studied and information on the ecology and habitat requirements of much of the aquatic biota is unknown. Fish and aquatic macrophytes ecology and distributions are better known as a result of greater commercial significance. The conservation status of some components of the aquatic biota has been assessed but no comprehensive strategy to protect them or to overcome threats has been established. This paper will discuss the current taxonomic knowledge of the major aquatic animal and plant groups and discuss their conservation status and major threats. Examples will be presented where appropriate and management options discussed.

Acacias, banksias, whales and frogs - implementing the National Biodiversity Strategy for Australia

Peter Bridgewater
Environment Australia

Problems of biodiversity conservation and management in Australia centre around rehabilitation and restoration of agricultural lands, management and conservation of endangered species, ensuring sustainable use of forest resources, ensuring viable fisheries in freshwater and marine systems and management of the 70% of Australia which are arid and semi-arid lands.

As a federal political system, with constitutional power for land and natural resources largely the responsibility of the States, Australia developed a biodiversity strategy as a co-operative exercise between all levels of government. A draft was produced for public comment in 1995 and the final document signed by the heads of all jurisdictions in February 1996. A separate strategy is being pursued for Endangered Species, and, while agreed, is awaiting final signature.

In addition, a wetlands policy for the Federal Government (likely to be reflected at state level) has recently been released. An oceans policy is being developed by the Federal Government for the EEZ. The biodiversity strategy is being implemented by an executive group of officials from nature conservation, environmental protection, agriculture, fisheries and forestry agencies, chaired by the Federal Government. Firm time-lines have been placed on the achievement of key objectives, leading to measurable and accountable outcomes.

Structure and stand development of kahikatea forest remnants in the western Waikato

B R Burns
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Dense kahikatea (*Dacrycarpus dacrydioides*)-dominant forest stands are a conspicuous though scattered and sparse landscape component of lowland alluvial plains in New Zealand. In the western Waikato, I examined plant species composition, characteristics of forest structure, and age- and size-class distributions of kahikatea populations within edge and interior plots at 9 stands all 5 ha. Species composition within stands varies with soil fertility, soil drainage, and proximity to edges. The interior of heavily-grazed stands have species compositions similar to stand edges. Various species show significantly different abundances on edges compared to the interior of stands. Stands are depauperate in epiphyte diversity and abundance, and in coarse woody debris. Basal areas of stands are high (mean = 102 m2ha-1) with kahikatea making up about 80% of stand basal area. The remainder is mostly contributed by pukatea *(Laurelia novae-zelandiae)*, tawa *(Beilschmiedia tawa)*, and titoki *(Alectryon excelsus)*. Kahikatea populations comprise two broad groups in almost all stands: a small group of large trees 1-2 m in diameter and 200-500 years old forming the core of the stand, and the majority of stems of 30-90 cm diameter and 80-120 years old surrounding this core. Thus the majority of the stands are formed from an even-aged cohort of kahikatea established at the time of extensive land clearance and drainage in the Waikato. Further stand development of these stands will see self-thinning of this even-aged cohort and an increase in importance of other shade-tolerant tree species. Remnants such as these, which developed their structure as a consequence of the fragmentation process, have not been adequately recognised in the fragmentation literature. However, as 'descendants' of a much-depleted indigenous ecosystem, their retention and management is critical to the conservation of biotic diversity associated with these landforms.

Ecology and management of red (copper) tussock (*Chionochloa rubra* ssp. *cuprea*) grassland in Southern New Zealand

Chris Bycroft
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Compared to other New Zealand tussock species, only a very limited amount of research has been carried out previously on the ecology and management of *Chionochloa rubra*. Research on the effects of burning and grazing should help in the management of copper tussock grassland. During late 1993 seven study sites were set up to look at these issues in Southland and Otago. Sites were chosen to represent the wide geographical, elevational and climatic range of copper tussock. Measurements of growth rates (leaf elongation, new leaf and tiller production) in each of three tillers in five marked tussocks at field sites were made at monthly intervals. Flowering was also recorded on these marked tillers and also in each of 50 tussocks over three seasons at each field site. At three of the study sites an area of copper tussock grassland was burnt and a range of clipping treatments made to simulate various intensities of grazing on burnt and non-burnt tussocks. The same growth measurements as mentioned above were used to compare the effect of these treatments with others, including controls. Recovery of copper tussock after burning is poor, particularly where grazing has occurred as well. The recovery of copper tussock grassland after fire appears to be different from that reported for other tussock species, particularly narrow-leaved snow tussock (*Chionochloa rigida).* This project has shown differences from *C. rigida* in the rate of leaf elongation and amount of flowering in the year following fire. These results and others will be discussed.

Host plant refugia for managing pest resistance to transgenic brassicas and potatoes

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The development of transgenic insect resistant plants offers great scope for reducing dependence on synthetic insecticides, especially through the use of *Bacillus thuringiensis* (Bt) toxin genes. As the deployment of monocultures of such plants is likely to encourage insect resistance to these toxins, the use of various forms of refugia for susceptible insects is usually recommended. Transformation of potato and brassica plants with Bt toxin genes provides protection from lepidopterous pests such as potato tuber moth on potatoes and diamondback moth on cabbages.
Studies of the host ranges of these two pests were conducted to determine what proportion of their populations occur in refugia and would therefore not be exposed to commercial transformed crops. To determine the natural plant associations of the pests in a vegetable growing region we surveyed the incidence of possible host plants and their infestation rates in road-side, waste and crop areas in a 2500 ha area at Pukekohe. Plant preference was also examined in a field trial. Although potato tuber moth was found on solanums other than potato in the field trial, these alternate hosts were rare in vegetable growing areas and therefore there were no significant refugia for this pest. Diamondback moth was common on crucifers other than vegetable brassicas, particularly mustard. Wild radish was less preferred, but was the most common alternative host plant on roadsides. The planting of mustard crops and the preservation of wild radish should therefore contribute to delaying resistance. These results indicate the need to manage each of these transgenic crops in a different manner.

The establishment of fruit crop arthropod pests and their natural enemies in New Zealand: From way back to the future

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Fruit crops in New Zealand are infested by 116 arthropod pests, which, in turn, are attacked by 134 arthropod natural enemies. Most pests (99) and natural enemies (116) are exotic. Ninety two species of natural enemies have established accidentally, compared with 24 through classical biocontrol introductions. Many fruit crop pests now have diverse, exotic natural enemy guilds, which are becoming increasingly important both economically and ecologically in Integrated Fruit Production and organic growing systems. It seems likely that exotic pests and natural enemies of fruit crops will both continue to establish in New Zealand at a long-term average rate of c.7 species per decade. The "greening" of horticulture means that more native insects will become pests too. The increasing pest load poses a significant threat both to the livelihood of orchardists and to the New Zealand economy. Biological control of pests by natural enemies, both native and exotic, and deliberately or accidentally established, will inevitably be further developed as a pest management strategy. Ecological studies will be required to provide the economic solutions required by orchardists on the one hand, and the environmental answers required by conservationists on the other. The existing exotic natural enemy guilds in managed environments may be a valuable resource to help predict the potential impact of new natural enemies on non-target species.

Strategies to use single gene products for pest management

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Anti-metabolites in transgenic plants

Bt-transgenic plants are a commercial reality. The international effort has focussed, correctly, on these compounds and the molecular biological problems have been largely overcome. The major concerns now regarding their utility are resistance management, specificity, and integration into IPM strategies.

Anti-metabolites have a role as adjuncts to Bt for resistance management (gene pyramiding). Modelling studies show this deployment of genes to be far superior to any other devised (refuges, non-transgenic mixtures, etc.). Anti-metabolites also have a role as an alternative to Bt to manage many commercially important pests (most coleoptera, orthoptera, hemiptera, homoptera).

Our work has focussed on two types of anti-metabolites, proteinase inhibitors and biotin-binding proteins. The insecticidal properties of these classes of proteins will be discussed and issues regarding their deployment raised. An assessment of the rather short list of known candidates to supplement or replace Bt endotoxins will also be provided.

GMO biopesticides

The use of biopesticides (bacteria, viruses, fungi, and nematodes which are insect pathogens) has languished for a number of well understood reasons. These are likely to be overcome by use of improved organisms and the involvement of molecular technologies in this process is clearly indicated. Our work is targeted toward improving the rate of mortality relative to wild-type organisms and is also addressing the environmental safety issues through strategies to eliminate persistence of the applied organisms without reduction in their efficacy.

The Predispersal 'seed' predators of the masting genus *Chionochloa* (Poaceae)

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Chionochloa is a genus of tussocks that often exhibit irregular flowering - a phenomenon often referred to as 'masting'. Inflorescences of *Chionochloa* are often damaged due to insect predation. White (1975) reported three different insect seed predators, but Kelly et al. 1992 found only a single insect.
This study aimed to clarify how many insects were attacking *Chionochloa*, determine what damage each insect causes, and determine how these insects respond to the fluctuating flowering levels. The aim was to determine whether these insects could have accentuated masting in *Chionochloa.*

All three 'seed' predators reported by White were found: *Megacraspedus calamogonus* Meyr, *Diplotoxa similis* Spencer; and an undescribed Cecidomyiid. All three feed at slightly different times. *Diplotoxa* feeds at early stages of inflorescence development, the cecidomyiid feeds later on the developing seed, and feeding by *M. calamogonus* overlaps between the previous two.
The different types of damage that each insect causes have been identified. This information makes it possible to estimate how much damage each species has caused.

Fluctuating flowering levels do affect these insects. The way the different factors affect each seed predator and the system as a whole, is still not clear. Each insect does possess its own set of attributes which may make it resistant, or vulnerable to satiation by masting.

Units of biodiversity management: a review of species concepts

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The past two decades have seen intense consideration of alternatives to the Biological Species Concept (BSC). A key failing of the BSC is its inability to cope with allopatric populations. In New Zealand, much of the biological diversity occurs among island populations, so the BSC may be of limited value for cataloguing natural diversity for conservation purposes here. We review alternatives to the BSC, especially, the Phylogenetic and Evolutionary Species Concepts, that may be preferable for dealing with island populations. Recent analyses of the taxonomy of New Zealand pipits and Australasian teal provide case studies that support reconsideration of the taxonomy of many widely distributed taxa. Lastly, we compare the use of various species concepts in New Zealand and overseas.

The evolution of feeding behaviour in carnivorous snails: phylogenetic evidence from *Wainuia*

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Carnivory has evolved in many separate snail lineages worldwide, but only in the New Zealand genus *Wainuia* does the diet contain a high proportion of arthropods. Two *Wainuia* species routinely consume forest litter amphipods. The behaviour is associated in both species with a reduction in the number of teeth and the geographic clustering of populations showing the behaviour leads naturally to the hypothesis that they form a monophyletic group. We test this hypothesis with a phylogeny based on new DNA sequence data from *Wainuia* populations throughout New Zealand. Sequences were obtained for regions of the cytochrome oxidase protein-coding gene and the 12S ribosomal subregion. In addition to shedding light on the evolution of carnivory, the DNA sequence data confirms the existence of at least three undescribed species.

Flower biology of *Geniostoma ligustrifolium* (Geniostomaceae)

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Geniostomaceae (*Geniostoma* and *Labordia*) forms a clade which is sister to the Apocynaceae s.l., so that aspects of their flower biology are important to an understanding of phylogeny in that large family.

G. ligustrifolium (we regard it as distinct at species rank) is a small endemic shrub with apparently simple green flowers. Its flower biology was described by Rattenbury, who outlined the pollen presentation mechanism and considered it to be dioecious, based on the flower morphology.

We have studied the development and function of flowers on male and female plants and made a functional assessment of sex expression. Flowers on male plants dehisce their pollen directly onto the stigma before anthesis. At anthesis the stigma functions as a pollen presenter. Long stigma hairs contain an adhesive under pressure and we believe this glues pollen onto pollinators. The stigma is not receptive at this stage. Later, when pollen has been removed, the stigma becomes receptive, at least in late season flowers. Flowers on male plants have fewer ovules than female flowers, and set varying amounts of fruit. Female flowers have smooth stigmas and hairy sterile anthers. We have seen no flower visitors or seed dispersers. The flowers are sweetly scented, unlike other species of *Geniostoma* which have offensive scents.

We conclude that *Geniostoma ligustrifolium* is gynodioecious, and that the flowers are not as simple as they appear. Other species of the genus (including *G. rupestre*) have been described as dioecious, and these should be reassessed.

Management of *Geodorcus ithaginis (Lucanidae)*, New Zealand's most endangered stag beetle?

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The Mokohinau stag beetle, *Geodorcus ithaginis (Coleoptera: Lucanidae)* is restricted to a single, approximately one hectare islet, Stack "H" within the Mokohinau Islands in the Hauraki Gulf. Historically many of the islands in the Mokohinau group had kiore, the polynesian rat *(Rattus exulans)* and have been modified by vegetation clearance. Stack H appears to have remained free from these influences. During 1990 kiore were eradicated from all islands in the group except Fanal, thus removing the risk of invasion of Stack H. Access to Stack H is highly weather dependent and fewer than 10 adult stag beetles have been seen on any one trip. Other Geodorcus species live in very moist habitats on mainland sites with larvae associated with moist rotten logs on the forest floor. By contrast the habitat on Stack H is arid with very poor moisture retention and a complete absence of rotten logs. Managing New Zealand's biodiversity involves the conservation of such endangered species. Management undertaken and planned for the species is outlined.

Conservation implications of cryptic diversity in the black mudfish, *Neochanna diversus*

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It is now generally accepted that if species are to be conserved, it is important that genetic diversity is in turn conserved to allow populations to evolve and withstand environmental change. Evolutionary theory predicts that the divergent, isolated populations of today have the potential to become the species of tomorrow. In order to maintain this diversity within species and therefore conserve evolutionary potential, genetic data can be used (i) to measure genetic variation within populations (ii) to identify evolutionary divergent populations (iii) and to assess conservation value of regions or populations from an evolutionary perspective.
We are currently determining the genetic diversity present in existing populations of the black mudfish, *Neochanna diversus.*

The black mudfish occurs from the King Country to as far north as the Kaimaumau Swamp, north of Kaitaia. This species is the most specialised of the three due to its northern range where it experiences the longest aestivation times. The major existing habitat for this species is the Whangamarino Swamp and the Kopuatai Peat Dome in the Waikato. Fire is a constant threat in these habitats with a fire in the summer of 1986 burning almost two thirds of the Whangamarino wetland. In Northland, the Hikurangi Swamp inland from Whangarei was an important habitat for black mudfish. However this wetland has been almost entirely drained for pasture conversion, leaving small remnants. It was in one of these remnants, the Otakairangi Wildlife Management Reserve, that the first black mudfish were found since the 1960's. The Kaimaumau Swamp is currently under threat through drainage. We have sampled populations from both Northland and Waikato to determine the level of diversity between regions and among populations through sequencing the D- Loop of the mitochondrial genome.
These results and the implications for the conservation and management of the black mudfish will be discussed.

An assessment of computer based interactive keys as a tool for plant identification and taxonomic revisions.

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At present one comprehensive computer package is available (DELTA - Intkey) for creating and running interactive keys, with another (LucID) under development. The possibilities of creating keys to large genera that will work with sterile plant material is demonstrated with a sample data set (New Zealand adventive Hieracium). Interactive keys can be used both for taxonomic revisions and as a flora-writing tool. The advantages and disadvantages of this method are compared.

Colour preferences in weka

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There is growing awareness and concern about native New Zealand birds eating poisonous baits intended for pest species such as possums and rats. It may be possible to discourage birds from eating poison baits by altering bait characteristics such as colour. This study investigates colour preferences in weka to determine which colours may act as deterrents. Weka were chosen as an initial study species as they are very vulnerable to poisoning.

A preliminary study with six domestic hens was conducted to investigate the feasibility of testing colour preferences in birds and to refine our methodology. The hens were offered a choice between pellets of six different colours (white, yellow, blue, orange, green, red). Each bird was tested daily, on its own, for six consecutive days. The amount consumed differed significantly between colours with more white and yellow being eaten than orange, green or red.

Eighteen wild weka from Kapiti island, which were in temporarily captivity, were tested for colour preferences. The same methodology was used as described for the hens. Again six different colours were offered (red, yellow, brown, green, light blue and blue). Weka ate significantly more of the red and yellow and less of the two blues and the green.

Results to date are encouraging in the search for ways of deterring birds from poisonous baits. Further studies are planned to clarify the relative importance of brightness and hue in weka colour preferences.

Housing the male native scale insects: garage, tent, or just a fluffy duvet?

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Male scale insects (Hemiptera: Coccoidea) undergo a metamorphosis from scale-like nymph through prepupa and pupa to winged adult. The last nymphal instar before prepupa secretes the protective covering under which these complex life changes take place. Each family of scale insects is characterised by a different type of male covering, whether cocoon, cap, or test. Male mealybugs make fluffy cocoons from cottony wax strands (the duvet of the title to this talk); eriococcids produce woven wax covers, and armoured scales incorporate their moulted skins into waxy caps (the tent); the Coccidae or soft scales construct glassy wax tests (the garage).

The coccid male test, being rigid, needs a mechanism for adult emergence. A suture across the posterior third of the test enables the back plate to flex at a pair of hinges (so forming the garage door). The hinges are secreted from groups of tubular ducts on the dorsum of 2nd-instar males. Scanning electron micrographs show the detail of hinge types and test structure.

Very little research has been published on male scale insects, and even less on their coverings. Much more detail is now known about the New Zealand soft scales. In comparison with North American species (Miller & Williams 1990), male tests of the New Zealand Coccidae are apparently unique in the way they are constructed in rows of hexagonal wax plates. Only two species of native soft scales have tests more like those in other parts of the world.

Miller, G.L.; Williams, M.L. 1990: Tests of male soft scale insects (Homoptera: Coccoidea) from America north of Mexico, including a key to the species. Systematic Entomology 15: 339 - 358.

Systematic ecological entomology

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Sustainable management of biodiversity is based on the simple concept of managing biological resources to meet the needs of this generation, without compromising the options of our children. This requires assessment of these resources such that their stewardship may be improved through management.

Such assessments need to: include entomology, because insects comprise the overwhelming majority of biodiversity; be ecological, to enable information to be related to systems and their processes; and be systematic, in that sampling methodologies and taxonomies must be standardised for information to be cumulative. The assessment of biodiversity thus involves skills from all three disciplines represented at this conference. The subject requires urgent integration of different perceptions of ecological systems and scientific enquiry. In addition, the lack of system entomologists relative to the enormity of this field requires a focusing on what is both achievable and useful.

Insects are integral to the processes of system maintenance in a variable environment, therefore their communities offer the means for both characterising system biodiversity, and providing detailed understanding of system processes. Beetles comprise c. 50% of NEW ZEALAND insect species, and Malaise trapped beetles provide a method for characterising insect communities from any habitat. Information collected to date using standardised protocols demonstrates a close relationship between samples, and system type and processes. Development of appropriate taxonomic and processing tools and personnel, together with detailed understanding of autecology of dominant species in samples, would enhance the application of knowledge gained, to the sustainable management of biodiversity.

Endocrine strategies for arthropod control and ecdysteroid receptors

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Insect growth regulators (IGRs) represent a relatively new category of insect control agents with high specificity which fulfill the requirements of being safer compounds and overcoming the development of resistance to ÈclassicalÉ insecticides. The increasing knowledge about endocrine mechanisms in arthropods facilitates target-site-directed search for drugs against insect pests that interfere with arthropod hormone action. On the basis of their mode of action, three different categories of IGRs are
discussed here: (1) hormone mimics or anti-hormones (e.g. ecdysteroids, juvenile hormone mimics, peptide hormones and inhibitors of their synthesis and degradation); (2) inhibitors of cuticle synthesis and degradation (cuticle synthesis and chitinase inhibitors, anti-sclerotization agents) and (3) others with, so far, unclear modes of action (e.g. triazines). Target sites such as ecdysteroid receptors have been selected in this presentation as an example of how the current biorational approaches to identify drugs against arthropods can be used. In addition, the current knowledge of ecdysteroid receptors in the regulation of insect larval moulting and metamorphosis will be presented.

Reproduction of *Dactylanthus taylorii*: towards unravelling its complexity

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The reproductive biology of the endemic root-holoparasite *Dactylanthus taylorii* (Balanophoraceae) has been studied. Female plants produce copious seed after pollination by either short-tailed bats or ship rats. Seeds can remain viable in the soil for at least 7 years in moist conditions. A percentage of seeds from this seed bank germinate every year, developing a 1-2 mm long radicle characterised by specialised surface cells and long hairs. These features aid in the attachment to a host root and are likely to also facilitate host recognition. In contrast to some previous suppositions *Dactylanthus* does not require a host stimulus for germination. Upon contact with a root, the long hairs secure the radicle tip in place, which in turn establishes the initial haustorial contact with the host and swells up to form a young *Dactylanthus* tuber. Apart from sexual reproduction, *Dactylanthus* is also capable of reproducing vegetatively through adventitious roots almost identical in their morphology to the radicle. Both radicle and adventitious roots appear to survive prolonged periods prior to any host contact, and will attempt to infect roots growing close to them rather than actively searching for a host. As *Dactylanthus* is currently endangered, mainly through extensive possum browsing of the inflorescences, an understanding of its reproductive biology is vital to the development of suitable protection strategies.

North Island Kokako - So much for that little battle and now, the war

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A co-ordinated pest mammal control programme ('Research by Management') and accompanying basic research has confirmed that predation is more important than food competition in current kokako declines, although ship rats and possums are both predators and potential competitors of kokako. Pest management significantly increased kokako chick output, from average ca 13% (of pairs fledging young, n=8, SD=10) in unmanaged years and blocks to ca 42% in managed years and blocks (n=12, SD=24). The primary mechanism for this was an increase in the success of breeding attempts, which also increased the number of females available to form attempting pairs. At Mapara (managed since 1989), the number of breeding pairs increased from 5 in 1991 to 38 by 1996, and 0 chicks fledged in 1989-90 cf 64 in 1996-97. Ship rats and possums can be controlled sufficiently with existing technology in areas up to ca 3000 ha to enable recovery of kokako populations. This new-found ability to produce kokako chicks at will enabled the Kokako Recovery Group at its April 1997 meeting to recommend phasing out captive rearing, and trialling the injection of Mapara subadults into other struggling mainland populations. We are currently reviewing which kokako populations will be managed into the future. Other site biodiversity values, and other planned management regimes (such as at mainland islands) will influence these choices. We are using models to explore management pulse intervals which most cost-effectively maintain kokako populations, and are commencing genetic studies of kokako populations. The upcoming revision of the Kokako Recovery Plan will address a 50 year planning period.

Invertebrate components of ecological restoration in an Urban Setting

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Areas of restored indigenous vegetation and two remnant forest fragments in Christchurch City (New Zealand) were surveyed for invertebrates during the summer of 1996-97. Sites included two 'sources' (Riccarton Bush and Dry Bush) and six paired restoration sites in three age classes (< 10 years, ~30 years, 50 years). Surveys included a combination of suspended malaise traps, pit fall traps and both systematic foliage beating and sweep-netting of individuals of three indigenous tree species found at each site *(Pittosporum eugenioides, Podocarpus totara, Plagianthus regius)*.

We test the hypotheses that:

1. The endemic/exotic species ratio varies significantly with site age, reflecting niche availability.
2. Older sites show greater species richness and abundances, and lower variance in abundance.
3. 'Restored' sites and remnant/source sites have equivalent guild structures.

On the basis of initial analyses, we conclude that specific site management (e.g. re-introductions) is not required for invertebrate community restoration in urban settings where remnant sources exist. We believe that an urban 'green network' has contributed to this apparent success. The nature of this contribution is the subject of future work.

Taxonomy, regional diversity, and ecological preferences of New Zealand Cixiidae *(Hemiptera)*

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Nine genera and 17 species of planthoppers of the family Cixiidae are known from New Zealand. These species are: *Aka duniana* (Myers, 1924); *A finitima (Walker, 1858); Cixius aspilus* Walker, 1858; *C. kermadecensis* Myers, 1924; *C. punctimargo* Walker, 1858; *Confuga persephone* Fennah, 1975*; Huttia harrisi* Myers, 1924; *H. nigrifrons* Myers, 1924; *Koroana arthuria* Myers, 1924; *K. interior* (Walker, 1858); *Malpha cockrofti* Myers, 1924; *M. iris* Myers, 1924; *M. muiri* Myers, 1924; *Oliarus atkinsoni* Myers, 1924; *O.oppositus* (Walker, 1851); *Semo clypeatus* F.B. White, 1879; *Tiriteana clarkei* Myers, 1924.

Myers (1924) furnished the most extensive treatment of the family for New Zealand, which included a key to the genera, descriptions of new taxa, and additional comments on a number of described taxa. This was followed by a revised key to the genera (Deitz and Helmore, 1979) and the description of a cave-dwelling species (Fennah, 1975).

The present study is based on all material contained in 8 New Zealand collections, and aims to provide the first comprehensive revisionary treatment of the family.

Results from a morphological study suggest that 3 additional genera and 10 new species should be recognised. Morphological characters and their diagnostic value at various classificatory levels are reviewed. In fulgoroid taxonomy the ultimate criterion for species recognition is the structure of the male genitalia, more particularly the aedaegus, and there is now no doubt that this is also true for New Zealand Cixiidae. Characters used to diagnose species and to hypothesise relationships are reviewed for a number of genera. Possible speciation patterns are examined in the light of information such as geographical distribution and ecological preferences. A preliminary analysis of phylogenetic relationships is also presented.

At least 75 % of New Zealand's cixiid fauna is endemic. Regional diversity and ecological assemblages, including habitat preferences and host-plant relationships, are briefly outlined. The indigenous genus *Aka* has one representative in Australia, where the cosmopolitan genera *Cixius* and *Oliarus* occur also. Apparently no species is shared between Australia and New Zealand.

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Environmental Correlates of tree alpha-diversity in New Zealand's Primary Forests

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Correlations between environment and tree alpha-diversity in New Zealand's primary forests were examined using an extensive quantitative dataset (14, 540 plots). Generalised additive models were used to examine relationships between species richness and temperature, solar radiation, root-zone moisture deficit, relative humidity, lithology, drainage, and plot size for all trees (111 species), and separately for broadleaved trees (88 species), conifers (17), and the genus *Nothofagus* (4). Diversity both for all tree species and for broadleaved trees was predicted to be highest on sites with high temperatures, high solar radiation, and high soil and atmospheric moisture, and on sedimentary and basaltic substrates. Highest conifer diversity was predicted on sites with intermediate temperatures, low solar radiation, high root-zone and atmospheric moisture, and rhyolitic and Quaternary substrates, particularly where drainage was impeded. Highest *Nothofagus* diversity was predicted for sites combining low temperatures, high solar radiation, low root-zone and atmospheric moisture, and on granitic substrates. Differences in diversity between the species groups on different lithologies are interpreted as reflecting both the effects of variation in large-scale disturbance histories, and the effects of confounding environmental factors associated with particular substrates. There were also significant interactions between species groups: both broadleaved tree and conifer richness were predicted to be lower on sites where one or more *Nothofagus* spp. - all of which have marked patchiness in their distribution -are present. These results suggest that both environment and history are important determinants of tree diversity in New Zealand.

Biodiversity assessment - key research issues from a New Zealand perspective

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Biodiversity assessment is a new imperative and a challenging focus for genetic, taxonomic and ecological research in New Zealand. It requires an understanding of the biogeographic origins of the indigenous biota, the characteristics of Tertiary ecosystems, and recognition of the major selective forces or extinction filters, all of which have shaped the development of plants and animals in New Zealand. Human settlement introduced a suite of novel selective pressures for the biota, particularly resulting from the spread of mammalian predators and herbivores, and a range of invasive plant species. This has resulted in rapid changes in biodiversity, including the extinction of major avian groups and the decline of other elements of the biota.

The critical research issues in biodiversity assessment are driven in part by conservation responsibilities of agencies under national legislation and international agreements. These agencies require methodologies to monitor, protect, and value indigenous biodiversity. To support these objectives, new research is required on the origin and maintenance of genetic diversity in indigenous taxa, and the relative vulnerability of species in relation to population size and endemicity/distinctiveness. The role of regional and local processes in maintaining the different elements of biodiversity will need to be determined, together with the regeneration requirements of communities and the identification of guilds/functional types within the biota. Establishing links between species and ecosystem function is a priority area, especially in habitats where key components of the biota may be missing or threatened.

A global perspective on biodiversity assessment - the US experience

Jane Lubchenco
Wayne and Gladys Valley Professor of Marine Biology
OSU Distinguished Professor of Zoology

(Background on Speaker)

Research Interests

evolutionary ecology of individuals, populations and communities
biodiversity, conservation biology, and global change
community structure, organization and stability
foraging strategies, life histories, plant-herbivore interactions
rocky intertidal communities, algal ecology, marine ecology

Science, Conservation, and Education Interests

science and the environment , public understanding of science , marine conservation biology , ecological causes and consequences of global change , evolutionary community ecology , marine biology , chemical ecology , biogeography , molluscs, schinoderms, seaweeds,

Recent Representative Publications

1996 Power, M.E., D. Tilman, J.A. Estes, B.A. Menge, W.J. Bond, L.S. Mills, G. Daily, J.C. Castilla, J. Lubchenco, and R.T. Paine. Challenges in the quest for keystones. *BioScience 46:609-620.*

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Ecosystems frameworks for addressing biodiversity management

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Articulating the great natural diversity in and around Aotearoa New Zealand at varying scales and in accessible and useful forms, is a challenge which Lucas Associates has been enjoying for some years through a nested hierarchy structure and pattern language approach.

Spatial depiction of ecosystem types, and representation of their lands, waters and biota in graphic and word, provides a framework for management that is scientifically robust as well as people friendly.

Ecosystem frameworks have been developed for regional to site scales. They provide the basis for policies, plans, management, advocacy and monitoring. Using a range of techniques data is provided that might tantalise people to a greater understanding of their place, its level of intactness, its vulnerability, and, its potential for recovery and restoration.

Biodiversity in an oligotrophic pond: focussing the science effort

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Biodiversity and its conservation represents one of the most significant and difficult problems facing any nation. As far as future generations are concerned, an intact biota is perhaps the most important cross-generational transfer that can be made. Biosystematics and ecology can make a highly significant contribution to maintaining this inheritance. However, New Zealand is faced with the problems of a burgeoning demand for funding for socio-economic concerns, and hence a shortage of funds for reallocation, a relatively small scientific budget that is just beginning to recover from savage cuts made over the last decade, and a small scientific workforce of highly variable morale. Present institutional structures prevent the development of optimal working relationships and inhibits mobility of scientific workers. Isolation of government policy makers from the practical world ensures that much policy is irrelevant to all but completion of the departmental Purchase Agreement.

There is a need for a clear practical strategy to ensure that funding is not wasted on pointless, albeit elegant, research, but directed towards the most pressing needs. Such a strategy will not be popular, and arguments will made in favour of continuation of the present arrangements that give maximum freedom to the researcher.

In considering these arguments, we have to remember that New Zealand makes a very small contribution to the world research effort in ecology and environment (just over 1%), and it follows that these fields can thrive without our intervention. In any case, much research under this rubric consists of high-level wheel-spinning and CV-padding. For instance, it dubious that the mathematically precise but often biologically naive ecological theorizing that has plagued the field since MacArthur and Wilson's paper on island biogeography has contributed much to the practical implementation of biodiversity programmes. Arguments based on the utility of serendipitous results of undirected ecological research have to contend with the fact that this is a highly unlikely way to solve chronic ecological problems. Before investing in expensive laboratory-based research and ambitious whole ecosystem or experimental studies of a sort currently favoured by the international trend to hypercompetiveness in science, we must ensure that our practical base is secure.

Therefore, our science effort should be focused on field observations of critical elements of the biota; good understanding of the dynamics of plant and animal populations; sound alpha level taxonomy; and well maintained distributional and ecological databases. This requires teams of field-experienced scientists, underpinned by securely funded, well run institutions that do not suffer periodic amnesia. To ensure openness to the practical concerns of the landscape manager and input to policy deliberations a greatly enhanced inter-organisational mobility is needed.

Wet and dry weta!

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The recently discovered Raukumara tusked weta is a medium-sized species which survives in mainland forest which it shares with various introduced predatory mammals. It burrows behind stones along stream banks, readily hops into water when disturbed and will stay submerged for several minutes at least. Observations and demographic information for this species have implications for the management of the endangered Mercury Island giant tusked weta, which survives marooned on one small and very dry offshore island with no freshwater.

Road verges and biological diversity: implications for invertebrates

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[2]*Department of Resource Management, Lincoln University, Canterbury*

The estimated 26400 hectares of verges along New Zealand's 66000 km of rural roads are potentially a significant contribution to maintenance of indigenous and exotic biodiversity (species). In most of the country that was originally forested, exotic vegetation predominates and even penetrates forested areas where bright sunlight reaches the ground. Indigenous vegetation persists on road verges where the soil is very poor, wet (fresh or estuarine) or shady when passing through forests. Diversity of exotic vegetation is increased through management practices including frequency of mowing, herbicide treatment, drain cleaning and grazing. Driving on wet verges, dumping rubbish and "floral enrichment" also influence the diversity of vegetation. Invasion of verges by indigenous plants is often limited by the absence of local seed sources.

The invertebrate fauna on road verges is closely linked to the type of vegetation. The fauna in ecosystems with exotic plants consists of predominately exotic species, whereas indigenous ecosystems contain mainly indigenous invertebrates. Relatively few indigenous phytophages live on exotic plants while a few indigenous species of saprophages and predators survive in habitats with exotic plants.

Road verges are a source of pests of agricultural/horticultural crops. They are also a source of natural enemies of many pests and are important for reduced pesticide crop management strategies such as integrated pest management. Maintenance of genetic diversity of pests is vital for strategies that aim to prevent and manage pest resistance to pesticides and resistance of transgenic plants to pests. Verges can provide sources of insects susceptible to pesticides and transgenic plants.

Towards protecting New Zealand's indigenous biodiversity in agricultural landscapes: restoring the riparian zone.

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The New Zealand government's Environment 2010 Strategy establishes the protection of indigenous biological diversity and sustainable land management practices as key goals for improving the New Zealand environment. These are to be addressed in part, through the maintenance and enhancement of the ecological integrity of remaining indigenous ecosystems, and development of sustainable land management strategies.

It is becoming more widely accepted that biodiversity conservation needs to be integrated with productive land uses such as agriculture. Indeed, New Zealand's Resource Management Act provides for this. However, measures to protect biodiversity on private land may also need to provide demonstrable benefits to the landowners, particularly if land is retired for habitat restoration.

Restoration of riparian vegetation has been advocated as a means of providing ecological services through filtering nutrients, minimising erosion, and reducing peak flood flow. It is also recommended as a means for providing habitat at a local level. Restored riparian vegetation may also act as a corridor for species movement throughout the landscape.

This paper proposes the restoration of riparian vegetation as a means towards creating ecologically sustainable agricultural landscapes in New Zealand; landscapes which protect biodiversity and provide for sustainable land use.

Predation on lizards by small mammals at Pukerua Bay, Wellington

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Pukerua Bay is the only mainland location where Whitaker's skink *Cyclodina whitakeri*, an endangered lizard, has survived. Whitaker's skinks are very rare at Pukerua Bay, and current monitoring efforts detect less than one animal per year on average. Pukerua Bay Scientific Reserve was established to protect Whitaker's skink as a member of a diverse lizard community also comprising copper skinks *C. aenea,* common skinks *Oligosoma nigriplantare* polychroma, brown skinks *O. zelandicum* and common geckos *Hoplodactylus maculatus.*

A trapping survey for rodents and mustelids at Pukerua Bay was run from August 1995 to May 1997 to: (a) provide baseline information on densities to allow assessment of the effectiveness of future management to reduce predator densities; (b) identify the species of rodents and mustelids present and the frequency with which they were consuming lizards throughout the year; and (c) to collect information on the population dynamics of small mammals to guide future control efforts.

Mice were extremely abundant at Pukerua Bay, with catch rates ranging between a low of 24/100 corrected trap-nights in summer and a high of 54/100 CTN in May. Breeding occurred between November and May, and appeared to be linked to increased consumption of invertebrates. Predation on lizards was recorded only between March and August (0.6% of 778 stomachs examined).

Only five rats were caught (0.3/100 CTN); all were ship rats *Rattus rattus*, and three had eaten common geckos. Seven mustelids were caught (two stoats *Mustela erminea* and five weasels *M. nivalis*) and three scats were also examined. Half of the mustelid stomachs/scats contained lizard remains, including one weasel that had eaten a Whitaker's skink.

Biodiversity at a local and regional level - safeguarding the life-supporting capacity of ecosystems

Shona Myers
Auckland Regional Council

In this paper I will cover some of the natural heritage issues in the Auckland region and how these are dealt with in the policy framework. I will primarily be talking from the perspective of the Auckland Region but I also hope to give some guidance on our policy and research needs from a national level and from the science community.

The Auckland region's natural environment has been extensively modified with less than 30% of the region's land cover remaining in indigenous ecosystems (forests, scrub, wetlands). Many of the remaining ecosystems are highly modified, severely reduced from their former extent and from their original character. Auckland's growth continues to generate impacts on natural ecosystems. Ongoing threats, such as urban growth, subdivision, spread of weeds and pests, are causing continued degradation, fragmentation and isolation of the remnants of the natural environment that are left, and loss of species.

Responsibilities of local authorities in safeguarding biological diversity, particularly under Part II of the RMA, include providing for the protection of significant natural areas from adverse effects, monitoring the state of the environment and facilitating the restoration of significant ecosystems whose viability is threatened. An important component is the need to ensure that policies and practices are working effectively in sustaining the biological diversity of the region. I will discuss some of the differences in policy responsibilities between Regional Council and Territorial Local Authorities in the region.

I will focus on some of the issues we are dealing with at a regional level and the use of natural heritage policies to provide for the protection of biological diversity. For example, development proposals are increasingly putting pressure on areas of modified vegetation, regenerating forest and scrub which are of value as links to sites of higher significance in the landscape, as seed sources for restoration, for their regeneration potential and their buffering quality. Loss of these areas will collectively lead to regional loss in biological diversity. We need to ensure that policies and plans allow for natural ecological systems and processes to be maintained in a modified landscape. We also need better scientific information on these ecosystems and processes to help us make informed decisions.

Greater co-ordination and sharing of ideas between organisations is required to ensure protection of biological diversity in NZ. For example, local authorities and the scientific community could work more closely together to determine the key issues and problems in sustaining the natural values of ecosystems and processes. We need to make sure that scientific input is effectively communicated and incorporated into plans and policies at all levels.

Coastal and oceanic biodiversity: a challenge for New Zealand

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New Zealand is surrounded by an EEZ with a surface area 15 times greater than its land area. We have more than 600 islands and islets in our archipelago and most major cities and towns are coastal. However, there is both an information and responsibility abyss when it comes to the marine environment of NZ - our biological knowledge base is poor and the administrative/legislative framework covering the conservation and management of our coastal and oceanic environment has gaps and overlaps that confuse accountability.

We examine our knowledge of different levels of biodiversity in marine systems (-gene, species, ecosystem). Notwithstanding the many thousands of seafloor localities that have been sampled for marine life in the New Zealand EEZ, the total area of seafloor sampled by the various types of collecting gear is c.1.5 square km. MAF research trawl surveys have covered over 5000 square km of seafloor, but very little by-catch was retained for museum collections. Thus NZ's total known marine invertebrate faunal diversity represented in existing musuem collections comes from an area not exceeding 2 square km - a tiny fraction of the 4 milion square km of the EEZ. Marine fishes in NZ are still in a phase of discovery - to the point that the known fauna has doubled in the past 15 years, and a new species of fish for NZ is recorded every 2-3 weeks. Some of the least known fish species are coastal. Marine algae in NZ waters are poorly known, a fact highlighted over recent years with the increase in harmful algal blooms. Baseline information is scarce and inadequate for making assessments of populations, of risks to biodiversity, predicting the effects of anthropogenic modifications, and identifying and monitoring these.

There is a plethora of different pieces of legislation as well as international conventions that affect the protection and use of marine resources in NZ. It is difficult to identify which organisations have overall accountability for the state of marine ecosystems and for oversight on marine issues. Both the Biodiversity Convention and the United Nations Convention on the Law of the Sea place obligations upon NZ to protect and preserve the marine environment. The research on marine biodiversity that needs to be carried out to support appropriate policy and decision making has been identified for only some sectors and not in any integrated or comprehensive way. Far too much marine research is being dictated by fishing industry lobbyists who because of property right issues under the fisheries management regimes exert an unhealthy and inappropriate influence on the orientation of fisheries research. The marine environment needs to be inventoried, managed and protected for all NZers and for future generations - not solely for the benefit of extractive fisheries. There is a clear need for an integrated approach to marine biodiversity in which national research needs are identified, adequately resourced and coordinated, and where there is a clearer assignment of accountability.

Biodiversity now....and then: pollen diversity in pre- and post-Taupo sediments

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We present data derived from ten late Holocene pollen diagrams from Mt Hauhungatahi, Tongariro National Park. Pollen diversity increased significantly, by 2.4 spp per sample (c. 9%), in post-Taupo time. This can be explained either by greater heterogeneity of community types on the landscape in post-Taupo time as a consequence of the eruption and subsequent maori burning, or as upslope movement of vegetation zones in response to a warmer and wetter climate. The results pose questions about the magnitude of diversity shifts in the past, and about major disturbance as a generator of diversity.

Experiences with sick and wobbly possums: searching for the unknown in the unexplored, and finding the unexpected

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As part of a wider research strategy focused on the biological control of the possum, studies of the microbial pathogens of the possum have been conducted over the last few years. The aim is to find pathogens that will have utility as either gene transfer vectors, or as the etiological agents of high mortality diseases. This research was commenced against a background of few known bacterial pathogens, no known viral pathogens of possums and few reagents. As such, it represents interesting experiences in biocontrol vector research, which may be applicable to the search for vectors for invertebrates. The presentation will focus on the various techniques that are being used to uncover the microbiota of possums. These have included molecular detection, in vitro isolation, screening of captured animals and collaboration with groups operating possum houses. The relative success of these techniques to date, and their utility for vector versus pathogen discovery will discussed. The presentation will include examples of various pathologies seen in possums as a demonstration of the unpredictability of searching for viruses and bacteria in a largely unexplored host species.

New Zealand's biodiversity strategy seeing the wood *and* the trees

S-J Owen & Glen Lauder
New Zealand Biodiversity Strategy project team

New Zealand has a commitment to prepare a national biodiversity strategy in response to becoming a signatory to the Convention on Biological Diversity in 1992.

Leadership of the process has been assigned to the Department of Conservation, which shares membership on a steering group with the Ministry for the Environment. Interagency cooperation is achieved at a central government level by an Officials Committee established by Cabinet, comprising officials from Ministries/Departments of Agriculture, Conservation, Commerce, Environment, Fisheries, Foreign Affairs, Forestry, Foundation for Research, Science & Technology, Internal Affairs, The Office of Treaty Settlements, Department of the Prime Minister & Cabinet, Research, Science & Technology, State Services Commission, Te Puni Kokiri, Treasury, and Women's Affairs. These agencies provided input and oversight over the biodiversity strategy analysis process. Their commitment will be an key part of implementing the New Zealand Biodiversity Strategy when it is adopted by Cabinet after a public process.

Implementation is not solely a matter for central government. Regional and local agencies, NGOs, the public generally, and iwi must be effectively involved. The scientific community in particular has already been vocal (if not unified) in its input to the process.

One of the challenges of preparing the strategy is to avoid becoming mired in a process of endless analysis and consultation. Because of the holistic nature of the issues it raises, a biodiversity strategy runs the risk of being "everything to everybody".

It cannot be so and be useful. Without losing sight of the big picture, the draft strategy in preparation seeks to promote purposeful discussion on a series of ten focus areas.

Beyond prediction: testing complex coevolutionary histories between birds and lice

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The coevolutionary history of a group of seabirds and lice was investigated. A Treemap analysis predicted that there had been two hosts switching 3 - 4 intrahost speciation, 10 -11 cospeciation and 8 - 13 sorting (eg. extinction) events. Molecular data (12S rRna) was found to be rate homogenous which allowed the testing of these predictions. The molecular data supported the existence of the cospeciating nodes, most of the predicted intrahost speciations and host switching events. An analysis of the NZ bird fauna indicated that sorting events involving chewing lice are common and that the number postulated by the Treemap analysis was realistic. These results mark an important step forward for cospeciation studies as they move from being merely predictive to actual tests for the existence of historical events.

Assessing the suitability of Mokoia Island for hihi

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The hihi or stitchbird (Meliphagidae, *Notiomystis cincta*) is a cavity-nesting honeyeater indigenous to New Zealand. Hihi were originally widespread but following European colonisation became confined to Little Barrier Island. Attempts to establish hihi on other islands appear to have been unsuccessful. The main reasons suggested for these failures are: (1) insufficient year round supply of nectar and fruit, (2) competition from the other more dominant honeyeaters (i.e., bellbirds *Anthornis melanura*, and tui *Prosthemadera novaeseelandiae*).

Mokoia Island is situated in Lake Rotorua, in the North Island. With an area of 135ha, it is the largest inland island in New Zealand. Mokoia has a long history of disturbance, with several Maori tribes occupying the island for various periods over hundreds of years.

The primary aim of this study is to assess whether hihi suffer increased mortality, or lose weight due to seasonal shortages in their food supply, and therefore whether artificial food supplimentation would be needed to sustain a population. These data allow me to identify periods when hihi were most limited by the naturally occurring nectar/fruit supply on Mokoia. This 'limitation' is measured in terms of changes in birds body mass, survival, reproduction, and foraging effort in response to food supplementation. The results obtained allow me to make recommendations concerning further supplementary feeding and planting programs on Mokoia to make the habitat more suitable to hihi.

Some parasitic insects as hazards to overseas travellers

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Apart from mosquitoes, black-flies, and their relatives, well known as travel pests, there are some less familiar to New Zealanders.

In the last few years, two such pests have been reported in this country for the first time; with the increasing ease of overseas travel, these are not likely to be the last occurrences, and precautions must be taken to avoid their attacks.

1. *Tunga penetrans* -- the "jigger" or "sand flea" has a predilection for persons exposing bare skin to sand/soil in Central and (northern) South America, as well as much of tropical Africa.

Recent reviews of Tungiasis draw attention to the widespread distribution of the infesting flea, the great ease with which it can be picked up and precautions which should be taken to avoid attack.

2. *Dermatobia hominis* -- the human bot-fly. In 1996 the first reported instance in New Zealand of this very unpleasant parasite was found in a traveller returning from Peru. Infestation at first resembles a `boil' on the skin but fails to respond to the customary treatment for that condition. It must be removed, by various methods, in its entirety. The life history of this fly is extraordinary, involving a form of phoresy in which an entirely different insect is used as a "porter fly" to transfer the eggs to the definitive host -- man or other mammals.

Precautions to avoid attacks by these two unpleasant insects, and recommendations for seeking medical treatment, will be mentioned.

Preliminary results - Costs and benefits of aerial 1080 possum poisoning operations to North Island robins in Pureora Forest Park

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Aerial 1080 possum poisoning operations are undertaken for two main reasons: to reduce damage to native forest ecosystems caused by possum browsing on vegetation and predation of native animals, and to reduce the likelihood of the transmission of bovine tuberculosis from possum populations to adjacent farmed cattle and deer herds. There has been some concern about the impact of such aerial operations on non-target animals, particularly native birds and invertebrates. Most monitoring of forest bird populations has involved the use of the 5-minute count technique. Reviewers have expressed concerns about the reliability of this technique to detect mortality of <25% for species of moderate density (0.2-1.0 per count). The mortality and breeding success of individually colour-banded North Island robins at treatment and non-treatment sites in Pureora Forest Park are being monitored before and after aerial possum poisoning operations. Results obtained following the first operation will be presented.

The familial placement of the mite genera *Halotydeus* and *Protopenthalodes*

Ting-Kui Qin

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The mite genus *Halotydeus* is currently placed in the family Penthaleidae, but a recent cladistic study indicates that it probably does not belong to this family. Members of *Halotydeus* have been found in Africa, Asia, and Australasia. The genus *Protopenthalodes*, described from Poland, was placed in another family, the Penthalodidae by the original author but it lacks many diagnostic features of this family. These two genera share some morphological features (fused rhagidial organs, lack of an epirostrum, small naso and small internal verticals, plumose body setae), suggesting they may belong to the same as yet unrecognised family. The best way to treat these two genera systematically will be discussed.

Community attitudes to biodiversity management

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We are not able to achieve the task of biodiversity conservation without community involvement. In cognisance of this factor the conservation agencies have been shifting to increasingly involve communities in the decisions and practicalities of conservation management. This paper looks at how community involvement has changed as the formulation of government policy has been modelled on changing notions of what is meant by 'community'. Over the last years there has been a shift from seeing communities as *(a)* dependent and in need of expert advice, to *(b)* seeing them as a collection of individuals, who in self-interest, work to maximise their own gains independent of the collective good, and more recently, to *(c)* seeing communities as participants in policy development and conservation management - communities capable of deliberation and learning from experience.

This paper discusses the latest model in terms of community development and why it is becoming increasingly important in the management of conservation. Essentially, healthy eco-systems are being increasingly associated with healthy communities can also be expected to have long term negative consequences on biodiversity conservation. The effects of government policies over the last years are considered in light of research in progress.

The commons becoming uncommon: steps towards increased integration in the management of aquatic biodiversity

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Department of Conservation

This paper highlights some of the notable features of the aquatic biodiversity of NZ which give rise to the particular values and vulnerabilities of certain species, community types and ecosystems. It summarises existing national biodiversity management objectives for aquatic ecosystems, including those in legislation, national strategies and site or species specific plans.

It outlines existing and changing property rights and responsibilities for aquatic biodiversity, while acknowledging that these are challenged by both Treaty claimants and land owners. It provides a broad explanation of statutory frameworks and agency management roles for freshwater biodiversity, ranging from international conventions through to local agency planning documents. Some of the strategic planning tools and other methods for promoting more integrated management are identified.

It discusses some of the unresolved issues and other challenges in management of aquatic biodiversity across administrative and/or ecological boundaries. These range from the difficulties in controlling land-use effects to safeguard downstream aquatic habitat quality through to dog-in -the-manger stalemates on esplanade reserves. The increasingly popular practice of unbundling common heritage property rights and responsibilities may achieve its goal of facilitating more focused and efficient utilisation, but it also brings the risks of dis-integration to planning and management of aquatic biodiversity.

A suite of principles to guide future strategic planning for the management of aquatic biodiversity is put forward for discussion.

The effectiveness of lilliputian bees as pollinators of declining mistletoes

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The red-flowered mistletoes (*Peraxilla* spp) are in decline in New Zealand. Recently we described severe pollen limitation as a cause of pollination failure of *Peraxilla tetrapetala*. The shortage of fruit in these populations may be preventing the replacement of individuals that die and the colonisation of new host trees. Pollination is normally by tui or bellbird as the buds must be opened by force, but we reported last year that small native bees could on occasion open buds. Here we report on the effectiveness of these bees as pollinators. Three species of native bee have been observed on the flowers at our study sites. The ability of the bees to open the buds appears to be determined by body size and the smallest bees seem unable to regularly perform this feat. Once buds have been opened, bees deposit similar amounts of pollen on stigmas as birds. The potential for bees to replace the role of birds as pollinators of mistletoes will be examined.

The ecological re-juvenation of Matiu/Somes Island

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Ecological restoration involves the re-instatement (to a particular place) of lost species, lost physical conditions or lost ecological processes. That restoration can occur through natural means or by human intervention. The Department of Conservation has developed a plan for the re-juvenation of Matiu/Somes Island. The primary objective of that plan is to restore to the island a coastal forest community of indigenous plants and animals native to the Wellington Ecological District and use the island as a refuge for a limited number of plant and animal species.

To develop the plan several information sources have been used including: biogeographical datasets about the current and former geographical distribution of plants and animals in the lower North Island; historical information; climatic, soil and landform information about the island; species-area curves; and intuition.

Some activities that are primarily for habitat protection on the island are identified and are distinct from the activities to restore to the island that which has already been lost. The ecological re-juvenation of Matiu/Somes Island is adaptive management and requires regular inspections to determine the effectiveness of the current planting programme and the pest plant control efforts. Suggestions are sought to improve the effectiveness of efforts to re-juvenate the ecology of Matiu/Somes Island.

Flowering phenology, stigma receptivity and nectar production of New Zealand pohutukawa (*Metrosideros excelsa)*

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Pohutukawa *(Metrosideros excelsa)* forms an important part of the native vegetation of New Zealand. Little is known about the reproductive biology of this species. In this paper, results of work on flowering phenology, stigma receptivity and nectar production of pohutukawa are reported.

Metrosideros excelsa has open inflorescences bearing 18 to 48 flower buds which develop throughout spring. Bud break typically occurs in the first half of December and the individual red brush flowers remain open for a period of about one week. The flowers initially go through a female phase, then become hermaphroditic for a period of five days and go through a second female phase concurrent with stamen senescence and abscission.

Stigma receptivity in flowers of different ages has been assessed in detail, using a range of methods such as the testing of peroxidase activity, pollen germination, pollen tube growth and seed set. Results from these experiments show that stigmas are receptive over a period of at least nine days.

Scanning electron microscopic observation of stigmas shows the presence of stigmatic exudate from the day after anthesis for a period of eight days. The exudate then dries up and the stigma surface becomes deformed.

The flowers produce nectar (average sucrose concentration: 17.7%) over a period of seven days at an average rate of about 46 ul/flower/day.

Many of the observed features suggest geitonogamy and outbreeding with potential pollinators being the New Zealand honey-eating birds and native and introduced bee species and are in accordance with the concept of a mixed mating system in pohutukawa.

Transgenic insects: a new means for pest control?

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There is currently world-wide interest in developing methods for generating transgenic insects. For over fifteen years it has been possible to make transgenic *Drosophila melanogaster* by using vectors based on the P transposable element. In this system, pre-cellular embryos are injected with a mixture of two plasmids. One plasmid codes for the P transposase. The other contains the P element inverted terminal repeats which are the targets of the P transposase. The gene of interest and a selectable marker gene (e.g. *white*), are inserted between the repeats. However, P-based vectors appear to be very host specific as they have only been successfully used for transformation of *D. melanogaster* and its close relatives. In recent years, a number of new transformation vectors based on other transposable elements such as Minos, Hermes, Piggybac and Mariner have been developed. Of these, Minos-based vectors have been successfully used for making both transgenic *Drosophila melanogaster* and *Ceratitis capitata* (medfly).

We are proposing to determine if Minos-based vectors can be used for generating transgenic *Lucilia cuprina* (Australian sheep blowfly). Our primary aim in making transgenics is to determine if female-lethal gene constructs we have tested in *Drosophila* , will function in *Lucilia*. Transgenic female *Drosophila* carrying these gene constructs are normally viable but die following heat shock and induction of gene expression. In the long term this could be used to improve the sterile insect technique (SIT) for controlling *Lucilia* . SIT is particularly effective if only sterile males are released. Transgenic technology could also be used for evaluating candidate insecticide resistance genes and for testing lethal gene constructs (e.g. dominant-negative ecdysone receptor) which could potentially be transmitted by viruses

Roost selection and social structure in long-tailed bats *Chalinolobus Tuberculatus* : limiting factors and implications for population viability

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Roosting behaviour and population biology of the threatened long-tailed bat were studied in temperate *Nothofagus* rainforest in Fiordland over four summers. After radio-tracking 60 bats, 308 roosts in 264 different trees were monitored. We investigated roost selection by comparing the structure and micro-climate of roost trees and their cavities with those available. Preliminary results infer a high degree of roost selectivity. Bats preferred dead trees and those with large stem diameters, higher total height, larger numbers of cavities, and lower canopy closure. Roosts exhibited more stable temperature and humidity levels and were more insulated than non-roost holes. The majority of roosts (70%) were used for only one day and reuse was very low (16%). Roosts were solitary (52.4%) or communal (47.6%). Communal roosts were relatively small (93% held <70 bats).

Radio-tracking showed that individual foraging ranges overlapped considerably. However, a banding study revealed that distinct, but cryptic, social groups existed. The bats almost always associated with some of their traditional roosting companions during the day, but mixed at foraging sites during the night. Of 1874 recaptures from three groups at communal roosts (n=65) there were only 32 cases (1.7%) of individuals switching between groups for one night. Those switching were mainly non-breeding (1-year old) females. Juveniles of both sexes returned to their natal group as one year olds.

Low levels of roost reuse, low roost fidelity and cavity specificity imply that bat populations require many suitable trees covering large areas of unmodified forest. Localised assemblages of bats linked through infrequent migration by a few individuals, indicates a metapopulation structure. If long-tailed bat populations are characterised by local extinction of groups in some patches of forest, and colonisation of others, then loss of lowland forests could have had a significant impact on the persistence of populations.

The impact of the Australian brushtailed possum *(Trichosurus vulpecula)* on New Zealand Loranthaceae mistletoes *(Peraxilla colensoi, Peraxilla tetrapetala,* and *Alepis flavida)*

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Endemic mistletoes in the family Loranthaceae provide one of the few sources of nectar and fruit in New Zealand beech forests. However, mistletoes are becoming increasingly rare throughout the country. Although possums have been considered a major cause of mistletoe decline, recent evidence suggests that in some forests, possum damage may pose a relatively minor threat compared to other factors such as forest clearance, the reduction of native pollinators, and flower predation by native invertebrates. Quantitative studies on possum impact are few and contradictory.

The purposes of this study are: 1) to quantify the differences in possum browse on the three beech-mistletoe species (*Peraxilla colensoi, Peraxilla tetrapetala*, and *Alepis flavida)* in four South Island forests, and 2) to compare three methods of monitoring possum browse (visual scoring, photopoints and leaf mapping). Preliminary results from this study indicate that possum browse does have a serious impact at some sites. However, other factors such as insect browse and wind throw are more important at other sites. A major methodological problem is large spatial and temporal heterogeneity in possum damage.

Maori and biological diversity

Piri Sciascia
Te Puni Kokiri

The knowledge systems by which traditional Mäori understood "biodiversity" are embodied in mätauranga Mäori. The status of mätauranga Mäori and the legitimacy of the relationship that indigenous people such as Mäori have with biodiversity is recognised in the Convention on Biodiversity and Article 2 of the Treaty of Waitangi, as well as in NZ's national legislation.

Traditional Mäori culture has evolved because of, and been determined by, the biological resources available to them. Biological diversity has determined cultural diversity.

Current issues relating to biodiversity are: Maori want to protect and manage their interests in species, ecosystems and genetic resources so that outcomes are compatible with their economic and cultural aspirations. Mäori want: genuine participation in the management and policy development relating to biodiversity; to discharge duties and obligations to ancestors and future generations; to share in the benefits of the use of biodiversity; and to utilise, promote and protect traditional knowledge about the conservation and sustainable use of biodiversity.

Current management issues are explored. Co-operative management arrangements that accommodate statutory requirements, ecological "bottom-lines" and expressions of rangatiratanga are proposed as a broad policy direction.

Access to and recognition of mätauranga Mäori is a crucial component of Maori participation in biological resource management.

Sustainable use of biodiversity is necessary if Maori are to use biological resources for customary purposes, medicines and other uses. Current conservation policy which is essentially focused on preventing species from becoming extinct needs to be broadened to include the enhancement of culturally important populations to allow for sustainable harvest.

In addition to the above key policy areas, there is a need to accommodate Mäori aspirations for biological diversity as part of the functioning of the RMA and also a need to incorporate Mäori aspirations within the mainstream science program so that research is appropriately directed.

Peat bog antiquity and resistance to environmental change

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Moanatuatua and Whangamarino are two peat-forming ecosystems in the Waikato region in around which the water table has been lowered in the last few decades. An investigation was carried out of the peat and vegetation to ascertain the effect of changes in water table. It appears that changes are having much greater impact on surficial peat and vegetation at Whangamarino vegetation than at Moanatuatua. This is surprising given that water level in the peat is higher at Whangamarino than at Moanatuatua. However at Whangamarino, large marginal zones of surficial degraded sedge peat, which overly healthy restiad (*Empodisma minus*) peat are presumably a response to lowered water table. At Moanatuatua there is little change in peat degradation state (healthy restiad peat characterises the upper parts of the peat profile) and no visible variations in vegetation that can be attributed to water level change.

Why should one bog be more resistant to depressed water levels than the other? Moanatuatua is far older than Whangamarino, with peat formation starting 13 000 yr BP as opposed to 1600 yr BP. The difference in age may be control their susceptibility to external influences, with older bogs being more buffered against environmental change. Factors such as nutrients, particularly nitrogen and potassium, and fire history will be discussed in the context of patterns of peat degradation.

A Pilot Study of the Impacts of Pollard 1080 Baits on Forest Invertebrates.

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The four invertebrate species most commonly found using 1080 pollard ("Wanganui No. 7 ^{R}") baits in podocarp/kamahi forest near Ohakune were observed in a BACI style one replicate experimental pilot study with the following aims : (1) to determine an efficient method for a larger scale study and (2) test whether changes in abundance could be detected by scoring numbers of the four species most commonly found on baits. There was no clear pattern in changes in abundance of the four main species which use the baits. These preliminary results will be discussed and plans for further research described.

Systematics of *scleranthus*

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Scleranthus is a genus of small herbs and subshrubs belonging to the family Caryophyllaceae (which also includes Chickweeds and Garden Pinks). *Scleranthus* includes about twelve species, three European natives and nine Australasian natives. Identification of monophyletic groupings within Caryophyllaceae is problematic, but the family is commonly subdivided into three subfamilies (Alsinoideae, Paronychioideae and Caryophylloideae). I report here on studies using DNA sequence data to shed light on relations between the species of *Scleranthus* and on their place in the Caryophyllaceae.

Nuclear ribosomal DNA Internal Transcribed Spacer (nrDNA ITS) sequences suggest monophyly of the Australasian and European species groups within *Scleranthus* with a recent divergence of these lineages. Traditional subgeneric division into section Mniarum and section *Scleranthus*, based primarily on breeding system characters, is not supported. Section *Mniarum* is apparently paraphyletic and section *Scleranthus* polyphyletic. Explanations of the disjunct distribution of Scleranthus between Europe and Australasia remain speculative.

nrDNA ITS sequences suggest *Scleranthus* is part of subfamily Alsinoideae. However the Alsinoideae as a whole may not be strictly monophyletic. Partial ndhF sequences for a small sample of genera support the paraphyly of Alsinoideae.

Genetic diversity in fisheries research and management

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Stocks are the basic management units in marine fisheries. The term stock is applied in a wide range of situations, but implicit in many uses is an intraspecific group with spatial and temporal continuity that is reproductively isolated from other stocks. No one technique is ideal for stock discrimination although genetic methods have been used extensively in recent years. The stock structure of orange roughy has been evaluated with three genetic methods: allozymes, mtDNA and RAPD's; spatial heterogeneity was found with all three methods. Allozyme markers show spatial and temporal differences along the Chatham Rise with evidence for isolation by distance rather than discrete stocks. There is no heterogeneity among east coast sites, which have higher average heterozygosity than the Chatham Rise sites. In contrast no significant genetic differences were found with allozyme and mtDNA markers among hoki samples from discrete spawning areas off the west coast South Island and Cook Strait. In other fisheries application of genetic techniques has revealed cryptic species of squid and sprat, and resolved taxonomic questions for surf clams and tarakihi. Conversely genetic markers in rock lobsters from Tasmania and New Zealand have shown that these two taxa are conspecific populations. Protein fingerprints are used for the identification of fillets and fish products to detect misreporting of catches and mislabelling in retail outlets. Genetic approaches are likely to find increasing application in enhancement programmes to ensure reseeding with compatible stocks and to track the integration of reseeded stock, to determine the selective effects of fishing gear, and to determine the origin and systematic status of introduced species.

Climatic effects on *Sphagnum* wetland dynamics

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Sphagnum moss harvesting may affect *Sphagnum* wetland dynamics, species interactions and biodiversity within the wetland and downstream. *Sphagnum* is a major water-holding component and removal of large quantities may affect the ability of the wetland area to retain water after rainfall events. Our results from other research suggest there may be a slow rise in average water table height as *Sphagnum* moss grows, presumably due to an increase in overall water-holding capacity within the wetland. *Sphagnum* has the ability to alter surface water acidity and temperature, so removal of *Sphagnum* may result in changes to water pH and temperature. Firstly, seasonal changes in surface water dynamics, chemistry and species biodiversity need to be identified in a self-contained catchment, so that the impact from subsequent *Sphagnum* harvesting can be measured against natural variation.

A *Sphagnum* wetland in Westland is being used for this trial. Weather conditions, changes in *Sphagnum* wetland surface water chemistry and wetland water level and flow are being monitored continuously. Species diversity is being recorded at regular intervals in identified plots within this wetland. Preliminary results from February to April show that water table height fluctuated between 200 and 400mm due to rainfall events. Water pH fluctuated between 4.4 and 4.9. Whilst mean air temperature dropped gradually during February and March, peat temperature continued to rise.

Setting priorities for ecosystem conservation management

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The priority setting problem includes depicting ecosystems and identifying the mix of actions which will bring the best overall return for biodiversity conservation from the financial resources available. Six factors contribute to priority:

1. *Biodiversity value of the ecosystem*: comprised of distinctiveness, representativeness and significance. This influences priority because resources should go to the actions which secure more valuable assets ahead of actions protecting less valuable assets.
2. *Efficacy of the management action*: the difference between expected conservation outcomes with and without a particular management intervention. This influences priority because resources should go to the action which offers the most conservation benefit.
3. *Urgency*: the time for the threat to take effect in absence of management and the time for management action to take effect. Urgency is pertinent because resources should go to management actions securing assets under most imminent threat, and of these actions, to those which bring the benefit soonest.
4. *Feasibility*: risk of failure to achieve the objectives of the management action. Five risk categories were recognised: outcome risk; operational risk; legal risk; collateral damage risk and; public reaction. Feasibility influences priority because actions with most chance of success should be resourced ahead of actions with higher risk of failure.
5. *Cost*: expense incurred by the management action. Cost influences the priority through both value for money and opportunity cost.
6. *Complementarity*: how much an action adds to the range of biodiversity conserved. To maintain the full extent of biodiversity, it is necessary to conserve a diverse range of equally deserving ecosystems and avoid concentrating action within a group of similar types at the expense of different types.

A method for delineating ecosystems and explicitly quantifying and integrating these factors will be presented.

Surviving *Brodifacoum*: the effects of rodent eradication on morepork (*Ninox novaeseelandiae*)

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On 18 September 1996 Department of Conservation (DoC) aerially applied Talon bait (active ingredient Brodifacoum) to Mokoia Island, in Lake Rotorua. The drop was an attempt to eradicate mice from the island, which is otherwise mammal free. Mokoia Island has become a "restoration project" with the translocation of North Island robin in 1991, saddleback in 1992, and hihi in 1994. The eradication of mice was seen as an important management strategy for further translocations to Mokoia.

The regenerating forest on 135-ha Mokoia supports a population of around 40-45 morepork. The aim of this study was to investigate the survival of morepork through the poison drop. Morepork are nocturnal predators which feed mainly on insects, but also eat birds and mice. Mice appear to be an important food source in winter on Mokoia. This means that morepork were subject to secondary poisoning by eating poisoned mice.

During the 1995/96 breeding season, we fitted morepork with small (6-7gm) back-pack transmitters and studied their breeding and behaviour. We captured additional birds during the winter of 1996, and fitted them with transmitters. At the time of the poison drop, 16 birds were carrying working transmitters. However, due to delay of the drop, from June/July to mid-September, the batteries of two of the transmitters ran out within 3 weeks of the drop. Of the other 14 birds, 3 (21%) were found dead. One had 1.1mg/kg of brodifacoum in its liver tissue. The others were too degraded for analysis. Another unmarked bird was found by DoC staff, and its liver contained 0.97mg/kg of brodifacoum. The likely cause of death for these birds is secondary poisoning, as mortality of these birds during this study has been negligible. Moreover, an assay of 0.4 - 0.8mg/kg in liver tissue of owls has been described as lethal in other studies. The 11 surviving transmittered birds, plus a further 4 colour banded morepork, were seen alive at least 2 months after the drop. Brodifacoum is known to persist in tissue for a long time, up to 16 weeks in sheep. This means we cannot be sure that more birds will not be affected by the persistence of this poison. Post poison drop breeding success has also been monitored, but will not be covered in detail in this talk.

Provenance variation in fuchsia (*Fuchsia excorticata*) in relation to palatability to possums

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Summary
Fuchsia (*Fuchsia excorticata*) has been heavily browsed and killed by brushtail possums (*Trichosurus vulpecula* Kerr) in many New Zealand indigenous forests, but remains healthy at some sites despite long histories of possum occupation. We attempted to determine whether the apparent regional differences in palatability of *fuchsia* to possums had a genetic basis by propagating material from six widely dispersed stands under identical conditions, and comparing leaf chemistry, leaf morphology, physiology, and palatability to captive possums. Leaves taken in the field from the six provenances varied phenotypically, particularly in the macro nutrients content and specific gravity of leaves, which may help explain differences in their apparent palatability. However, captive possums ate similar quantities of foliage from all provenances grown in a shadehouse, and patterns in foliar macro nutrient concentrations, leaf morphology, and physiology, were unrelated to the apparent palatability of *fuchsia* in the field, suggesting that genetic variation between the six provenances does not explain their observed differences in health. Other possible explanations are discussed.

Biodiversity of New Zealand native aphids *(Homoptera: Aphididae)*

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There are approximately 120 species of aphids (Homoptera: Aphididae) in New Zealand but the vast majority are considered to be recent introductions. Six described species are likely to be indigenous including *Taiwanaphis northofagus* (Cottier), *Neophyllaphis totarae* Cottier, *Aphis coprosmae* Laing ex Tillyard, *Aphis healyi* Cottier, *Aphis nelsonensis* Cottier, and *Paradoxaphis aristoteliae* Sunde. Up to a further six species have been collected but their descriptions have not been published. *Aphis* sp. nr. *epilobii* and *Trichocallis foxtonensis* (Cottier) were first found in New Zealand but may be introductions. Some indigenous species are difficult to find in the field and have only been observed on one or two occasions and/or localities. This report details the re-discovery of at least two previously undescribed species. Taxonomic affinities of New Zealand aphids are also discussed along with host plant associations, species distributions and abundance. Issues relating to bio-diversity of New Zealand native aphids are investigated.

Masting: tests of the pollination efficiency hypothesis

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One theory attempting to explain mast flowering is known as the pollination efficiency hypothesis. This hypothesis predicts that the benefits gained from increased pollination success associated with mast flowering, outweigh the disadvantages of foregoing reproduction in the intervening years. This hypothesis was tested on wind-pollinated (*Chionochloa macra*) and animal-pollinated (*Phormium tenax*) species in the 1996 season. No clear benefit of higher flowering density on female function (seed set, seed weight) could be found in either species. There are four possible reasons: (1) the benefit is outbreeding not seed set; (2) the benefit is through male function; (3) the experiments were at the wrong spatial scale; or (4) there is no benefit from masting.

Fight them on the beaches! Habitat use and vulnerability to introduced predators of shoreline lizards

David R Towns
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Shore skinks (*Oligosoma smithi*) on Korapuki Island, Mercury Islands, showed significant shifts in population structure, capture frequency, and habitat use following removal of kiore (*Rattus exulans*) in 1986. Considerable variation in distribution and habitat use is found in the egg-laying skink *Oligosoma suteri*, a shoreline species absent from Korapuki Island but abundant on neighbouring islands. Circumstantial comparisons indicate that these variations are related to the presence of introduced predators. This possibility was tested following reintroduction of *O. suteri* to Korapuki Island in 1992. The translocated population bred successfully after release, showed high post-release survivorship, and was highly mobile. The previous absence of *O. suteri* from Korapuki Island is not consistent with existing habitat deficiencies. The species is, however, now using habitats where risks of predation are likely to have been high before kiore were removed.

Disturbance of successional vegetation on the shoreline of Lake Waikaremoana : effects of lake level management

Chris Ward
Department of Conservation

Lake Waikaremoana was lowered by 5m in 1946 in the course of hydro-electric utilisation of its water. A gently sloping bench around the natural lakeshore, eroded into soft mudstones and/or built out by unconsolidated sediments, has been more or less permanently exposed. Complex vegetation has established on the newly exposed land.

On the mid-upper elevations of the exposed bench there is a wide range of primary successional vegetation featuring red, black and silver beech, kanuka, manuka, kowhai and many other broadleaved tree and shrub species. At the lowest elevations, an ecotone with vegetation zones dominated by herbaceous and quick-maturing species is now well established and adjusted to frequent submergence, where there are stable substrates. In between, there is a complex zone of ongoing disturbance where the physical effects of occasional high lake levels (mainly various forms of erosion) interact with primary successions.

The most obvious form of disturbance is the erosion of a new bench in mudstone and unconsolidated sediment with common formation and retreat of a scarp or bank. Less obvious but equally important, the stripping of soil or former lake sediment and related processes have affected much of the lakeshore in occasional high lake levels up to 2.2m above the modern view of "lake full". The effects include the slowing of growth rates and the processes of primary succession, or the setting of successions back to earlier stages. In widespread bare-rock benches, vegetation successions are continually reset back to "zero".

The Department of Conservation has proposed a lake level management regime with reduced "normal operating range" and tighter management of high and low lake levels, to minimise the adverse effects of lake levels beyond a 3-metre range.

It is not realistic to compare the modern lake in any detail with the natural lake's hydrological patterns of wide ranging levels (up to 7.3m extreme range) and its lakeshore geomorphology and ecology. It is not realistic to set an objective of recreating "the natural state" on the lakeshore. Erosion effects, mainly consequent on lowering the lake levels, would result in excessive disturbance and shoreline instability over several hundred years if the current lake management regime were to be continued.

Instead, accepting the lake's lowered levels and manipulated outflow, the Department of Conservation proposals set an objective of a "quasi-natural" shoreline zone with markedly reduced instability, disturbance and rate of change over several decades. Over this more comfortably human time-frame, a transition zone from lake to undisturbed terrestrial vegetation would develop that was narrower and more "mature" than would be the case under current lake level regime.

A phylogenetic study of *Tiphobiosis* and related genera (*Insecta: Trichoptera: Hydrobiosidae*)

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Tiphobiosis is an endemic genus of New Zealand caddis (*Trichoptera*) whose species are found in small forested streams, often associated with waterfalls and cascades. Small, open streams at high altitudes are also favoured. Their taxonomy constitutes an interesting "growth area". Although the first species was caught in 1903, by as late as 1953 only three species were known. Nineteen species are recognised today. Some are widespread but all are quite rare.

The work described here was motivated by the discovery of a new species, in Northland and Auckland, that possesses some typical *Tiphobiosis* autapomorphies, but also has characters in the wings and male genitalia that are unknown in the other *Tiphobiosis* species. The work will decide on the genus to which this new species belongs.

Biodiversity and ecosystems: grasslands, islands and afterlife effects

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Most studies considering the effects of biodiversity on ecosystem properties have concentrated on live plants and above-ground relationships, but most plant production eventually enters the soil where it has potential "afterlife effects". Firstly we report on a three year study involving the experimental reduction of plant diversity in a Waikato perennial grassland, and the effects of this on ecosystem properties with emphasis on the decomposer subsystem, soil food-webs and soil biodiversity. Contrary to popular theories relating biodiversity to ecosystem function, we found few consistent adverse effects of plant species reduction on soil nutrient status, populations or levels of key groups of decomposer organisms, taxonomic diversity of key groups of soil organisms, stability of ecosystem components or key ecosystem-level processes. Secondly we evaluate why our results are inconsistent with theories and earlier experiments indicating beneficial effects of biodiversity on ecosystems. One possibility is that the main studies claiming these effects have serious flaws in their design, invalidating their conclusions [M. A. Huston, *Oecologia* (in press)]. Another is that earlier studies have concentrated mainly on above-ground interactions and processes, while ours has moved below-ground; biodiversity - ecosystem function relationships may be far weaker in the below-ground context. We report two experiments which support this. In the first [Wardle, Bonner & Nicholson (1997); *Oikos 79*: 247-258], we experimentally varied species diversity of plant litter from one to eight species and found that litter diversity had few predictable effects on key decomposition-related processes. In the second, we describe a study on the relationships between island area, plant species assemblage, plant diversity and key below-ground processes [Wardle, Zackrisson, Hörnberg & Gallet, *Science* (in press)], which found that plant community structure (and the traits of the component species), rather than species diversity *per se,* determines key ecosystem processes. We conclude that there is relatively little evidence to support the popular notion that biodiversity is inherently "good" for ecosystems when appropriate consideration is given to the below-ground subsystem.

Management of ecosystems in the rural landscape

Liz Wedderburn
AgResearch

There are many scales of biodiversity, in a rural context these range from paddock, farm, catchment and region. The management of these ecosystems is dynamic given the spatial arrangement of farming practices and their changes over time. Rural landscapes not only have their own ecosystem function and processes but human preferences for the output derived from these systems often controls placement and size of these systems. Linking ecological and social processes is crucial for appreciating the relationship between biodiversity and ecosystem function. Major interactions exist among ecosystems at a landscape scale and the sustainability of the individual components of the landscape is dependant on the total network of landscape structures. This paper looks at the interactions which can exist and the influence of human decision making.

Hybridisation - how, or should it be managed?

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Hybridisation may be defined as "interbreeding of individuals from (presumed) genetically distinct populations regardless of the taxonomic status of such populations". Although an evolutionarily constructive process, hybridisation is viewed as increasing and threatening and arising primarily from human induced habitat modifications, habitat fragmentations and exotic species introductions. Management responses to inter-specific hybridisation tend to be contradictory and subjectively-based but generally in line with the sentiment that refers to hybridisation as "pollution", "infection" or "deterioration". Pertinent NEW ZEALAND examples will be highlighted. Restoration ecology has provided a new focus by considering hybridisation at the intra-specific level. A widely supported sentiment against intra-specific hybridisation of NEW ZEALAND plants is based on the ready recognition of local adaptation. Not so for New Zealand's fauna where any detectable genetic "difference" between populations is being presented as worthy of preservation. Is a little deliberate genetic reparcelling all that bad?

The New Zealand terrestrial environment: balancing indigenous and introduced biodiversity

Warren Williams
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For economic and social reasons, New Zealand's land mass now hosts a mosaic of two distinct sources of biodiversity: the indigenous/endemic and the introduced/naturalised. This situation is unlikely to change in the foreseeable future. So for this next period, New Zealand should have strategies in place to enable society to optimise the management of both components and minimise the tensions between them. Much of the terrestrial indigenous biodiversity can be managed *in situ* as ecosystems in the network of National Parks, Forest Parks, etc. The adequacies and inadequacies of these ecosystems as maintainers of diversity must be urgently reviewed and the need for other strategies, such as *ex situ* conservation be undertaken in certain cases. The inadequate representation of lowland and coastal ecosystems in the scheme is one that is currently being addressed. A need for a better understanding of genetic diversity in the indigenous systems is a clear need, even for benchmark purposes. Policies on access to indigenous biodiversity are especially important as they impact on access to introduced biodiversity.

A national strategy for the management of introduced biodiversity is in urgent need of formulation. The strategic reliance of New Zealand on the biodiversity of other countries and the key reasons for it must be made better known. The need to continue to cautiously import and conserve biological diversity is recognised. A national genetic resources strategy is advocated as a key element of the biodiversity strategy. Because of its reliance on introduced biodiversity, New Zealand must improve its international genetic exchange activities and re-join the major international networks, especially CGIAR.

Finally, New Zealand, in establishing national biodiversity policies and strategies, needs to develop better ways of managing the enormous interfaces between the two sources of biodiversity. Many of these interfaces are transition zones which, for effective management, require knowledge and understanding of both systems. In this context, the setting up of a National Science Strategy for biodiversity that includes both introduced and indigenous biodiversity would be a useful step toward coordinating knowledge of these transitional zones, identifying the knowledge gaps and formulating a strategy for managing both sources of biodiversity and the interfaces. So let New Zealand drop its infamous "conservation" and "exploitation" organisational groupings and develop a working system that will enable conservationists sustainably using introduced biodiversity to work together with those who are conserving indigenous biodiversity for sustainable use.

ABSTRACTS OF POSTERS PRESENTED AT BIODIVERSITY NOW

Species diversity in the *Erioptera (Trimicra) pilipes (Dip., Tipulidae)* complex

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Two species of the cranefly subgenus *Trimicra* are recorded from the main islands of New Zealand in the latest revision (*Oosterbroek* 1989). One of these, *E. pilipes Fabr.*, is regarded as a highly variable cosmopolitan species with several subspecies. Evidence is presented here that New Zealand specimens previously considered to be pilipes actually represent at least three rather variable species (A, B, C), all of which occur sympatrically in the Manawatu region. Constant morphological features have been identified which distinguish the three forms. Comparison with European material suggests that species A is *pilipes*. Species C appears to be *inconstans Alexander*, a form which had been relegated to subspecific status. The remaining species (B), which is widespread in New Zealand, has not yet been identified with any named species. The results of a mating preference study conducted with freshly captured active specimens of all three forms, together with another common species (D) related to *confluens Alexander,* support the notion that the above-mentioned forms are specifically distinct. Allozyme comparisons are underway to address the question of reproductive isolation.

Biosystematics of *Hebe (Scrophulariaceae):* a multidisciplinary approach

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Hebe is New Zealand's largest genus of land plants and one of the most distinctive. The latest revision is that of Moore (in Allan 1961) and, since completion of that work, the circumscriptions of some taxa have been questioned and a large number of unnamed species have been suggested. Our research will evaluate the status of these taxa, using an assessment of morphological and chemical (leaf flavonoid) variation. A compilation of information on the distribution, habitat and variation of each species will form the basis of a comprehensive, fully illustrated monograph (to be completed by 2002). Descriptions will be generated from a DELTA dataset, and the printed monograph will be supplemented with an interactive key. Recent cladistic studies indicate that *Hebe* is of recent, New Zealand, origin and has undergone a rapid radiation. A phylogenetic hypothesis of *Hebe* will be used in to assess generic limits, produce an infrageneric classification, and to provide further insight into the evolutionary and biogeographic history of the group.

Kill the browsing animals and plant diversity takes care of itself

Geoff Baylis
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Great Island in the Three Kings Group was reduced by Maori settlers and a herd of goats to grass and teatree. About a century after the Maori departed the goats were shot (1946). At this time there were 15 "At risk" (Given, 1981) plant species surviving on the island, 14 of them reduced to fewer than 6 specimens. Adjacent islets supplemented these seed sources at least for *Meryta* which was absent.

Today all but two of the "at risk" species are generally or locally plentiful. The exceptions (*Tecomanthe speciosa* and *Pennantia baylisiana)* were reduced each to one plant but will survive indefinitely as the vine layers and the tree produces coppice shoots.

This example argues against planting programmes for endangered species, as unnecessary, interfering with natural succession, involving risk of introducing weeds and disease and diverting funds that can be so profitably spent on eliminating browsing animals.

Southern connections in the moss genus *Fissidens* - Is endemism a declining variable?

Jessica E Beever
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It has been stated, with respect to Australasian bryophytes, that 'knowledge of present distributions is without exception incomplete and is often merely fragmentary, while knowledge of past distributions is negligible. Quantitative calculations of endemism are therefore futile' (Scott, 1988).

Fissidens, a widespread genus of moss with over 900 species recorded, has some 30 species currently recognised in New Zealand. Known distributions range from narrow endemics found only in New Zealand, to species widespread in both hemispheres.

This poster illustrates the state of flux of known bryophyte distributions, exemplified by New Zealand *Fissidens*. A comparison is made between distributions given in Index Muscorum (Wijk et al 1962, 1969) and present known distributions.

Perceived endemism has decreased because:

- species previously thought to be confined to separate territories are now regarded as synonymous
- known species have been recorded in new territories

The opposing trend has occurred, but to a lesser extent, due to taxonomic studies

- rejecting earlier geographic records
- splitting existing taxa
- recognising new species

Only 2 of the 5 species listed as New Zealand endemics by Index Muscorum are now considered to be so: *F. anisophyllus* Dix. and *F. hylogenes* Dix. The perceived proportion of endemics has reduced from 25% in 1969 to 15% in that time, and will no doubt continue to change. Endemism can be labelled as 'a declining variable'.

Biogeographic interpretations based on distribution data of as yet inadequately known groups of organisms must be undertaken with caution.

Aerial persistence of *Btk (Bacillus thuringiensis* var *kurstaki*) spores and their penetration into dwellings, following the spraying of Foray 48B over suburban Auckland

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The white spotted tussock moth, *Orgyia thyellina* (Lepidoptera: Lymantriidae), was recently discovered infesting parts of Auckland. Although only occasionally a pest in its home range of eastern Asia, there were major concerns about the pest potential of this moth for forestry, horticulture and native forests. In response, a large-scale eradication campaign was initiated by the Ministry of Forestry, based on the aerial application of *Bacillus thuringiensis* var *kurstaki* (Foray 48B). In this study we investigated the penetration of *Btk* spray into eight homes within the spray zone, and the aerial persistence of *Btk* spores for periods of up to 90 minutes after overflight of the spraying aircraft.

There was considerable variation in the extent of the penetration of the *Btk* spray into homes. Numbers of viable spores detected in the air inside closed rooms varied from less than 4 to 940 CFU.M^{-3}. The lowest concentrations of spores were found in homes with no chimney or open fireplace and which had steel or aluminium window joinery. Outside homes, the airborne concentration of *Btk* spores was found to be approximately 12,000 CFU.M^{-3} during the first five minutes following overflight of the spraying aircraft. After 90 minutes, the air-borne concentration had reduced to 60 CFU.M^{-3}, a substantially lower concentration than that of *Aspergillus* and *Penicillium* spores, which are found in Auckland air at concentrations exceeding 500.M^{-3} for much of the year.

The aerial application of Foray48B over a populated area provided a unique opportunity to study the penetration of a pesticide spray into homes with a remarkable level of sensitivity. Unlike chemical sprays, which are technically difficult to quantify at low concentrations, this study has demonstrated that single droplets of *Bt* spray can be detected by the use of a relatively simple culture technique.

Presence of *Bacillus thuringiensis* var. *kurstaki* (*Btk*) in the tussock moth outbreak area of eastern Auckland prior to aerial spraying

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The distribution and occurrence of *Bacillus thuringiensis* subsp. *kurstaki (Btk)* in the tussock moth outbreak area of eastern Auckland was surveyed prior to aerial spraying with Foray 48B *Btk*. Soil samples were collected from 100 sites within the designated DC-6 spray area during July and August, 1996. Spore-forming bacteria from each sample were grown on bacteriological media and 2875 *Bacillus thuringiensis*-like colonies were chosen for further examination. Stained smears of each colony were examined for the presence of the protein crystals characteristic of *Bt*. A total of 378 *Bt* isolates were found. Isolates producing diamond-shaped shaped crystals typical of *Bt kurstaki* were selected for further DNA analysis in order to search for the characteristic crystal protein gene combination found in Foray 48B *Btk*. Twenty eight of these isolates were shown by PCR to contain a *cry* gene combination similar to that of the *Btk* isolate in Foray 48B. These *Btk*-like isolates were restricted to just six sites. The remaining 350 *Bt* isolates were widely distributed amongst 65 of the 100 sites sampled in the spray zone. The results demonstrate that *Bt* isolates possessing a *Btk* crystal morphology, and a *cry* gene profile similar to that of the *Btk* isolate in Foray 48B, were a natural but infrequent component of the Auckland soil environment prior to aerial spraying.

Phytoliths and the use of phytolith analysis in paleoenvironmental reconstruction

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Pollen analysis is the most widely used and arguably the most successful of the methods used in the reconstruction of terrestrial Quaternary environments. However, one limitation with many palynology studies is the absence of pollen in many strata, especially loess deposits. By contrast phytoliths are often well preserved in loess deposits and phytolith analysis provides a method of extracting environmental and probably climate information from long late Quaternary records.

Phytoliths are produced when higher plants absorb silica in a solution with the ground water and redeposited intracellularly. Phytoliths are produced in large numbers, are easily fossilised and range in size from about 5 to >100 µ. The shapes of the silicified forms in many plants are highly distinctive and in many cases are linked to a single plant species. When a plant dies most of its phytoliths are released directly into the soil, creating an in-situ record of vegetation.

An example showing the potential of phytolith analysis in paleoenvironmental reconstruction is presented from an ongoing study.

What bugs you most ?

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At Mt Albert Research Centre, Manaaki Whenua Landcare Research staff answer many enquiries about insects from members of the public. Enquiries are of two main types. Either the insect is a pest and the caller wants to know how to get rid of it, or the caller has found something that he or she has never seen before and is wondering what it is. Some insects are asked about repeatedly, others may be unique. Occasionally a previously unreported insect is brought to our notice. This is how the tussock moth currently bugging Auckland was first noted, and recently a new species of sawfly defoliating willows, was reported by a member of the public.

For some years we have been recording information from enquiries, which have been grouped into categories based on frequency. It appears that spiders are the group most asked about. The seasonal pattern of enquiries is graphed. A list of the top ten insects most frequently asked about is presented and illustrated.

Spatiotemporal modeling for possum management

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The unacceptability of current levels of possum impact in New Zealand is now generally agreed and significant resources are being applied to possum control. However, systems are needed to ensure that these resources are well targeted and achieve the maximum possible benefit. It is argued here that a spatially explicit framework can succeed in integrating the key ecological and management components of the problem where other approaches fail.

Dispersal into controlled areas is a major constraint on the effectiveness of control. Its rate depends on the dispersal behaviour of possums, the size of a controlled area and the distribution of possums in the surrounding landscape. These factors have been integrated with in situ density-dependent recovery in a spatiotemporal population model (Efford 1996). Within the same spatiotemporal framework it is also possible to meet the requirements of pest managers for tools to design, cost and record control operations. A prototype computer system will be demonstrated.

Efford, M.G. 1996: Simulating spatially distributed populations. In: R.B. Floyd, A.W.Sheppard & P. J. De Barro (eds) *Frontiers of population ecology* CSIRO Press, Melbourne. Pp 409-418.

Restoring the biodiversity of the Chetwode Islands

Peter Gaze
Department of Conservation, Nelson

The Chetwode Islands comprise Nukuwaiata (195 ha) and Te Kakaho (89 ha) at the entrance of Pelorus Sound, Cook Strait. The islands have a history of Maori occupation and the introduction of kiore to Nukuwaiata followed by grazing and the release of weka, deer, pigs, goats, and rabbits. All introduced animals including the weka have now been removed from the islands. The size and relative isolation of these islands provides considerable potential for biological restoration.

The Department of Conservation aims to restore much of the original biodiversity of these islands. Most of the original flora is still intact and weed species are not a serious problem. However, the islands lack many of the animal species presumed to have been present originally. Restoration of these species must have regard to:
identifying those species likely to have been present; determining the extent to which these species may be better conserved by transfer;
determining the availability of these species from elsewhere in the ecological district;
identifying potential inter-specific conflict;
identifying the contribution these species may make to island communities;
establishing a time ordered process for the transfers.

This poster presents an analysis of these criteria with respect to a range of potential species.

'The Karioi Rahui/Sanctuary', Rangataua Forest, North Island - a joint Department of Conservation / Ngati Rangi forest restoration project

Bryan Gascoigne
Tongariro/Taupo Conservancy, Department of Conservation

Rangataua Forest is a red beech-silver beech-mixed podocarp forest covering around 10 000 ha of the southern slopes of Mt Ruapehu, on the Central Volcanic Plateau, North Island. The forest lies just outside the present boundary of Tongariro National Park, and is administered by the Department of Conservation Te Papa Atawhai. The forest contains the Lake Rotokura Ecological Reserve, also administered by the department. Rangataua Forest represents an altitudinal sequence of mixed beech forest vegetation that is unbroken from 700 m a.s.l. to bushline on Ruapehu at around 1300 m. The forest supports 7 of 17 conservancy conservation-priority animal species including North Island robin (*Petroica australis longipes*), North Island kaka (*Nestor meridionalis septenoralis*), New Zealand falcon (*Falco novaeseelandiae*), and a population of over 7000 volcanic plateau short-tailed bats (*Mystacina tuberculata rhyacobia).* Lakes and rivers in the area support a rich waterfowl fauna including New Zealand dabchick (*Poliocephalis rufopectus*) and blue duck (*Hymenolaimus malacorhyncos*). Threatened plant species are also found in the forest, including the crimson mistletoe *Peraxilla colensoi*, the red mistletoe *P. tetrapetala*, and the golden mistletoe *Alepis flavida*. The area is also important culturally to the Ngati Rangi people who hold the encompassing Karioi area as part of their rohe. The forest is wahi tapu, and the Rotokura area itself has a high wahi tapu value to Ngati Rangi.

The Tongariro/Taupo Conservancy of the Department of Conservation has previously ranked Rangataua Forest as an ecologically important area which would benefit from more intensive 'mainland island'-style ecological management.

Following negotiations with the Ngati Rangi Trust, the Conservancy signed a Memorandum of Agreement with the Trust to investigate the feasibility of such a project for the Karioi area. As part of this project, an ecological survey of the forest was undertaken from November 1996 to March 1997. Work on this project was carried out in conjunction with the project steering committee, composed jointly of Department of Conservation staff and Ngati Rangi Trust members. The steering committee progressed pest control and sanctuary options to the Ngati Rangi iwi and worked to address Department of Conservation and iwi issues with regard to the establishment of a sanctuary of around 1600 ha within Rangataua Forest. The Conservancy is now committed to initiation of the 'Karioi Rahui/Sanctuary' project in the 1997/98 financial year with an initial pest control programme using a combination of control methods as approved by Department of Conservation and the Ngati Rangi iwi.

Golden Orbweb Spider In New Zealand

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The large golden orbweb spider *Nephila edulis* (Koch), from Australia, occurs in New Zealand occasionally. First recorded here in 1975, these spiders turn up every few years, usually only one or two at a time. However in some years large numbers have turned up, and 1996-97 has been such a year.

Large mature females up to 4 cm in body length are noticed at the end of summer; their webs reach up to 2 metres across and appear golden in the sunlight. Females often deposit a large fluffy egg sac of golden yellow silk in the corner of the web in autumn, and usually die off at the beginning of winter. Egg sacs have been kept under observation and all have turned out to be infertile. No males have ever been found here, although in Australia tiny males can be seen on the edge of the web.
These spiders are chance occurrences here, being windblown across the Tasman as young spiderlings. If the males make the journey too, they must be too few and too widely dispersed to find the females.

The golden orbweb spider is widespread in occurring in Western Australia, New South Wales, Queensland, and on islands of the Great Barrier Reef.

Taxonomy of *Hebe rigidula* and *Hebe species 'q'*

Gillian Harper
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Hebe rigidula and *Hebe sp. 'q'* are two species of plants found in the Nelson-Marlborough region and considered at present to be similar to each other, to the point where *Hebe sp. 'q'*, an un-described species, is listed in Department of Conservation databases as simply "affiliated to *rigidula*". The aim of this project is to clarify the relationship between the two species and to gain a better idea of variation within *H. rigidula.*

There are three entities in *Hebe rigidula. H. rigidula s.s.* is found on the mainland along the Bryant and Richmond Ranges, from Mt Duppa in the north to the Wairau river in the south. Another group of populations grows on D'urville Island in the Marlborough Sounds. As the plants differ recognisably in the field from *H. rigidula s.s.*, they have been represented as a separate form. A North Island form is restricted to an area some 12 km square south-east of Kawhia. These plants have larger leaves than any of the South Island plants and there are also differences in leaf and bud shape. Southern plants have a round bud in cross-section while Kawhia plants have a more square bud with prominent mid veins and strongly plicate leaves.

'Q' plants are found from the Richmond Range and through the Nelson Lakes area into North Canterbury. *'Q'* differs from other groups in the complex in that leaves are larger, cupped, and wider towards the tip. The plant architecture is also different - 'q' can be a rounded bush up to 1.2 m high and 3 m across, compared with *rigidula's* erect shrubs which never exceed 0.5 m high.

Variation within the North Island form has been described but little taxonomic work has been done on the southern populations of *H. rigidula* and almost nothing is known about *sp. 'q'.*

Methods used to describe variation among seven sites include leaf and floral anatomy, bioflavonoid analysis, and an SEM study of leaf surfaces, particularly leaf wax. Preliminary anatomy and SEM results suggest that *H. rigidula* is highly variable and that there are substantial differences between *'q'* and *rigidula.*

Riwai - the Maori potatoes

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It is generally accepted by scholars, that potatoes were first introduced to New Zealand in the late 1770s by de Surville and Cook. Further introductions from a variety of sources including possible direct introductions from South America followed into the 19th century. Maori were quick to recognise the advantages of these new introductions over the kumara and other traditional food sources and they soon became a staple item in their diet as well as a trade commodity. The various cultivars were given Maori names and many of these early introductions are still grown by Maori today.

Many Maori believe that they brought some varieties of potatoes to New Zealand with the kumara, taro and other introductions and that these were grown in some areas. While there is some anecdotal evidence this has not been scientifically proved.

'Urenika' is the cultivar most commonly grown by Maori and it is widely believed that this is one of the pre-European types. It is often found growing "wild" in uncultivated ground and is sometimes found growing at old Maori occupation sites. Scientists believe 'Urenika' is likely to be synonymous with the European cultivar 'Congo'.

In cooperation with the *Scottish Crops Research Institute,* Open Polytechnic staff are undertaking a project to attempt to match some of the Maori potato varieties with 18th and 19th century European varieties that are grown in the Scottish collections. As part of the project a collection of 13 varieties is being maintained in plots in the Hutt Valley and in the Wairarapa..

Matching of varieties will be done by DNA "fingerprinting" after initial possible matches are made from historical records, anecdotal evidence and by comparing and matching botanical characteristics from descriptors published by UPOV (Union for the Protection of Plant Varieties.) 'Urenika' and 'Kowiniwini' are two that are being tested initially.

While this procedure won't necessarily provide evidence of pre-European potatoes, it may well provide some useful leads.

Ecological effects of genetic manipulation: a modified predator-prey interaction

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A principal aim of genetic manipulation of plants is to make them resistant against herbivores. One way of doing this is to insert genes whose products modify herbivore digestion by inhibiting digestive enzymes. This can results in effects modifying, among others, predator-prey interactions through changes in prey behaviour, availability, and food quality for predators. The ecological effects of genetic manipulation of the lower trophic levels (plants) were studied in a model food chain in the laboratory. An insect prey, the larvae of the cosmopolitan moth *Helicoverpa armigera* were fed on a plant-mimicking diet containing a proteinase inhibitor. The caterpillars were subsequently offered as prey for a generalist predator, the adults of the ground beetle *Harpalus affinis.* The predators consumed less of the 'manipulated' vs 'non-manipulated' prey. Predators fed 'manipulated' prey also consumed less of their normal prey 24 hours after exposure to the manipulated food. Manipulating food source for herbivorous insects can have cascading consequences for predator-prey relationships. This has potential to modify biological control effectiveness and trigger changes in other, non-manipulated ecological communities.

A systematic study of the liverwort genus *Frullania* in New Zealand

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The liverwort genus *Frullania* is a large genus with approximately 26 recognised species present in New Zealand, the majority of these being epiphytic. Recent reports suggest that until a thorough and critical study of the group is made, classification within the genus will remain largely unclarified.

The focal point of this study will be to examine the New Zealand taxa and their relationship to overseas taxa in order to resolve the taxonomy of the genus in New Zealand. The information obtained from this will provide the foundation for research investigating other aspects, including the ecology, conservation and biology of *Frullania* species.

A broad range of techniques is being utilised in this biological study of *Frullania.* These include morphological, anatomical, ecological and reproductive studies. Further work will include molecular and cytological techniques to complement the other areas of study on the New Zealand taxa.

This study has already demonstrated the importance of collecting data from field studies, yielding information not available from herbarium material alone. Examination of fresh material has permitted an investigation of the oilbodies, an important hepatic feature which has not previously been reported for the New Zealand taxa. Field investigations have also included studies on reproductive behaviour and ecology. This has included the discovery of some *Frullania* species growing as epiphylls - an aspect of their ecology previously undescribed in New Zealand. Furthermore, two new species of *Frullania* previously unreported in New Zealand have been discovered.

The combination of data from these different sources is enabling us to increase our understanding of the taxonomic relationships between the species with greater accuracy.

Assessment of the ecological health of urban forest fragments

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Fragments of indigenous forest within the urban environment show a remarkable resilience to the detrimental impacts of land clearance and development, pest and weed invasion, pollution and the dumpage of inorganic rubbish. Vegetation, weeds and ground-dwelling invertebrate fauna were surveyed to assess the ecological health of four central urban forest fragments in Waitakere City. Results were compared with those of a reference site contiguous with the Waitakere Ranges.

The general diversity of invertebrate communities was analagous amongst all sites. This suggests the ground fauna of urban forest fragments is preserved, despite gross changes in flora and considerable disturbance. Difference in community composition between the reference site and the most disturbed urban site are explained by an influx of invasive tourist species.

Mature exotic trees in the canopy tier of urban forest fragments erode indigenous character but do not prevent the regeneration of native species. Cycles of species regeneration and succession have been severely disrupted through urban development but are being restored naturally. Differences in the vegetational structure and species composition, between the urban and reference sites, will be reduced through time.

Results were integrated with the findings of Lisa Eve on aspects of Island Biogeography and birds, to develop management guidelines for urban forest fragments.

Infraspecific taxonomy of *Hebe stricta (Scrophulariaceae)* about Wellington

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According to the first volume of the Flora of New Zealand, *Hebe stricta* currently includes five varieties, two of which are tetraploid and therefore thought to be different species. I am dealing with the taxonomy of the two Wellington varieties - *Hebe stricta* var. *Macroura* and var. *atkinsonii* found in coastal and inland locations respectively.

The first indication that the current classification may be incorrect was given by Cockayne in 1916, who could find no consistent differences between var. *macroura* and var. *atkinsonii.*

Therefore, the hypothesis that I have tested is that coastal and inland Wellington populations are morphologically distinct. Eventually I will provide further evidence by means of flavonoid analyses.

Coastal and inland populations differ with respect to a few characters. At present, I am assessing the statistical and taxonomic significance of this variation.

Towards a simulation model of indigenous landscape elements

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Many of New Zealand's cultural landscapes are almost devoid of indigenous elements. A nature conservation goal for these fragmented environments is to restore a functionally integrated balance of indigenous and adventive species. To achieve this goal a number of questions must be addressed. What is the optimum and minimum area, breadth, shape, connectivity and configuration of indigenous habitat that will sustain particular plant and animal population levels? What resources would be required to achieve the goal within specified time frames? How long will it take to reach a balance given specified resource inputs? With the current areas of discretionary land in the rural-urban matrix, what is the maximum level of species diversity and population size that can be sustained?

Since we have insufficient direct evidence of the dynamics implied by these questions, one approach is to test the implicit hypotheses by carrying out computer simulations using a knowledge of component species' autecology, migration rates and distances, and ecological processes. We start with intra-patch dynamics using the well tested LINKNZ model to simulate forest succession. The second step is to link the external products of a site succession (source propagules) to a receptive target environment (a sink). This establishes a simple, single step model of inter-patch dynamics. The arrival of propagules to a target site initiates forest succession that again can be described by the LINKNZ model but with different starting parameters and with additional propagules arriving produces new successional trajectories. This target site then becomes a secondary source and so the process can be repeated until all potential receptive sites have been filled.

Our preliminary model uses a very simple example of landscape dynamics assuming a uniform empty or willow-filled environment, with perfect availability of vectors, and with receptive sites beyond the primary source. The diagrams show the indigenous elements of an hypothetical landscape with a primary source providing propagules that arrive over time to a target site, which as growth and succession proceeds produces propagules that are dispersed to and establish at a secondary sink.

Predator research priorities for the Department of Conservation

Elaine Murphy
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The endemic fauna of New Zealand evolved in the absence of mammalian predators and has proved particularly vulnerable to some of the mammals introduced since human settlement. Many threatened species in New Zealand have not reached any sort of equilibrium with introduced predators and predation is known, or thought to be, an important factor contributing to their present status.

The amount of predator management being undertaken by the Department of Conservation is increasing steadily. Some of these programmes aim to protect a single threatened species, while others attempt to benefit a range of species through habitat restoration. With the exception of rodent eradication from islands, our predator control techniques are now not keeping pace with conservation requirements. Strategic research on these techniques is fundamental to further progress in managing predation effectively and efficiently.

The department will continue to rely almost exclusively on the traditional methods of trapping and poisoning to control and eradicate predators for at least the next 10 years. It is essential that we refine and develop these techniques.

Key issues identified:

1. Long-life bait. The development of a generalised long-life bait matrix that could be used in combination with different lures and toxins for different species.
2. New toxins. The identification of new toxins, both broad-spectrum and species-specific, is essential for the continuance of long-term control operations.
3. Secondary poisoning. The degree of secondary poisoning of predators from rat and possum control operations and the duration of any benefit need to be determined.
4. Prey switching. Information is required on the impact on threatened species of any predator prey switching, or predator guild changes, resulting from control operations for rodents or rabbits.
5. Damage thresholds. Information is required on the level of control needed to reduce predator populations below damage thresholds.
6. Information transfer. It is vital that maximum use is made of available information and that future research and management are co-ordinated nationally.

Resource allocation in two megaherb species, *Anisotome latifolia* and *Pleurophyllum speciosum*

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Megaherbs (*macrophyllous forbs)* are a group of herbaceous perennials considered to have unusually large leaves and storage organs, and uncommonly colourful floral displays. Predominantly occurring in subantarctic Auckland and Campbell Islands, they appear to be adapted to survive in cool, moist and exposed conditions, perhaps as a consequence of their characteristic growth form.

Six plants each of *Anisotome latifolia* and *Pleurophyllum speciosum* were harvested and analysed for their tissue allocation patterns. These were compared with the Chatham Island's forget-me-not, *Myosotidium hortensia* (which has similar characteristics), and with other herbaceous perennials.

Megaherbs allocated a large proportion of their biomass to leaf tissue, and a smaller amount to storage organs (be it rhizome or taproot). Allocations to laminal support tissues were greatest in the upright *Anisotome* and *Myosotidium,* in comparison with the rosette-forming *Pleurophyllum. Pleurophyllum* had a higher allocation to reproductive tissues at the time of collection than *Anisotome.*

Megaherbs appear, in comparison with other herbaceous perennials, to invest a greater proportion of resources in both storage and light harvesting structures, verifying the uniqueness of their characteristics.

Density indices used in monitoring native frogs, *Leiopelma archeyi* and *L.hochstetteri*

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A study of Archey's and Hochstetter's frogs (*Leiopelma archeyi* and *L. hochstetteri)* was undertaken in mixed podocarp-broadleaved forest of the Tapu River catchment, Coromandel. Monitoring comprised repeated diurnal searches of strip transects at approximately monthly intervals over January to October 1995. Six 50m by 2m transects were situated on the forest floor near ridges to monitor the terrestrial species *L. archeyi;* nine 50m long transects were placed on small forested creeks for semi-aquatic *L. hochstetteri.* Search effort data (search time, numbers of potential frog retreat sites searched) were noted during monitoring.

Search effort indices are an indication of frog density expressed as x frogs/hour searched, or x frogs/100 sites examined. While susceptible to bias from external factors including search speed, terrain, and retreat site density, such measures are frequently found in literature on *L. archeyi* and *L. hochstetteri* (e.g. Bell 1978, McLennan 1985, Green & Tessier 1990, Thurley 1996). Patterns of frog density for this study were determined both from search effort indices, and sample densities from fixed area counts, for each species. The results of each method were compared to determine whether external factors significantly biased the search effort index of relative densities over space and time.

Biosystematics of New Zealand EEZ fishes

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The known fish fauna of New Zealand has doubled over the last 15 years, and continues to increase at the rate of a new species every 2-3 weeks. In addition, many described species are poorly diagnosed and are therefore very difficult to identify. Currently over 140 species are held in the national fish collection awaiting proper description, including numerous commercial, ecologically important, and endemic species. The main objective of this project is to carry out biosystematic investigations on New Zealand EEZ fishes in order to facilitate their accurate identification. Taxonomic specialists from New Zealand and overseas will prepare c.1,200 species descriptions and 230 family keys over a six-eight year period, and make these available through a comprehensive illustrated guide to EEZ fishes and in other scientific and popular publications. Reliable descriptive information on our fish fauna is required by the fishing industry, NIWA, DoC, fish stock managers, regulatory authorities and researchers to underpin the research, conservation, management and utilization of this diverse and valuable natural resource. FRST contract MNZ 603.

Alternative toxicants for control of 1080 shy possums

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The difference between an acute and a chronic toxicant is the speed of onset of poisoning symptoms. Sodium monofluoroacetate (1080) is an acute toxicant; rapid onset of poisoning allows possums to associate cause and effect, leading to persistent aversion to 1080 cereal bait among the survivors of control operations. In contrast the symptoms of chronic or sub-acute toxicant poisoning are delayed and consequently less likely to be associated with the ingestion of toxic bait. This trial, using possums (Trichosurus vulpecula) made shy in captivity, investigated the effectiveness of switching from 1080 to the alternative toxicant Campaign® (the sub-acute toxicant cholecalciferol) or Talon® (the chronic toxicant brodifacoum). Possums re-exposed to 1080 ate a mean of 3.8g + 0.9 (half of the LD95 dose) of bait during the trial, compared to 18g + 6.5 of cholecalciferol (twice the LD90 dose) and 456g + 93 SE of brodifacoum (four times the LD95 dose). 1080 killed 0% of shy possums, whereas cholecalciferol killed 64% and brodifacoum killed 80%. While both commercial baits were effective there was a significant difference in the amount of bait consumed prior to death, which has implications for their relative cost-effectiveness. In this trial, individual possums consumed a mean of $0.93 worth of cholecalciferol bait compared to $2.44 of brodifacoum. This equated to a cost per possum killed of $1.46 for cholecalciferol and $3.05 for brodifacoum. Research investigating the use of these alternative toxicants in an alternative bait matrix, which should enhance their effectiveness against shy possums, is currently underway.

Comparative embryology and pollen hydrodynamics of Matai *(Prumnopitys taxifolia)* and Miro *(P.ferruginea)*, Podocarpaceae

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Comparative Embryology:

The embryology of the two New Zealand species of *Prumnopitys* are being studied with the aim of filling gaps in the known reproductive cycle. Specimens have been collected and fixed at successive stages of development, some embedded in paraffin wax and sectioned for light microscopy, others embedded in resin to be sectioned for both LM and TEM. For late stages of embryo development, seeds have been collected, planted in seed trays, and exhumed at intervals prior to germination, the kernels extracted, and then fixed and sectioned in the same way as the specimens collected in the field. A number of stages not illustrated in the literature have been observed so far, such as a non-linear megaspore tetrad in an immature ovule, and egg nucleus formation in a mature gametophyte (miro in both cases). Matai embryo development has been observed in detail from 'fruit-fall' to seedling germination. The equivalent stages in miro have yet to be observed, due to this species' much slower rate of germination.

Pollen Hydrodynamics:

The pollen grains of matai and miro are typical of the Podocarpaceae in being bisaccate. Earlier studies of other conifer species with saccate pollen have proposed that the sacci confer buoyancy properties which correlate with other characters such as inverted ovules and pollination drops. The hydrodynamics of matai and miro pollen is being examined with various experiments involving, for instance, columns of water and
water drops on glass slides. From my observations, the pollen grains of both species show similar properties, being buoyant yet wettable; two characteristics which are thought to aid pollination of inverted ovules via a pollination drop.

The work on both embryology and pollen hydrodynamics continues.

New Zealand oxyopidae (lynx spiders)

Phil J Sirvid[1] & Cor J Vink[2]
[1] *Museum of New Zealand, PO Box 467, Wellington*
Email: Phils2@tepapa.govt.nz
[2] *Department of Entomology & Animal Ecology, PO Box 84, Lincoln University*
Email: vinkc@lincoln.ac.nz

The spider family Oxyopidae has a worldwide distribution with approximately 410 species. Oxyopids are very distinctive, diurnal cursorial spiders. New Zealand has one described species, *Oxyopes gregarius* (Urquhart, 1884) and it has been suggested there are more species. We have examined specimens from all over New Zealand and found evidence for only one species and we speculate on the origins of Oxyopidae in New Zealand.

Modelling the distribution of *Triglochin procerum* in Bool Lagoon with respect to water regime

Wendy Stubbs
Botany Department, University of Otago

Triglochin procerum R. Br., an aquatic macrophyte found widely distributed throughout Bool Lagoon (South Australia), demonstrates a mosaic of different age stands. It was hypothesised that this was a result of the dynamic water regime. Field experiments quantified the survival and growth of the different life history stages of *T. procerum* defining different windows of opportunity for each with respect to water regime. These data were used to quantify a computer model which examined the role of inter annual variability of fluctuating water regimes on movement of windows of opportunity of each life history stage, and the consequent effect on the distribution of *Triglochin* stands. Simulations using this model suggest that the population at Bool Lagoon consists of a mosaic of stands, derived from separate establishment events. Furthermore, long term (6 years) asexual reproduction was clearly implicated by the model in the maintenance of the distributions observed.

Community-led environmental management: what assists and what deters it in New Zealand today?

Rhys Taylor
Lincoln University

(Work in progress 1997)

Lincoln University Resource Management Masters student Rhys Taylor, recently emigrated from the UK, is investigating people's voluntary involvement in ecosystem management and restoration projects. This exploratory study focuses on what helps or enables voluntary community groups to lead such projects, and conversely what holds up or disables them.

A sample set of projects across NEW ZEALAND is being selected to provide telephone and first-hand interviews during July and August 1997, followed by qualitative analysis of factors influencing each project's progress, seeking generalizable experience. A Report will be available in January 1998.

Conference participants who can suggest likely community-led projects for a shortlist are invited to contact the researcher: Rhys Taylor,
Telephone 03 358 7244. E-mail: taylor@kea.lincoln.ac.nz
Postal address: 45 Lynfield Avenue, Ilam, Christchurch 8004

Interviews will also be arranged with professional ecologists and others, such as local authority field staff, who regularly advise such community groups.
Please make contact if you have such relevant experience.

The researcher was Director of a UK Government-funded support scheme for 2,500 community environmental projects: 'Rural Action for the Environment' 1992-95, and has worked since 1976 variously as a nature reserve warden, community development fieldworker, journalist, publisher, policy analyst and national projects manager.

Assessing the weediness of weeds on conservation land

Susan M Timmins, S-J Owen & Carol West
Department of Conservation, PO Box 10 420, Wellington, New Zealand

A system for scoring the weediness of plant species has been developed by The Department of Conservation. Two numerical ratings are derived by assessing two sets of criteria for each weed species. The Biological Success rating describes the biological capacity of the weed species. Those characteristics often associated with successful weed syndromes are given a high score, e.g. fast establishment and growth rate, high number of seeds produced per plant, very effective asexual spread. Thus, a high Biological Success rating suggests that a species is likely to be very invasive.

The Effect on System rating assesses the actual behaviour of a weed species, where it is having the greatest impact. Those features which are most detrimental to native communities are given the highest scores, e.g. major disturbance to the structure, composition and natural processes of a native community.

The weediness scorings provide some objectivity to decision-making on weed management priorities in DoC. The Biological Success ratings can highlight which new species should be closely monitored and they can be used to assess the potential for spread of an invading weed if it is left uncontrolled. The Effect on System ratings help in determining priorities for control, both where species are well established and where they have just invaded a new site or region.

More information on the scoring system and criteria used is available in:
Owen, S-J, Timmins, S.M., West, C.J. 1996. Scoring the weediness of New Zealand's ecological weeds. In Shepherd, R.C.H. Proceedings of the Eleventh Australian Weeds Conference. Weed Science Society of Victoria, Melbourne.

Fire - its role in New Zealand's indigenous biodiversity

Susan M Timmins[1], & Liam G Foggarty,[2]
[1]*Science Technology and Information Services Division, Department of Conservation, PO Box 10-420, Wellington*
[2]*New Zealand Forest Research Institute, Private Bag 3020, Rotorua*

Most New Zealand communities are not fire adapted and even low intensity fires are a major threat to indigenous biodiversity. Conversely, under some circumstances, fire may be managed to promote biodiversity for some fire-induced communities (e.g. particular tussock grasslands, shrublands, and wetlands).

New Zealand has 2,000 wild fires per year Most are caused by human activity: land management, recreation, arson or accident. When native vegetation burns, it may not recover to pre-burn composition and fire sensitive species may be lost.

Fire management is increasingly critical to maintaining and improving New Zealand's indigenous biodiversity for several reasons:

- the conservation goal to protect natural ecological processes from unwanted disturbance by fire
- the goal to maintain examples of seral states of fire-induced communities such as pakihi and tussock grasslands
- wild fires are often hotter and burn more intensely than controlled fires
- the fragmentation of native vegetation
- weeds which readily ignite and burn more intensely than native species
  the abundance of weed propagules which readily invade sites opened up by fire
- the Tenure Review process which may bring up to 1 million ha of tussock grassland into Department of Conservation administration with likely concomitant increase in fuel loads and back country recreation
- the management of fire on conservation land by non DoC self interest groups

Fire must be actively managed to ensure protection of New Zealand's indigenous biodiversity. To do otherwise is to leave management of conservation land to other self interest groups or to chance.

Summary of *Mecodema oconnori* Study Coleoptera : Carabidae

J I Townsend
J I Townsend, Levin

A good population of *Mecodema oconnori* was located in a half-hectare patch of lowland forest near Levin. A census of beetle numbers and their movements, with minimum disturbance to habitat was carried out over two years by turning suitable ground-cover and individually marking all adults found. An indication of their natural food was obtained by examining fecal material left in tubes while specimens awaited marking. Predation by small animals, probably mice was noted. The population of *Mecodema* present was treated as a fully interbreeding one for the course of the study, but fighting between individuals may indicate that in fact there are two cryptic species present, separated by their larger and smaller sizes and some very slight morphological differences which could well be considered dubious by conservative taxonomists. Previously I had found the smaller form in gardens around Levin (and other places throughout the North Island) and the larger, more typical *oconnori* in selected areas of native forest, many of which also contain populations of *Powelliphanta traversi* snails. While a direct relationship between these species is not implied, there may be a connection with certain earthworms that are a food source for both these species. Perhaps it was an example of larval nutrition - where larger worms occur, larger adults may develop? However, the possibility of larval nutrition giving rise to robust or smaller adults requires further discussion. Should it be dismissed as an explanation as all food in the study area should be equally available to all individuals? Or perhaps the high density of *Mecodema* present in this area means that there is increased competition for food, giving rise to a population showing intermediate morphological characters. It seems likely that the beetles are using pheromones to mark suitable cover as favourable habitat. It is interesting to speculate that pheromones may also be the guiding influence to mating behaviour leaving the taxonomists with only subtle morphological characters to define species. Perhaps future DNA studies could determine whether two isolated breeding populations are in fact present in the area.

Monitoring emergence of apple leafcurling midge *(Dasineura Mali* Kieffer: Diptera: Cecidiomyiidae) adults from soil beneath apple trees

D J Wilson, A R Tomkins, C Thomson
HortResearch, Ruakura Research Centre, Private Bag 3123, Hamilton

Apple leafcurling midge (*Dasineura mali*) (ALCM) populations have risen substantially in New Zealand apple orchards in the last decade. ALCM oviposit on apple tree shoot tips, their larvae developing inside rolled leaves preventing them from unfolding. On the completion of their development, larvae emerge from leafrolls and drop to the soil or crawl down the tree. Pupal cocoons are then constructed in the soil or attached to the tree. The timing of adult emergence, particularly for the first generation in spring, determines when insecticides are applied against this pest. A study was therefore conducted to monitor adult ALCM emergence from overwintering sites beneath apple trees in the Waikato. Large muslin-covered cages were constructed and placed around the drip-zone of trees. ALCM adults emerging from the soil beneath the cages were trapped on sticky surfaces which were replaced at regular intervals and the trapped ALCM counted. Delayed emergence was found to occur with ALCM adults emerging throughout the season. This finding is important and may help to explain some of the difficulties which have been encountered trying to manage this pest.

Studies on New Zealand *Ranunculi* and *Myosotis*

Richard Winkworth[1], Patricia McLenachan[1], David Havell[2], David Glenny[3], Phil J Garnock-Jones[4], Alastair Robertson[1], Uwe Jensen[5] & Peter Lockhart[1]

[1] *Departments of Plant Biology and Biotechnology/Ecology, Massey University, Palmerston North*
[2] *Manawatu Polytechnic, Palmerston North*
[3] *Manaaki Whenua Landcare Research, Lincoln*
[4] *Victoria University of Wellington*
[5] *Institut für Pflanzenökologie und Systematik, Universität Bayreuth, Germany*

We present comparative analyses of chloroplast *mat* sequence data from New Zealand *Ranunculi* and *Myosotis*. We discuss the utility of this molecular marker and its limitations for systematic studies. We also describe recent work with AFLP which we have implemented as a means to identify highly variable regions in plant genomes. The development of molecular markers for such regions should be helpful for many interesting questions on relationships within the New Zealand flora.

Landowners, Resource Management Act district plans, and biodiversity protection: what is happening.

Victoria Froude

Abstract

This paper addresses part of a comprehensive study researching how territorial authorities, unitary authorities and regional councils were implementing the biodiversity protection provisions in the Resource Management Act.

About two thirds of territorial authorities reviewed have included or proposed to include in their district plans, schedules of ecologically significant sites usually with rules restricting land use activities in these sites. Many landowners have objected to having part of their property identified and their use of the identified land restricted.

This paper describes what is happening around New Zealand with schedules of ecologically significant sites and related mechanisms for promoting biodiversity protection. It ~~being~~ describes problems relating to aspects such as poor quality information on biodiversity values and boundaries of sites; inadequate consultation and negotiation processes; a lack of understanding about biodiversity values and threats and alternative mechanisms to promote biodiversity protection; and a reluctance by a number of councils to take responsibility for promoting biodiversity protection in their districts.

The paper concludes with an example where both landowner concerns and biodiversity protection objectives have been satisfactorily addressed.

The ecology of urban forest fragments

Lisa Eve
University of Auckland (MSc)

Five areas of forest in and near Waitakere City were studied and vegetation, bird community and weed presence data was collected. The data was analysed and relationships to physical factors such as size, shape and isolation were investigated.

Vegetation was found to be largely an expression of past disturbance and clearance. Differences were identified between non-urban forest with minimal disturbance, and urban forest fragments which had a history of clearance and are continually subjected to high levels of disturbance.

A measure of conspicuousness for birds was developed. The conspicuousness values, and the species present in each area, were strongly related to some components of isolation. A high correlation was also found between presence of weed species and absence of bird species. This reflects a direct relationship but is also a consequence of the fact that both weed presence and native bird presence are related to isolation levels.

The results of this research, combined with those of Janet McDonald regarding restoration aspects were used by Waitakere City to develop management priorities and guidelines for urban forest fragments.

ACCOMMODATION FOR BIODIVERSITY NOW

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Tariffs are quoted February 1997 and are subject to change.

ACADEMY MOTOR LODGE 327 Adelaide Rd Ph: 3896166
Fx: 389 1761

All rooms have kitchens, except studios (tea &coffee and microwave). Studio $90, 1 bdrm $100, 2 bdrm $105
Extra Adult $15, Extra Child $10

ADELAIDE MOTEL 209-211 Adelaide Rd Ph: 389 8138
Fx: 389 8138

Some rooms have kitchen facilities, others tea &coffee only. Studio $90, 1 bdrm $102
Extra person $12, under 12 no extra charge. Off-street parking, guest laundry.

APOLLO LODGE MOTEL 38-49 Majoribanks St Ph: 385 1849
Fx: 385 1849

Most rooms have kitchen facilities. 1bdrm units $90 single, twin/double $95.60, 2 bdrm from $120.
Extra Adult $15, Extra Child $10

CAPITAL VIEW MOTEL 12 Thompson St Ph: 384 4845
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Rooms have fully equipped kitchen with microwave. Studio $95, 1bdrm $112,
Extra person $10.

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Fx: 385 7036

Communal kitchen . Single $56, Double $69, Twin $78, Quad $90

GLEN ALTON MOTEL 5 Glen Alton Ave(Johnsonville) Ph: 0800 42
42 22 Fx: 478 8152

Serviced units tea/coffee only, others have fully equipped kitchens. Serviced Units $94, studio $98, 1bdrm $115,
2 bdrm $130. Extra person $14

HALSWELL LODGE 21 Kent Tce Ph: 385 0196
Fx: 385 0503

Some rooms have kitchen facilities. Single $69, double $79, twin $89, kitchen unit $110
Extra Adult $15

HARBOUR CITY MOTOR INN 92-96 Webb St Ph: 384 9809
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Some rooms have full kitchen facilities, others.with tea/coffee/toaster. Double/twin $130, weekends $103.

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Fully equipped kitchens, microwave. $90 single, $95.60 double/twin. Extra person $15, extra child $10.

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Fx: 478 1342

Studio $105, Business unit $105, Spa unit $130, Family units $115 double/twin. Extra adult $15. Some rooms have full kitchen facilities, others tea and coffee only. Licensed restaurant. Conference facilities.

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Fx: 385 2499

One bedroom, kitchen or studio units (with tea & coffee). Studio $99, 1 bdrm $110.25

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Ph: 472 3823
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Tea/coffee making facilities, licensed restaurant and bar. Standard single/double/twin $ 125 incl GST Mon-Thurs, $85 inc GST weekends.

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Ph: 385 2153
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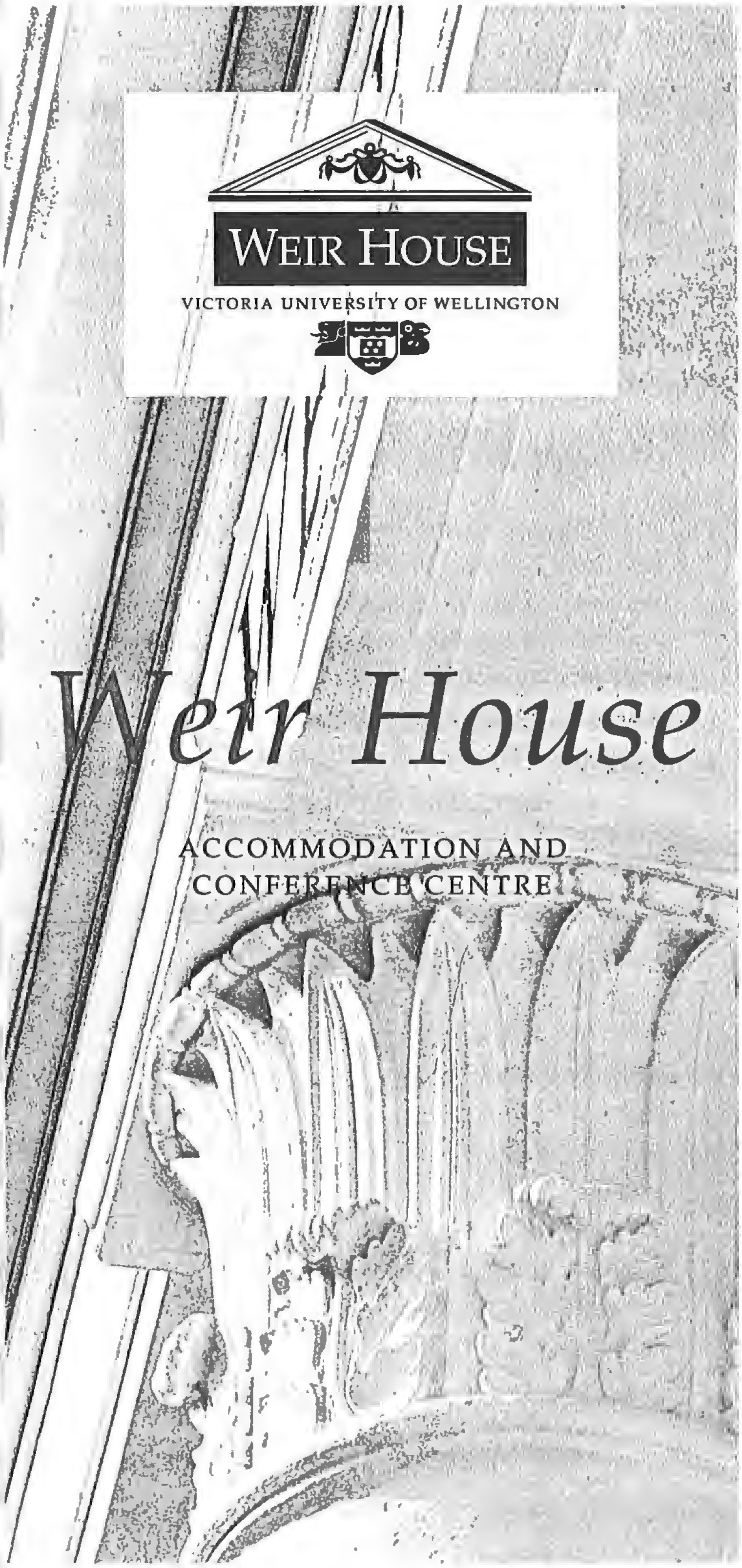
Two restaurants/bars. 1 bdrm $89, 2 bdrm $99.

WALLACE COURT MOTELS 88 Wallace St
Ph: 385 3935
Fx: 385 3937

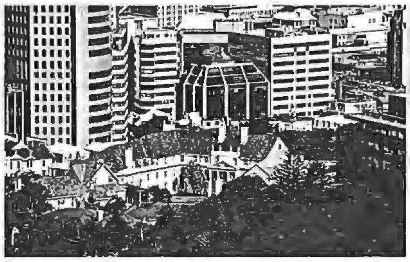
Fully equipped kitchens and/or tea/coffee making facilities. Studios $90, 1bdrm $110
Extra person $15

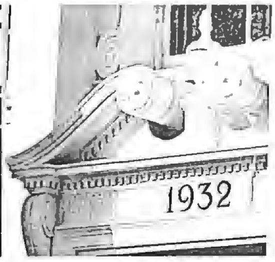


Weir House, Victoria University's historic hall of residence, has long been used in the University vacation periods by a wide range of national and international groups, large and small.

Nestled in the heart of Wellington's famous 'dress circle' with its stunning harbour views, Weir House is secluded and private, yet it is less than five minutes away from both the University and Wellington's vibrant inner city.

It can fully accommodate 200 people. Many large groups, both academic and non-academic, take advantage of the extensive facilities of the University for their conference or festival.



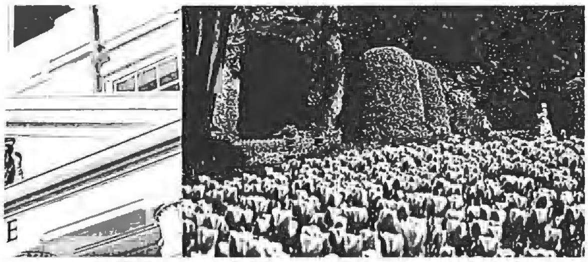


For smaller groups of up to 80, Weir House provides a wide range of services – accommodation, full catering, meeting rooms, recreation – all under the one roof.

Casual visitors – whether individuals, school groups or families – often use it as a base to explore Wellington.

Whatever your reason for staying at Weir House you will enjoy personalised and friendly service, the warm community environment, old-world architectural grace mixed with the youthful vitality of the student residents, and above all, the relaxed home-away-from-home atmosphere.

welcome to use, including two trading banks and ATMs, the University Book Centre with postal and dry-cleaning services, pharmacy, travel agency and a number of café-style restaurants.
Many of the University facilities and venues are available, by arrangement, for your conference needs. These include: the Student Union Complex with its large multi-functional hall incorporating two levels, ideal for large social events or expo-type displays, many good-sized meeting rooms and the Memorial Theatre; the Hunter Building's Council Chamber; the School of Music including the Adam Concert Room; the main University Library; and the Recreation Centre, with indoor courts and weights room.



Take a break . . .

A quick and fascinating trip on the cable car, which stops within a stone's throw of Weir House, and suddenly you are in the heart of Wellington city. Whether it's shopping, theatre, cafés or galleries you enjoy, Wellington has the best to offer – and all within a compact city centre. At night, the city comes alive, with workers relaxing at the end of the day and theatre- and cinema-goers enjoying the bars and cafés which provide inexpensive meals and drinks until late – many offer outdoor dining.
Two minutes walk takes you to the top of Wellington's famous Botanic Gardens, through which you can stroll, via Lady Norwood's Rose Garden and the historic Bolton Street Cemetery down on to Lambton Quay.
The cable car links with bus services to all suburbs of Wellington, the Wellington Railway Station, the Inter-island Ferry Terminal and Wellington Airport.

Availability and rates

Weir House is primarily a student hall of residence owned and managed by the University. Its availability is restricted to the University vacation periods – the summer break from early November to late February, and the mid-year break.
Facilities for workshops and strategic planning meetings are available throughout the year.
Rates are kept to a minimum and are extremely competitive, with a range of packages available to suit your budget.
Enclosed with this brochure is an up-to-date list of University vacation periods and rates.

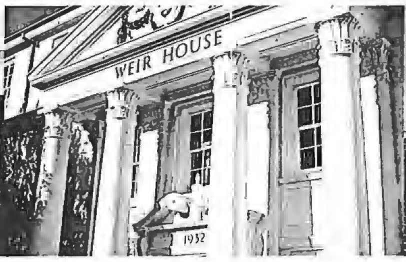
If you need more information,
please contact Weir House,
telephone 0-4-472 1351,
facsimile 0-4-471 1128,
or write
c/- Weir House,
Gladstone Terrace,
Kelburn,
Wellington,
New Zealand.

The services and facilities, coupled with extremely competitive rates, make Weir House one of the best value-for-money conference facilities in the capital city.

Facilities

Weir House offers:

- Full residential conference services, including accommodation, meeting facilities and catering.
- A venue for workshop and strategic planning meetings, with full catering.

- Short-term accommodation for conference delegates attending a conference either on campus or elsewhere in Wellington, with either full-board or bed-and-breakfast options.
- Casual short-term accommodation during University vacations, with either full-board or bed-and-breakfast options.
- Casual longer-term accommodation over the summer vacation period with full board.

ACCOMMODATION

Weir House has two wings: the original William Weir Wing, and the James Hutchison Wing.

The William Weir Wing was built in the grand and spacious style of the early 1930s, and has recently been renovated to enhance its architectural character while modernising its facilities. The rooms provide either twin-share or linked single rooms, and many command stunning harbour views.

The James Hutchison Wing is a more modern building, which has also been extensively renovated and a new third storey added. There are 100 single rooms in this wing, each fully furnished including a wash basin.

On each accommodation floor there are one or two new small kitchenettes, which can be supplied with tea, coffee and milk supplies.

Self-service laundry facilities contain automatic washing machines, clothes driers, irons and a drying room.

Accommodation and bathroom facilities especially designed for guests with disabilities are available; there is access by elevator to four of the floors.

Recreation facilities include: four television lounges,

one with Sky, a fully-equipped billiards room, table tennis, volleyball and basketball.
Adjacent off-street parking is available for up to 30 cars.

CATERING

Weir House caterers are happy to respond to our guests' requests, whether it be for cut lunches or late meals, budget menus or full-scale conference dinners with full table service, standard meals or special diets. The Dining Hall seats 200.

CONFERENCE ROOMS

- The newly built Conference Room, adjacent to the Dining Hall, accommodates meetings of up to 80 delegates. A large circular, modular conference table is available for use in this room.
- Three 'break-away' rooms – the Gallery and Meeting Rooms One and Two – accommodate 12 to 35 delegates.
- The Common Room in the William Weir Wing comfortably accommodates 40.

Venues for larger meetings can be arranged at Victoria University.

EQUIPMENT

Photocopying and facsimile facilities are available on-call.
Weir House also provides a wide range of fully serviced audio-visual equipment for hire at very reasonable rates:

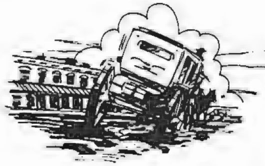
- Audio equipment, including portable PA systems, cassette recorders, microphones and headphones.
- Projection equipment, including overhead projectors, carousel slide projectors, fader units (carousel), AV cassettes (sync), 16mm movie projectors, and screens, tripods.
- Video equipment, including VCR

  player/recorders and various monitors, all colour.
- Other equipment such as lighting units, power leads, whiteboards, etc.

Teleconferencing facilities are also available, by arrangement, on campus at Victoria University.

Other facilities at Victoria

The main Kelburn campus of Victoria University is less than five minutes easy walk away. On campus are many facilities and services which you are



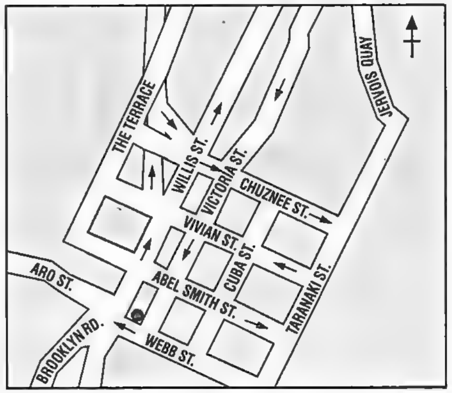
From Wellington's earliest colonial days Willis Street has featured on street maps.. However, back in 1875 at least one citizen wrote to the 'Wellington Omnibus' complaining of potholes in the road 'deep enough to bury the Mayor and two or three of his colts (horses)'.

Willis Street is today smooth paved and the address of two of Wellington's loftiest man-made landmarks... the wooden gothic style St Peter's Church (1879) and the 31 storey glass and steel BNZ Centre (1983).

Wellington Harbour

Wellington

Willis Street



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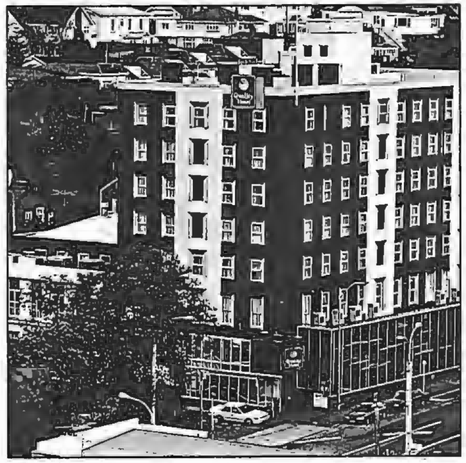

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Guests who love the theatre keep telling us how much they appreciate staying at Quality Hotel Willis Street. Then again, we get told the same by guests who are keen on the game of cricket and others who enjoy tennis, or delight in shopping, or have an interest in art and history or find true relaxation walking through a park.

Situated at the top end of Willis Street, our 84 room international standard hotel and conference centre boasts one of Wellington's closest-to-everything localities. Just minutes down Willis Street beats the heart of the city. Business. Entertainment. Restaurants. The harbour. Cross over from our lobby to Webb Street for an easy stroll to the National Museum and Art Gallery, and onwards to Basin Reserve, home of New Zealand cricket. Almost directly opposite your well appointed room is the Renouf Tennis Centre and the expansive and beautiful Central Park, taking its name and inspiration from New York. Beyond the park, the suburb of Brooklyn and historic Aro Valley. Of course, helping you choose just which option to take is one of the little things we do.

A prime locality such as ours goes hand in hand with first class conference rooms, a full range of business services and guest facilities that include a brasserie, gymnasium, sauna, spa, squash court and indoor heated swimming pool.

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The practical choice

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82 international standard.
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Six Conference Rooms.

Challenge Hall	*200-450*
Longdale Room	*80-120*
Metro	*60-80*
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A haven for the busy traveller our well appointed rooms and studios make the perfect base, enjoy the tourism, cultural entertainment and shopping opportunities that Wellington has to offer.

Our studio rooms which include a microwave and utensils provide a unique innovation to the accommodation scene in Wellington.

The Abel Tasman Hotel is able to provide you the business person or traveller with the accommodation and services to complement a visit to the Capital City.

Standard room

Spa bath in suites

The Abel Tasman Hotel has many of Wellington's restaurants, bars, theatres and cinemas located right on its doorstep.

Guest Services and Facilities

- 76 Spacious suites, superior, standard and studio rooms
- Inhouse Covered Parking
- Buffett breakfast - full or continental
- Licensed restaurant/bar
- charge back arrangements with other restaurants
- 24 hour reception with fax service
- Meeting and Conference facilities
- Colour/Sky Television
- STD and IDD Telephone
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- All Major Credit Cards accepted
- Dry cleaning service
- Mini bars
- Room Service
- Computerised reservation and accounting system
- Rates inclusive of GST

Special Weekend Rates

Facts at a glance

LOCATION:

Situated in the heart of the capital with direct access to Lambton Quay: Wellington's premier shopping precinct and The Terrace: the principal commercial district and within close walking distance of the Cable Car, Botanical Gardens, Parliament, National Library and Arts Museum and the exciting waterfront development.

ROOMS:

260 air-conditioned rooms on 17 floors including the Endeavour Suite, City Suites, Directors Suites, Premium Doubles, Executive Doubles, Twin Rooms. Facilities for the disabled.

FACILITIES:

All rooms feature: direct dial IDD/STD phones, colour TV with SKY TV, AM/FM radio, room service, minibar, refrigerator, tea and coffee making facilities, private shower and bath, iron and ironing board, hairdryer, bathrobe and toiletries.

SERVICES:

Hotel features: tour desk, car rental, 24 hour reception, laundry and dry-cleaning service, safety deposit boxes, foreign exchange, under-cover parking, complimentary newspaper and on-call doctor.

VENUES:

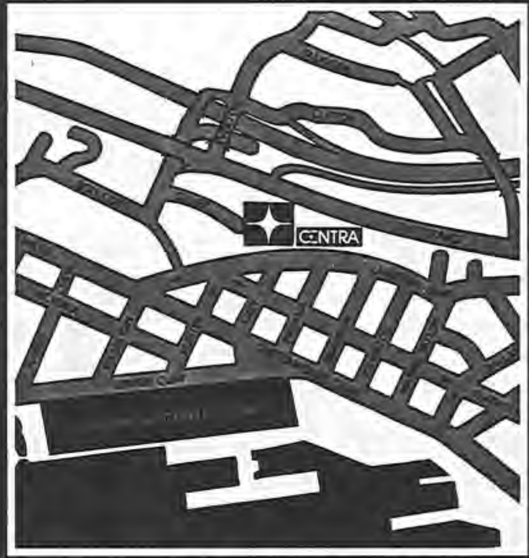
Conference and exhibition areas to suit every requirement, with conference and incentive reward packages.

BUSINESS:

For corporate travellers: working desks in rooms, secretarial assistance, communications support, personal computer service and a serviced office for rental.

RELAXATION:

Whitby's Restaurant, for sumptuous smorgasbord breakfasts, lunches and dinners and extensive à la carte dinner menu Monday to Saturday. Seats 140. The Piano Bar for after-work and evening get-togethers with colleagues and friends. Seats 48.



Worldwide Reservations Service

New Zealand
Nationwide Freefone 0800 801 111
Auckland (09) 377 7717
Facsimile (09) 303 3106

Australia
Nationwide Toll-free 1-300 363 300
Facsimile (02) 437 6366

United Kingdom
Nationwide 0345 40 4040

U.S.A./Canada
Nationwide (800) 835 7742

Japan
Tokyo (3) 5276 2611

Hong Kong
Toll-free (800) 2700

Singapore
Toll-free (800) 6011 888

Malaysia
Free call (800) 8899
Kuala Lumpur (603) 242 5588

Papua New Guinea
Port Moresby (675) 20 1000

Any Forte Hotel, Utell International, Delton Reservation Centre. GDS Access code: SP. Your airline system or travel agent.

Distinction
The New Zealand Way

Centra Hotels Locations
New Zealand: Auckland • Wellington • Christchurch
Australia: North Sydney • Melbourne

James Cook
CENTRA
WELLINGTON

147 The Terrace
P.O. Box 2429, Wellington, New Zealand
Telephone: 0-4-499 9500, Facsimile: 0-4-499 9800

SOUTHERN PACIFIC HOTELS

JAM 0203 25/6/96

James Cook CENTRA WELLINGTON

WELLINGTON NEW ZEALAND

SOUTHERN PACIFIC HOTELS

*W*elcome to James Cook Centra

At the centre of Wellington, in the heart of the Capital, the James Cook Centra reflects the beat of a vibrant city, with a pace of its own.

Sparkling harbour, buildings of power, tree clad hills, and corporate towers... Wellington combines beauty with purpose. So do our 260 rooms and suites. Relaxed yet practical settings for business or pleasure.

Bustling city outlook. Serviced office and affordable secretarial assistance available if required.

*R*oom to move

Plenty of space with fashion and function. Stylish surroundings, practical in purpose including facilities for disabled guests. Well-appointed rooms, most providing queen size beds complete with writing desks or bureaus.

Full-length mirror, television with Sky TV, minibar, hairdryer, iron and ironing board, tea and coffee making facilities available in all rooms.

260 rooms and suites on 17 levels including the premier Endeavour Suite with an impressive outlook over the capital city. Stretch out, without stressing out.

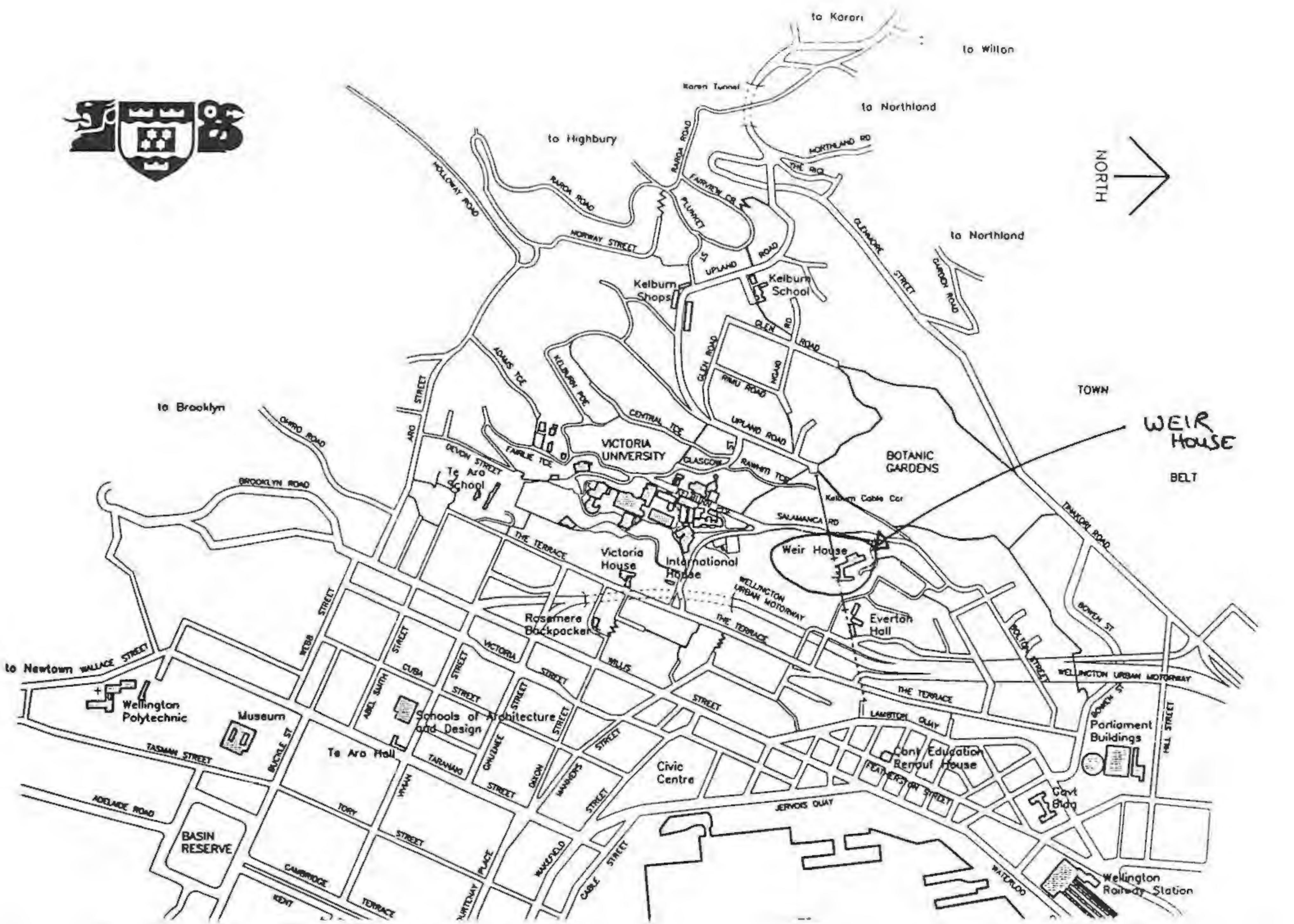
*E*at, drink...

A renowned restaurant and lively bar to satisfy every occasion. A business lunch, pretheatre drinks, an evening with clients or friends, holiday relaxation, a touch of romance.

Select from an extensive à la carte dinner menu or a delicious smorgasbord morning, noon or night at Whitby's Restaurant and Bar.

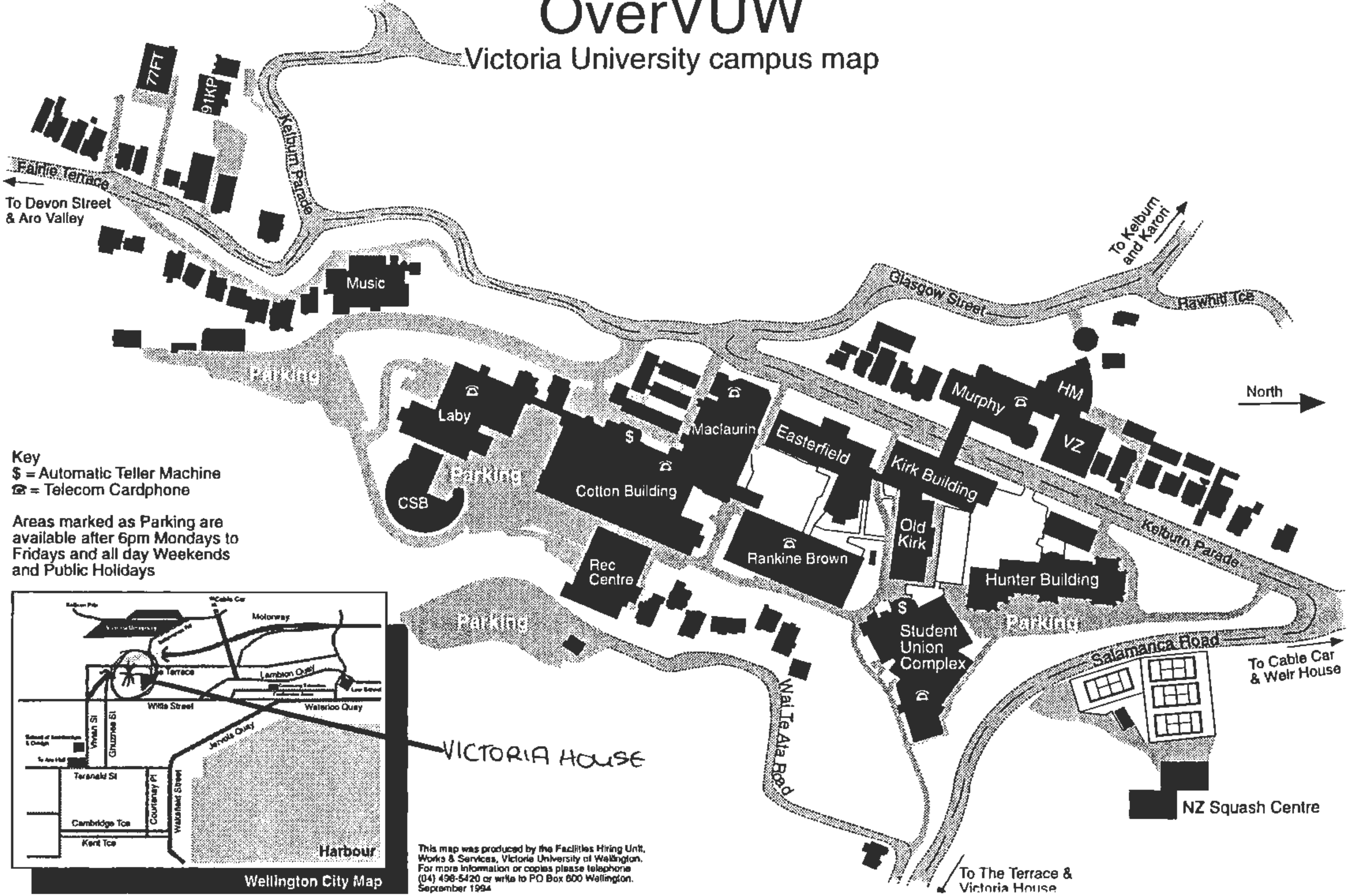
Experience the atmosphere of the Piano Bar, a popular inner-city meeting place after work and late into the evening.

MAPS FOR BIODIVERSITY NOW


to Karori
to Wilton
Karori Tunnel
to Northland
to Highbury
NORTHLAND RD
THE RIGI
NORTH
HOLLOWAY ROAD
RAROA ROAD
FAIRVIEW CR
PLUNKET
GLENMORE STREET
to Northland
NORWAY STREET
UPLAND ROAD
Kelburn Shops
Kelburn School
GARDEN ROAD
GLEN RD
ROAD
ADAMS TCE
KELBURN PDE
GLEN ROAD
NGAIO
RIMU ROAD
TOWN
to Brooklyn
ARO STREET
CENTRAL TCE
UPLAND ROAD
WEIR HOUSE
OHIRO ROAD
DEVON STREET
VICTORIA UNIVERSITY
BOTANIC GARDENS
FAIRLIE TCE
GLASGOW ST
RAWHITI TCE
BELT
Te Aro School
BROOKLYN ROAD
Kelburn Cable Car
SALAMANCA RD
TINAKORI ROAD
THE TERRACE
Victoria House
International House
Weir House
WELLINGTON URBAN MOTORWAY
Everton Hall
BOWEN ST
Rosemere Backpackers
THE TERRACE
BOLTON STREET
WEBB STREET
VICTORIA
WILLIS
WELLINGTON URBAN MOTORWAY
to Newtown WALLACE STREET
CUBA STREET
STREET
STREET
STREET
THE TERRACE
BOWEN ST
Wellington Polytechnic
ABEL SMITH
STREET
LAMBTON QUAY
HILL STREET
Museum
Schools of Architecture and Design
GHUZNEE
STREET
STREET
Parliament Buildings
TASMAN STREET
BUCKLE ST
Te Aro Hall
TARANAKI
STREET
DIXON
MANNERS
Civic Centre
Cont Education Renouf House
FEATHERSTON STREET
ADELAIDE ROAD
TORY
STREET
JERVOIS QUAY
Govt Bldg
BASIN RESERVE
STREET
CAMBRIDGE
PLACE
WAKEFIELD
CABLE STREET
WATERLOO
Wellington Railway Station
KENT
TERRACE
COURTENAY

OverVUW

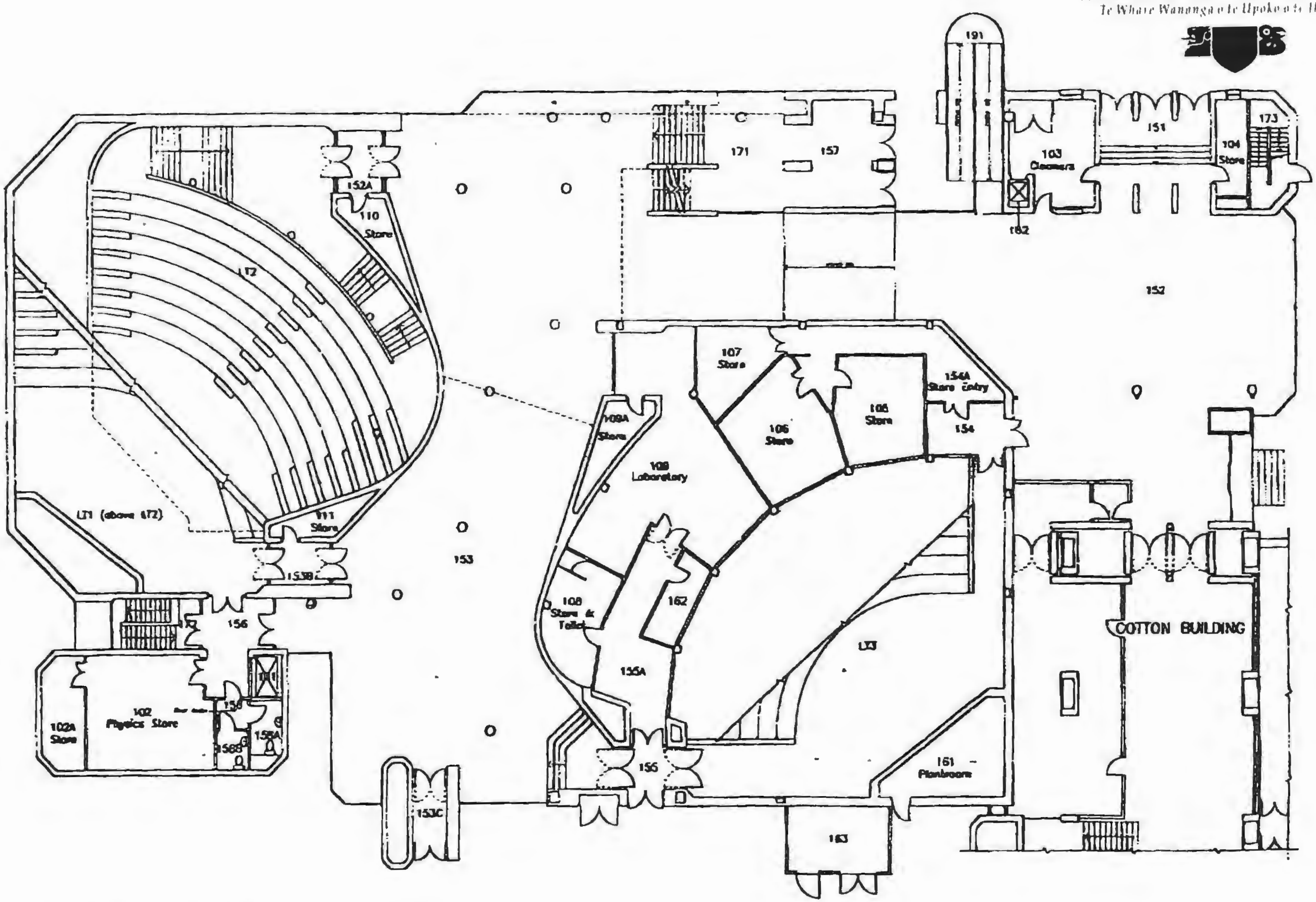
Victoria University campus map



This map was produced by the Facilities Hiring Unit, Works & Services, Victoria University of Wellington. For more information or copies please telephone (04) 496-5420 or write to PO Box 600 Wellington. September 1994

[redacted]

VICTORIA UNIVERSITY OF WELLINGTON
Te Whare Wananga o te Upoko o te Ika a Maui



MACLAUREN LECTURE THEATRES
LEVEL 1 FLOOR PLAN

INFORMATION FOR BIODIVERSITY NOW PARTICIPANTS

INFORMATION

Airlines

Air New Zealand: Reservations — tel. 388-9737; Flight inquiries — tel. 388-9900
Ansett New Zealand: Reservations and flight inquiries — tel. 471-1146
Qantas: Reservations — tel. 0800-808-767; Flight inquiries — tel. 388-9900
United Airlines: Wellington — tel. 472-0470; Auckland — tel. 09-379-3800

Airport shuttle

Super Shuttle Passenger Transport System: tel. 387-8787

ATMs/Banks

Bank of New Zealand: Cotton Building, Victoria University campus
National Bank: Student Union Building, Victoria University campus

Bookshops

Victoria Book Centre: Student Union Building, Victoria University campus
BAM Books Art Music: Mezzanine level, Wellington Public Library, 65 Victoria St
Bennetts Government Bookshop: cnr Bowen St and Lambton Quay
Unity Books: cnr Willis and Manners Sts

Doctors

Student Health Service: Victoria University campus — 4 Wai-te-ata Rd
Dr David Velvin: Kelburn Medical Centre, 36 Upland Rd, tel. 475-8078
After Hours Medical Centre: 17 Adelaide Rd, Newtown, tel. 384-4944

Fax

A fax is available in the University Library, in the administration office at the north end of the third floor.

Parking

Victoria University staff carparks may be used by conference participants after 6pm At other times participants will need to maĸe their own parking arrangements.

Pharmacy

There is a pharmacy in the Atrium of the Student Union Building. It is open 8.30am-5pm weekdays.

Photocopying

Copying facilities are available in the University Library (see opening hours under *Fax* above). Outside library hours, urgent copying may be done in the History Department Office — those with urgent requests should make contact with a member of the conference organising committee to arrange this.

Restaurants

Kelburn: Marbles Restaurant, 87-89 Upland Rd, tel. 475-8490; Shangri La's Indian Restaurant, 92 Upland Rd, tel. 475-8981

Aro Valley: Aro Street Café, 90 Aro Street, tel. 384-4970

Brooklyn: Brooklyn Café and Grill, 5 Todman St, tel. 385-3592

Central City: there are numerous restaurants on Willis St, particularly between Manners and Mercer Sts; in Cuba St; in the Courtney Pl/Blair St precinct; and on the waterfront at Queen's Wharf (opposite the Parkroyal Hotel).

Taxis

Gold and Black Taxis: tel. 388-8888

Status Taxis: tel. 801-5000

Wellington Combined Taxis Ltd: tel. 384-4444

Telephone

Card phones: these are located in the Student Union Building beside the entrance to the Victoria Book Centre; in the Kirk foyer opposite the entrance to the Ilott Café; and in the foyer of the University Library.

Coin phone: there is a coin phone in the Student Union Building opposite the VUWSA office.

Programme outline

All Sessions are in Maclaurin Lecture Theatres, Victoria University, Kelburn Parade.

Sunday 29 June
Student day

Monday 30 June

10.30 - 5.00	Symposium part 1: Strategies
evening	Poster session and Social function

Tuesday 1 July

morning	Contributed papers (3 concurrent sessions)
afternoon	Symposium part 2: Assessment
evening	Conference dinner

Wednesday 2 July

morning	Symposium part 3: Management
afternoon	Concurrent sessions: 2 of contributed papers, the other a mini symposium: Molecular biology for insect control
all day	NZ Genetics Society Session

Thursday 3 July
Field trips

A detailed programme listing all sessions and speakers will be available in the Abstract Booklet.

The conference includes Symposium sessions on
New Zealand's Biodiversity:
- **Strategies**
- **Assessment**
- **Management**

It will provide an opportunity for scientists, policy makers and managers to discuss some of the issues that surround the preparation of the New Zealand Biodiversity Strategy.

Invited speakers include:
- Jane Lubchenco (USA)
- Peter Bridgewater (Australia)
- Matt McGlone (Landcare Research)
- Chris Richmond (Department of Conservation).

There will be open sessions of papers and posters presented by members of the three organising societies.

In addition, the NZ Genetics Society will be holding a one-day session of contributed papers as an adjunct to the conference for its members on Wednesday 2 July.

Deadline for registrations is **Monday 26 May.**

Deadline for offers of contributed papers and posters, enclosing abstract, is **Friday 16 May.** Abstracts to the conference organiser, ***Dr Fran Kell, P O Box 41072, Eastbourne.***

Inquiries should be addressed to:
NZ Ecological Society, P O Box 25-178, Christchurch

NZ Entomological Society, 8 Maymorn Road, Te Marua, Upper Hutt

Systematics Association of NZ, c/- Dept of Entomology & Animal Ecology, Lincoln University, P O Box 84, Lincoln

Biodiversity NOW

29 JUNE to 3 JULY 97

The 1997 joint annual conference of

New Zealand Ecological Society (Inc.)

The Entomological Society of New Zealand (Incorporated)

SYSTANZ Association for the study of biodiversity

Supported by

Ministry of Research, Science and Technology
Te Manatu Putaiao

Department of Conservation
Te Papa Atawhai

TE PAPA

CENTRE FOR CONTINUING EDUCATION

VICTORIA UNIVERSITY OF WELLINGTON

CONFERENCE REGISTRATION FORM

- Complete one form per person.
- Return by the closing date for registration **26 May 1997** to:

Centre for Continuing Education
Victoria University
P O Box 600, Wellington.
Tel 0-4- 499 4745 Fax 0-4- 496 6550
email: tony.cairns@vuw.ac.nz

Surname: .... Title: ....
First name (for name tag): ....
Full postal address: ....
....
....
Daytime phone: .... fax ....
email: ....
Evening phone .... fax. ....

I am a member of (✓):

NZ Ecological Society	❑
NZ Entomological Society	❑
SYSTANZ	❑
NZ Genetics Society	❑

- I wish to offer a paper/poster and have sent/ enclose an abstract. *(cross out the options that do not apply)*
- I wish to attend the student only day on Sunday *(no fee)* ❑
- Student travel grant application forms are available from Society contacts overleaf.

School Party: *School* ....
Student's names: *Class:*
....
....
....
....

Day Registrations Only

If you are only enrolling for part of the conference tick the day(s) you wish to attend. (✓)

Sunday(No fee)	29 June	❑	Student only Day
Monday	30 June	❑	Conference Day
Tuesday	1 July	❑	Conference Day
Wednesday	2 July	❑	Conference Day
Thursday	3 July	❑	Field Trip Options

Accommodation

Weir House Hall of Residence (bed & breakfast)
(✓) single ❑ ($40) or share twin ❑ ($25)
with whom ....
OR
linked single room where available ❑ ($32)
for night(s) of (✓)

Sunday 29 June	❑	Wednesday 2 July	❑
Monday 30 June	❑	Thursday 3 July	❑
Tuesday 1 July	❑		

NB Your accommodation requirements should be made direct with Weir House. We will forward your $10 deposit to them.

Special diet
Vegetarian ❑ Other ❑ (specify) ....
Special needs
(eg: mobility, other) .... ♿

Accommodation Inquiries

Conference Manager
Lesley Smith
Gladstone Terrace
Kelburn, Wellington
Tel 0-4- 472 1351
Fax 0-4- 471 1128

Payment details
Conference registration:

Waged member of one of the societies
Full conference at $125 ______
Number of days ...... at $60 per day ______
OR
Student and unwaged member
Full conference at $90 ______
Number of days ...... at $45 per day ______
OR
Non-member
Full conference at $165 ______
Number of days ...... at $80 per day ______
School Party
(teacher & up to 4 students)
Number of days ...... at $45 per day ______
Social evening
at $15 per person ______
Conference dinner
at $45 per person ______
Field trip options
Somes Island (maximum 70) at $25 ______
OR
South Sea Coast at $25 ______

Accommodation Deposit $10 ______

Total fee $ ______

Payment method

❑ cheque(payable to Victoria University)
❑ Mastercard ❑ VISA

Credit Card Number
| | | | | | | | | | | | | | | | |

Expiry date ***Cardholder name***
| / | | |

- All fees include GST and our GST number is 10-665-485.
- Registration will be confirmed with a GST tax receipt.
- Fee includes lunches for all days except **Sunday 29 June.**

Course no. 97099