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CONTENTS

GUEST EDITORIAL

Plant conservation genetics—are we missing the boat?

Currently there is a great deal of interest in the application of plant conservation genetics in New Zealand, primarily from scientists and conservation officers in the field. This article provides a general introduction to the theory and practice of conservation genetics as it might be applied to the New Zealand flora and follows on from a presentation at the second DOC Threatened Plant Workshop, held at Miranda in May 1999.

Conservation genetics is a basic and applied science primarily motivated by concern for the depletion of genetic diversity within species. It involves the study of molecular biology, population genetics, ecology, mathematical modelling and evolutionary systematics and the application of management techniques. Changes in migration, selective pressures, geographical isolation, establishment of a new population from only a few individuals all result in the loss of genetic diversity. Each of these factors affects which individuals will be part of the new generation and therefore which genetic sub-sample will determine the future of the species. A population is more susceptible to the loss of genetic diversity when the number of individuals becomes small, since the loss of an individual represents loss of a greater proportion of the available diversity. However, sometimes a population can have many members but still undergo loss of genetic diversity. This can happen through geographic isolation, where a population of plants may become separated into subgroups by some new barrier, for example through a change in the course of a river or the development of a subdivision creating houses and roads on pristine swampland. When this happens, the pool of gene variants in the subgroups may differ from one another.

Even though the tools and methods of genetic analyses are available, little is known about such parameters as gene flow (movement of genes from one population to other populations) and effective population sizes (the actual number of successful breeding individuals) for New Zealand plant species. Methods of measuring genetic diversity have an important role in conservation programs. The genetic structure of a population determines its capacity for response to selection pressure (like sudden crises), both natural and man-made, and as such is the primary consideration in the development of conservation strategies. Genetic studies provide conservation scientists and ecological managers with new insights regarding the extent of diversity of individuals within and between populations. Without an understanding of genetics, we can be left conserving the wrong population, or

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wasting valuable resources on a population that isn't endangered or one that adds little to the diversity of the species!

As a practical example of the use of conservation genetic techniques, we might consider the study by Rossetto et al. (1999) of two critically endangered eucalypts (*Eucalyptus phylacis* and *E. dolorosa*). Both species were known from single locations in Australia, within pockets of native vegetation surrounded by agricultural land. The development of appropriate conservation strategies required the appraisal of the extent of clonality within both species as well as the definition of species identity for *E. phylacis*. The use of genetic analysis revealed contrasting stories for these threatened species. Genetic analysis contributed to the identification of *E. phylacis*, which was shown to be a single clone and, as a result, possibly the rarest eucalypt known. Despite its isolation, *E. dolorosa* still retained sufficient genetic variability to enable the production of highly outcrossed seed. Different conservation strategies were suggested for the two species.

A primary objective for New Zealand plant conservation should be to conserve the range of genetic diversity present within a taxon (organism of undetermined rank) or maintaining a gene pool. The process by which conservation genetics might be carried out begins with defining the populations and areas of interest. We observe the target taxon and then ask questions such as:

1. Can we define a natural evolutionary group that includes this taxon. What are its closest relatives?
2. Can we classify this taxon as a distinct species?
3. What is the variation within the taxon and what are the features used to classify this variation?
4. What is known about the history of the populations and what can we expect to observe at the genetic level?
5. What is the sexuality of the taxon (monoecious, dioecious, hermaphrodite, etc)?
6. How adaptable is the taxon to various temperatures, soils, and water conditions?
7. What are the pollinators and their requirements?
8. What are the threats to the habitat due to human, climactic factors, etc.

The first four points above should involve examination of genetic characteristics. In this way, we can determine relatedness and obtain information on population structure, gene flow and genetic diversity. If genetic diversity becomes low, that species becomes increasingly at risk. If new pressures (such as environmental disasters occur, a population with high genetic diversity) has a greater likelihood of having some individuals whose genetic makeup enables them. If genetic diversity is very low, none of the individuals in a population may have the characteristics needed to cope with the new environmental conditions. The commonly used method of vegetatively propagating plants from a small population for the purpose of boosting numbers in the same area may, in the long term, not assist its survival. Such a population could be very suddenly wiped out! In practice, the measurement of genetic differences among populations and species is needed to direct translocations designed to preserve the maximum genetic diversity and to prioritise species for conservation.

I recently began a preliminary investigation in to *Cheesemania* "Chalk Range", a habitat-specific, range-restricted taxon that is considered critically endangered (Cathy Jones pers.

Opinions expressed in this article are those of the contributor, and do not necessarily represent the policy of the Department of Conservation.

comm.). According to genetic analyses of the New Zealand Brassicaceae (Mitchell and Heenan 1999). *C.* "Chalk Range", *C. fastigiata*, and *C. stellata* make up a closely related species complex. Although the taxonomic status of the close relatives have been assessed based on morphology (Heenan and Garnock-Jones 1999), the status of the *C.* "Chalk Range" entity has not been investigated. The genetic diversity and gene flow within and between populations of *C.* "Chalk Range", *C. fastigiata*, and *C. stellata* are unknown. Genetic data will play an important role in estimating diversity within this closely related complex. If genetic, morphological and physiological data supports specific status for *C.* "Chalk Range", then we need to act urgently to maximise the chances of this taxon surviving.

Anthony Mitchell
Soil, Plant and Ecological Sciences Division,
Ecology and Entomology Group,
Lincoln University, Canterbury.

References and suggested reading

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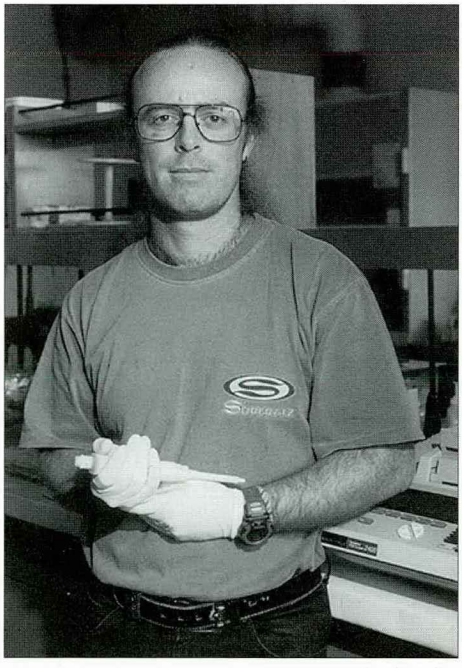
http://www.inet.net.nz/~anthony



Dr Anthony Mitchell is a contract research scientist in the Ecology and Entomology Group, Lincoln University. He has held post-doctoral research positions in plant biosystematics both here in New Zealand and in Regensburg, Germany. His primary research interests include conservation genetics, evolution, species complexes, and phylogenetic relationships. Rare plant species found in the Chalk Range have been the recent focus of attention, but Anthony's research has included population genetic and phylogenetic studies on members of the Araliaceae, Apiaceae and Brassicaceae.

RESEARCH IN PROGRESS

Studies on the biology of *Dactylanthus taylorii*—a brief summary

Over the last four years we have been studying aspects of flower morphology, sexual and vegetative reproduction, and genetic diversity of *Dactylanthus taylorii*, a category 'A' threatened plant species. This research was conducted as a DPhil project for one of us (SH) jointly at the University of Waikato and the Free University of Berlin, Germany.

While the full results will be published, we want to provide here a brief summary of those results which have bearing on the conservation management of this species.

A peculiar plant

Dactylanthus taylorii, which is endemic to New Zealand, is a unispecific genus in the Balanophoraceae, a mainly tropical family of fully parasitic flowering plants. It consists of a completely or partly underground, woody tuber varying in size from a small fist to a soccer ball attached to the roots of a variety of indigenous tree and shrub species. During autumn, flowering shoots (inflorescences) develop from the tuber and appear above the forest soil, and only then does the angiospermous nature of the plant become obvious. Each inflorescence consists of a fleshy peduncle (flowering stalk), terminated by a single capitulum (head) 2–4 cm in height and 1.5–3.5 cm in diameter. Individual flowers, which are among the smallest found in flowering plants, are arranged on 2–3 cm long, upright spadices (small branches) tightly grouped within the capitulum (Fig. 1). *D. taylorii* is endangered today mainly because of the lack of reproduction, caused largely by browsing of the nectar-filled inflorescences by possums and rats, collection of specimens by curio hunters, and loss of habitat.

Reduced flowers

Male and female flowers in *D. taylorii* are reduced to their bare essentials. The female flower consists of a single egg-shaped ovary tapering into a slender style, with two filamentous perianth remnants at its base. The entire female flower rarely exceeds 5 mm in length. The male flower is equally reduced, and is comprised of a single upright anther about 1 mm in total length, and also bears two filamentous perianth remnants. Flowers are principally pollinated by the New Zealand short-tailed bat, *Mystacina tuberculata*, one of the few known cases in the world where a plant flowering at ground level is pollinated by a bat. In the absence of bats, mice and rats also act as pollinators, though the latter often destroy the flowers rather than pollinate them.

After fertilisation, female flowers develop into small fruits, consisting of a fleshy ectocarp (outer tissue) which later becomes papery, and a single, hard 'stone' containing the small seed with its simple embryo.

Monoecious or dioecious

In general, male and female flowers are on separate inflorescences and on separate plants, thus the species is usually regarded as dioecious. Very rarely do spadices bear some female flowers at their base, with the rest of the spadix covered with male flowers. However, male and female inflorescences sometimes grow from what appears to be a single tuber, raising the question of whether these individuals are in fact monoecious. Using a mo-

lecular technique (RAPD, Random Amplified Polymorphic DNA) to compare DNA from inflorescences of either sex from the same tuber, we can show that in every investigated case the two inflorescence types came from two genetically distinct individuals, and therefore no indication of regular monoecy in the species could be found. Thus, tubers can consist of a number of individuals growing so close together as to appear as a single plant. This makes an assessment of the number of individuals in a population even more difficult than it already is due to the mainly underground habit of the plants.

Germination without a host

Contrary to what is known of many holoparasitic plants, seeds of *D. taylorii* do not require the presence of a host root to trigger germination. In an experiment conducted during the study, seeds germinated readily on moist capillary matting alone. However, germination is a slow process. Seeds probably need to be in the soil for several years before they may germinate. Once the tiny radicle (germination root) has developed, seedlings are able to survive for several weeks or even months in this state. During this time the radicle will attach to a root growing in its vicinity. If that root is of a suitable host, the terminal portion of the radicle will grow into a tiny tuber, which in turn stimulates the host root to expand below the infection site. Thus, the host root enlarges parallel with the growing tuber of the parasite to form a so-called 'wood-rose', a finely grooved contact surface with the tuber tissue, through which the exchange of nutrients and other substances occurs. Apart from infection through seeds, *D. taylorii* is also able to infect suitable roots through tiny, radicle-like infectious roots located at the base of the inflorescence stalk.

Genetic variability

Using the RAPD technique (see above), we were able to show that genetic variability corresponds with spatial distribution, i.e. that as a rule of thumb the degree of similarity between populations decreases with increase in distance. While this was not unexpected, we also found that even two populations growing only 3 km apart may be genetically distinct, with some genetic markers consistently present in one, but completely absent in the other. This indicates that gene flow between populations, even over a short distance, is restricted. One may wonder whether the underlying poor long-range dispersal of seed and pollen is a recent occurrence, perhaps brought about by loss of the principal pollinator or seed dispersal agent(s), or whether populations have always been to some degree isolated from each other. The presence of population-specific genetic markers, likely to have developed over considerable periods of time, supports the latter view. However, our knowledge of seed and pollen dispersal in *D. taylorii* is still very limited, and thus a clear assessment cannot be made. In the meantime, as a precautionary step, populations should be regarded as genetically distinct, and this distinctness maintained and protected.

As usual, our study has raised more questions than we were able to answer, such as the nature of the seed dispersal agent, the mechanism of host recognition and infection by the seedling, and host specificity within populations or progenies. However, we have managed to shed some light on important aspects of the biology of *Dactylanthus taylorii*, aspects which

RESEARCH IN PROGRESS

have implications not only for the species and its conservation, but for the family as a whole and for parasitic plants in general.

Financial assistance for SH through the Land Berlin (NaFög), DAAD, Nga Manu Trust, the Lotteries Board and the Department of Conservation (DOC grant 2054) have made this project possible and is gratefully acknowledged.

Sebastian (Avibhakta) Holzapfel (DOC, Waikato Conservancy), Warwick Silvester (University of Waikato), Chris Ecroyd, Tom Richardson (both Forest Research, Rotorua) & Werner Greuter (Botanisches Museum, Berlin, Germany).

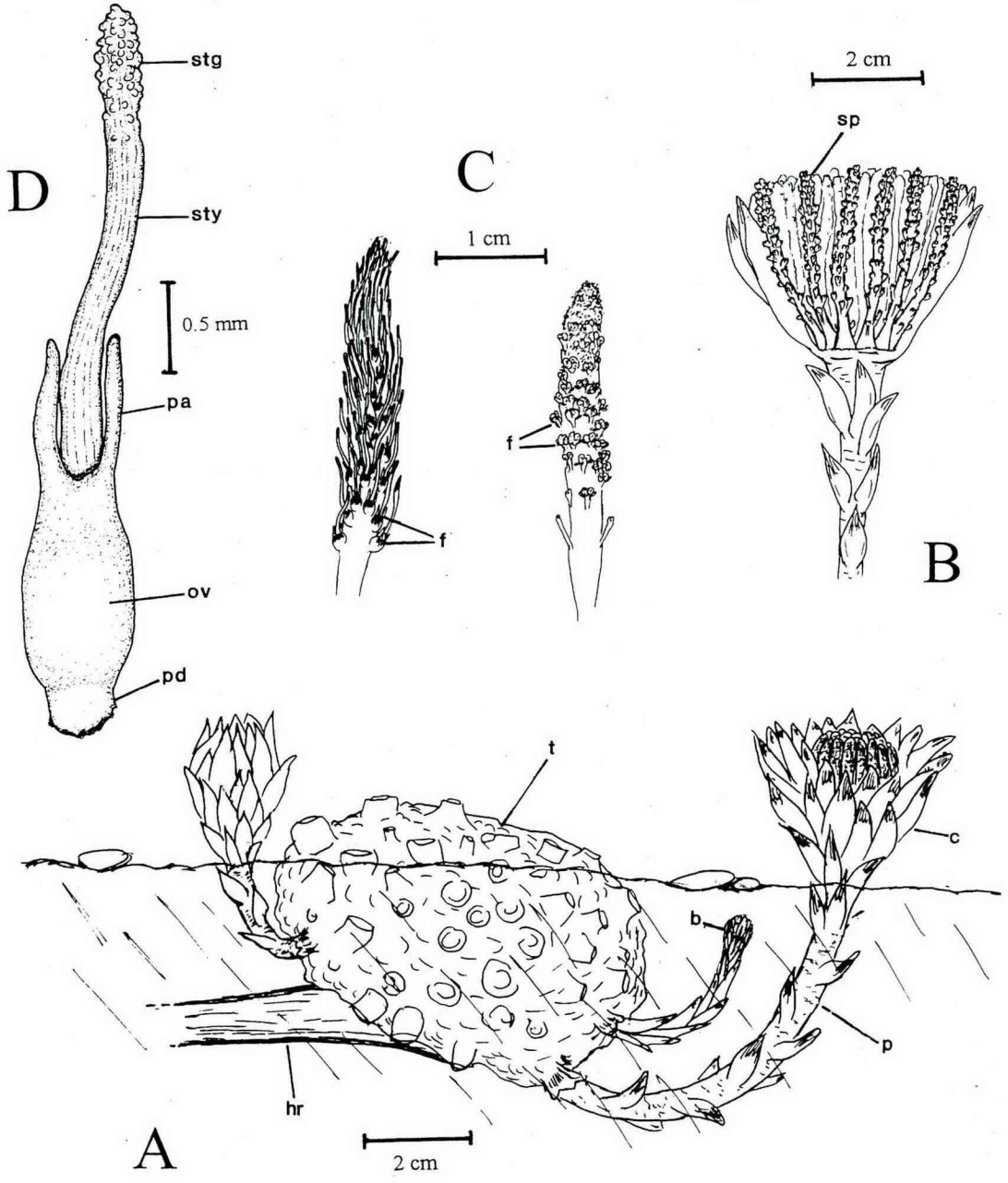


Figure 1. General habit of *Dactylanthus taylorii*. **A.** Habit of flowering, partly exposed plant (semi-schematic). hr: host root, t: tuber, b: bud, p: peduncle, c: capitulum. **B.** Flowering male inflorescence. The capitulum has been cut open along the front to expose spadices (sp.). **C.** Individual female (left) and male (right) spadix, covered with flowers (f). **D.** Single female flower. pd: pedicel, ov: ovary, pa: perianth member, sty: style, stg: stigma.

NOTES AND NEWS

Snowy plover in Oregon—dune restoration may have potential for Chatham Island oystercatcher

Snowy plover *Charadrius alexandrinus* is a threatened shorebird of North America and in western USA it possibly declined in numbers from >10,000 breeding birds in the late 1970s to <8000 ten years later. Loss of habitat, disturbance, and predators are implicated in the decline in coastal areas.

In 1999, I visited a snowy plover conservation area in Coos Bay, Oregon. The area had been in the news earlier that year, when the *New Carissa* ran aground and spilled oil, fouling the beaches and incapacitating wildlife. A multi-agency and public response team swung into action to control the spill, clean the beaches, and rehabilitate wildlife. Although by no means a perfect operation, a catastrophe was averted. Conservation action at Coos Bay had seen the plover population build up to over 90 breeders, but this was set back with oiling of a large proportion of the birds and a bad winter which had caused high mortality. A spin-off from the emergency, though, was an increased amount of funds for plover conservation.

Figure 1. Researchers visiting a predator enclosure around a snowy plover nest within a dune restoration area.

When I visited Coos Bay in July 1999, part of the hulk of *New Carissa* was still standing sentinel offshore. However, my main interest was not the effects of the spill, but the conservation work that was underway to enhance the breeding potential of birds in the area. One problem to be overcome was predation by introduced foxes, ravens, and crows. Another was the over-stabilising of dunes by European beachgrass (*Ammophila arenaria*) (known as marram in New Zealand) which had replaced the less dense native grasses, and caused birds to nest too close to the high tide mark. Shorebirds, such as the plovers, tend to nest in the open so they can see predators approaching. When disturbed they readily leave the nest to draw the intruder away. With fewer suitable sites available for nesting in the foredunes, this leaves only the beach itself, where losses from wave action during storms are more likely. The same problems face the Chatham Island oystercatcher, which I was about to start work on, so I was interested to see what was being done to remedy the situation for snowy plover.

Coos Bay has a Habitat Restoration Area where efforts have been made since 1994 to maintain adequate and protected nested habitat for plovers. Large-scale marram grass removal involved using a bulldozer to breach and flatten the foredune to open up nesting habitat and restore natural sand movement between the beach and the dunes. Herbicide, tilling, and repeated hand-pulling of grass kept the marram under control, while application of oyster shells limited sand-blow and created more attractive nesting habitat for the birds. The beach was roped off to limit human disturbance and the dunes were fenced with predator-

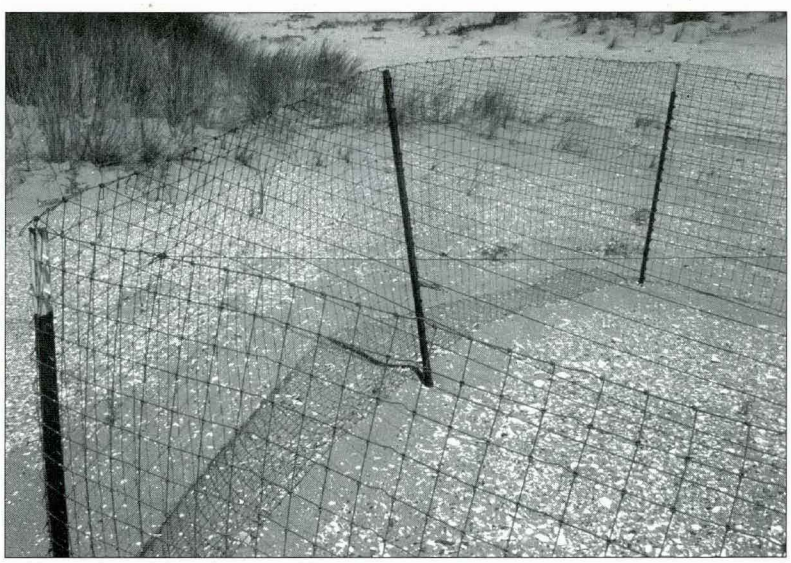


Figure 2. A close-up of an exclosure. Note the oyster shell used to stabilise the sand and provide nesting camouflage.

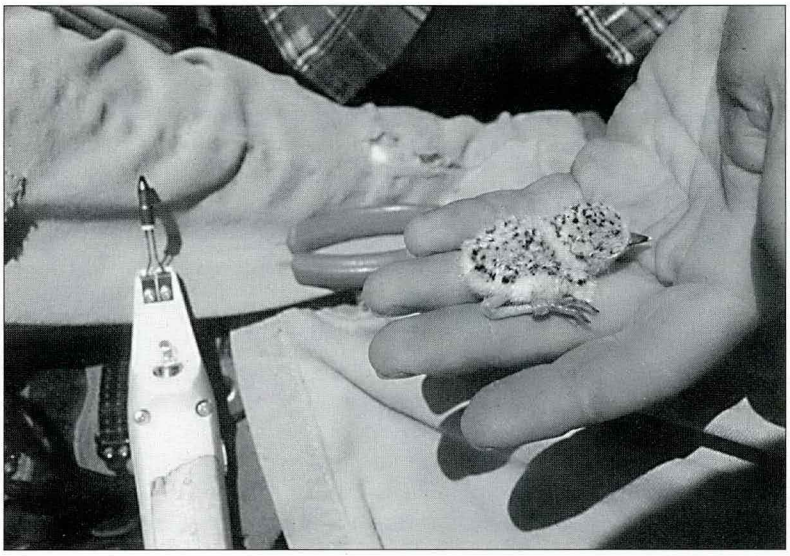
proof mesh. As the main predators were large and the plovers small, the mesh was coarse (about 5 cm). When wildlife rangers found plover nests they placed predator exclosures around them, using the same mesh for the walls and strings over the top to limit aerial predation (although the problem-solving skills of the ravens meant that some modifications had to be made to the design). The plovers could move to and fro through the mesh.

Paradoxically, although plover numbers had increased in Oregon from 1994–1997, productivity had decreased. Success would probably have been lower still without the conservation intervention. At the Coos Bay restoration area, the plover nests were now made in the oyster shell rows of the opened-up dunes, whereas previously the nests would have been vulnerable to being washed away during high seas. Overall, in Oregon in 1998, 70% of nests with predator exclosures successfully reared young, whereas only 6% of unprotected nests were successful.

Predator exclosures for Chatham Island oystercatcher nests aren't practical, unfortunately, because of the relative size of bird to predators. However, the DOC Area Office is engaged in intensive predator control over two strips of northern coast, and anti-predator netting is being used on a fence in one area to limit reinvasion of mammals and weka from the neighbouring farmland. Productivity was high in those areas in 1998/99. Since up to half of oystercatcher egg losses in the north are a result of high seas, it is well worth considering a dune restoration programme along the lines of that in Oregon. The dune system these days is generally a very narrow strip between the beach and farmland, so restoration within selected oystercatcher territories would have to be done very carefully so as not to do more harm than good. Dune restoration could be a valuable tool to help build up numbers of this rare species while re-establishing native dune vegetation communities.

Peter Moore
S&R Unit, Tory street.

Figure 3. Snowy plover chick just after being banded.



The Science Business Group

(All Staff are based at Tory Street, Wellington.)

'After thirteen years in DOC, if I have learned one skill it's adjusting to change with out batting an eyelid'—Rob McColl

Rob McColl

Science Business Manager

Rob is responsible for three groups which provide service and support to DOC science staff and programmes. The groups presently comprise ten permanent staff and four temporary or contract workers.

Rob was formerly a wetland ecologist with the DSIR, working on nutrient enrichment of lakes and rivers; and Water Quality Manager with Ministry of Works and Development, advising on water pollution research and management. Rob now oversees the department's science contracting and science support services. He retains a special interest in forest management, representing DOC on the NZ Forest Health Research Collaboration and the MFE Carbon Monitoring Steering Committee. Rob maintains liaison with a wide range of external science organisations that provide science information to DOC.

Science Support Group

Paul Westerbeke

Finance and Administration Manager

Paul has been with the department for just under nine years, working mainly in the areas of financial and administration support. He leads the Science Support Unit which provides administrative, financial and building support services. Paul has recently been involved in the Connect 2000 rollout and is now working on the impending relocation of Tory Street staff to new premises. During his time with the department he has completed a Masters degree in Social Science Research, with his thesis focusing on visitor satisfaction with the Department's visitor centres.

Rob's Mob at play, including extras Sonia and Margaret.

Carol Robson

PA to Managers, Science & Research

Prior to coming to DOC Carol worked for the Wellington Regional Council, where she was involved in the operation of the 5 regional parks. During her 5 months with DOC she has been responsible for assisting and supporting all Science Managers. Using new and innovative techniques to control them, she maintains tracking and monitoring systems to assist their efficiency and performance and takes quantitative diversity measurements to make sure they do not become a threatened species.

Helen Shand

Reception and word processing

Helen has been with Science & Research for nearly a year. She came in a relieving capacity and stayed on part time in a currently vacant position. Helen previously worked for the Parliamentary Service.

Mark Stephen

Science Contracts Officer

Mark prepares and monitors science contracts and provides contract management support. He liaises with a wide range of external science providers and maintains extensive records of current and past research. He supplies up-to-date forms and templates for science planning and contracting. Mark aims to establish fully electronic systems for science management information.

Mala Nesaratnam

After 10 years on the reception desk at Tory Street, plus being Travel Clerk for all Tory Street and SRU staff nation wide, and providing word-processing services, Mala has now moved into the contracts area. She helps Mark Stephen in writing contracts, updating the Science Database, filing, and other duties as required.

Margaret Wood

Margaret has been with DOC for just over twelve years working as a Human Resource Officer in the Human Resource and Organisation Division of Head Office. Margaret is temporarily filling an administrative clerk slot for a few months.

Science publications and Marketing Group

Kaye Green

Publications and Marketing Manager

Kaye has been with DOC since it was formed in 1987. Before coming to S&R, she was joint manager of the Archaeological Unit, NZHPT, with Jan Coates, and then Manager, Protection, in the Auckland Conservancy. Kaye has degrees in History and Law and twenty years' practical experience in the archaeology of New Zealand and Island Polynesia. Kaye's first job on joining S&R was as co-ordinator of Science Publications Unit. As a result of the recent re-organisation of Science & Research, the science editing function was separated from the printing, distribution, and marketing function, with Kaye responsible for the latter. Kaye's current job centres around production, distribution, and marketing, editing of the S&R newsletter *ConScience*, production and distribution for the Biodiversity Recovery Unit and Conservation Sciences Levy Reports. A current output project is developing a market-led basis for science publications.

Sarah Vaughan

Publications and Marketing Officer

Sarah develops new marketing tools and runs all aspects of the sale and distribution of individual orders. Sarah manages a database of DOC science publications, maintains our science publications on the Intranet and is working with the Chief Science Editor to develop science publications marketing on the Intranet and the Web.

Herman Weenink

Publications Clerk

Herman maintains our equipment and assists in the dispatch of publications. In his spare time Herman makes bat boxes and other electronic surveillance gear for DOC staff.

Sonia Nesaratnam

Casual Publications Support

Sonia works as needed (a lot) in her spare time. Her *real* job is studying for a BCA at Victoria University.

Science Editing Group

Jaap Jasperse

Chief Science Editor

As Chief Science Editor, Jaap continually challenges his own adage: 'Perfection in print is a contradiction in terms'. With his team of two expert science editors on staff (Lynette Clelland, Ian Mackenzie), plus another on contract (Geoff Gregory) he likes to process manuscripts efficiently, with quality, to the publication stage—both in print and on the Intranet. A Dutch Doctoral Degree in Biology, a PhD in Communication Studies, many years as a science journal editor and several as an information technologist are proving useful attributes for coping with content and tools of the job. Enough said: Jaap featured in *ConScience* about a year ago (December 1998 issue); he has since made good his promise to participate in the Taupo cycle challenge as part of a DOC relay team.

Jaap and his team have been busy expanding and perfecting the system for handling manuscripts, improving quality control, and upgrading the science database.

Ian Mackenzie

Science Editor

Ian studied geology and archaeology, and has a post-graduate Diploma in Library Studies from the National Library of New Zealand. After several career false starts in banking, teaching, and librarianship, he began science editing in 1971 with the DSIR. This mostly involved geological and earth science editing,

(L to R) Ian, Lynette, and Geoff.

including the editorship of the *New Zealand Journal of Geology and Geophysics*. He started in a job-share editing position (50%) with Science & Research, DOC, in 1991. Much of Ian's job satisfaction comes from the design, layout, and physical creation of a book, so the NZAA Monograph 23: *Archaeological site recording in New Zealand* (recently published) was an exciting challenge for him. Ian's hobby interests are gardening and collecting fine art.

Lynette Clelland

Science Editor

After completing a BSc honours degree in geology at Victoria University, Lynette worked for DSIR for 13 years, 11 years in the Geothermal Co-ordination Group and 2 years as an editor for the Geological Survey. She started working for DOC in 1994, initially job-sharing with Ian Mackenzie and then full-time. Lynette edits papers and reports submitted by staff and contractors, and lays out reports to be published by S&R. Most of her time is spent on contract reports that are published as part of the *Science for Conservation* and *DOC Technical Series*. She also regularly edits texts for the posters produced by Chris Edkins and produces other stand-alone reports.

Geoff Gregory

Contract Editor

Geoff does freelance editorial and science writing work under contract to a range of DOC units, and as part of the S&R editorial team. On early retirement from the Institute of Geological and Nuclear Sciences (GNS) six years ago, he set up his own small company, Word Therapy. His recent work has been for a diverse range of organisations, including DOC, Institute of Professional Engineers NZ, GNS, the Royal Society of NZ, and the Earthquake Commission. Before freelancing, Geoff had been a science editor and/or information officer in a range of science publishing organisations, including NZ Geological Survey, Science Information Division of DSIR, the Open University (UK), the Society of Chemical Industry (London), and the Commonwealth Agricultural Bureaux. Geoff has an MA from Oxford University, with an honours degree in forestry supported by botany, chemistry, and geology.

NEW PUBLICATIONS

New from Science & Research Unit

DOC Technical Series

Henderson, R.J.; O'Connor, C.E.; Morgan, D.R. 1999. **Current practices in sequential use of possum baits.** *Department of Conservation Technical Series 22.* 67 p. $22.50 incl. GST.

Fitzgerald, G. 1999.**Community involvement in conservation management issues.A New Zealand action research project.** *Department of Conservation Technical Series 21.* 59 p. $22.50 incl. GST.

Blackford, C. 1999. **Methodology for evaluating DOC's public awareness activities.** *Department of Conservation Technical Series 19.* 36 p. $12.50 incl. GST.

Science for Conservation

Hutcheson, J. 1999. **Characteristics of Mapara insect communities as depicted by Malaise trapped beetles: changes with time and animal control.** *Science for Conservation 135.* 21 p. $12.50 incl. GST.

Department of Conservation 1999. **Progress in mammal pest control on New Zealand conservation lands.** *Science for Conservation 127.* 74 p. $22.50 incl. GST.

Threatened Species Recovery Plan

Innes, J.; Flux, I. 1999. **North Island kokako recovery plan.** *Threatened Species Recovery Plan 30.* 32 p. $15.00 incl. GST.

NEW PUBLICATIONS

Science Posters

Wilkinson, I.; Childerhouse, S.; Duignan, P.J.; Gulland, F.M.D. 1999. **Infanticide and cannibalism in the New Zealand sea lion.** *Science poster 27.*

Joint DOC/Niwa Publications

Boubée, J.; Jowett, I.; Nichols, S.; Williams, E. 1999. **Fish passage at culverts: a review, with possible solutions for New Zealand indigenous species.** 118 p. (incl. 11 colour pages and "Culvert" programme for PC on floppy disc.) $35.00 incl. GST.

Rutherford, J.C.; Davies-Colley, R.J.; Quinn, J.M.; Stroud, M.J.; Cooper, A.B. 1999. **Stream shade: towards a restoration strategy.** 161 p. (incl. 9 colour pages.) $45.00 incl. GST.

Conservation Advisory Science Notes

Childerhouse, S. 1999. **Fifty-first meeting, Scientific Committee of the International Whaling Commission.** *Conservation Advisory Science Note 270.* 11 p. $3.50 incl. GST.

Reid, H.; Jones, P. 1999. **Organochlorine contaminants in northern royal albatross from Taiaroa Head, Otago Peninsula.** *Conservation Advisory Science Note 269.* 15 p. (incl. 1 colour page.) $4.50 incl. GST.

Berry, C. 1999. **Potential interactions of hedgehogs with North Island brown kiwi at Boundary Stream Mainland Island.** *Conservation Advisory Science Note 268.* 22 p. $3.50 incl. GST.

Hendra, R. 1999. **Seasonal abundance patterns and dietary preferences of hedgehogs at Trounson Kauri Park.** *Conservation Advisory Science Note 267.* 12 p. $3.50 incl. GST.

Andrew, N.L.; MacDiarmid, A.B. 1999. **Sea urchin fisheries and potential ecological interactions with a kina fishery in Fiordland.** *Conservation Advisory Science Note 266.* 12 p. $3.50 incl. GST.

Nairn, I.A. 1999. **Ruapehu crater rim inspection 13 April 1999: Developments since 1997.** *Conservation Advisory Science Note 265.* 11 p. (incl. 3 colour pages.) $6.50 incl. GST.

Trotter, M.; McCulloch, B. 1999. **Impact of a planting programme on historic and archaeological sites of Quail Island, Lyttelton Harbour.** *Conservation Advisory Science Note 264.* 19 p. (incl. 2 colour pages.) $5.50 incl. GST.

McDowall, R.M. 1999. **Migration season of whitebait or giant kokopu, *Galaxias argenteus*.** *Conservation Advisory Science Note 263.* 9 p. $3.50 incl. GST.

Boon, W.M.; Chambers, G.K.; Daugherty; C.H. 1999. **Genetic analysis of Forbes' parakeet (*Cyanoramphus forbesi*).** *Conservation Advisory Science Note 262.* 6 p. (incl. 2 colour pages.) $5.50 incl. GST.

Spurr, E.B. 1999. **Toxicants for control of stoats (*Mustela erminea*).** *Conservation Advisory Science Note 261.* 8 p. $3.50 incl. GST.

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