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CONTENTS

GUEST EDITORIAL

Margaret O'Brien, our senior social science researcher, shares some thoughts on the new directions that the Department will be following as a result of the recent restructuring.

The inadequate language of consumerism

On the little card each member of staff received last November, there is in "The Framework for Quality" an emphasis on creating a customer focus throughout the organisation and ensuring that our quality end product is one of satisfied customers. I find this little message that we are now asked to carry around with us quite intriguing. For instance, who is the customer? Are we talking about members of the public, or the Minister, or should we actually be thinking that the environment is our customer? There are several models within the field of social research that indicate our organisation would be radically different depending on our customer focus. Indeed, I suspect that even now, after all our restructuring, the fact that we have not answered this question satisfactorily still undermines our effective functioning as a Department.

But let us assume that we all agree that the public are our customers. The emphasis on the public has the merit of forcing the Department to look outward to those who use and receive its services. However, the danger is that the language of consumerism is inadequate to describe the complexities of the Department's work.

There are limits to the extent to which the Department can regard those effected by its services as customers whose wishes are to be met. The Department has the distinctive task of putting into practice the policing powers of the state. It regulates and controls the take of whitebait, monitors by-catch in the fishing industry, and prohibits the illegal capture of wildlife. It is not helpful then to treat as customers those who are controlled by our organisation.

Similarly, as a Department providing free services, we sometimes have to ration those services, determining who will receive them and who may not. In some instances, the Department will also have to decide between competing interests, as is presently the case with the closure of many back country huts and the upgrading of those facilities closer to 'civilisation'. Again, it is not helpful to regard as customers those whose wishes are not met.

Then there is also the issue of the extent to which Departmental processes should be influenced by the models of the private sector. In this

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Department of Conservation
Te Papa Atawhai

GUEST EDITORIAL

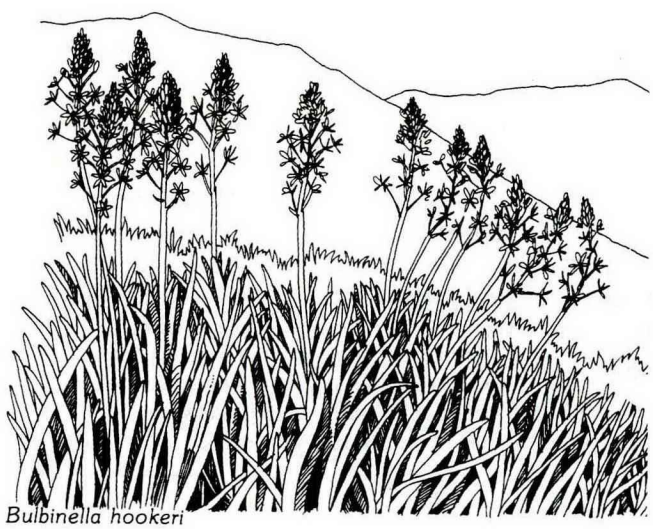
country's shift from strong state control to strong private sector control, we have tended to revere all that is associated with business. But business is not all good and Government is not all bad. For instance, not all businesses treat their customers well. Presumably the planned obsolescence of many business strategies — of building quality out of the system — is not what we want to emulate. Nor, I expect, do we want to encourage consumerism.

What we have overlooked is that the good that comes in the shift from state to private may not be associated with business *per se*, but rather the fact that we are achieving more of a balance between different ways of achieving the goals of society. It is a balance in all that we do that will bring about sustainable development, not a shift from one side of the pendulum to the other.

Finally, if I were a user of departmental services, I would have difficulty accepting that I am just a customer of Government. There is no doubt that, as a tourist, I would enjoy an informative chat with DoC staff and enjoy staying at park huts. I would also enjoy the security of knowing that if I get into trouble there would be a service provided to help me out. But I would expect far more than direct services from Government. I would also have rights as a citizen. I am an active participant of Government and have obligations as a subject. I pay taxes and abide by Government regulations on the basis that Government will provide for the common good and provide the public infrastructure that goes with it. If a national survey suddenly found that a majority of the public wanted conservation funds diverted to implementing a policy of full employment I would hope that the Department, in defence of the common good, would fight this.

So, while within the restructuring it has been important to borrow what is useful from business, we need to bear in mind that conservation is not a business. We need a more complex language than that offered by consumerism, one which recognises the more complex tasks of a Department functioning for the common good. We are a public service, and a great one at that!

Margaret O'Brien,
S&R, Tory Street



Bulbinella hookeri

Bulletin — John Holloway

On Friday 27 February John Holloway, Manager of Science and Research, was unexpectedly diagnosed as having a brain tumour, and underwent surgery at Wellington Hospital on Monday 2 March. We are pleased to report that John is recuperating well following this major operation. He is at home, and you can send him messages through Science & Research Division, P.O. Box 10-420, Wellington, or on his wife Linda's internet connection:
lholloway@clear.net.nz

REPORTING BACK

Mark-recapture modeling workshop, held at University of Canberra, ACT, Australia, 20-21 November 1997

This workshop was conducted by Ken Pollock, one of the leading biometricians in the world and an expert on mark-recapture models. Most conservation scientists and mangers are familiar with the basic concept of mark-recapture methods but, like me, are rusty on the details. Also, some of us tend to be put off by the word "model" with its implicit artificiality and the apparently multifarious assumptions required for mark-recapture models to approximate the real world.

Ron Moorhouse reports back on the Mark-recapture modeling workshop

However, as pointed out in the workshop, no method of counting animals (not even the good-old five minute count) is assumption-free. The suite of mark-recapture models available today can cope with most kinds of sampling bias encountered in animal populations and are far more precise than index counts since they provide an estimate of density and a variance. They are applicable to species which are neither sedentary or territorial and, unlike distance sampling, they can be used on species that are difficult to see or hear in the wild (amphibians and reptiles, invertebrates, pest-mammals). In addition to estimating density, open mark-recapture models can also estimate survivorship and recruitment.

On the downside, mark-recapture is relatively labour intensive and, like most statistical methods, requires a reasonable amount of data to produce estimates with tolerable error. As a rule of thumb, closed models require a minimum of five sampling bouts with a recapture probability of 0.02 to estimate population size with reasonable precision. To use the goodness-of-fit tests incorporated in the program CAPTURE (well worth doing) five sampling bouts with a recapture probability of at least 0.1 (i.e., a ten percent chance of recapturing each marked animal) are required. Thus mark-recapture methods aren't suitable for low density populations or where animals are either hard to catch/resight or extremely trap-shy. In these situations, provided you can easily detect the beast in question, you'd be better off using distance sampling or some other transect count method.

Main topics covered

The main topics covered in the workshop were:

1. Basic principles
2. Closed population models
3. Open population models (The Jolly-Seber Model)
4. Combination Closed/Open Models
5. Software

Basic principles

Mark-recapture methods are all based on the idea that if a sample of animals (n_1) from a population is marked and released the number of marked animals (m_2) in a subsequent sample (n_2) should reflect the proportion of marked animals in the total population (N):

$$m_2 / n_2 = n_1 / N$$

From this it is possible to derive the population size:

$$N = n_1 n_2 / m_2$$

This is the basic Lincoln-Peterson Model (often erroneously called the Lincoln-Index). The second sample can be obtained by whatever means was used to capture the first but

vey, are preferable as this removes the possibility of trap shyness/addiction. In practice, at least five sampling bouts rather than the two shown in the simple model above are required. Data are recorded in a 1/0 format where 1 = recapture and 0 = non-recapture (Table 1).

Data recorded in this format in WORD or EXCEL and saved as an ASCII file can be analysed by the programs CAPTURE or JOLLY.

Closed population models

As the name suggests, closed population models assume that the population under investigation is closed to immigration and recruitment, emigration and mortality. This doesn't mean that these models are only applicable to some mythical immortal species which does not replicate itself. Closed models can be applied to any species so long as the interval between sampling periods is sufficiently short that the probability of additions or losses from the population is insignificant. Obviously, the interval between sampling periods will be determined by the life-history of the species in question. If you were working on rats sampling intervals would need to be no longer than a few days to avoid violating the assumption of closure. If, however, you were estimating the size of the present kakapo population, it would be safe to sample at yearly intervals.

TABLE 1. EXAMPLE OF DATA FORMAT REQUIRED FOR MARK-RECAPTURE.

	SAMPLING BOUT				
ANIMAL	1	2	3	4	5
1	1	1	0	0	0
2	1	0	0	0	0
3	1	0	0	1	0
4	0	1	1	1	1

Despite the apparent limitation of being unable to deal with additions or losses from populations, closed models are powerful because they can cope with the kinds of sampling bias frequently encountered in the real world. A suite of closed models are available which can handle everything from variation in the capture probabilities of individuals (The Heterogeneity Model), trap shyness/addiction (The Trap Response Model), and variation in capture probabilities through time (The Time [or Schnabel] Model). There are also hybrid models which can take account of variation through time and capture probability, or variation through time and trap shyness/addiction. All these models require repeated sampling bouts and individually marked animals. The programme CAPTURE provides goodness-of-fit tests between models to indicate which best approximates the data. These must, however, be interpreted with caution (they are not independent) and it is desirable to use biological information to select the appropriate model (e.g., if there was clear evidence of trap shyness/addiction use the Trap Response Model).

Open population models

If the interval between sampling bouts is such that the possibility of immigration, recruitment, emigration and mortality cannot be excluded, open models are appropriate. The are a variety of open models, most of which are designed for specific situations, e.g., birth but no mortality during the duration of the study. The most general open model, The Jolly-Seber Model (also commonly referred to as the Cormack-Jolly-Seber Model) was the one examined in depth in the workshop. In addition to estimating population size, the Jolly-Seber model

also allows estimation of survival, and, so long as there are clearly identifiable age-classes, recruitment. It cannot, however, cope with variation in capture probability or trap shyness/addiction both of which are common kinds of sampling bias. Temporary emigration, where an animal leaves the population then returns, will seriously bias population size estimates. Although Jolly-Seber estimates of population size are not robust to many common kinds of sampling error, the survival estimates are and consequently the facility to estimate survival is often the principle reason for using Jolly-Seber model. As with Closed Models, at least five sampling bouts are required.

Combination closed/open models

It is possible to have the best of both worlds. If bursts of intensive sampling are conducted at regular intervals over a long time-frame, then it is possible to use a closed model to estimate populations size within each intensive sampling bout and the Jolly-Seber model to estimate survival and recruitment between bouts (using the pooled data from each bout). For example, if sampling was conducted on seven consecutive days each month the appropriate closed model could be used to estimate the population size during each week-long sampling bout and the Jolly-Seber model could be used to estimate survival and recruitment over the entire duration of the study.

Software

I was provided with copies of CAPTURE (for closed models) and JOLLY (open model). A major innovation is the development of a Windows interface which makes these packages relatively easy to run for those uninitiated in MS DOS. We were also given a preview of the programme MARK which is still in development but which will soon become the state of the art. I am happy to provide copies of CAPTURE, JOLLY and the Windows interface to anyone interested. I will also lend the course notes to anyone who wants to photocopy them.

Acknowledgments

Thanks to Ian West for helpful comments on an earlier draft.

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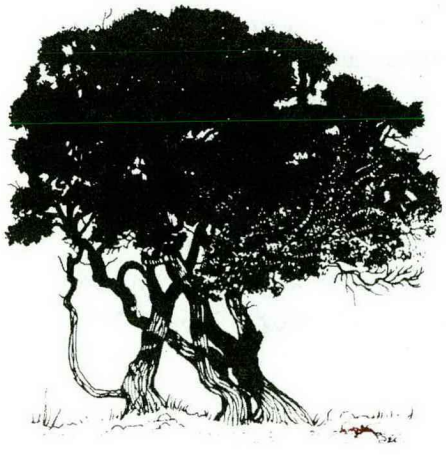

NOTES AND NEWS

Is habitat selection related to morphology in ancient New Zealand frogs?

From the Abstracts of the papers presented at 3rd World Congress of Herpetology, Prague, August, 1997.

New Zealand has four species of endemic frog, all in the ancient family Leiopelmatidae. In Whareorino forest remnant populations of two species, the terrestrial *Leiopelma archeyi* and the semi-aquatic frog *L. hochstetteri*, occur sympatrically. Surveys of habitats throughout Whareorino forest were conducted to show displayed habitat preference by individuals of both species. A range of body measurements were also taken to allow correlation to body morphometrics with the habitat selected. Multivariate data analysis enabled the species to be grouped according to habitat preference. It was found that separation into groups is size-related in *L. archeyi*. Small individuals (<20 mm) are found in grass habitat while large individuals (>20 mm) are found under rocks. In *L. hochstetteri* separation into groups is based on morphology. Each group is associated with a different habitat. Ecotypic divergence in *L. hochstetteri* has occurred.

Karen E. Eggers, I.A.N. Stringer and R.A. Fordham
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Biodiversity conservation — Myths and realities

Announcing the Society for Conservation Biology International Meeting 1998 to be held at Macquarie University, Sydney, 13-16 July, 1998

The 12th Annual Meeting and the 3rd International Meeting of the Society for Conservation Biology will be held at Macquarie University, Sydney, Australia, from 13 to 16 July, 1998.
The Scientific sessions of the meeting will consist of two plenary sessions, 20+ Symposia, 4 Workshops and a number of open sessions for posters and spoken papers. The plenary sessions to be held on Tuesday and Thursday will be directly related to the conference theme (Biodiversity conservation — Myths and realities).
The Keynote speakers at the plenary sessions will include Dr Peter Bridgewater, Professor Sir Robert May, and Professor Michael Soulé. Several of the symposia are open to submissions from interested persons. A complete and up-to-date list of symposia and their convenors can be obtained by consulting our web site at http://www.bio.mq.edu.au/consbio or via e-mail from the organisers by contacting george.mckay@mq.edu.au
Anyone interested in presenting a spoken paper or poster should check the web site or contact the organisers for further details. Abstracts for papers and posters must be submitted by 28 February, 1998. Poster presentations are preferred and we will guarantee to provide space for all poster submissions provided the abstracts meet the specified requirements.
At the time of writing all other information is tentative. We will be updating the information on our web site in mid December and regularly thereafter. Please check the site for information on field trips, accommodation and travel arrangements. Registration information will appear on the Web site in January. Registration deadlines will be 30 April for early (discounted) registration and 31 May for normal registration.

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Trisetum aff. *antarcticum* (*T.* "serpentine") discovered at Surville Cliffs, North Cape

By P.J. de Lange & E. Edgar

The grass genus *Trisetum* of temperate, usually montane to alpine regions, in both hemispheres (often called "oat grass" (Hubbard 1980)) has just been revised by one of us (E. Edgar) for the upcoming New Zealand grass flora and a paper on the subject has been submitted to the *New Zealand Journal of Botany*. At present within New Zealand we have several described species and four undescribed "tag-named" taxa, which are loosely allied to *T. antarcticum*. One of these, a small oat grass, nick-named *Trisetum* "serpentine" by botanist Tony Druce, has hitherto only been recorded from the magnesium rich rock belt of the Nelson/Marlborough Region. Within this area, this elusive grass is generally considered scarce, possibly even threatened (S.P. Courtney pers. comm.), and as such it has been ranked by the New Zealand Threatened Plant Committee as "Insufficiently Known/Taxonomically Indeterminate" (see Cameron *et al.* 1995: 22).

During April 1997 field work conducted by Peter Heenan and Peter de Lange on *Notothlaspi* aff. *australe* (an apparently undescribed endemic of the magnesium-rich rocks of the Red Hills, in the headwaters of the Motueka River), disclosed that *Trisetum* "serpentine" is in fact locally common on ultramafic boulders and cliffs faces above the Maitland Stream and elsewhere within the southern and central parts of the Red Hills. However, at that time it was still believed that this grass was endemic to this general part of the South Island.

During October 1996, while on a visit to the Surville Cliffs Scientific Reserve with Northland Threatened Plant Botanist Michael Heads and geologist Fred Brook, one of us (Peter de Lange) collected a small *Trisetum* (CHR 513773) growing on the magnesium-rich serpentinite rocks which form the Surville Cliffs. Initially, it was presumed that this specimen belonged to the *T.* "ordinary" complex, so named because it is the form of *T. antarcticum* found throughout the North Island usually at low altitudes. However, on closer inspection, the extremely hairy culms, suggested the specimen belonged to another, as yet unnamed component of the complex, tag-named *T.* "mountain", whose previous northern limit had been Mt Pirongia (959 m) in the Waikato. At this stage the specimen was forwarded to Landcare for formal identification.

The Surville Cliffs *Trisetum* has now been identified as *T.* "serpentine". Like *T.* "mountain", this taxon has hairy culms, but it has narrower flower heads and shorter awns than either *T.* "mountain" or *T.* "ordinary". Biogeographers are left with an impressive, puzzling disjunction of *c.* 950 km between which *T.* "serpentine" has yet to be discovered. Geologically, ultramafic rocks of the Surville Cliffs and the Nelson/Marlborough Region have a similar (but not the same) geochemistry. These magnesium-rich rocks typically support unusual and often locally endemic species adapted to tolerate the unusually high concentrations of magnesium and other elements such as iron, chrome and nickel. They also support unusual disjunct occurrences of often small herbaceous plants otherwise unable to compete within more normal rock and soil conditions, and thus scarce outside ultramafic areas, e.g., *Carex uncifolia*. The unu-

sual disjunct distribution of *T.* "serpentine" has led us to postulate that this undescribed grass may also occur at West Dome, near Mossburn, where similar ultramafic rocks occur. That it may occur here is quite possible, as another ultramafic endemic *Pimelea suteri* — long thought endemic to the Dun Mountain/Red Hill ultramafic suite also occurs on West Dome. Furthermore, recently Peter Heenan and Peter de Lange have discovered a distinctive, apparently undescribed *Uncinia* following a similar pattern to that exhibited by the *Trisetum*, i.e., present on the Surville Cliffs, and (for the time being at least) known from one site on the Red Hills.

Acknowledgments

The authors would like to thank Shannel Courtney for useful discussion. Peter Heenan, Michael Heads, Fred Brook and Linda Winch for company in the field. Trevor Bullock and Francis Fitzpatrick of the Te Paki Field Centre for organising transport and providing access to the Surville Cliffs.

References

Cameron, E.K.; de Lange, P.J.; Given, D.R.; Johnson, P.N.; Ogle, C.C. 1995. New Zealand botanical society threatened and local plant lists (1995 revision). *New Zealand Botanical Society newsletter 39*: 15-28.

Hubbard, C. E. 1980. Grasses. Penguin Books, Suffolk, 463 p.

RESEARCH IN PROGRESS

Climate change in Antarctica— The continuing advance of Ross Ice Shelf

Climate change is expected to have dramatic effects in Antarctica earlier than most other parts of the world. In addition the Antarctic holds information relating to past global changes.

Because of technical difficulties, this Investigation Summary from Harry Keys missed inclusion in "DOC ongoing Science Project summaries— 1996/1997. K. Green (Comp.) Science & Research Internal Report no. 159. *(Published January 1998.) I thought the content was so interesting that it should get into print! —Ed.*

Globally important research projects have been developed spurred on by SCAR and IGBP because of these factors. The project aimed to study ice front change and iceberg distribution as dynamic sources of uncertainty in ice shelf mass balance. Recent retreats of some ice shelves in the Antarctic Peninsula have been dramatic and are due to climate warming. This warming is at least regional in scale but is inconsistent with most models of global warming suggesting that either the models are inadequate or that the warming is not part of global change. These ice shelves may not be representative of ice fronts generally. Their current retreats may just be part of natural variability as some have had large increases in area (by up to 40%) as well as retreats (by up to 100%) this century. We need to characterise the extent and style of natural variation more clearly so we can determine what is "unnatural". This topic is part of the "grand old Antarctic problem" itself — the current status of the Antarctic ice sheet. Early warning of changes attributable to climate change will assist in the mitigation of global change. Greenpeace has been actively using this and the Peninsula ice shelf collapse in its advocacy of reduced human impact on global atmosphere.

Results from 1996/97 work

A period of accumulated research time was used to obtain historical data, develop a system for analysing this and data collected in 1994, and prepare a detailed outline of a paper for the international conference on Antarctica and Global Change held in July 1997. A further map of the ice front was made in February 1997, with support from the U.S.A. Analysis and write-up were completed by May and the paper has since been accepted for publication (1997/98 FY).

Conclusions

1. The western part of Ross Ice Shelf is now further north than it has ever been recorded (i.e., since 1841). This may be due to a lack of bottom crevasses in the area, which reduces the frequency of calving.
2. Large calving events at long intervals of time determined by the spacing of transverse crevasses are characteristic of large ice shelves, but do not significantly change the size of such shelves.
3. The height of the ice front varies with ice shelf thickness and time since calving due to normal dynamic glaciological processes. But the front is lower where a warm ocean current flows under it due to enhanced basal melting and this has persisted over much of this century.
4. The calving front of Ross Ice Shelf has shown large scale stability and small scale changes relative to its size over the historical record, consistent with more or less steady-state conditions.
5. Pine Island Glacier which Hughes hypothesised was "the weak underbelly of the West Antarctic Ice Sheet" and possibly in rapid retreat, in fact seems to be also in a steady-state condition, but has a very high basal melt rate (the highest yet recorded in Antarctica).

RESEARCH IN PROGRESS

6. Ship-based measurements of West Antarctic ice fronts as far east as Alexander Island off the west coast of the Antarctic Peninsula showed no clear trend to 1994, attributable to climate change. However, recent satellite imagery studies by Lucchitta and others indicate some shelves near the island are now showing clear signs of imminent rapid decay.
7. Records of 16 mainly West Antarctic ice shelves suggest that calving-induced reductions equivalent to less than 30% of the ice shelf area (when it was first discovered) are reversible on time scales related to ice velocity and residence times. Reductions of greater than this have not been reversible in historic time so an empirical hypothesis is that this is a limit to natural variability under present-day environmental conditions.
8. On this basis the Koettlitz portion of the McMurdo Ice shelf may be the southern-most ice shelf showing abnormal retreat. This would not be due to the conventionally defined climatic limit for ice shelves being reached (as in the Peninsula) because the mean annual air temperature in Ross Sea is -20°C. Therefore summer warming or radiation balance may be important factors.
9. Modern satellite-based sensors, such as SAR and RADARSAT, now allow accurate position control for long-evolving features like ice fronts, without fixed reference points. Modern ship-based observations are finally becoming obsolete.
10. Iceberg concentrations peaked near active glaciers, in some areas shallower than 500 m on the continental shelf, just north of the continental slope and within the pack ice belt.
11. The highest concentration of icebergs was found off Wordie Ice Shelf consistent with its recent (climatically induced) collapse but generally iceberg distribution is too variable in space and time and too subject to ocean currents to be a reliable or sensitive indicator of climate-induced change of marine-based glaciers.

Publications or other significant outputs

1994 Ice sheet behaviour and global change. *Antarctic Bulletin* 13(7): 305-309.

1994 Keys, H., Jacobs, S.S., Brigham, L.W. The evolving front of Ross Ice Shelf. *Antarctic Journal of the US* 29: 125-126.

1994 Jenkins, A., Jacobs, S.S., Keys H. Is this little PIG [Pine Island Glacier] in hot water? *Antarctic Journal of the US* 29.

1994 Marine ice studies— contribution to Nathaniel B. Palmer NBP94-02 cruise report to National Science Foundation

1995 Ice shelf break-up in the Peninsula— early warning of global warming? *Antarctic Bulletin* 13(9): 361-364.

1996 Jenkins, A. *et al.* Glaciological and oceanographic evidence of high melt rates beneath Pine Island Glacier, West Antarctica. *J. Glaciology* 43(143): 114-121.

1997 Ice shelf changes. Poster at New Zealand Antarctic Science Strategy Workshop, Christchurch.

1997 Overseas travel report. 21 p.

1997 Conference report: Antarctica and Global Change. 5 p.

In press Keys, H., Jacobs, S.S., Brigham, L.W. Continued northward expansion of the Ross Ice Shelf. *Annals of Glaciology* 27.

Harry (J.R.) Keys,
DoC, Tongariro/Taupo.

NEW PUBLICATIONS

New Books from Science and Research Division

Science for conservation

Smith, M., Bentley, N. 1997. **Underwater setting methods to minimise the accidental and incidental capture of seabirds by surface longliners. Report on a prototype device developed by MS Engineering.** *Science for Conservation: 67.* 9p. $12.50(incl. G.S.T.)

Several concepts of bait placement devices were evaluated by MS Engineering. Two methods were selected for further in-depth evaluation. The design concept of a transportation capsule which clamps the baited snood until the capsule reaches its determined depth proved successful.

Barnes, P., Walshe, K.A.R. 1997. **Underwater setting methods to minimise the accidental and incidental capture of seabirds by surface longliners. Report on a prototype device developed by Akroyd Walshe Ltd.** *Science for Conservation: 66.* 21 p. $12.50 (incl. G.S.T.)

Trials on two U tube devices developed by Akroyd Walshe Ltd are described. A backward-facing U tube succeeded in flushing bait in all trials to the setting depth of 1.5 m.

Cessford, G. 1997. **Visitor satisfactions, impact perceptions and attitudes toward management options on the Tongariro Circuit Track.** *Science for Conservation: 65.* 56p. $22.50 (incl. G.S.T.)

Walkers were surveyed as part of a wider study of Great Walks track users. Visit evaluations on this track were highly positive, with little dissatisfaction or need for urgent management action.

Cossee, R.O. 1997. **Report on bird banding in New Zealand 1993/1994.** *Science for Conservation: 64.* 24p. $12.50 (incl. G.S.T.)

During this banding year 18,559 birds of 101 species were banded, and 226 previously banded birds were rebanded.

Hunter, G.G., Scott, D. 1997. **Changes in tussock grasslands, South Island high country, 1973–1993.** *Science for Conservation: 63.* 69 p. $22.50 (incl. G.S.T.)

Part 1 covers trends in plant frequency at photoplots in eastern Waitaki steeplands. Part 2, changes in central Waimakariri River basin from 1980.

Jensen, C.A., Webster, R.J., Carter, D., Treskonova, M. 1997. **Succession in tussock grasslands: implications for conservation management.** *Science for Conservation: 61.* 45 p. $22.50 (incl. G.S.T.)

Vegetation changes were investigated on Otago, Canterbury, and Marlborough high country land, generally tall tussock grassland, retired from stock grazing since the late 1970s.

Gumbley, W. 1997. **Archaeological mapping of pa in four Taranaki Historic Reserves.** *Science for Conservation: 60.* 14 p. $12.50 (incl. G.S.T.)

The earthworks of Tapuinikau, Puketarata, Urenui, and Okoki Pa were mapped at large scale using tape and compass methods. A plan of each pa was produced.

Other books

McFadgen, B. 1997. **Archaeology of the Wellington Conservancy: Kapiti–Horowhenua. A prehistoric and palaeoenvironmental study.** 43 p. $22.50 (incl. G.S.T.)

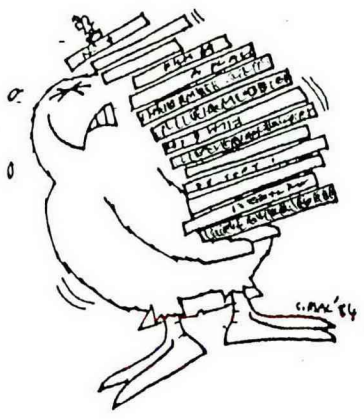
Archaeological sites are dated by their stratigraphic relationship with dune-building phases, and by oral tradition. Two cultural periods, an early and a late, are recognised.

Timmins, S. 1997. **Environmental Weeds Research Plan 1997–2006.** 28 p. $12.50 (incl. G.S.T.)

Establishes the priorities for the Environmental Weeds Research Programme for DoC for the next decade.

Williams, P.A. 1997. **Ecology and management of invasive weeds.** *Conservation Sciences Publication: 7.* 67 p. $22.50 (incl. G.S.T.)

Provides an understanding of the overall nature of weeds, their relationship with native vegetation, and the importance of weed biology when considering control measures.



Conservation Advisory Science Notes

Norton, D.A. 1998. **Impacts of tree coring on indigenous trees.** *Conservation Advisory Science Notes: 186.* 6 p.

McDonald. S. 1998. **The parasitology of the black stilt (*Himantopus novaezelandiae*).** *Conservation Advisory Science Notes: 185.* 36 p.

Jones, P.D. 1998. **Analysis of organic contaminants in New Zealand marine mammals.** *Conservation Advisory Science Notes: 184.* 8 p.

Davies, T.R. 1998. **Franz Josef Glacier access road — security of road-end facilities.** *Conservation Advisory Science Notes: 183.* 11 p.

Chambers, G.K.; Coddington,S.J. 1998. **Molecular systematics of New Zealand fairy tern (*Sterna nereis davisae*) based on mitochondrial DNA sequences.** *Conservation Advisory Science Notes: 182.* 9 p.

Lento, G.M.; Baker, C.S. 1998. **Diversity of microsatellite loci in New Zealand otariids: A pilot study.** *Conservation Advisory Science Notes: 181.* 4 p.

McCluggage, T. 1998. **Herbicide trials on *Tradescantia fluminensis*.** *Conservation Advisory Science Notes: 180.* 8 p. + 7 p. colour plates. **Special price: $10.00.**

Walls, G. 1998. **Mid Pohangina valley exclosure plots March 1997.** *Conservation Advisory Science Notes: 179.* 7 p.

***Conservation Advisory Science Notes: 178* is still in press.**

Polly, B. 1998. **Mosses and lichens of Paengaroa Scenic Reserve.** *Conservation Advisory Science Notes: 177.* 7 p.

Burns, B. 1998. **Awaroa wetlands: Value assessment.** *Conservation Advisory Science Notes: 176.* 4 p.

Reed, C. 1998. **Review of black stilt management data (1981–1995).** *Conservation Advisory Science Notes: 175.* 17 p.

Walls, G. 1998. **Vegetation monitoring in the subantarctic islands.** *Conservation Advisory Science Notes: 174.* 31 p. (incl. 9 p. colour plates. **Special price: $12.50.**

Spurr, E.B.; Wright, G.R.G.; Potts, M.D. 1998. **Persistence of sodium monofluoroacetate (1080) and diphacinone in hen eggs for control of stoats (*Mustela erminea*).** *Conservation Advisory Science Notes: 173.* 6 p.

Tennyson, A. 1998. **Large carabid beetles Stephens Island 30 April – 3 May 1996.** *Conservation Advisory Science Notes: 172.* 7 p.

***Conservation Advisory Science Notes: 171* is still in press.**

Ryan, P.A. 1998. **Effects of biologically active discharges into aquatic ecosystems: Review of treatment systems and standards.** *Conservation Advisory Science Notes: 170.* 17 p.

Espie, P.R. 1997. **Tekapo Scientific Reserve: Ecological restoration.** *Conservation Advisory Science Notes: 149.* 26 p. + 2 p. colour plates. **Special price: $5.00.**