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LEAD ARTICLE

Study shows weta populations not significantly affected by 1080

Conservation workers have been concerned at the sight of some species of invertebrates, including weta, eating toxic baits after a 1080 drop. Also, some captured weta have contained residues of 1080. Eric Spurr and Peter Berben of Landcare Research have been investigating the effects of 1080 on weta and other invertebrates in a range of circumstances, and we are able to bring you a preview of their results. It is planned to publish the full report in the New Zealand Journal of Ecology***—Editor***

Our study

Our study, funded by the Foundation for Research, Science, and Technology (FRST), monitored weta occupying artificial refuges before and after simulated aerial 1080-poisoning (i.e. baits spread by hand). We set up 20 plots at least 50 m apart on a north-facing ridge in Tararua Forest Park in August 1999. Within each plot, we randomly placed 10 artificial refuges (Fig. 1). Each month from October 1999 we checked the refuges for occupancy by weta and other invertebrates. Tree weta occupying the refuges were individually marked with coloured paint. Cave weta occupying the refuges were mostly too small to mark. On 22 August 2000, we selected 10 plots at random and spread 1080 bait across them by hand. The bait was green-dyed, cinnamon-lured, Wanganui No.7 cereal-based bait containing 1500 ppm (0.15%) 1080, and was spread at 5 kg/ha. The remaining 10 plots were not treated with bait. We checked all the artificial refuges for occupancy by weta and other invertebrates a week after bait application, and then again at monthly intervals for the next 4 months.

Weta in artificial refuges

We found two species of weta occupied the artificial refuges: the Wellington tree weta (*Hemideina crassidens*)

Figure 1. Artificial refuge used for monitoring weta populations, Tararua Forest Park (lid ajar to expose galleries inside).

Department of Conservation
Te Papa Atawhai

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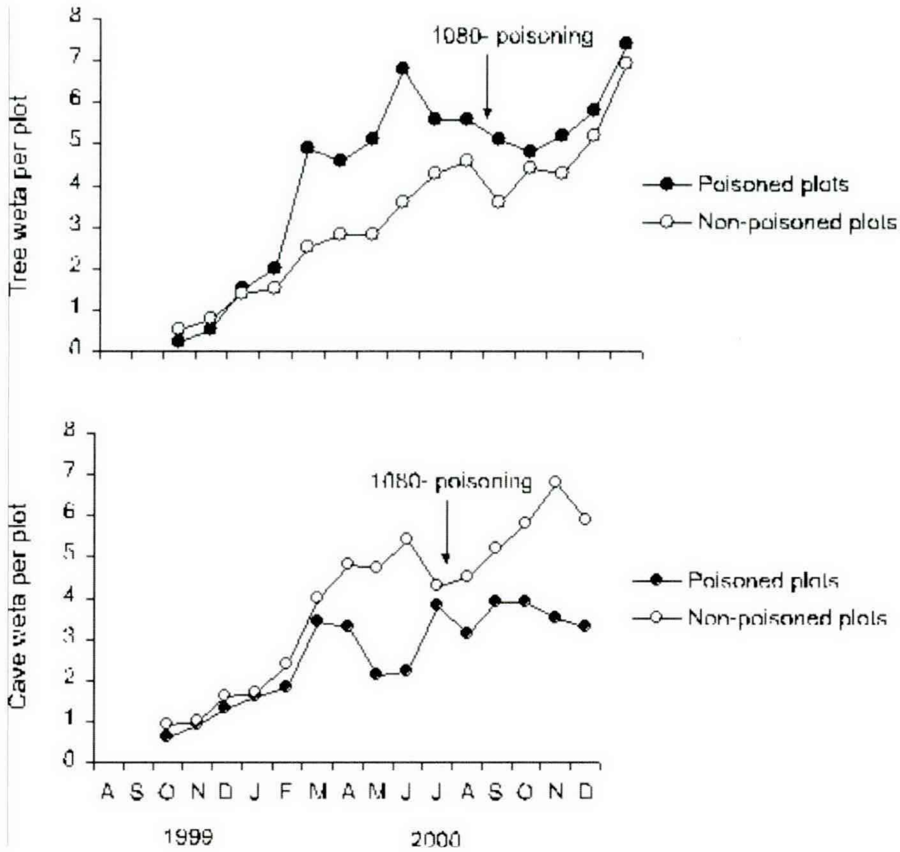

Figure 2. Number of weta occupying artificial refuges in poisoned and non-poisoned plots, before and after the experimental 1080-poisoning operation.

and a species of cave weta (*Isoplectron* sp.). Flatworms, slugs, snails, spiders, harvestmen, amphipods, millipedes, centipedes, cockroaches, and beetles also occupied the refuges. The numbers of tree weta, cave weta, and other invertebrates recorded in the refuges increased steadily over the 15 months of monitoring, in both the poisoned and non-poisoned plots (Fig. 2). Although the number of cave weta recorded in the poisoned plots was generally lower than in the non-poisoned plots, there was no significant impact of bait application on the numbers of either species of weta. The numbers of slugs, spiders, and cockroaches (the main other invertebrates occupying the refuges) were also not affected.

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Editor—Kaye Green
Layout—Ian Mackenzie

Contributions are invited from our readership, and should be sent to the Editor, at this address. Opinions expressed are those of the contributors, and do not necessarily represent the policy of the Department of Conservation.

Re-sighting of marked tree weta

One week after spreading bait, we re-sighted (alive) 80% of the 56 marked tree weta in the poisoned plots and 72% of the 46 marked tree weta in the non-poisoned plots. The number of marked tree weta re-sighted alive declined over the next 4 months, but the rate of decline was similar in both the poisoned and non-poisoned plots (Fig. 3). We presume the decline was a result of natural mortality, predation, loss of colour markings, and movement out of the artificial refuges into natural refuges. There was

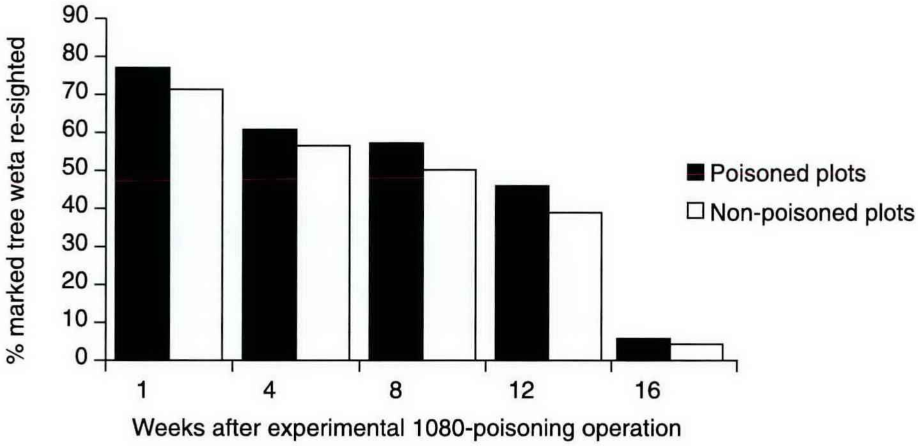

Figure 3. Percentage of individually marked tree weta re-sighted in poisoned and non-poisoned plots.

The full scientific article, of which this is a small part, has been submitted to the New Zealand Journal of Ecology—***Editor***

no evidence that it resulted from 1080-poisoning.

Implications

Our study indicates that aerial 1080-poisoning for possum control is unlikely to affect the population numbers of Wellington tree weta or *Isoplectron* cave weta. Aerial 1080-poisoning is also unlikely to affect the population numbers of slug, spider, and cockroach species recorded in the artificial refuges. The study was restricted to one area in Tararua Forest Park, but there is no reason to believe that the results would be different for these or related species elsewhere in New Zealand.

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What did we do last year?

Summaries from Science Investigations running in 2001/2002 are now available on DOCNET. Staff can access them at
http://docintranet/content/sru/invest/Investigation-Summaries2001-02.htm
Summaries are filed by key output and within that by investigation number.

Fiona McKay and Mark Stephen collected and edited the summaries. Jaap Jasperse made up the file and set it up on DOCNET.

Kaye Green
Science Transfer Manager, SRU

STAFF NEWS

Lisa Sinclair

Lisa Sinclair, entomologist and SRU exterminator, looked into the mini lab the other day ...

If beauty is in the eye of the beholder, then sometimes it pays not to look too closely!

It was an average Tuesday morning just before my caffeine fix wore off. I stared blankly at the piles of dust in the mini lab as they blew around with the air conditioning. There was dust in the sink, the cupboards, piles on the floor and all over the bench. The lab was clearly in a state of Flux. 'Urgh'—I thought—'why doesn't someone tidy up in here?' I had come to inspect a container of bran and mealworms. The owner had gone on holiday. It was now a container of meal beetles, the 'worms' having done what beetle grubs do, they had pupated. Obviously conditions had agreed with them. Unfortunately they had also agreed with some tiny mites that were apparently taking over the lab. Problem was I was darned if I could see them. 'OK', I thought, 'this was a great joke'. But as I walked to my desk I just couldn't shake the feeling that dust wasn't supposed to creep.

Ever wondered why old wheat-germ looks puffy or why the surface of opened powdered milk seems to shimmer? It's not because you stood up too quickly. Reach for your anti-itch creams and asthma inhalers. This is how nature takes civilisation down a few pegs.

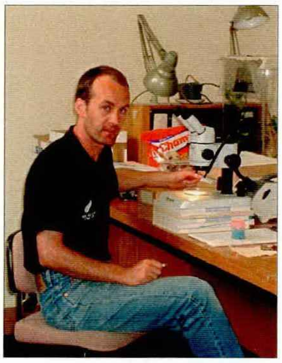
The grain mite goes by the rather uninspiring name of *Acarus silo*. First described by Linnaeus in 1758, it has the dubious honour of having ruined stored grain products for centuries. Where threat is a way of deterring would-be attackers, so too was the dusty appearance of billions of skins shed by billions of minute mites rapidly colonising the mini lab. Under the microscope these $^1/_8$ mm blobs assume quite an innocent appearance—their pudgy pink bodies are sprinkled with glass-like hairs twice the length of their body. For something so apparently vulnerable their success is quite charming.

In the home, grain mites infest a wide range of stored products: usually flour, cereal, and other grain-derived foodstuffs and sometimes nuts, yeast, cheese, and powdered milk. In finely ground products like flour and milk powder they only infest the surface layer. Infestations usually happen after products get damp or mildewy. If fed to small mammals (like yappy dogs) the mites can cause irritation (perhaps temporary relief from the yapping), reduced food intake, inflammation of the small intestine and, not surprisingly, diarrhoea.

Heavy infestations in food can make it look or smell 'off'—mites have a mildly pungent, sometimes 'minty' odour. Getting rid of the product usually halts the infestation. In the minilab I assumed the role of The Godfather. The culture of bran and meal beetles from whence the problem arose took a long, cold nap in the freezer. While the eggs of mites can endure several months of zero degree cold, they aren't so good at minus 20! Mites can live about a month and females lay at least 500 eggs with a minimum life cycle of 17 days in optimal conditions. Thorough cleaning of the surfaces afterwards is recommended. Some people may experience mild dermatitis ('grocers itch') apart from a suite of psychosomatic illnesses that can accompany situations like this. Descriptions of infestations are so vivid that they send even the most hardened entomologists into nervous fits of scratching!

Prevention is the best medicine. These mites thrive in products that have 15–18% moisture (or in 65% atmospheric humidity). Keeping storage areas dry, *but not humid*, is very important, but is tricky since the beetle cultures must be moist to favour breeding of the mealworms. The grain mite has a dormant stage that can survive starvation, desiccation and most chemical treatments so nuking with fly spray is usually unsuccessful. Selective miticides can be purchased from hardware stores, but simply removing the source and cleaning of surfaces is sufficient to clear the problem. To make absolutely sure I also borrowed a heater to dry out the air in the minilab, then bribed the cleaners with chocolate to dispose of The Evidence. This seemed to work.

So who gets the last word? Will the mealworm owner be tapped on the shoulder for leaving his charges unchaperoned? Well, let's just wait and see if his name comes up in our annual Christmas awards!



Mike Wakelin

Meanwhile there's another lab at Victoria University, where Mike Wakelin often hangs out ...

When DOC Science & Research, Wellington, shifted out of Tory Street to its Victoria Street site, new space for its laboratory had to be found. Dead animal smells and dangerous chemicals just weren't compatible with the recirculated air conditioning of the new downtown library building. Expelling fumes into Civic Square wasn't an option either, so space was leased at the Victoria University Kelburn campus, and the lab shifted in where the smells and chemicals are more acceptable.

Two adjoining rooms provide wet and dry working areas, lots of sinks and benches and room to spread work out. Most of the supplies and equipment of the old lab are set up for use there, with fume hood, chemical storage, balances, ovens, glassware, freezers, etc. There is a also a phone and laptop/monitor with dial-in access to the DOC network.

Mike, who is a regular lab occupant, is working on the effect of pest control on forest invertebrates. This involves microscope work, sorting and identifying trapped insects collected and stored in alcohol. Some 300,000 bugs have been picked out so far.

DOC staff are encouraged to use this facility, a 15-minute walk from Victoria Street (admittedly an easier return trip down the hill).

Alternatively, there is a permit in the lab for a handy reserved car park.

Location: DOC University lab room 107, Level one,
New Kirk building,
Victoria University of Wellington.
Ph. 463-5507

Six DOC Weedos go wild in Western Australia

In early September six DOC weed enthusiasts (Ian Popay, Kate McAlpine, Susan Timmins, Keith Briden, Phil Dawson, Tony McCluggage) joined ten other Kiwis and about 500 delegates at the 13th Australian Weeds Conference in Perth, Western Australia. Although it's an Australian conference, there were delegates from Europe, the USA, South America, Africa, and Asia. It was certainly a great place to share experiences and stories of weeds from everywhere.

The conference brings together weed scientists, planners, public awareness professionals and field staff. Australia has a commendable level of public involvement in weed work from control work by Friends Groups to rearing of biological control agents by school children. Plenty of ideas for us to emulate in New Zealand; time and again the papers demonstrated the need to translate scientific information into useable form for the weed practitioners out in the field. Similarly, it is important for research to be presented in such a way that the results can be used by planners and policy folk to demonstrate the impact of weeds on our natural environment and their huge economic cost.

One of the most interesting parts of the trip was discovering the very high regard that Australians, and others, have for DOC's weed control efforts. Several Australian speakers publicly stated their admiration for the way we do things. Immediately after the conference, a group of Hawaiian visitors came across to Auckland to find out how New Zealand's biosecurity works—they don't seem to have comparable systems in place in Hawaii.

Many of you will be aware that DOC is about to appoint a national weed awareness co-ordinator so it was very timely to get the chance to talk with those involved in Weedbuster activities in Australia. It was great, too, to meet some of the famous Australian experts on environmental weeds—people like Kate Blood, Sandy Lloyd, and Rod Randall. After the conference Kate McAlpine spent two days at a workshop run by Rod Randall, one of the world's leading authorities on weed risk assessment. The workshop was at-

The field trip team in Karri forest, Western Australia. From the left: Susan Timmins (NZ), Rod Randall (Australia), Kate Blood (Australia), Daniel Stock (Australia), Kate McAlpine (NZ), John Randall (California), Sarah Brunel (France), and Philip Thomas (Hawaii). Ian Popay (NZ) seated in front.

Kate McAlpine in a field of invading arum lillies.

tended by Weedos from South Africa, France, the Galapagos, the USA, and all states of Australia, all keen to learn about Western Australia's weed risk assessment system. Rod's tools and processes are so powerful that Kate is intent on getting them for use in DOC.

You've probably all heard about Western Australia's famous wild flowers, and the wild flower season was just beginning when we were there. Sadly, though, these days you need to take an expert to tell you which are the wild flowers and which are the weeds. King's Park, for example (beautiful parkland in the middle of Perth), has extensive areas of banksia trees and underneath them are lots of beautiful, fragrant ... freesias. They are attractive garden plants, but they originated in South Africa, and have become wild weeds in several parts of Australia.

Several of us enjoyed the weekends before and after the conference on field trips with local weed experts. For example, we travelled to Margaret River, 300 km south of Perth, to experience the joys of the famous local wines, as well as, I hasten to add, the wild flowers and also weeds like coastal tea-tree, *Leptospermum laevigatum*, originally from Eastern Australia and now going wild in the west. We stopped to admire an awe-inspiring stand of native karri, *Eucalyptus diversicolor*, a magnificent hardwood, but were sad to see the first signs of invasion by arum lily, *Zantedeschia aethiopica*, a weed we saw plenty of during our foray.

Previously, the Australian Weeds Conference has been held every three years, but in future it will be held every two years. New Zealand societies such as the Biosecurity Institute and the Plant Protection Society have been invited to organise their meetings in association with the next Australian conference. When it comes to making useful weed contacts and finding out what's happening in the weed world, the Australian Weeds Conference is hard to beat. Look forward to seeing more of you New Zealand Weedos in Wagga Wagga in 2004.

Ian Popay,
SRU, Hamilton

FUTURE RESEARCH DIRECTIONS

Future research directions for the Species and Ecosystems Under Threat Portfolio, 2003 onwards—Part 1

This is a new feature in ConScience aimed at keeping readers up to date on the direction of science in DOC. We begin with part 1 of *Species and Ecosystems under threat.* ***For more information about portfolios and priority actions, see*** *Science counts!—National strategic Science & Research portfolios, programmes, priority actions.* ***(A free 6-page brochure available from DOC Science Publishing)—Ed.***

1. Background

The following is a synthesis of research directions collected over the last 6 months. The directions come from a variety of sources including: the CAS Research Needs Database (CHCCO-14473)*, Portfolio Leaders Meeting, Regional Science Group Meetings, National Recovery Group Leaders Meeting, DOC/Landcare Workshop on Identifying Priority Places for Biodiversity Conservation, Joint SRU Portfolio Meeting (Pests, Restoration & Species & Ecosystems under Threat) and Natural Heritage Management Systems meetings.

The paper outlines the **Proposed Directions** resulting from these meetings, **Recent Actions** we have undertaken to begin addressing these needs in the 2002/03 financial year, and **Recommendations** for building on these programmes in the future (2003/04 and beyond). Priority directions are listed under each Priority Action. The paper is intended to inform the Science Planning Group of directions that need investment in research in the future and to provide feedback to users of science in DOC.

2. Strategies guiding Portfolio directions

The major strategic driver for the Portfolio's Priority Actions is the NZ Biodiversity Strategy, particularly Goal 3 (Halt the decline in New Zealand's Biodiversity). This goal requires that we 'maintain and restore a full range of remaining natural habitats and ecosystems to a healthy functioning state' and 'maintain and restore viable populations of all indigenous species and subspecies across their natural range' as bottom lines. This intent is signalled in DOC's Statement of Intent (2002-2005). The Department is committed to a strategically effective mix of intensive site-based conservation together with threatened species management and more extensive ecological conservation to protect terrestrial natural heritage:

- Statement of Intent Key Step 1 'Expand biodiversity effort' [1.1 Restoring Natural Character; 1.2 Threatened Species; 1.3 Legal Protection]
- Key Step 5 'Engage the community in Conservation'
- Key Step 5 'Promote effective partnerships with tangata whenua.

3. Portfolio mission

To determine and provide tools and advice to remedy the critical factors (agents) and processes undermining the viability of New Zealand's threatened terrestrial biodiversity, its habitats and ecosystem health.

4. Focus of the Species and Ecosystems under Threat Portfolio

The Portfolio concerns itself with four umbrella objectives:

- Evaluating and testing the application of conservation biology principles in the New Zealand situation through observation, modelling and experimentation
- Undertaking critical autecological research on threatened species, including threatened populations, taxa and subspecies
- Undertaking critical research on threatened ecosystems and threatened ecological processes funda-

* These are Document Manager identification numbers and they are available only on the DOC computer network—*Editor*

mental to the healthy functioning of those ecosystems
- Defining ecological and biological conservation management units

Our business is the identification of long- and short-term causes and processes that threaten New Zealand's biodiversity. We seek to devise innovative, integrated and sustainable techniques that remedy these problems. The work is done in a coordinated and collaborative way with the rest of the Department. These objectives are closely aligned to those of Recovery Groups, Biodiversity Recovery Unit, and Technical Support Officers and Programme Managers with responsibilities for biodiversity, which have five main needs for knowledge:

- Identification of biodiversity, its distinctiveness and distribution
- Understanding threatened species and ecosystems
- Understanding agents of decline
- Understanding interactions between agents of decline and behaviour of the threatened species
- Understanding how to manage threats and recover populations

This Portfolio focuses on terrestrial systems, but its activities have strong interrelationships with other Research Portfolios and business is undertaken in a co-ordinated manner. Two specific areas of concern are delegated to other Portfolios because of the expertise available in these areas. The Aquatic Protection and Restoration Portfolio takes responsibility for work on threatened aquatic taxa and threatened aquatic ecosystems. The Terrestrial Restoration and Pests Portfolio co-ordinates research on two of the major factors limiting the viability of threatened biodiversity, namely animal pests and weeds, and focuses on restoration techniques, once critical factors causing decline have been identified. However, these Portfolios take their strategic direction with regard to threatened species and threatened ecosystems from the Species and Ecosystems under Threat Portfolio.

5. Strategy for future work

With 845 taxa classified as acutely or chronically threatened, a further 1518 classed as 'at risk', and an indeterminate number of threatened ecosystem types and communities, our research needs to focus on work that:

- Has the widest possible relevance to conservation management
- Adds most value to our knowledge
- Has multi-species and multi-situation relevance

Document CHCCO-29704 explains the detailed basis for choosing the priority actions that follow on from these concerns. WGNCR-37418 lists current (2002/03) approved science projects related to this Portfolio [See Box]. Building on the directions outlined in CHCCO-29704, for the 2003/04 financial year we are looking at building on the programmes commenced in 2002/03 and increasing effort under priority actions where needed. Although the work of the Portfolio has been divided into seven Priority Actions, much of the research being proposed in future will add to our knowledge of a number of Priority Actions at once, i.e. Priority Actions are not mutually exclusive.

Future advances in understanding will be made by reviewing knowledge from previous work and summarising its relevance to DOC's strategic directions, maximising the benefits derived from our existing investment in long-term studies, then balancing this with new work on high-priority ecosystems and taxa where our investment is poor.

It is our intention to develop research programmes built around common themes that are relevant across Priority Actions, and in some cases, across Portfolios (see section 7). In areas

FUTURE RESEARCH DIRECTIONS

where major new investment in programmes is commencing, we will include scoping and pilot studies in the first year to focus the research on highest priority needs and experimental approaches requiring testing. For example:

- The fragmentation research (Priority Actions B, F) Investigations 3482: *The consequences to threatened plants and insects of fragmentation of alluvial plains podocarp forest*; 3579: *Pollination and seed dispersal processes in fragmented landscapes: a case study using tui and kereru*
- Our conservation biology research (Priority Actions A, B) Investigations 3351: *Defining conservation management units and maintaining genetic diversity in threatened species*; 3575: *Identification of appropriate conservation management units for threatened taxa*; 3576: *Role of in-breeding and genetic diversity in maintaining long-term viability of threatened species*; 3581: *Utility of population viability analysis in conservation planning: exploring multispecies PVA for threatened braided riverbeds*

We aim to develop high-quality, well-worked case studies for managers demonstrating the utility of conservation biology techniques and the use of appropriate analytical techniques. These should be written in language that managers can understand and framed in a way to provide impetus for them to use conservation tools confidently in their own situations. The case studies will invariably involve some fundamental research on threatened taxa or communities. The challenge is to make the case studies as widely applicable as possible.

We also aim to expand our efforts with long-term population studies with species and community/ecosystem studies. Studies will be chosen if the results will increase our understanding of threatening processes significantly, and act as role models on how such information can lead to significant change in conservation management. [To be continued]

Colin O'Donnell
Portfolio Group Leader
16 August 2002

Examples of current Portfolio case studies of threatened taxa (a snapshot)

More detail including projects on more generic threats to threatened taxa is available on request (WGNCR-37418)

1. Case studies of threatened ecosystems and communities

Karst plant communities, dune slacks and ephemeral wetlands, seral shrub lands, tussock grasslands, dry land ecosystems, *Kunzea* shrub lands, riverine-alluvial forest systems, fragmented lowland and urban landscapes, lowland, coastal, and tussock land invertebrate communities, vulnerable forest types.

2. Specific threatened taxa case studies

Mammals: long-tailed bat, short-tailed bat

Reptiles: Otago skink, grand skink, chevron skink, striped skink, harlequin gecko

Amphibians: Maud and Stephens Island frogs, Hochstetter's frog, Archey's frog

Birds: all kiwi species, saddleback, mohua, kaka, robin, kereru, wrybill, black-fronted tern, banded dotterel, tui, orange-fronted parakeet, Forbes' parakeet

Invertebrates: Robust grasshopper, *Powelliphanta* spp., *Placostylus* spp., Middle Island tusked weta, speargrass weevil

Plants: Lepidium spp., *Hebe* spp., native broom species

RESEARCH IN PROGRESS

Evaluation of six multiple-species projects in the conservation of threatened species

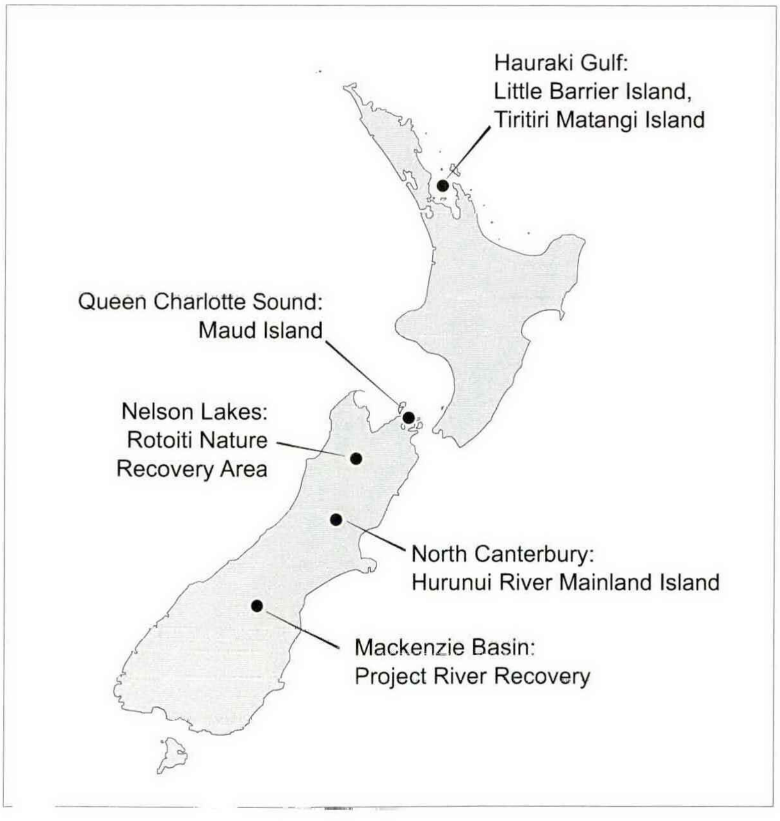
We investigated six multiple-species projects to see how successful and cost-effective they are in the conservation of threatened species. Managers in New Zealand are required to be cost-effective in recovering species and preventing biodiversity loss (DOC 2001). Determining success and cost-effectiveness requires quantifying the costs, and the outputs produced by these projects.

Although not the chosen technique of DOC to determine cost benefit, and success of threatened species projects, this investigation may be of interest and value to others engaged in similar work. —Ed.

Measuring the success of threatened species recovery projects requires comparison of the conservation status of a species over time 'with the project' to what its status would have been over time 'without the project'. The contribution of a project to threatened species conservation, is the sum of any differences between the conservation status of a species 'with the project' and the species' status 'without the project'.

Species recovery projects may also have other goals, e.g. development of management techniques, or education and advocacy. The overall success and cost-effectiveness of a project can be evaluated in terms of all their stated goals, however, we focus on the success and cost-effectiveness of projects in conserving threatened species as this is their, and DOC's, fundamental goal.

Location of the multiple species projects within New Zealand.



Research method and results

We asked project managers and species managers to estimate the status of a species on a continuum from 0.00 (Extinct) to 1.00 (Not Threatened). The continuum is linked to the categories in the Molloy et al. (2002) Threat Classification System and uses a quadratic scale which ensures that conservation status scores increase at a diminishing rate as a species moves closer to 1.00 (Not Threatened). The quadratic scale places more value on improving the conservation status of endangered species than improving the status of less threatened species. Use of a continuum from 0.00 to 1.00 allows for accuracy in measuring changes in the conservation status of species.

We summed the yearly ('with the project' minus 'without the project') scores for a threatened species to calculate the output measured in units called Conservation Output Protection Years (COPY). For the six multi-species projects, we added the numbers of COPY produced for each threatened species identified by the manager, to calculate the total output from the project, again measured in COPY. Information on the project costs was obtained from the project managers.

Opinions expressed are those of the contributors, and do not necessarily represent the policy of the Department of Conservation

The six projects studied are listed in Table 1. Three of the sites are offshore islands and three are Mainland Habitat Islands. Five of the projects have a goal of threatened species conservation, and the sixth, Rotoiti, has a goal of protecting native species and allowing their populations to recover.

The numbers of COPY produced at each of the six projects are reported in Table 1. There are significant differences in the measured output between the projects. The Little Barrier Island, Maud Island, Hurunui River Mainland Island, and Project River Recovery (PRR) projects have operated for seven or more years, include a large proportion of the total population of at least one short lifespan threatened species, and the first three of those projects have achieved significant success with at least one threatened species. In contrast, the Tiritiri Matangi Island and Rotoiti Nature Recovery Area projects provide habitat for small fractions of the total population for each threatened species present, and the projects have, as yet, achieved little success in improving the status of those species compared to their status without the project. Recovery of species often takes many years, but the Rotoiti project has been in operation for only five years.

Table 1 also reports the Present Value of expenditures over the life of the projects, using a 6% discount rate, and their annualised costs per hectare. Noticeably, the three projects with the smallest areas have 20 times greater costs-per-hectare than do the three larger projects. Tiritiri Matangi, the smallest project area, costs 30 times more per hectare per year than does Hurunui, the largest project area. Table 1 also shows the relative cost-effectiveness of each project by comparing measured output produced (number of COPY), to their Present Value of expenditures. The Little Barrier Island project is largely responsible for maintaining the Stitchbird as Range Restricted and is the most cost-effective project in the conservation of threatened species. Maud Island provides protection for the Maud Island frog and the striped gecko, and is the second most successful project. Hurunui makes a major contribution to the management of orange-fronted parakeet. PRR provides management for the Black Stilt. As well as PRR, a black stilt program also manages this species and much of the black stilt's

TABLE 1. THE SIX MULTIPLE SPECIES PROJECTS.

PROJECT AND LOCATION	AREA (ha)	PV OF COSTS R = 6%	ANNUALISED COST PER ha	COPY PRODUCED	PV PER COPY
Offshore Islands					
Little Barrier Island	2,817	$792, 120	$28.96	2.99	$432,852
Tiritiri Matangi Island	218	$1,651,838	$780.15	0.15	$20,647,975
Maud Island	320	$2,162,521	$695.80	2.38	$1,404,234
Mean Offshore Islands	1,118.3	$2,012,675	$501.64	1.84	$749,502
Mainland Islands					
Rotoiti	825	$1,411,605	$34.81	0.00	undefined
Hurunui	12,000	$874,605	$26.10	1.28	$840,966
River Recovery	11,000	$4,021,954	$46.33	0.45	$14,415,605
Mean Mainland Islands	7,941.7	$1,535,493	$35.74	0.58	$7,628,286

improvement has been attributed to that programme. Tiritiri Matangi manages only small percentages of the total populations of threatened species, hence it makes minor contributions to the species' status. Rotoiti provides habitat for the South Island kaka and two other endangered species, but the project manages only small percentages of the total populations of these species, and it has little potential to contribute to the conservation of threatened species until this changes. The three Mainland Habitat Islands have a mean annualised cost of $317,734, double that of the three offshore islands ($158,094). However, the three Mainland Habitat Islands are less successful in the conservation of threatened species (mean COPY 0.57) than the three offshore islands (mean COPY 1.84), and are much less successful than eight single species programs studies in Cullen et al. (2001, see table 4) (mean COPY 1.12). The mean cost-effectiveness ratio of the single-species programs (PV per COPY) is $645,482, less than 10% of the mean PV per COPY for the five multiple species projects ($7,548,326 per COPY).

Conclusion

Sites lacking a high percentage of at least one threatened species are unable to make much contribution to the conservation of threatened species. We found evidence that single-species projects are more cost-effective than are multi-species programmes. Mainland Habitat Island projects with their broader focus and their need for ongoing pest control, are more costly and less productive than are offshore island and single-species programmes. The tool we used to measure success and cost-effectiveness of threatened species projects is ecologically relevant, light on data requirements, and straightforward to use. The next step is to see how well it can measure ecosystem performance where there are threatened or endangered indicator or umbrella species present, thus avoiding the need to use more complex and costly techniques.

Acknowledgements

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BOOK REVIEWS

The archaeology of Otago. By Jill Hamel. Department of Conservation, Wellington. 2001. 226 p.

Archaeology of the Taranaki–Wanganui Region. By A. Walton. *Science for Conservation 154*. Department of Conservation, Wellington. 2000. 52 p.

Archaeology of the Wellington Conservancy: Kapiti–Horowhenua. By Bruce McFadgen. Department of Conservation, Wellington. 1997. 43 p.

This review is reprinted from Archaeology in New Zealand 145: 1 ***with the permission of the editor and the author.***

The Department of Conservation is to be congratulated on the publication of these conservancy-based archaeological reports. Two of those reviewed here are by Department staff members; the third is from a long-time worker in Otago pre-European and historic archaeology.

Jill Hamel's is much the most substantial, and deserves most attention. The first half deals with Maori prehistory and archaeology, with an emphasis on economic and environmental matters. There are excellent summaries of the archaeological evidence for moa hunting and the exploitation of other birds, sea mammals, freshwater mussels, dog and kiore, each with a map showing the distribution of relevant sites. An account of stone resources available to Otago Maori in particular deals with silcrete, porcellanite and nephrite.

A section on settlement types that deals with just four defended pa in the whole region shows how different is the archaeological landscape to most of the North Island. In the last section, the Little Papanui, Long Beach, Whareakeake, and Shag Point sites are introduced, where archaeological evidence illustrates change over time, before the author gives a general account of culture change ending with the impact of European settlement.

The second half of the book deals with the historical period. Whaling station dates are not all correct, the author being unaware of 1844–47 statistics in 'The New Zealand Spectator and Cook's Strait's Guardian' and other data. There is a pioneering summary of the archaeology of early pastoralism, beautifully illustrated from Blackstone Hill and other stations. This is a topic that is crying out for more work.

Three-quarters of this part of the book is concerned with gold mining, reflecting once again the disproportionate interest that is a wider problem in Australasian historical archaeology. The emphasis can be seen in the site distribution map. It is not that gold mining is not a fascinating topic, but that other topics deserve at least equal archaeological attention, in particular pastoralism and agriculture, and urban, civic and industrial Dunedin and the region's rural towns and villages.

That having been said, the chapters on alluvial and quartz mining, 20th century mining and the Chinese presence do give an excellent summary of the subject, superbly illustrated from the special Central Otago landscape. Pictures of lovely stone buildings (see the 1873 Serpentine Church, p. 140) and other sites are supplemented by Kevin Jones' detailed aerial shots.

'The archaeology of Otago' is an outstanding introduction to the subject. The photographs in particular tell of the relationship of people with the landscape and resources of the region. There are however relatively few photographs in the first half of the book to give context to Maori sites and archaeological data. In the historical section every one of nearly 100 black and white pictures deserves it place. There is also a section of colour photographs of Maori and European sites.

In the introduction the Department of Conservation is credited with being in operation in the early 1980s, which is incorrect. 'Ngai Tahu' in the first half of the book is suddenly 'Kai Tahu' from page 103, and site numbers undergo a change from mostly metric to mostly imperial at the same time.

Tony Walton's work provides a useful summary of archaeological work carried out in the Wanganui Conservancy for people with little or no prior knowledge of the subject. The material is organised under resource use, settlement patterns, change and historical archaeology. Suggestions for a research agenda also have site protection implications. An 11-page bibliography is a useful start for anyone working in the region. Appendices list site surveys, excavations and radiocarbon dates. There is a production glitch at the bottom of page 10 [where 3 lines are repeated,] and inconsistent treatment of new chapters throughout.

Bruce McFadgen has produced a more particular report, which deals only with the dune-belt and related sites of the Horowhenua and Kapiti coasts. The approach is signalled by the subheading describing the work as, 'a prehistoric and palaeoenvironmental study'. An appendix lists radiocarbon dates obtained from sites in the Wellington Conservancy as a whole. While I found this report very interesting—perhaps because I knew less of the topic than the others—it did make me think about the purpose of these publications.

The most accessible of the three reports as a presentation of current knowledge and a call to action is Walton's, which should be useful to archaeologists and non-archaeologists alike. Hamel's report is more ambitious, and deserving of a wider readership than will be achieved by the format and restricted publication outlet. The Kapiti-Horowhenua publication is more limited in scope.

While there is something to be said for a variety of approaches according to the strengths and interests of authors, there is also an urgent need for standard, comprehensive and clear direction for planners and resource managers who know little or nothing of what is out there. The Department of Conservation may need to think more clearly about exactly what purpose the reports are to serve.

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Apology and correction

In the last issue of *ConScience* (no. 44), an error was printed which was entirely the fault of the Editor. In Work Reported: *Fangs lunch—a tragedy on camera*, I attributed the video work to Terry Greene, of SRU. I am now informed that the camera set up was largely done by Les Moran, and the camera batteries were changed by the staff of the Rotoiti Nature Recovery Project.

My apologies to Les Moran (and the staff who made sure of the battery changes) for the mistaken statement, and a chocolate fish to Dave Butler, who sent in the correction.

Kaye Green—Editor

New from DOC Science Publishing

Measuring Conservation Achievement

One of the most important titles to come out of DOC Science Publishing recently is *Measuring Conservation Achievement: concepts and their application over the Twizel Area (Science for Conservation 200).*

New Zealand has a huge range of plants, animals, invertebrates and natural environments and the challenge for conservation can be to articulate what differences DOC's work makes to this natural heritage.

While individual species are relatively easy to monitor, forests and other complex ecosystems are more difficult. Since the mid 1990s, work has been done to try and formulate a model that might allow DOC to prioritise its conservation management activities in such a way that the maximum possible benefit is achieved.

This new publication describes the concept and the model development, and then looks at its application over the land administered by DOC's Twizel Area Office, South Island.

The report is lavishly illustrated with maps, diagrams and charts, and includes much detailed data. It also contains a useful glossary of the relevant terms and indices relevant to this project.

If you would like a briefer explanation of this concept, and its application, two previous publications may be of interest. In July 2001, DOC Science Publishing put out the leaflet *Tracking the fate of New Zealand's natural heritage,* and a small, full-colour, booklet *Making the Best Choices for Conservation.* These publications both outline the basic ideas behind the Measuring Conservation Achievement concept, and its potential benefits for conservation in New Zealand.

PUBLICATION DETAILS

Measuring conservation achievement: concepts and their application over the Twizel area.
T. Stephens; D. Brown; N. Thornley 2002. *Science for Conservation 200.* 114 p. $40.00.

Making the best choices for conservation.
2001. A5 booklet. 23 p. Free.

Tracking the fate of New Zealand's natural heritage.
2001. Factsheet. 4 p. Free.

All three publications are available from DOC Science Publishing. For more details on placing an order:

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