Numbers 40 & 41

30 July 2001

ISSN 1172-2606

ConScience

CONServation SCIENCE NEWSletter

Published by
DOC Science Publishing
Science & Research Unit
Department of
Conservation

CONTENTS

EDITORIAL

A new look for DOC Science Publishing

This issue, which is late, combines two issues (40 due in April and 41 due in July) into one. I apologise to all, and hope that when you know the reason for the delay you will forgive us and continue reading.

The former S&R Publications Group has been undergoing a reorganisation, and the first call on our time was getting the new structure right and, for my part, handing over to my successor. The new unit, which is intended to function as a one-stop shop for all science editing and publishing functions, features a Science Publishing Manager (Jaap Jasperse—formerly Chief Science Editor), with new staff in production, marketing, and sales.

My position will be Science Transfer Manager, a new job concerned with understanding and promoting the transfer of scientific and technical information to all levels of the Department. This position is a key part of the science restructuring of 1997, and of the Department's Science Strategy.

Science Publishing Manager
Jaap Jasperse

Science Editors
Lynette Clelland
Ian Mackenzie

Science Publishing & Marketing Officer
Sue Wilkins

Science Publishing Support Officer
Lisa Peters

The new DOC Science Publishing structure and staff.

Over the next three years I want to look at the transfer role of the Science Research Unit, how well we are doing and how we can improve.

Outside the Department I will be looking at how we are communicating to our different audiences, and whether these are the most important places to be aiming conservation science.

I would like to hear from readers who can comment on science uptake in the Department, or on the proper transfer role of DOC science in the wider community.

Kaye Green
Editor
Conservation Science Newsletter

The publishing group is about to introduce changes to DOC's current science publication series to help customers differentiate them better, and solve some anomalies in their content and purpose.

Department of Conservation
Te Papa Atawhai

NEW STAFF

Sue Wilkins

Motorbikes have been a part of my life for the last 20 years—ever since I arrived in Australia from the UK, cashed in my return ticket and bought my first machine. A couple of years earlier a friend had taken me out on his screaming Italian two-stroke and I'd been hooked by the time we got to the end of the drive.

However, motorbikes had not been part of my upbringing in Birmingham. The daughter of two lecturers, I had left school as early as possible (not seeing any use for too much education) and done a secretarial course in the hope of earning some money. However, it really wasn't for me so I moved to the country and joined a commune. There I learned to drive tractors, milk cows, run a shop, shear sheep, do accounts, chair meetings, and get into endless inter-personal arguments.

I liked the outdoor life and farming so went on to Agricultural College in Scotland where I specialised in welding and sheep breeding. (Shorthand was getting comfortably far away!) I was the first female student at the college and the need to prove myself never went away. I had to be the first to volunteer for anything—even castrating sheep with my teeth. Becoming a jillaroo on a sheep station in the outback of West Australia seemed a fairly rational move after all that, and it did lead to my first motorbike.

In West Oz I quickly moved on to work in Saltland Agronomy for the Department of Agriculture, particularly on seed trials of *Atriplex* spp., and grazing habits of sheep on shrubland. I also edited my first book, 40 papers from a conference on forage and fuel production from saltland, and became the in-house photographer for Agriculture Protection. I also bought 'Nellie', an 1100 cc touring bike, on which I saw a lot of the state.

My personal life took me (and Nellie) back to Shropshire in 1990 to raise rare breeds of poultry and grow ancient varieties of apple tree. To stop my brain from atrophying I also took up part-time extramural study. When the vagaries of said personal life then brought me (still with Nellie) to New Zealand, I was loath to throw away all the good marks I'd been getting so I enrolled at Victoria, finished the BA, did Honours, got hooked on research and did a thesis. My MA in early 18th-century poetry, publishing practice, and copyright law was finished last November, and finally here I am, combining a love of books with a love of the outdoors. I now own 'Ingeborge', a 1986 Paris-Dakar BMW, and an ideal companion for exploring the gloriously scenic bits of New Zealand.

Lisa Peters

My name is Lisa Peters and my involvement as Science Publishing Support Officer with the Department of Conservation began in May of this year after completing a BA degree in English literature at Victoria University. My interest in conservation issues led to my choice of career, and I find the work of the Department very interesting.

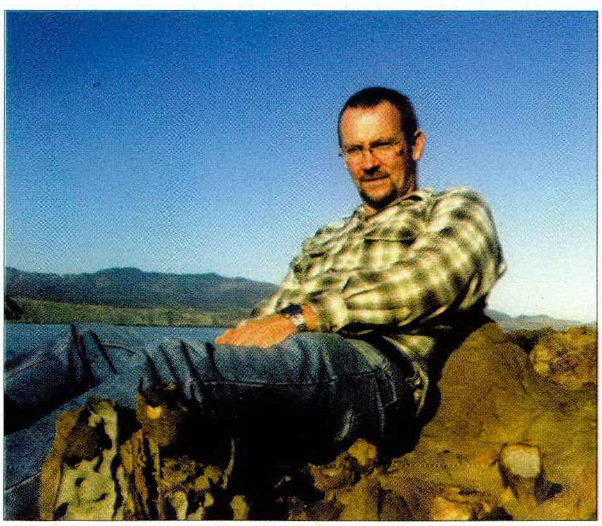
Hobbies of mine are music, netball, hockey, reading, films, and computers. My future aims are to travel within New Zealand and overseas and to learn more about the publishing industry.

Tony Nightingale

Tony Nightingale has taken up the position of Scientific Officer Historic and Cultural. He brings a wealth of experience to this new position, as he tells us here—Editor

About twenty years ago, at a time when the environmental division of the New Zealand Forest Service was flush with funds, the West Coast conservancy employed a group of university students and others to work on the historic interpretation of Waiuta—an abandoned industrial gold-quartz mining town. This was a great summer job and my immediate problem was to obtain a driver's licence in the four weeks before the job began.

Having gained the all-important credentials, I was not in the least put off when 'industrial archaeological site survey' translated into 'slashing blackberry'. At least while we slogged away at the undergrowth we could dwell on the stunning Grey Valley views. I went on to write my history thesis on the town, and this was used as the basis for a book. The project was a lot of fun and successful, but in the early 1980s I was unaware of any possibility of working as an historian outside teaching, so I moved to Wellington and became a public servant.



After a further stint in Christchurch, I returned to Wellington to be with my partner and became a contract historian for the Department of Internal Affairs. Somehow between 1991 and 1998 I managed to survive as a freelance contractor and pay the mortgage. From 1998 until I began with DOC, I worked for the Waitangi Tribunal and was closely involved in the production of reports on the Whanganui River, Ngati Awa, and Rekohu/Chatham Island. My work has always had a practical bent in that I like to solve problems for people and to be paid to do that.

Historians, given the chance, spend a lot of time thinking about the philosophy of what they do and have been described as 'opportunistic storytellers'. I am looking forward to the opportunities ahead.

I live with my partner in Crofton Downs where my industrial archaeological experience comes in handy when 'interpreting' the blackberry on the steep bank that forms part of our section.

RESEARCH IN PROGRESS

Welfare of brodifacoum-poisoned rats and possums

Report of a talk given at the 13th AWMS meeting, 2000, Queenstown

There can be no argument about the importance of controlling introduced pests in New Zealand. However, there is no reason for pest control methods to be inhumane merely because an animal is a pest rather than a house pet. Increased public awareness of this fact, and of animal welfare issues in general, has led to a collaborative effort between Massey University and Landcare Research to rank the humaneness of poisons currently used to control brushtail possums, and to improve the humaneness of possum poisons and anticoagulant rodenticides. At the AWMS 2000 meeting in Queenstown, we presented our findings on one of these poisons: the behaviour, pathology, and times to death of Norway rats and brushtail possums poisoned with brodifacoum.

This paper reports on work in one of the interesting new developments in animal research—namely the increasing call for the humane treatment of the animals—Editor

Brodifacoum is a second-generation anticoagulant pesticide. It is used world-wide to control a variety of rodents, and in New Zealand it is also used to control possums. Brodifacoum leads to a reduction in normal blood clotting. Animals develop widespread haemorrhaging and generally die from respiratory failure, heart failure, or kidney failure.

We used singly caged laboratory-bred Norway rats and wild-trapped brushtail possums in this study. Treated animals were fed on proprietary forms of brodifacoum in cereal baits, while control animals remained on a normal diet. All animals were routinely observed for behavioural changes (using instantaneous scan sampling), and autopsies provided information on areas of haemorrhage.

Both rats and possums showed similar behavioural changes after brodifacoum poisoning. Initially, there was no difference between the behaviour of control animals compared to poisoned animals. At about 15 days after poisoning in possums, and 4 days in rats, both became less active and were often seen lying or crouching (hunched posture). Feed intake dropped at about the same time, and some animals developed pale noses, and had external bleeding (mainly from the nose). Later still, one-third of the rats became paralysed. Possums died 15–45 days after ingesting brodifacoum and rats died after 6–9 days. This meant that possums appeared sick for about 5 days before death, and rats were sick for about 3 days. (Our previous studies on possums suggest that haemorrhages begin about a week after poisoning, so it seems that possums are undergoing patho-physiological changes before they show behavioural changes.)

Autopsies revealed widespread haemorrhaging in both animals. However, the pattern and sites differed. More rats had large areas of more severe haemorrhaging, and these haemorrhages occurred mostly in the thorax, limbs, and testes. Possums had most haemorrhaging above the tail, and in the abdomen, organs, limbs, and testes.

We can conclude that commercially available forms of brodifacoum cause similar behavioural and pathological changes in rats and possums, and cause a delayed and prolonged period of sickness during which welfare is reduced. Clearly, the duration of sickness and time until death is longer for possums than it is for rats.

Compared to faster-acting poisons including cyanide (see Gregory et al. 1998, *New Zealand Veterinary Journal 46*: 60–64), 1080, phosphorus, and cholecalciferol, the duration of sickness and time to death is prolonged in brodifacoum-poisoned animals. However, we need to assess the welfare costs in relation to other management issues (e.g. efficacy, environmental safety, user safety) if we are to provide adequate tools for controlling possums and rats. One way to reduce welfare costs of poisons that have other management benefits would be to improve the humaneness of existing poisons, where there is a need to do so. For example, there are many ways to shorten the time to death of animals poisoned with brodifacoum and similar anticoagulants (such as by using drugs like aspirin to enhance the tendency to bleed). We are currently researching ways to make anticoagulant rodenticides, and some possum poisons, more humane.

The quest to find useful, safe, and humane new tools for pest control is not easy, but is necessary if we are to maintain public acceptance of our pest control programmes in New Zealand. We hope that research such as ours, focusing on more-specific, humane control tools, will provide new alternatives for the future.

We thank DOC for awarding Kate Littin the student prize for innovative research, for this work presented at the AWMS meeting, and acknowledge funding support from FRST.

Kate Littin
Animal Welfare Science and Bioethics Centre, Massey University, Private Bag 11-222, Palmerston North.
Ph. 06 356 9099.
Email: K.E.Littin@massey.ac.nz

Cheryl O'Connor
Landcare Research, PO Box 69, Lincoln.
Ph. 03 325 6700 ext. 2228.
Email: oconnorc@landcare.cri.nz

Spectacular recovery of kohekohe at Motatau, Northland

There are surprisingly few published examples showing that possum control benefits forest canopies. Those that do exist are equivocal. In central Northland we have observed spectacular improvement in the condition of kohekohe (*Dysoxylum spectabile*) after possum control in a 350 ha remnant of broadleaved forest at Motatau.

Our project is a unique partnership in pest control between tangata whenua (Ngati Hine), the Department of Conservation, and Landcare Research. Our main focus is the restoration of kukupa (native pigeon) by intensive possum and rat control, but we are also monitoring the canopy condition of several tree species preferred by possums.

Pest control

We established bait stations throughout the forest in 1997, using 1080 cereal pellets as bait. Trap catch rates (possums caught per 100 trap nights) fell from 25.6% before control to 11.7% immediately after control in this baited area. A nearby uncontrolled block (Okaroro) experienced increased trap catches (from 32.6% to 60.8%) over the same period. This increase is thought to reflect a seasonal increase in possum trapability rather than an increase in possum numbers. We followed this initial control with ongoing use of brodifacoum in the bait stations. By September 1999 the

Motatau trap catch had declined to 2.7% while that at Okaroro was still high at 43%.

Browse assessment

We used the now-standard Foliar Browse method to assess browse levels and the percentage of foliar cover on six tree species preferred by possums. These assessments were carried out at Motatau and Okaroro before control (September 1997) and 2 years after control (September 1999). The six species monitored were kohekohe and Mahoe (*Melicytus ramiflorus*), Totara (*Podocarpus totara*), taraire (*Beilschmiedia tarairi*), tawai (*Weinmannia silvicola*) and mamaku (*Cyathea medullaris*).

Improvements measured

We observed positive responses to possum control (i.e. increases in foliage cover) in four of the six species: kohekohe, mahoe, tawai and mamaku (Fig. 1). By far the most dramatic improvement was in kohekohe: in just 2 years, the mean Foliar Cover Index at Motatau increased by 37% compared with an increase of only 5% at Okaroro. Mahoe and mamaku also demonstrated marked increases in foliar cover at Motatau, but these increases were not statistically significant compared to the uncontrolled Okaroro block.

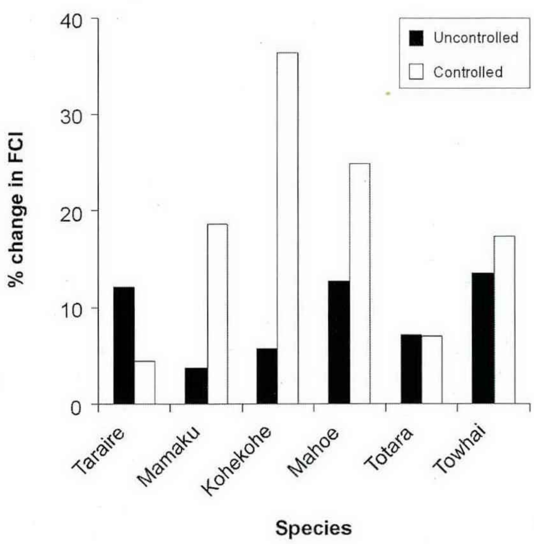


Figure 1. Mean changes in Foliar Cover Indices (FCI) between 1997 and 1999, by species, for Motatau (where possums were controlled) and Okaroro (possums not controlled)

Results for taraire were a reversal of this pattern. The mean Foliar Cover Index for this species improved more in the uncontrolled block (12%) compared to the controlled block (4%). Although this difference was not significant, we suspect the result may partly reflect observer differences.

However, we can rule out observer differences as an explanation for the overall improvement in canopy cover across all species. When we compared changes in foliar cover for trees that had been browsed in 1997 with those that had not been browsed, by far the biggest improvements occurred in the trees that originally had been most heavily browsed by possums (Fig. 2). This was particularly true for kohekohe and mahoe.

We also noticed differences in the numbers of kohekohe trees dying in each block. Nearly 20% of the trees browsed in the uncontrolled area in 1997 had died by 1999, compared with only 2% of the trees in Motatau.

Future changes expected

Both kohekohe and mahoe are trees with large and relatively soft (highly digestible) nutrient-rich leaves. These characteristics probably explain both their palatability to possums and their rapid response to possum control compared to slower-growing smaller-leaved species like totara. There was little difference between areas in the change in foliage cover of totara between 1997 and 1999. However, by 1999 the totara at Motatau were covered with new lateral and terminal shoots (representing unbrowsed new growth). These were mostly absent on the trees at Okaroro. Over a longer period of time, we expect that the accu-

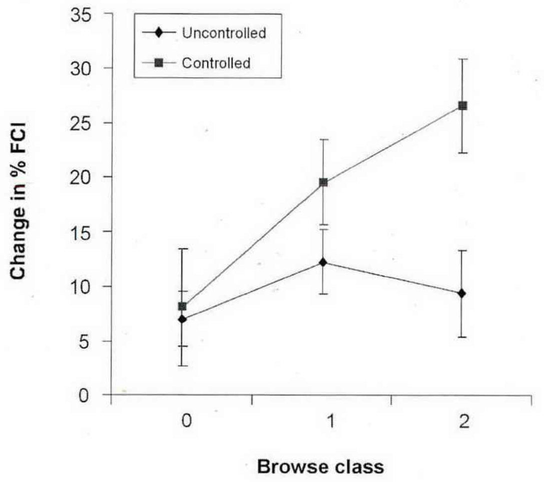


Figure 2. Mean changes in Foliar Cover Indices (FCI) for all species combined, by 1997 browse class (0 = not browsed in 1997; 1 = <25% of leaves browsed; 2 = >25% of leaved browsed), for Motatau (controlled) and Okaroro (not controlled).

mulation of such new growth will eventually be reflected in higher foliage cover scores for totara at Motatau. Overall, our results provide unequivocal evidence that the dramatic improvement of foliage cover in kohekohe is a response to the removal of browse pressure by possums. This recovery is being mirrored in most of the other species being monitored. However, these were nowhere near as heavily defoliated initially and their foliage production rates seem slower; so the recovery is more gradual, and the amount of recovery possible is much smaller. Nonetheless, we expect some further improvements in the canopy condition of these species, provided, of course, that possum numbers at Motatau are held to the current low levels. In contrast, we expect the higher mortality of trees at Okaroro to continue.

Jackie Whitford
Graham Nugent
John Innes
Landcare Research

Fire and threatened-species management in a Waikato wetland

Research by David Norton and Peter de Lange focused on the role of fire in sustaining the critically endangered swamp helmet-orchid (Corybas carsei) *in a large Waikato wetland.*

New Zealand has 511 threatened or uncommon vascular plant species, accounting for some 22% of the native flora. Understanding the factors threatening these species is a key focus of threatened plant research. Historically, fire has been seen as a threat to natural plant communities and fire suppression has been actively pursued in most parts of the world. More recently natural fire has been recognised as playing a key role in determining the composition of many plant communities. As a result, fire is now commonly used as a conservation management tool in areas where natural fire patterns have been modified by human activities.

Although natural fires are not as common in New Zealand as in Australia or North America, they have still played an important role in determining the composition of many plant communities including wetlands like the large one that we studied in the Waikato.

The Whangamarino wetland complex, 50 km north of Hamilton, is a 4871 ha wetland management reserve composed of four peat bogs. The vegetation is dominated by tall sedges (*Baumea, Schoenus, Tetraria*), with wire-rush (*Empodisma minus*), the woody shrub *Epacris pauciflora* and tangle-fern (*Gleichenia dicarpa*) also common. In 1994 we implemented a series of controlled burns. We measured the abundance of all plant species, including the swamp helmet-orchid, before the fires, then at between two and six month intervals after fire, until late 1998, and again in early 2000 in both burnt and unburnt plots.

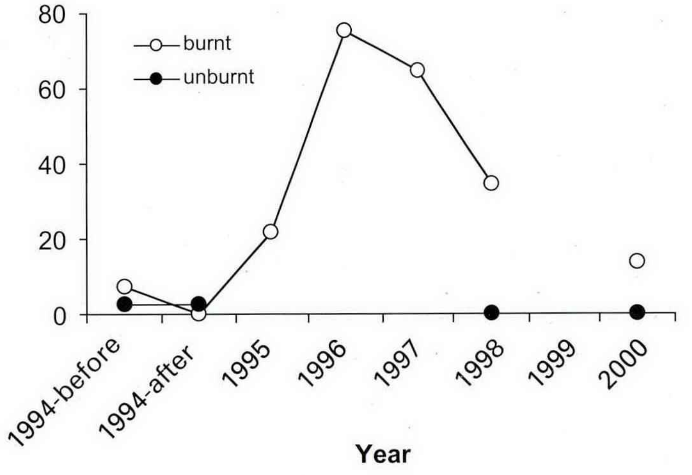
Figure 1. Flowering specimen of swamp helmet-orchid.

Immediately after fire no plant species remained in the burn plots, but two months later many of the rhizomatous species were resprouting. By the end of the first summer, plots were dominated by sundews (*Drosera binata, D. spathulata*) and other plants were appearing. By the second summer the rhizomatous species had virtually returned to their pre-fire dominance while many of the obligate seeding species (e.g. manuka, *Epacris pauciflora* and wire-rush) were also present in the plots, though for the duration of the study these species never recovered their former dominance. By the end of the experiment several species absent from the plots prior to the burns had also established themselves (e.g. *Schoenus carsei* and *Lycopodiella serpentina*).

The critically endangered swamp helmet-orchid (*Corybas carsei*, Fig. 1) was present in all plots (burnt and unburnt) prior to the fire and, along with all other plants, were killed by the experimental fires. They remained absent from the burn plots for the rest of 1994. In 1995 the swamp helmet-orchid reappeared in the burn plots at a higher density than before the fire, with density peaking in 1996, two years after the fire (Fig. 2). A revisit to the study site in July 2000 (six years after the fire) showed that the density of swamp helmet-orchid plants had continued to decline, although there were still more plants present than prior to the fire. In contrast, swamp helmet-orchid was lost from the unburnt control plots between the fire and the final measurement four years later, and was still absent after six years. Fire also provided optimal conditions for swamp helmet-orchid flowering. Swamp helmet-orchid had only been observed to flower once previously, yet it flowered vigorously after fire.

The results clearly show that fire has enhanced the habitat of swamp helmet-orchid with a ten-fold increase in plant numbers two years after the burns. Six years after fire, the number of plants in the burn plots is still twice the number prior to the burn, suggesting that the benefits of burning last several years. The main effect of fire was to provide the open habitat that swamp helmet-orchid favours. Optimum swamp helmet-orchid habitat appears to be a relatively low cover of tall plants over a dense ground cover of bryophytes and small herbaceous vascular plants (Fig. 3). With time, after fire, light levels at the ground surface decline and the bryophytes are lost along with swamp helmet-orchid. Eventually, in the absence of fire, the open vegetation favoured by swamp helmet-orchid is replaced by dense wire-rush dominated vegetation. The loss of swamp helmet-orchid from other sites and its decline at the study site are thought to be due to this process and our results strongly suggest

Figure 2. Swamp helmet-orchid abundance in burnt and unburnt plots before and after experimental fires.



that the maintenance of swamp helmet-orchid habitat requires regular fire.

Swamp helmet-orchid was not the only threatened or uncommon plant species that responded to the experimental fires. For example, the orchids *Prasophyllum* aff. *patens* and *Pterostylis paludosa*, fern-ally *Lycopodiella serpentina*, and sedge *Schoenus carsei* were all absent prior to the fire but present afterwards. In fact, *Lycopodiella serpentina* had been considered locally extinct at this site prior to our research.

Figure 3. Flowering swamp helmet-orchid growing in open wetland vegetation.

Our results have highlighted the importance of fire in peat bog systems. Without fire, community composition becomes more simple and a number of species are lost, including some nationally threatened species. It seems likely that recent fire suppression policies have played a role in the decline of threatened species such as swamp helmet-orchid. While fire is likely to be an important tool in the future conservation management of these bogs, if not used properly the use of fire could lead to a suite of other problems. For example, too frequent an occurrence of fires is likely to lead to changes in community composition including invasion of exotic weedy species. The results of this study suggest that some fire is good for maintaining habitat heterogeneity within these wetlands and in allowing threatened species to persist. Certainly for the critically endangered swamp helmet-orchid, fire could be used to temporarily reverse vegetation succession, thereby creating 'windows of opportunity' for colonisation by this species.

David A. Norton
School of Forestry,
University of Canterbury
d.norton@fore.canterbury.ac.nz

Peter J. de Lange
Science & Research Unit,
Department of Conservation
Pdelange@doc.govt.nz

RESEARCH IN PROGRESS

Characterising *Pimelea* "Turakina"

Members of the plant genus *Pimelea* (=fat-bearing, referring to the seeds), of the Daphne family, Thymelaeaceae, occur widely in New Zealand, with more than 15 species being recognised (cf. Allan 1961; Druce 1993). *Pimelea* forms with hairless leaves and white, succulent fruit occur especially along the coasts and in lowland to montane grassy, shrubby and gravelly areas. Their classification is quite confused. Through studies of population samples grown in pots in shadehouse conditions in Christchurch, the taxonomy of these small shrubs is gradually being resolved. They include some widespread entities, and others that are very local, and threatened by habitat destruction.

Among these latter is a suberect form, given the tag name of "Turakina" by A.P. Druce (1993) as it was found growing on sand near the Turakina River. It appears to have died out in several of the few Manawatu-Rangitikei localities where it once grew (C. Ogle pers. comm.). By 1997, when this study began, it was known from only one site, at Himatangi Beach, west of Palmerston North. A recent find by Colin Ogle of a very similar form, at Castlecliff Beach near Wanganui, appears to have increased the known localities to two.

Pimelea forms of the hairless, white-fruited group (including *P.* "Turakina") bear their small, somewhat bluish, usually round-tipped leaves in successive, opposite pairs at right angles (i.e. in four ranks). Their leaf-stalks and the ovary portions of their floral tubes are red. Some have hairy stems, others are hairless. Many forms in the group have stems that lie along the ground (are prostrate) while, less commonly, other forms are erect or sub-erect. Like other species of *Pimelea* in New Zealand almost all of the hairless-leaved, white-fruited group have the sexes differentiated, as female, or bisexual plants. The females bear fruit, though in some species, at least some fruit occur on bisexuals. The chromosome number for *P.* "Turakina", as for most forms in the hairless-leaved, white-fruited group is $2n = 36$ (Dawson & Beuzenberg 2000). That is the lowest known and most usual number for all New Zealand *Pimelea* species.

How does *Pimelea* "Turakina" stand out from others of the hairless-leaved, white-fruited group? A comparison with three other forms: from coastal Taranaki (prostrate); near Mount Tongariro (prostrate); and near Cape Reinga (sub-erect) is summarised in Table 1.

Differences between *P.* "Turakina" and the other forms are both vegetative and reproductive. No other *Pimelea* so far examined by me in New Zealand (except a single plant from Castlecliff Beach) has only small, bisexual flowers. When a *P.* "Turakina" flower opens, the stigma (bearing large papillae) lies just below the mouth of the floral tube, with the anthers just above. Pollen-shedding occurs soon after and some pollen falls on the stigma. Although flies visit the flowers (cross-pollinating them) it is likely that self-pollination can occur in nature. A single plant from Castlecliff maintained in a pot in Christchurch, with no other *Pimelea* species adjacent, flowered and produced fruit. In most respects it is very similar to *P.* "Turakina" from Himatangi and the two are here regarded as conspecific.

In *P.* "Turakina", after pollination, the style elongates a little so that the stigma ultimately lies just above the anthers. In the comparatively large bisexual flowers of other New Zealand *Pimelea* species the stigma papillae are relatively small; when a flower opens the stigma lies well down in the floral tube. Thereafter the style elongates greatly, pushing the stigma well above the mouth of the tube.

Contrasting with the other forms tested (Table 1) *P.* "Turakina" develops a terminal, opposite pair of branches each time that it flowers (up to three times a year). Also, the fleshy part of the fruit is translucent and the seeds germinate readily. Although the Himatangi plants of *P.* "Turakina" grow in seasonally very wet dune hollows, the similar plants at Castlecliff occur on a coastal, wet, mudstone cliff (Colin Ogle pers. comm.).

Overall the conclusion is that *P.* "Turakina" is a distinct species which should be managed carefully to maintain it in the wild. One very positive feature is that it flowers well each year and the seeds germinate readily, so that it can be propagated easily to build up large populations. It also transplants well. The seeds of other *Pimelea* species have proved to be difficult to germinate, usually taking at least a year to do so.

Steps should be taken now to grow populations of *P.* "Turakina" to plant out in appropriate natural locations. Further work on the whole group is needed before the classification of *P.* "Turakina" and its relatives can be formalised.

References

Allan, H.H. 1961: Flora of New Zealand Vol. 1. Wellington, Government Printer.

Dawson, M.I.; Beuzenberg, E.J. 2000: Contributions to a chromosome atlas of the New Zealand flora—36. Miscellaneous families. *New Zealand Journal of Botany 38*: 1-23.

Druce, A.P. 1993: Indigenous higher plants of New Zealand. Wellington (compiled and published by the author).

Colin Burrows
Department of Plant and Microbial Sciences, University of Canterbury Christchurch

TABLE 1. SOME RELATIVE DIFFERENCES AND SIMILARITIES BETWEEN *Pimelea* "Turakina" AND THREE OTHER FORMS FROM THE HAIRLESS-LEAVED, WHITE-FRUITED GROUP.

	P. "Turakina" HIMATANGI BEACH	*P.* "Taranaki" MANAIA BEACH	*P.* "Tongariro" VOLCANIC PLATEAU	*P.* "Reinga" RIDGE NEAR CAPE REINGA
Growth habit	erect-decumbent	prostrate	prostrate	erect-decumbent
Main branching mode	terminal dichotomy	lateral	lateral	lateral
Stomatal distribution on abaxial side (top) of leaf	nil	nil	present	nil
Sex distribution in plants	all bisexual	females & bisexuals	females & bisexuals	females & bisexuals
Size of bisexual flower	small	large	large	medium-large
Anther tip	small blunt point	rounded	rounded	rounded
Maximum bisexual style length	short	long	long	short-medium
Size of papillae on bisexual stigma	large	small	small	medium
Intensity of fruit opacity	translucent	partly opaque	opaque	partly opaque
Ease of seed germination	easy	difficult	difficult	difficult
Habitat	coastal dune hollow	coastal cliff top	montane grass-land-scrub	lowland grass-land-scrub

RESEARCH IN PROGRESS

About *Atriplex billardierei*

In 1849, in the Museum of Natural Sciences, Paris, French Botanical Professor Moquin-Tandon erected a new genus of plant, *Theleophyton*, with the one species *T. billardierei* Moq. This accommodated a somewhat unusual coastal strand plant gathered from Tasmania by French botanist and adventurer J.J. de Labillardière (1755–1834).

Moquin-Tandon's little plant belongs to the Chenopodiaceae family, i.e. the same family from which we derive our silverbeet, beetroot, and spinach. Moquin-Tandon also recognised that *Theleophyton* was closely allied to another large, cosmopolitan genus *Atriplex* from which it differed in one respect: during fruit maturation the seed twists 90° to fit within the pouched bracteoles, something which doesn't happen in *Atriplex*. However, this novel distinction did not sufficiently impress the English botanist Joseph Hooker who, in 1853, placed Moquin-Tandon's genus, and species *Theleophyton billardierei*, into synonymy within *Atriplex*, as *A. billardierei* (Moq.) Hook.f. Still Hooker's view was not universally accepted, and thus over the last 151 years of its 'official' taxonomic existence, *Atriplex* (*Theleophyton*) *billardierei* has shuttled back and forth between the two genera, as various northern hemisphere systematists have argued the merits of the generic importance of the seed's twisting 90°. In the meantime, back in the Southern Hemisphere, *Atriplex billardierei* (as we believe it should be called) began to vanish from large chunks of its Australasian range.

Figure 1 *Atriplex*

This decline was possibly first identified by David Given who, in his 1981 landmark book *Rare and endangered plants of New Zealand*, suggested that, in New Zealand at least, the species (as *Theleophyton billardierei*) might be in trouble. As a result, and being further prompted by Given's verbal concerns and the fact that no one seemed to know much about the species, Peter de Lange undertook a herbarium study of New Zealand material of *Atriplex billardierei* during 1990. The results suggested three things:

- New Zealand herbarium specimens were represented by two distinct morphologies.
- The species seemed to be an annual.
- It seemed to only survive in the far north of the North Island, and on the Chatham Islands, despite having been recorded much more widely around New Zealand in the past.

Following these preliminary investigations inquiries were made to various Australian herbaria, to see how common the species was there, and whether they too, had both forms. Correspondence on the matter soon revealed that only Tasmanian botanists were familiar with the species, and that one of the forms present in New Zealand was not present in Australia. At that point fieldwork was started to see if the species could still be found in Northland, and whether it might be cultivated.

During October 1990 Gillian Crowcroft and Lisa Forester (DOC, Northland) located two of these plants on a remote beach near North

Cape. From these a single cutting was taken and grown on at Percy Reserve, Petone. This cutting was of the form apparently endemic to New Zealand, i.e. it had irregularly sinuate-dentate leaves, and smaller flowers, fruits, and seeds. Later in January 1991, David Given sent specimens from the Chatham Islands to Percy Reserve: these represented the other form which has entire leaves, and larger fruits and seeds. This same form was once present in the South and Stewart Islands, and mainland Australia, and is the kind which still persists in Tasmania. Although seed from both forms was obtained from the original cultivated plants, few seedlings were germinated and none of these successfully set seed, thus further *ex-situ* study into the ecology and relationships of both forms of *Atriplex billardierei* was temporarily halted. However, in the field, DOC staff continued to count the numbers of plants which appeared in the far North, and Chatham Island staff put in plots to determine whether their plants were truly annual. From these studies it became evident that Given was correct: *Atriplex billardierei* was a threatened species in New Zealand and, perhaps more significantly, it was also in trouble in Australia. Furthermore, if the northern form was truly distinct from *A. billardierei* sens. str. it was in serious threat of extinction.

Because of these concerns, in 1995 Northland Conservancy put forward a Science & Research proposal to investigate the ecology, threats and relationships of both forms of *Atriplex billardierei*. This project, funded directly by Science & Research has now been completed, and the results published in the *New Zealand Journal of Botany 38*. That paper (de Lange et al. 2000) formally recognises that there are two species in New Zealand. One matches the type material of Moquin-Tandon's *Atriplex (Theleophyton) billardierei*, while the other is described as a new endemic species to New Zealand, *Atriplex hollowayi*. This epithet honours the late Science & Research Director John Holloway, who was a strong supporter of this project, and also recognised the importance of the department taking a stronger lead in classifying our threatened biodiversity. Aside from resolving the taxonomic status of the two 'forms' of *A. billardierei*, the paper provides a wealth of information on the autecology, relationships and the threats these unusual strand plants face.

Ecological research revealed that both species are quite similar, being annual strand plants of open sandy beaches, whose seeds are dispersed by near-shore currents. Seed germination trials further confirmed that, as with many other strand plants, seed germinates better if first soaked in seawater for several months and then flushed in fresh water before sowing. This germination mechanism ensures that seed will only germinate once terrestrial conditions are reached, and thus dormant seed can be dispersed via oceanic currents without risk of accidental germination. Incidentally, it is assumed that this mechanism enabled *A. billardierei* to colonise New Zealand and the Chatham Islands from Australia (cf. *Atriplex cinerea* (de Lange et al. 1998)). Once terrestrial conditions are attained, plants invariably germinate in early October, reaching their maximum size by December. Flowering and fruiting occurs on single plants, commencing within 3-4 weeks of germination and ceasing only when the plants dry off in late April, or when they have been damaged. As with many annuals the seed bank is potentially long-lived; for example in one experiment *A. billardierei* plants germinated sporadically over 4 years following the sowing of a single batch of 100 seeds. At the completion of this germination trial, 81 seeds were still viable and had yet to germinate.

From our fieldwork and research we accessed the conservation status of both species (de Lange et al. 1999). *Atriplex hollowayi* is now rated as 'Critically Endangered' while *A. billardierei* has been assessed as 'Declining'. Herbarium specimens suggest that *Atriplex hollowayi* was once locally common in parts of the North Island, but by 1920 the species had become confined to the far North. Significant factors in this species decline were over-collecting by early New Zealand botanists, sand mining and coastal resort development, trampling by people and livestock, and, more recently, summer storms. The possibility that the species decline has been accelerated by the spread of aggressive, exotic strand plants has also been suggested. At present the species is under imminent threat of extinction. During the 1999/2000 summer, only 2 plants of *A. hollowayi* were recorded. However, this is not the first time the population has plummeted to such low levels. Based on an analysis of the last 10 years monitoring, extreme population fluctuations characterise this species, so its plight, whilst undeniably serious, may improve if we have a good growing season this summer. However, it still remains one of New Zealand's most threatened species.

Atriplex billardierei seems to be extinct on mainland Australia, and in the South and Stewart Islands of New Zealand. Fortunately, on Tasmania and the Chatham Islands it remains locally common. In Tasmania at least, there is some evidence that the species is contracting its range, possibly as a consequence of competition with exotic strand plants. Determining why the species vanished from the South Island and Australia has proved difficult. Several Australian botanists now suspect competition with exotic strand plants. Certainly in New Zealand such competition, together with over-collecting by early botanists, does seem to be the most plausible reason for its demise. Despite the historical decline of *Atriplex billardierei,* provided Tasmanian populations don't decline further and Chatham Island populations remain stable, it is concluded that there is little reason to classify this species as Threatened.

Now that the biosystematic status and general ecology of both species has been determined, the next issue will be how to prevent further decline of *A. billardierei* and the extinction of *A. hollowayi.* One possible avenue is to prepare a recovery plan to outline the various management options available for both species. While this step has already been suggested, the urgency of preventing the extinction of *A. hollowayi* has prompted some novel—for a plant—measures by Northland Conservancy botanists Lisa Forester and Nicky Syddall. As an interim measure both staff have suggested management actions similar to those used for managing Fairy Terns. It is their hope that staff will be deployed to protect *A. hollowayi* plants from summer storms, trampling, and other threats, while any seed produced will be sown in suitable sites along several Northland beaches. We can only hope that these pioneering measures in strand plant management are successful. New Zealand has very few indigenous strand plants; we can ill afford to lose any of them, especially the only endemic one!

Acknowledgements

We wish to acknowledge the following current and former Department of Conservation staff for their field assistance, advice, and knowledge-sharing: Amanda Baird, Alison Turner, Lisa Forester, Graeme Taylor, Shannel Courtney, Bec Stanley, Mike Avis, Trevor Bullock, Francis Fitzpatrick, Bruce Waddel, Nicky Syddall, Suzanne Clegg, Miriam Ritchie, John Sawyer, Geoff Walls, Don Newman, and the late John Holloway. Without these people this project would never have been possible. We especially thank Ewen Cameron (AK), Patrick Brownsey (WELT), Paul Wilson (PERTH), Roy Vickery (BM), Fiona Willis (K), Mauro Raffaeli (F), and Phillipe Morat (P)—all herbarium keepers—for facilitating interloans, allowing access to specimens, and advice. Lastly we thank Naomi Lawrence, Alex Buchanan, and Andrew Rosefels (Hobart, Tasmania) and Neville Walsh (Melbourne, Victoria) for permits, advice, and field assistance.

References

de Lange, P.J.; Murray, B.G.; Gardner, R.O. 1998: *Atriplex cinerea* (Chenopodiaceae) in New Zealand. *New Zealand Journal of Botany 36*: 521–529.

de Lange, P. J.; Heenan, P. B.; Given, D. R.; Norton, D. A.; Ogle, C. C.; Johnson, P. N.; Cameron, E. K. 1999: Threatened and uncommon plants of New Zealand. *New Zealand Journal of Botany 37*: 603–628.

de Lange, P.J.; Norton, D.A.; Crowcroft, G.M. 2000: Taxonomy, ecology, and conservation of *Atriplex billardierei* and *A. hollowayi* sp. nov. (Chenopodiaceae) in Australasia. *New Zealand Journal of Botany 38*: 549–565.

Peter J. de Lange
Science & Research Unit
Department of Conservation
Auckland

David A. Norton
School of Forestry
University of Canterbury
Christchurch

Gillian M. Crowcroft
Natural Resource Assessors
16 Jesmond Terrace,
Mt Albert, Auckland.

NEW PUBLICATIONS

New DOC Science Publications

You can borrow copies of these publications from your PRS, CAS or the Information Resource Centre (IRC—click on the 'i' symbol on the top of the home page of the intranet). Hardcopies are available from DOC Science Publishing.

DOC science publications

Weed surveillance plan for the Department of Conservation, by H. Braithwaite 2000. Department of Conservation. 24 p.

What's happening with stoat research? 2nd report on the five-year stoat research programme. Department of Conservation. 2000. 31 p.

The state of wilderness in New Zealand, by G.R. Cessford (Ed.) 2001. Department of Conservation. 107 p. $35.00 incl. GST

National overview of biological monitoring in New Zealand's marine protected areas, by A. McCrone 2001. Department of Conservation. 123 p. $19.50 incl. GST

Possum: everybody's problem, by Jo Ritchie (comp.) 2000. Department of Conservation. 16 p. $5.00 incl. GST or $350 per 100 copies.

Compendium of published CSL reports, 1995/96 to 1999/2000. Funded by Conservation Services Levy 2000. Department of Conservation. 186 p.

[CSL Stakeholders will receive complementary copies. Other bound copies are available at $32.00 incl. GST. All individual CSL reports are available from the DOC webstite at http://csl.doc.govt.nz.]

Science for conservation

155. Options for managing the Kaimaumau Wetland, Northland, New Zealand, by D.L. Hicks; J. Campbell; I.A.E. Atkinson 2001. 75 p. $30.00 incl. GST

156. Risk assessment for establishment of polistine (*Polistes* spp.) and vespine (*Vespula* spp.) wasps on the Three Kings Islands in the Far North of New Zealand, by J.J. Dymock 2000. 64 p. $12.50 incl. GST

157. Inventory of New Zealand's active dunelands, by M. Hilton; U. Macauley; R. Henderson 2000. 28 p. $27.00 incl. GST

158. Feasibility of immunocontraception for managing stoats in New Zealand, by L.A. Hinds; C.K. Williams; R.P. Pech; D.M. Spratt; A.J. Robinson; G.H. Reubel 2000. 109 p. $25.00 incl. GST

159. Community perceptions of landscape values in the South Island high country, by S.R. Swaffield; R.J. Foster 2000. 54 p. $22.50 incl. GST

160. Rotoiti nature recovery project: an evaluation of advocacy, by B. James 2001. 46 p. $22.50 incl. GST

161. Evaluation of kiwi advocacy programmes in Northland and

ERRATUM

Conservation Advisory Science Notes 332. Preliminary aerial survey of Hector's dolphin (*Cephalorhynchus hectori*), north-west North Island. C. Duffy; B. Williams. 2001. 13 p. $5.50 incl. GST.

This CAS Note was released without Table 1: "Species observed on each transect flown". A single page containing this table is now available, at no charge, on application to DOC Science Publishing.

email: science.publications@doc.govt.nz

Coromandel, by B. James 2001. 51 p. $22.50 incl. GST

162. Aerial poisoning of wasps, by R.J. Harris; J.S. Rees 2000. 26 p. $22.50 incl. GST

163. Distribution and biology of the endangered kauri snail *Paryphanta busbyi watti*, by I.A.N. Stringer; R. Montefiore 2000. 42 p. $23.50 incl. GST

164. Possum monitoring using raised leg-hold traps, by M.D. Thomas; J.A. Brown 2000. 17 p. $12.50 incl. GST

165. Review of control methods for pampas grasses in New Zealand, by D.S. Gosling; W.B. Shaw; S.M. Beadel 2000. 32 p. $22.50 incl. GST.

166. Ecosystem-based conservation strategy for Central Otago's saline patches, by G. Rogers; A. Hewitt; J.B. Wilson 2000. 38 p. $22.50 incl. GST

167. Burrow competition between broad-billed prions (*Pachyptila vittata*) and the endangered Chatham petrel (*Pterodroma axillaris*), by N.W. Was; W.J. Sullivan; K.J. Wilson 2000. 41 p. $23.50 incl. GST.

168. Lepidoptera of small-leaved divaricating Olearia in New Zealand and their conservation, by B. Patrick 2000. 26 p. $12.50 incl. GST

169. Facilitating community-based conservation initiatives, by V. Forgie; P. Horsley; J. Johnston 2001. 76 p. $30.00 incl. GST

170. Review of international literature relevant to stoat control, by R. McDonald; S. Lariviere 2001. 78 p. $30 incl. GST

171. Population dynamics 1994–98, and management, of Kaimanawa wild horses, by E.Z. Cameron; W.L. Linklater; E.O. Minot; K.J. Stafford 2001. 165 p. $35.00 incl. GST

172. Understanding the conservation expectations of Aucklanders, by B. James 2001. 36 p. $22.50 incl. GST

173. Visitor impacts on marine protected areas in New Zealand, by A. McCrone 2001. 68 p. $22.50 incl. GST

174. Measuring environmental distinctiveness, by J. Overton; J.R. Leathwick. 2001. 20 p. (incl. 7 colour pages) $22.50 incl. GST

175. Weed surveillance—how often to search? by S. Harris; J. Brown; S. Timmins 2001. 27 p. $12.50 incl. GST

176. Molecular systematics and conservation of kakariki (*Cyanoramphus* spp.), by W.M. Boon; J. Kearvell; C.H. Daugherty; G.K. Chambers 2001. 46 p. $22.50 incl. GST

DOC SCIENCE PUBLISHING ORDER FORM

Please include payment with order. All cheques must be in NZ dollars and made out to the Department of Conservation. Add postage and packaging of $2.00 for one publication, or $4.00 for two or more. Send order to: DOC Science Publishing, P.O. Box 10-420, Wellington, NZ.

Please send me:

Title ________ Copies

____

____

____

Deliver to:

____

____

____

Payment options:

☐ A cheque is enclosed.

☐ Charge my Visa/MasterCard $ __________

Card no.: ______________________

Expiry date: ______________________

Name: ______________________

Signature: ______________________

Department of Conservation technical series

25. A performance monitoring framework for conservation advocacy, by B. James 2001. 24 p. $12.50 incl. GST.
26. Cave invertebrate collecting guide, by M. Hunt; I. Millar 2001. 29 p. $12.50 incl. GST

Science & Research internal reports

181. Predictive models of archaeological site distributions in New Zealand, by J.R. Leathwick 2000. 12 p. $12.50 incl. GST
182. An archaeological survey of Triangle Flat, Puponga Farm Park, by A. Walton; S. Bagley 2000. 16 p. $12.50 incl. GST
183. Review of satisfaction research and measurement approaches, by T.M. Latu; A.M. Everett 2000. 47 p. $22.50 incl. GST
184. Management practice for allocation of recreational concessions, by D. Parr 2000. 33 p. $22.50 incl. GST
185. Estimating Kaimanawa feral horse population size and growth, by W. Linklater; E.Z. Cameron; K.J. Stafford; E. Minot 2001. 40 p. $25.50 incl. GST
186. Social impact issues among visitors to Franz Josef Glacier, Westland National Park, by R. Corbett 2001. 34 p. $12.50 incl. GST
188. Re-establishment of the shrubby tororaro (*Muehlenbeckia astonii* Petrie), a nationally threatened plant, by D. Norton. 2001. 21 p. $12.50 incl. GST.
190. Evaluating methods for the protected natural areas programme, by P. Bellingham 2001. 32 p. $12.50 incl. GST

Threatened Species Recovery Plans

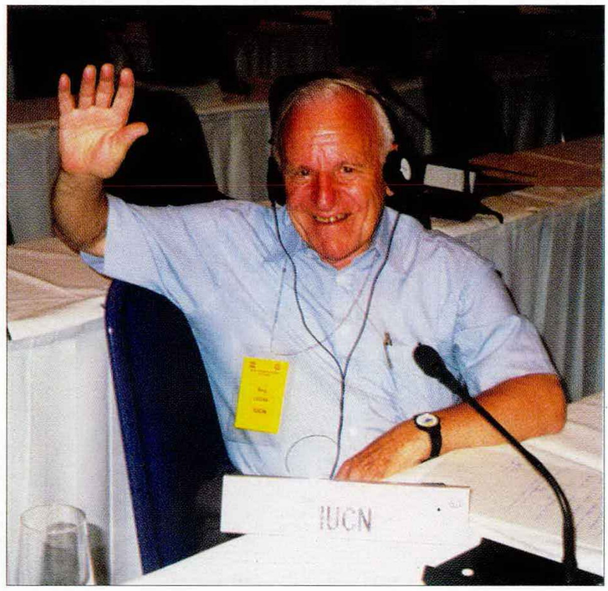
33. *Hebe cupressoides* recovery plan 2000–10, by D.A. Norton 2000. 20 p. $15.00 incl. GST
34. Protection and recovery of the pygmy button daisy 2001–2011. 2001. 36 p. $15.00 incl. GST.
35. Hoiho (*Megadyptes antipodes*) recovery plan 2000-2005, by B. McKinlay 2001. 26 p. $15.00 incl. GST.

DOC staff can find a cumulative publications catalogue on the intranet, at
http://docintranet/intranet/content/sru/pubs/docspcat.htm
Publications listed are available in portable document format from there.

The public website also lists all DOC Science Publications, at
http://www.doc.govt.nz/cons/scires/scires.htm
Pdf files are, as yet, not available to the general public.

IN MEMORIAM

Bing Lucas



An edited version of the eulogy delivered by Paul Dingwall at the funeral of Bing Lucas, December 2000—Editor

In the Province of Sichuan, deep in the heartland of China, lies the magnificent Juizhaigou Nature Reserve. It's an extensive mountain park, reminiscent of our own Southern Alps national parks, and is one of the world's natural treasures. At the gateway to the park, surrounded by nine newly constructed international-standard hotels, is an impressive set of panels displaying images of the park and messages of welcome for visitors. Prominent among these is a series of large coloured photographs, framed behind glass, featuring one man—Bing Lucas—photographs taken to record his official inspection that led to designation of the reserve as a World Heritage Site.

Bing's outstanding leadership and long commitment to conservation were recognised by his professional peers when the World Conservation Union (IUCN) enrolled him as a Member of Honour. Bing and the late Lance McCaskill are the only New Zealanders so recognised.

Bing Lucas' work began, of course, in New Zealand. He first rose to prominence as a professional conservationist in 1969 when, as an administration officer for reserves in the Department of Lands & Survey, he won a Winston Churchill Fellowship for a study tour of the national parks of North America. His skilfully crafted report entitled 'Conserving New Zealand's Heritage' stands as a landmark in the history of conservation in this country.

Bing's 38 'Lessons for New Zealand' became the blueprint for the modern development of New Zealand's national parks and reserves system. Bing's appointment as the first Director of Parks and Reserves provided an effective platform from which to launch his ideas—among the most important of which were:

- Greatly expanded park interpretation and public education
- Improved and well-co-ordinated administration and financing
- Underpinning of management with planning and science

and above all

- A professional, well-trained and uniformed park ranger service that was to grow to become the envy of the world

The foresight of Bing's conviction that highly skilled field staff were the key to the success of parks is manifest in the team of dedicated operations staff in the Department of Conservation today.

Paralleling these innovations was Bing's influential role in weaving the policy and legal fabric for the country's parks and reserves. Included in this is the Reserves Act of 1977, which is still regarded as among the best-crafted and most effective conservation law in existence anywhere in the world. Bing also supported stronger legal protection for indigenous wildlife and State forests. The opening up of Crown lands as Farm Parks for public recreation and nature protection and the extension of protection to the coastal realm in the Maritime Parks of the Marlborough Sounds and the Bay of Islands were among the other notable achievements during Bing's tenure of leadership.

Extending beyond public lands, Bing was central to initiatives for heritage protection and recreation on private lands, particularly Open Space Covenants under the Queen Elizabeth II National Trust Act. Construction of a national network of walking tracks under the NZ Walkways Act resulted in a superb system of 126 tracks by the time he retired. (How supremely fitting, therefore, that Bing should spend the last hours of his life enjoying the pleasures of one of the country's finest walkways.)

At the time of Bing's retirement as Director-General of Lands in 1986, New Zealand's system of national parks and reserves was widely hailed as the finest in the world. His vision and tireless efforts set the stage for the smooth transition to the stewardship of the present Department of Conservation. We can but stand in awe of his many achievements, which rank him as an equal among the greatest names of New Zealand conservation. To the roll of honour that includes such notable politicians, officials, and naturalists as Thomas Potts, William Fox, W.T.L Travers, Leonard Cockayne, Harry Ell, A.P Harper, and Lance McCaskill, we can add with acclaim the name of P.H.C. (Bing) Lucas.

To have achieved all he did in his New Zealand working career is surely enough for anyone—but Bing was someone special, and he went much further in taking his professional interests and convictions onto the world stage. From 1971 when he joined IUCN's Parks Commission—the world's leading body of protected area experts—over the next three decades he served as its Regional Vice-Chair for the New Zealand, Pacific, and Antarctic Regions; as Deputy Chairman; as Chairman; as Senior Advisor; and finally as Vice-Chair for World Heritage. He held the post of IUCN Regional Councillor for Australia/Oceania, during which time in 1981 New Zealand hosted a General Assembly of IUCN. His promotion of the innovative protected and cultural landscapes led to his writing of the definitive book on the subject and to inscription of Tongariro National Park as the first cultural landscape on the World Heritage List.

For me and for so many others, Bing was more than a professional colleague—he was a mentor and friend. He leaves an enduring mark on the minds, hearts, places, and landscapes of people throughout New Zealand and the world. His passing creates a void that can never be adequately filled, and tragically, we are denied the further wisdom from his planned memoirs. But his example lives on in the life and work of the countless people he touched in the noble cause of conservation.

Paul Dingwall
Science & Research Unit
Department of Conservation

Conservation Science Newsletter is issued by DOC Science Publishing, Science & Research Unit, Department of Conservation, P.O. Box 10-420, Wellington.
General Editor—Kaye Green
Layout and design—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.