What's happening with stoat research?

Second report on the five-year stoat research programme

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Cover: Dog stoat in tussock, Otago Peninsula. *DOC Audiovisual collection.*

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Stoat Research Programme

A stoat control research programme was initiated in July 1999 with an injection of funds from the New Zealand Government of $6.6 million over five years.

The programme aims to find more cost-effective and sustainable approaches to controlling stoats, which are a critical threat to much of our native wildlife.

The Stoat Research Programme is guided by the vision:
'That stoats will no longer be a threat to indigenous biodiversity'

The four key objectives of the programme are:

- To make stoat control more cost-effective where it is already successful
- To develop new techniques so that control can realistically be undertaken in more and larger areas
- To expand the arsenal of methods to ensure that control is sustainable
- To seed new longer-term projects which have potential to dramatically increase the effectiveness of control

A Stoat Technical Advisory Group (composed of experts from the Department of Conservation, Lincoln University and Auckland University) has been established to develop and oversee this research programme. Funding for the first year was $338,000 with funding increasing in 2000/01 to $1.406 million and for the subsequent three years, $1.631 million, each year.

This is the second in series of progress reports on the programme. The first was published in January 2000.

Overview

The New Zealand Government announced in 1999 that an extra $6.6 million over five years would be given to the Department of Conservation to fund an integrated stoat control research programme. Stoats are widely regarded as the most significant predator of a number of New Zealand's most threatened and endangered native bird species.

Stoat control in New Zealand will have to be ongoing if some endemic species are to survive on the mainland. Currently, stoat control relies largely on labour-intensive trapping and the use of poisoned hen eggs. New, more cost effective and sustainable approaches to controlling stoats are urgently needed. The extra funding allocated means that there is now a real opportunity for finding cost-effective solutions for managing stoats.

A stoat advisory technical group composed of representatives from the Department of Conservation—Elaine Murphy (Programme Manager), Leonie Fechney, Craig Gillies, Ian McFadden, Elaine Wright, Wayne Hutchinson, and Ray Pierce; from Lincoln University—Graham Hickling; and from Auckland University—Mick Clout, was established to develop and oversee this new research programme. Funding for the first year was $338,000 with funding increasing in 2000/01 to $1.406 million and for the subsequent three years, $1.631 million, each year.

Ten new research projects were funded in the first year to enable the scoping and initial set-up of projects prior to the first year of full project operation, which commenced in July 2000. These projects, several of which were literature reviews, have provided valuable information to assist the Stoat Technical Advisory Group in determining the direction of the programme and in their assessment of future research proposals. Two projects also took advantage of the stoat plague experienced in beech forests during the 1999/2000 summer by trialing two new methods of controlling stoats on a large scale.

In January of this year the stoat technical advisory group asked for expressions of interest from research providers and other interested parties. Ninety such expressions were received, which highlighted the interest and widespread concern about the impact of stoats on native species. A workshop was also held in April to provide up-to-date information about the stoat control research programme and to provide opportunity for interested parties to discuss and make suggestions about the programme for the ensuring years.

The stoat programme has given DOC the opportunity to broaden its relationships with other key agencies, both within New Zealand and internationally. For example, a research relationship has been established with the Pest Animal Control Co-operative Research Centre in Australia, and this has resulted in invaluable advice to the programme. These linkages are vital to ensure best use is made of the knowledge and expertise available and are likely to have flow on effects to our other research programmes.

The programme in the second year has concentrated on finding more effective baits, lures and traps, as improvement in these areas will bring quick gains in the short term. However some longer-term, higher-risk projects were also funded, because a variety of methods are likely to be needed if stoat control is to become sustainable. Most of the projects funded were for one year only, as it is intended to review the progress made at the end of this year and only continue with those that show the most promise. Once we have some new basic tools, funding will be directed to more strategic research.

Stoat (*Mustela erminea*).

1. Introduction

Welcome to the second year of the stoat control research programme. In the last financial year (1999/2000) ten research projects were funded. These projects, several of which were literature reviews, have provided valuable information to assist the Stoat Technical Advisory Group in determining the direction of the programme and in their assessment of future research proposals.

This report will provide:

- A brief insight into the findings from research completed
- A summary of new research initiatives funded
- Details on the process for funding in 2001/02

2. Year two of the stoat research programme

2.1 EXPRESSIONS OF INTEREST

In January 2000, the advisory group sought expressions of interest to undertake research for year two of the stoat control research programme.

When seeking expressions of interest the following priority areas were identified:

- New baits and delivery systems
- More effective traps
- New toxins
- Better lures
- Improvements to aid current best practice
- Non-lethal methods of control
- Refining monitoring techniques
- Evaluating stoat parasites, viruses, and bacteria for biological control
- Possible use of canine distemper as a control agent
- Possible use of a chemical fertility control agent, such as cabergoline
- Research into the social acceptability of the various control options for stoats
- Modelling the dynamics and control of stoats, and the effect of reduced stoat numbers on key native species to determine ecological thresholds for management
- Stoat demography and interaction studies in different habitat types, to provide information on how any potential control could be used most effectively
- Consequences of stoat control on other predator and prey species

Stoat killing a pukeko.
Photo: Wayne Hutchinson

- Seeding projects—defined as innovative research that has the potential to increase dramatically the effectiveness of stoat control

A total of 90 expressions of interest, covering a wide range of research topics, was received by the advisory group. The variety and calibre of the research proposed was impressive and regretfully a large number were unable to be funded.

The advisory group assessed each expression of interest in terms of the:

- Objectives of the stoat research programme
- Views expressed from the stoat workshop held in April 2000
- The benchmarking study of DOC current practice (see below)
- Relevant experience of the research provider
- Proposed methodology

2.2 STOAT CONTROL RESEARCH WORKSHOP

The Stoat Technical Advisory Group held a workshop at Canterbury University in April 2000 to:

- Provide up-to-date information about the stoat programme
- Provide opportunity for interested parties to discuss and make suggestions about the programme for years two to five
- Provide a forum for discussion on priorities
- Learn about concerns over different possible stoat control options
- Ask if there are any gaps in our proposed approach

Fifty-three people attended the workshop including representatives from universities, non-government organisations, RNZSPCA, crown research institutes, Australian research institutes, private consultants and industry. Working groups discussed research priorities for stoat control. The wide range of views and ideas expressed during the workshop were summarised and distributed to workshop participants in May.

While the ideas proposed at the workshop were not prioritised overall, their diversity was useful to the advisory group in assessing the expressions of interest received. Of value also was the process that each group went through in their evaluation and prioritisation of these ideas. This information confirmed to the group that their initial thoughts on the strategic direction of the programme was shared by the broader community of interest.

The workshop provided a forum for scientists and managers to interact and discuss stoat control problems and possible options for future research. It also provided an opportunity for scientists to hear about management needs, and for operational staff to understand some of the scientific challenges faced in this area of research. Continuing dialogue between scientists and managers is important to ensure that research is targeted to operational needs.

2.3 BENCHMARKING OF CURRENT PRACTICE

The first two of the objectives (see p. 4) of the stoat control research programme aim to:

- Make stoat control more cost effective where it is already successful.
- Develop new techniques so that control can realistically be undertaken in more and larger areas.

To ensure that these objectives are met, the advisory group developed a questionnaire that was sent to DOC staff involved with stoat control. The aim of this questionnaire was to gather information on current and/or planned stoat control operations. The findings have been summarised in a database, which will be used as a benchmark to test the efficacy of new techniques resulting from the stoat research programme. The database will also help ensure that current practice is shared nationally.

Input was also sought from staff as to which areas of research they considered necessary to help their direct operational management needs. The majority responded with the need for better baits, lures and toxins. More effective traps and trapping methods were also considered to be a high research priority for control on the ground. Other suggestions included research into methods for monitoring the success of a control operation, information on dispersal and distribution of stoats, and predictive modelling.

2.4 LINKAGES WITH OTHER RESEARCH AGENCIES

The stoat programme has given DOC the opportunity to broaden its relationships with other key agencies, both within New Zealand and internationally. Landcare Research and DOC have jointly funded two projects, which has really added value and resulted in true collaboration. A Memorandum of Understanding has been signed with the Pest Animal Control Co-operative Research Centre (PAC CRC) in Australia. This has resulted in invaluable advice being provided to the programme, particularly concerning the potential offered by research into biocontrol techniques and in more strategic planning issues. A relationship between the Victorian Department of Natural Resources and Environment in Australia, Landcare Research, and DOC has been established to share expertise in the development of both a mustelid-specific and cat-specific toxin. Discussion is currently underway on funding a PhD student through CSIRO and the PAC CRC in Australia, to link in with the Landcare Research stoat reproductive study. These linkages are vital to ensure best use is made of the knowledge and expertise available and are likely to have flow on effects to our other research programmes.

TABLE 1. LIST OF APPROVED RESEARCH PROJECTS.

PROJECT TITLE	LEADER (CO-WORKER/S)	ORGANISATION
Feracol for stoat control	Jeremy Kerr (A Lavrent)	Feral Control R&D Ltd
Development of a long life bait for the control of stoats	Ray Henderson (Chris Frampton, James Ross)	Pest Tech Ltd
Paired trial of long-life stoat baits in northern coastal environment	Nigel Miller (Pete Graham)	DOC
Testing the attractiveness, palatability and longevity of novel stoat lure and bait formulations	Kay Clapperton (Lloyd Robbins, AD Woodhouse, RFR Porter)	Private
Prey odours as lures for stoats	Andrea Byrom (Eric Spurr, Cheryl O'Connor)	Landcare Research
Field trials of rodent scented lures as attractants for use in stoat bait stations	Tom Montague	Roe Koh and Associates Ltd
Evaluation of new toxins for mustelid control	Cheryl O'Connor (Charlie Eason)	Landcare Research
Automatic stoat trap pilot study	Ian Domigan (Bruce Warburton)	Lincoln University
Develop a prototype kill trap for stoat control	Malcolm Thomas	Pest Control Research
Gotcha electronic trap	Warren Agnew (M Chitterden, E McCall, G Moon)	Private
Tracking tunnels for monitoring stoats	Craig Gillies	DOC
Refining stoat monitoring techniques (linked to Craig Gillies project)	Jennifer Brown	Canterbury University
Using colours to increase trap and tracking success rates of stoats	Billy Hamilton (Henrik Moller)	Ecosystems Consultants Ltd
Optimum spacing of bait stations and traps for efficient stoat control.	Henrik Moller (Billy Hamilton)	Ecosystems Consultants Ltd
Quantifying stoat and rodent population parameters in podocarp/broadleaf forests for predictive modelling	Wendy Ruscoe and Andrea Byrom	Landcare Research
Ecology of stoats in a SI braided river valley	John Dowding (Mike Elliott)	DM Consultants
The movement and diet of stoats in an alpine-beech forest habitat	Des Smith (Ian Jamieson)	University of Otago
Modelling the immigration rate of island stoat populations	Graeme Elliott (Murray Willans)	DOC
Modelling the dynamics and control of stoats	Nigel Barlow	AgResearch
Cost-effectiveness of exclusion fencing for stoat control	Tim Day (Lindsay Matthews)	AgResearch
Stoat reproductive biology	Cheryl O'Connor (Janine Duckworth, Frank Molinia, Andy Glazier)	Landcare Research
Review of potential "Achilles Heel" characteristics of the stoat	Clive Marks	Pest Animal Control CRC, Australia
Social acceptability of the various control options for stoats	Roger Wilkinson (Gerard Fitzgerald)	Landcare Research
'Find out' project	Warren Agnew (E McCall, G Moon)	Private
Biological control of stoats using a vaccine strain of canine distemper virus	Tao Zheng (Bryce Buddle, Annie Dickie, Lindsay Matthews)	AgResearch
Bait marker for stoats	Eric Spurr (Cheryl O'Connor)	Landcare Research
Mustelid bibliography on-line database	Kim King	Waikato University
Pending		
Helicobacter mustelae as a vector for biological control of stoats	Paul O'Toole (John Lumsden, Kathy Parton)	Massey University

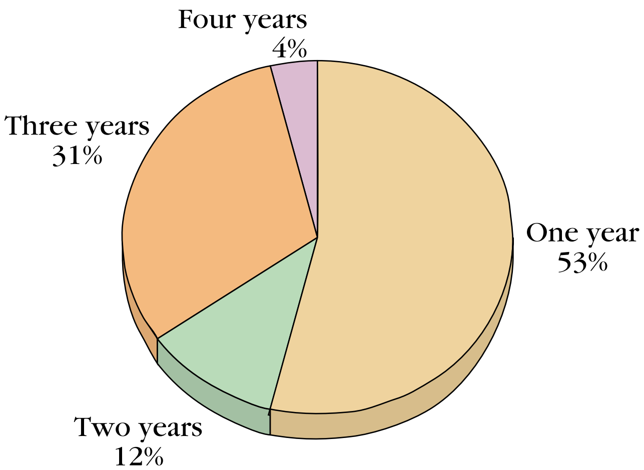
3. New research funded for 2000/01

The programme was designed to help meet the needs of managers who require quick solutions, as well as seeding longer-term research that could dramatically improve the effectiveness of control.

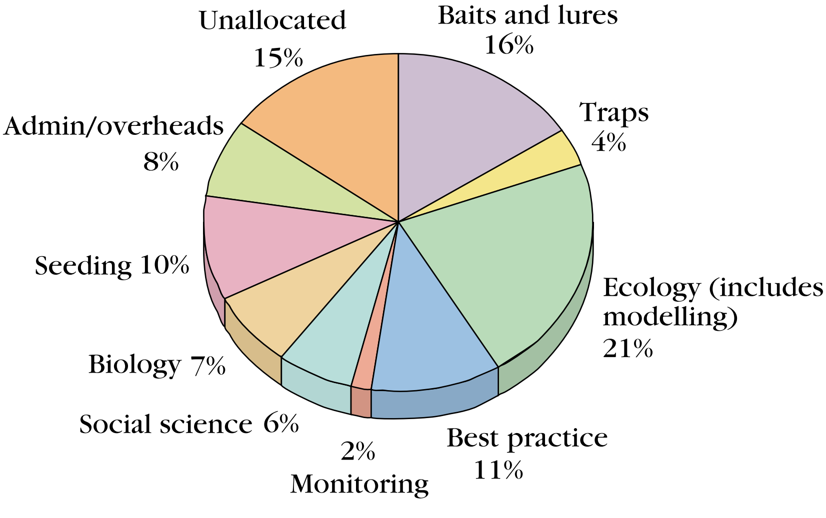
The research approved is listed in Table 1. Most of the projects are funded for between one to three years.

A summary of the research to be initiated this year is provided on following pages.

Duration of research projects funded in 2000/01



Approximate funding allocated to each research area



3.1 BAITS AND LURES

One of challenges that currently faces agencies involved in stoat control is the short life span of both baits and lures. Currently, eggs or fresh meat are mostly used. Fresh meat deteriorates quickly and, although whole hen eggs are long lasting, they are not as effective as cracked eggs (and are also not that easy to carry in the field!). Having to change baits frequently is very labour intensive and increases the cost of stoat control.

Three of the projects funded will be investigating the use of incorporating prey scented lures into long-life matrices. The advisory group decided that as this was a critical area where progress was needed, it was worthwhile to fund three separate groups using different approaches.

Feracol® for stoat control

Jeremy Kerr (Feral R&D Limited) and co-worker A. Lavrent will undertake a study on the effectiveness of a prototype bait that they have developed. Preliminary trials have indicated that this new bait is readily eaten by captive stoats. However, further work is needed on the formulation to ensure stability in the field. This work will build on that previously carried out by Landcare Research and if successful, will be field trialled in conjunction with DOC. Currently, 1080 injected into hen eggs is the only poison bait available for the control of stoats. A ready-made bait would be more cost effective and would increase the arsenal of techniques available for stoat control.

This project will be completed in June 2001.

Development of a long-life bait for the control of stoats

Ray Henderson (Pest-Tech) will develop a long-life bait as a cost-effective alternative to the current methods of stoat control (traps and poisoned eggs). Current stoat control methods involve a high cost in terms of resources because the baits are only effective for a short period before they deteriorate. A long-life bait placed in widely spaced bait stations may be a cost-effective alternative to current stoat control strategies. This project will look at the palatability of potential ingredients to captive stoats and then the preferred combination will be waterproofed with polymer additives and microcides to further enhance durability.

This project will be completed by June 2001.

Paired trial of long-life baits in a northern coastal environment

Nigel Miller and Pete Graham from the Department of Conservation, Northland will compare the use of fresh rabbit with dehydrated rabbit as a bait in Fenn traps. Experience to date has shown that baiting traps with fresh rabbit meat can be more effective in warmer climates than hen eggs. However, the baiting of traps with fresh meat is labour intensive as the meat rapidly deteriorates. If fresh meat could be preserved yet still retain its attractiveness, this would present a more cost-effective means of managing stoats and therefore protecting indigenous bird species at risk.

This project will be completed by June 2002.

Testing the attractiveness, palatability and longevity of novel stoat lure and bait formulations

The aim of this research is to search for new, highly attractive, long-life lure and bait formulations. Kay Clapperton and co-workers Lloyd Robbins, A.D. Woolhouse, and R.E.R. Porter will compare different lures (including rabbit, rat, hen egg, and sparrow) in a range of long-life matrices for their attractiveness, palatability, chewability and longevity in terms of attracting stoats. These long-life lures could be used to lure stoats to a trap, or entice stoats to eat a poisoned bait or a bait which contains a vector for biological control. The most attractive lures will then be field-tested in an intensively managed stoat population at Lake Waikaremoana.

This project will be completed in June 2003.

Prey odours as lures for stoats

Andrea Byrom and co-workers Eric Spurr and Cheryl O'Connor from Landcare Research will undertake a three-year project on the development of a prey odour lure. Preliminary research has indicated that rodent odours are attractive to stoats. The aim of this project is to develop a lure that acts as an attractant to stoats. The natural prey odour(s) will be encapsulated into a long-life, slow-release matrix. This matrix (lure) will then be tested on stoats in pen trials. This long-life lure could be used in baits or traps.

This project will be completed by June 2003.

Field trials of rodent scented lures as attractants for use in stoat bait stations

Tom Montague will aim to significantly increase the rate of consumption of eggs by placing a rodent scented lure in stoat bait stations. The results of this work will indicate whether stoat mortality can be increased by attracting them to a bait station using the odour of one of their most common prey items—rodents. It is considered that the use of this common prey odour (which would be encountered regularly when stoat are out foraging) will avoid any unwanted associations.

This project will be completed by June 2001.

3.2 TOXINS

Evaluation of new toxins for mustelid control

Cheryl O'Connor and Charlie Eason from Landcare Research are developing a humane, mustelid-specific toxin. Control strategies for mustelids using poisoned baits currently rely on the use of 1080. While effective, the widespread use of 1080 is controversial, due to its lack of target specificity. There is a need for a more target-specific toxicant for mustelid control and as a first step towards achieving this goal, a report was prepared in 1998 for DOC entitled 'Mustelid-specific toxicants'. This report identifies a range of poisonous materials to which mustelids appear to be particularly susceptible. In particular, methaemoglobin-inducing agents and non-steroidal anti-inflammatory agents looked promising. All mustelid species are pests in New Zealand and sustainable and cost-effective mustelid control tools are essential. A useful novel tool for conservation that is designed with specificity and humaneness as the most important attributes, will increase public support for mustelid control. This project has been funded by DOC since 1998.

3.3 TRAPS

Automatic stoat trap pilot study

Ian Domigan (Lincoln University) and co-worker Bruce Warburton (Landcare Research) have teamed up to develop a cost-effective automatic kill trap. The mechanism to deliver a lethal blow in a trap has already been developed as a prototype. However, this now needs to be optimised for capturing and killing stoats. This new trapping system has the potential to provide a robust, multiple-capture trap that will significantly reduce the field time in servicing traps (particularly in remote areas such as offshore islands). Such a trap will also avoid the potential problem of localised trap saturation in years of high stoat numbers.

This project will be completed by June 2001.

Development of a prototype kill trap for stoat control

Malcolm Thomas of Pest Control Research Limited proposes the development of a cost effective, compact and efficient kill-trap. Once the prototype kill trap has been developed and manufactured it will undergo preliminary tests in the field.

This project will be completed by December 2000.

Gotcha electronic trap

Warren Agnew and co-workers Mark Chittenden, Eric McCall, and Geoff Moon will develop an electronic trap for stoats. The trap will operate on a sensor unit that will be activated once the animal enters the trap. Two models of this trap will be developed. The first will be a live capture trap which will be activated by animals larger than 105 mm and will produce a radio signal when activated. The second model will operate as a kill trap that could potentially deliver a fatal dose of a toxin to the back of the animal passing through.

This project will be completed by June 2001.

3.4 MONITORING

Evaluating the use of rodent tracking tunnels as a method for monitoring mustelids also

Ink footprint tracking tunnels are now commonly used at many mainland conservation sites to monitor the effects of pest control operations on rodent activity and abundance. Since the technique does not impact upon the pest population it can be used for direct comparisons between managed and unmanaged sites. At sites where managers wish to monitor both rodents and mustelids it would be logistically much simpler if the same tunnels could be used to track both pests. Craig Gillies (DOC) is investigating whether a small change in the current protocol for using tracking tunnels to monitor rodents is all that is required to allow the same tunnels to be used to track mustelids. The tracking tunnel indices will be calibrated against other estimates of mustelid and mouse abundance. This project has been funded by DOC since 1999.

Refining stoat monitoring techniques

Jennifer Brown of the University of Canterbury will be helping Craig Gillies (see above) to ensure any protocol developed will be statistically robust.

3.5 BEST PRACTICE

Use of colour to increase trap and tracking success rates of stoats

Billy Hamilton and Henrik Moller of Ecosystems Consultants Ltd will determine if stoats have a sensory bias (in terms of colour) towards coloured tracking tunnels or trap surrounds. Four different colours (black, green, red, and yellow) will be tested. Yellow will be tested as anecdotal reports have suggested an increased capture rate or bait take when yellow surrounds are used in control operations involving small mammals. There is also scientific evidence that many animal sensory systems are triggered or 'biased' in favour of certain colours (e.g. red). This study will compare the tracking and trapping success of the different coloured equipment and the two most 'successful' colours will then be tested. The identification of a sensory bias towards colour by stoats will be applicable to existing stoat control techniques and future methodology.

This project will be completed by March 2001.

Optimum spacing of bait stations and traps for efficient stoat control

Henrik Moller and Billy Hamilton of Ecosystems Consultants Ltd will also look at the optimum density of control stations (bait stations, traps) and monitoring stations (tracking tunnels) in two different types of habitat (beech and podocarp forests). It is recognised that there are many measures available to determine the size of stoat home range in different habitats but there is no information available on the number of control/monitoring stations needed per home range. This project aims to determine the optimum spacing of control and monitoring stations to increase trackability and trappability. This information should result in an increase in efficiency of control operations.

This project will be completed by December 2002.

3.6 ECOLOGY

Previous studies on stoat ecology have largely focused on stoats living in beech forest (where the main prey of stoats are birds and mice), so it was viewed as important to increase our understanding of other habitats where different prey were important. For North Island brown kiwi in particular, a better understanding of stoats living in podocarp/broadleaf forests (where rats are a major prey) is urgently needed.

North Island brown kiwi.

A kiwi chick killed by a stoat. An average of only 6% survive to become adult on the mainland.

Quantifying stoat and rodent population parameters in podocarp/broadleaf forests for predictive modelling

Wendy Ruscoe and Andrea Byrom from Landcare Research will undertake a three-year study of the ecology of stoats in a podocarp/broadleaf forest. The mechanisms regulating the density of stoats in a podocarp/broadleaf system and their propensity to prey on key native bird species is not well understood. In addition the interaction between rodents and stoats is complicated by secondary poisoning through the 1080 poisoning of possums. The aim of this study is to:

- Gain information on the recovery of stoat and rat populations after a 1080 control operation
- Determine the nature of the relationship between rat and stoat abundance
- Determine dispersal and survival characteristics of adolescent stoats in response to food availability (rodents) and the density of resident stoats

The need for this work was identified as a key 'knowledge gap' in our understanding of stoat ecology and our ability to mitigate their impacts on indigenous wildlife. The information obtained from this study will allow the nature of the interactions between stoats and rodents to be determined and provide parameter estimates for use in predictive modelling.

This project will be completed by June 2003.

Ecology of stoats in a South Island braided river valley

John Dowding of DM Consultants and co-worker Mike Elliott will look at the ecology of stoats in a large braided river valley in the Mackenzie Basin, where a major prey of stoats is rabbit. South Island braided rivers provide an important breeding habitat for a number of threatened endemic ground nesting birds including, black stilt, wrybill and black-fronted tern. The aim of this research is to provide information on stoat abundance, home range size, diet, activity patterns and habitat preferences. Indices of potential prey abundance will also be collected. The information from this study will indicate the factors that are important in determining the distribution and density of stoats in braided rivers and will provide managers with recommendations for management and control of stoats in this habitat. This project will be completed by September 2002.

Adult wrybill. *Photo: Richard Duirs*

Black stilt.

Tasman River, a braided river in the Mackenzie Basin. *Photo: John Dowding*

The movement and diet of stoats in an alpine-beech forest habitat

Des Smith (MSc student) and Ian Jamieson (University of Otago) will continue their study of the effectiveness of low intensity trapping techniques in the Takahe Special Management Area. A low intensity trapping technique has been shown to work in a large, wide, low altitude valley in Fiordland (Eglinton). However, much of Fiordland is made up of smaller, montane valleys and alpine areas and the effectiveness of this low intensity trapping technique has not been tested in these areas. This study will use mark and recapture techniques combined with radio tracking to gain information on stoat movements in the study area, as well as an estimate of the effect of low intensity trapping on stoats.

This study is a continuation of the work initiated last year that will form part of an MSc thesis. A summary of the findings to date can be found at the end of this report. This work will be completed by December 2001.

Modelling the immigration rate of island stoat populations

Graeme Elliot and Murray Willans of the Department of Conservation will conduct a four-year study looking at the invasion rate of stoats to 22 islands in Fiordland. All the islands included in this study are within stoat swimming distance but are too small to support resident stoat populations. The results of this study will be used to construct a model relating invasion rate to topographical and population parameters. Predator-free islands are important in the conservation of some of our most endangered species and while many of the islands in this study are too small for this purpose, the information obtained will allow us to estimate likely re-invasion rates. If re-invasion rates are low and stoat control efficient, such islands (although within swimming distance for stoat) may be safe enough to support key endangered species.

This study will be completed by June 2004 .

Modelling the dynamics and control of stoats

This two year project will be undertaken by Nigel Barlow from AgResearch and will implement one of the recommendations from the review of modelling undertaken last year (refer summary of completed research). The first year of this project will use models which require little additional data to assist the Department in screening and prioritising research options for novel control methods such as the use of pathogens and immunocontraception. These basic models will then be improved by using initial data obtained by other researchers and by incorporating slightly more complex features such as age structure and prey-dependence. The results of this study will provide more soundly based assessments of the feasibility of biological control options and of the likely levels of control necessary to achieve the given reductions in stoat density. This work could be extended to apply to the evaluation of all controls (traditional and novel).

The project will be completed in June 2002.

3.7 NON-LETHAL METHODS

Cost-effectiveness of exclusion fencing for stoat control

Tim Day and Lindsay Matthews of AgResearch will look at the cost-effectiveness of using exclusion fencing compared to conventional control for protecting threatened fauna from stoats and other pests in intensively managed, localised areas (e.g. mainland islands). A low cost fence design, that is an effective barrier to many vertebrate pest species, has recently been developed. This may provide a cost-effective alternative to current trapping and poisoning control techniques for specific areas and provide an alternative to the traditional electrified fencing. This research will provide scientific rationale (including a decision support system model) for determining when and where exclusion fences are a cost-effective option for stoat and other pest control.

This project will be completed by June 2001.

3.8 BIOLOGY

Stoat reproductive biology

Development of an effective fertility control for stoats will require a good understanding of stoat reproduction, about which little is presently known. Cheryl O'Connor and co-workers Janine Duckworth, Frank Molinia, and Andy Glazier from Landcare Research will undertake a three-year study on stoat reproductive biology. They will:

- Monitor reproductive biology, stress physiology, immunology and behaviour of wild-caught stoats during and following acclimatisation to captivity.
- Alter photoperiod (light-dark cycle) to look at control of oestrus, seasonal breeding and prolonged 10-month period of embryonic diapause.
- Develop techniques to assess and manipulate the reproductive state of stoats during oestrus and pregnancy.
- Optimise husbandry and welfare of stoats leading to the establishment of a captive breeding colony of stoats which will benefit research in many areas of stoat control.

This project will be completed by June 2003.

Review of potential 'Achilles heel' characteristics of the stoat

Clive Marks, sub-contracted by the Pest Animal Control CRC (Australia), will undertake an 'Achilles heel' review of the characteristics of the stoat. This type of review does not confine itself to investigating known control types or categories of control, but attempts to identify anomalies in the pest that could lead to the development of a stoat-specific method of control. This approach has not been widely exploited in New Zealand and many of the potentially useful publications (e.g. those dealing with physiology and biochemistry) have not been identified, as they are not directly concerned with pest control. One such example of where the Achilles heel principle has been successfully applied is the identification of unique enzyme deficiencies and digestive processes in the feral cat and this has subsequently led to the development of a species-specific toxicant and delivery system in Australia.

This review will be completed by June 2001.

3.9 SOCIAL SCIENCE

Social acceptability of the various options for stoat control

Roger Wilkinson (Landcare Research) and Gerard Fitzgerald (Fitzgerald Applied Sociology) have teamed up to determine the social acceptability of new stoat control techniques as well as the acceptability of the existing trapping and poisoning techniques. Some new stoat control techniques may be contentious and it is recognised that these can only be realistically and sustainably used if there is public support and understanding. The findings from this research will enable the Department to assess the level of public knowledge of stoats and their impact on New Zealand's environment and their knowledge of current stoat control strategies. This information will assist the department and other researchers in their decisions on, and marketing of, stoat control strategies.

This project will be completed by June 2003.

'Find out' project

Warren Agnew and co-workers Eric McCall and Geoff Moon will develop and trial the Find Out project for use in schools. Students will use tracking tunnels to obtain data on the distribution of stoats (and rodents) that will be presented on a website. The aim of the programme is to increase public awareness and to provide an opportunity for young New Zealander's to take part in determining stoat distribution patterns.

This project will be set up and completed by June 2001.

3.10 BIOCONTROL

Biological control of stoats using a vaccine strain of canine distemper virus

Tao Zheng (AgResearch) with co-workers Bryce Buddle, Anna Dickie, and Lindsay Matthews will investigate whether the vaccine strains of Canine Distemper virus can be used as a lethal agent for the biocontrol of stoats. Overseas studies have shown that stoats and other mustelids are susceptible to the canine distemper virus and the vaccine strains of this virus can cause mortality in ferrets. Using the vaccine strain of the virus has several advantages:

- The vaccine strains are currently approved in New Zealand as a vaccine for dogs.
- The vaccine would not represent a biological hazard to domestic animals.
- The use of the vaccine strain would not require genetic manipulation of an agent and is unlikely to attract the same level of public concern as a genetically modified organism would.

Two types of vaccine are available and overseas studies have shown that there is a difference in the virulence of the vaccines depending on which species is exposed. For example an attenuated vaccine can be used safely in red fox but is fatal for grey foxes yet they are both of the same family.

The key aims of this study are to determine the:

- Lethality and transmissibility of vaccine strains of Canine Distemper virus in stoats
- Infection status of New Zealand stoats to the Canine Distemper virus by examining the sera from trapped animals.

The project will be completed by June 2003.

Helicobacter mustelae as a vector for biological control of stoats

Paul O'Toole of Massey University has been funded by Landcare Research to investigate the prevalence of the mustelid-specific gastric bacteria, *Helicobacter mustelae* in stoats. *H. mustelae* produces mild gastritis and may establish a permanent mucosal infection, which could lend itself to be engineered as an antigen delivery vehicle to interfere with stoat fertility. DOC will fund the second year of this project, contingent on *H. mustelae* not occurring in non-mustelid species (e.g. cats or dogs).

3.11 MISCELLANEOUS

Bait marker for stoats

Eric Spurr and Cheryl O'Connor of Landcare Research will test the effectiveness and persistence of Rhodamine B (a systemic and external marker) on stoats. Rhodamine B has been shown to become incorporated into the growing hair of cats, rats and rabbits and it appears as a band detectable under fluorescent light. The persistence of the marker depends on the growth rate of the hair. The identification of an effective, persistent bait marker for stoats will help to determine the proportion of the stoat population that is ingesting the bait and would be a prerequisite for the development of new toxic baits and biocontrol techniques.

This project will be completed by March 2001.

Establishment of an on-line database on mustelids

Kim King of Waikato University will complete the compilation of an on-line mustelid bibliography. This project was initiated several years ago and funded by the J.S. Watson Trust and the Pacific Conservation and Development Trust, but funds are required for it to be put on the web. An on-line database for possums (compiled by Stephen Sarre, Massey University) has already proved very effective and a mustelid database would be also very worthwhile.

This project will be completed by June 2001.

Above: Remains of New Zealand dotterel from a stoat den at Waiaua Spit. This stoat killed 1% of the breeding adults (northern sub-species) within two months. *Right:* New Zealand dotterel displaying near its nest.
Both photos: John Dowding

4. Research completed during 1999/2000

The summaries provided below are a brief insight into the findings from the research completed during the first year of the programme. The summaries are based on the recommendations and/or abstracts from the reports. The reports are currently in the process of being published and will be available from DOC Science Publications, PO Box 10-420, Wellington, New Zealand. Email: science.publications@doc.govt.nz

4.1 REVIEWS

A review of overseas studies relevant to stoat control

Robbie McDonald (University of Bristol, UK) and Serge Larivere (USA) prepared a comprehensive review of the literature on demography, captive breeding, diseases, biocontrol, non-lethal control, metabolism and toxicology of stoats and other closely related mustelids. They found that the life history of stoats (short-lived and highly productive) means that they are resilient to all forms of population control.

They concluded that:

- The collection of demographic data should be ongoing to provide data for predictive modelling exercises.
- A captive colony of stoats is necessary for testing control technology including the control of reproduction.
- Aleutian disease, mink enteritis and canine distemper (virulent diseases affecting close relatives of stoats, particularly mink and ferrets) could all be tested as potential pathogens to free living stoats.
- Biological control is a technologically challenging method of limiting stoat populations. It was considered that prior to investing in biotechnology research the feasibility of fertility control techniques should be investigated through predictive modelling. It was also considered that a more detailed understanding of stoat reproductive physiology is needed in order to direct fertility control agents at the factors controlling delayed implantation.
- Non-lethal techniques for limiting predation, such as physical barriers to predators, may have a limited but cost-effective role in protecting tree nesting species.
- Certain fungi produce toxins that could be used as alternatives to highly persistent poisons.
- The greatest metabolic weakness of stoats is their high-energy demand and dependence on fluctuating prey supplies. This could be exploited by targeting control efforts at a narrow window in time when female stoats control their fertility.

Scoping review: feasibility of immunocontraception for managing stoats in New Zealand

Lyn Hinds, Kent Williams, Roger Pech, Dave Spratt, Tony Robinson, and Gerhard Reubel from CSIRO, Wildlife and Ecology, Australia prepared a comprehensive review of the feasibility of immunocontraception for managing stoats. It was considered that biocontrol, including fertility control, has potential as an additional management tool for stoats and should be considered as part of a longer-term strategy. However, careful consideration of the essential characteristics of any biocontrol agent, e.g. specificity, humaneness and route of delivery will need to be carefully considered.

Five approaches to biocontrol, three of which use genetically modified organisms (GMO's) were considered in the review. They were:

- Lethal biocontrol organisms
- Disseminating immunocontraceptive GMO's
- Non-disseminating immunocontraceptive GMO's
- Non-disseminating non-GMO immunocontraceptive products
- Chemosterilants

No mustelid-specific mortality agents were identified from the literature, thus it was considered that the use of lethal biocontrol agents is limited unless further research is undertaken. Canine distemper is a possible lethal biocontrol for stoats, weasels and ferrets but it is not specific to mustelids. Its delivery by bait would reduce the risk to non-target species and there is a vaccine available to protect domestic and zoo animals.

Other parasitic organisms of stoats offer no obvious mortality agent for application to control stoats in New Zealand.

The literature search for potential vectors of immunocontraceptives for stoats or mustelids did not offer any clear candidates.

Viruses that effect mustelids are not well researched. Viruses may be suitable as vectors for an immunocontraceptive vaccine although no candidates are stoat-specific or mustelid-specific. While viruses have been used in other species their potential for stoats is unknown and a significant amount of research would be required to ascertain this.

Despite problems with potential vectors, it was considered that the reproductive physiology of stoat appears amenable to disruption. Their breeding pattern is seasonally regulated, there is a long period of embryonic diapause and delayed implantation. Several critical steps in this reproductive cycle could be disrupted. It was considered that research is required to identify and characterise the likely reproductive antigens and determine their specific effects on stoats and other mustelids.

Chemosterilants currently have a low specificity and their delivery to stoats and other mustelids would be similar to that of non-specific poisons and as labour intensive and costly. It was considered that research in this area would be a low priority. There are however, some chemical agents that warrant further investigation. These are:

- Cabergoline which inhibits prolactin secretion which could affect the success of breeding or lactation. It is not species specific and while work has been carried out on other animals such as dogs it has not been tested on stoats.
- Mifepristone or RU486 (anti-progesterone compound) which binds to progesterone receptors in tissues especially the uterus. Its effect on mustelids has not been investigated, however it is not species-specific and current availability and price may curtail its immediate use.

The review recommended that consideration be given to the development of a non-disseminating immunocontraceptive GMO as the highest priority for fertility control. In addition, a robust bait attractive to stoats or mustelids, and suitable for aerial delivery, should be developed. The development of an immunocontraceptive vaccine would require a 5–10 year investment and while the overall task is difficult and there is no guarantee of success, the pathway to achieving the product is technically feasible.

It was noted that further ecological research is required to determine the reduction in stoat density needed to protect species threatened by predation and to develop strategies for integrating fertility control with existing management techniques.

It was also recognised that the nature of this research necessitated the need to ensure that there is compliance with the regulations relating to GMO's in New Zealand and to take into account the public attitudes and perceptions with respect to the use of GMO's.

A review of mustelid studies from the former Soviet Union

Artyom Polkanov undertook a review of literature from the former Soviet Union on the biology, ecology and captive breeding of stoats and other mustelids. He found few papers were published after 1991, because of the disintegration of the 'All Union Institute of Hunting Industry and Fur Mammal Breeding' which followed the collapse of the Soviet Union.

Observation on the experiences of keeping stoats in captivity and the procedures used for successful breeding were summarised in detail.

Information on diseases and parasites, while numerous, were based almost exclusively on data from fur farms that existed in the former Soviet Union prior to 1991 and is limited because stoats were never bred in captivity in commercial numbers. However, there is information that stoats and other mustelids are carriers (vectors) for dangerous infections such as the plague and tularemia.

Various traps were described briefly and it was noted that poisons were never used in Kazakhstan for the eradication of mustelids. An interesting description of an odorous bait and its preparation was described in detail and it was observed that a mince prepared of lizard, snake, or frog meat was the best attractant for stoats.

4.2 MODELLING

Preliminary modelling of stoat control options

Nigel Barlow (AgResearch) and David Choquenot (Landcare Research) reviewed approaches to modelling pest impacts and pest control in order to identify useful approaches to modelling stoat dynamics, their control and their effects on key prey species. The modelling options involve either interactive models in which the primary prey (mice or rats) drive stoat abundance, or non-interactive models where stoat densities drive stoat numbers. In both cases, stoats then drive secondary prey (species at risk). Ultimately the two approaches need to be combined in a single model in order to predict the effect of stoat control on secondary prey.

The authors advised that modelling should precede and accompany, rather than succeed field work if maximum benefit is to be gained. One of the main benefits of this is to guide data collection, to ensure the right sort of data is collected.

Recommendations for modelling needs, and the data needed to best support the predictive modelling approach, are included in the review and one of the recommendations has been funded for year two of the stoat programme (refer to new research initiated).

Colonisation of new areas by stoats: time to establishment and requirements for detection

David Choquenot (Landcare Research) has devised a simple deterministic accounting (function) model to predict:

- The time a colonising stoat population requires to reach specified levels of abundance (establishment rate).
- The number of tracking tunnels necessary to detect the presence of a colonising stoat population and the certainty of detection when the number of tracking tunnels is known (detection requirement).

The period between initial colonisation of an area and the rapid increase in density was defined as 'establishment'. The study found that founder populations that included both males and females established more quickly than those consisting of one or two pregnant females in the absence of males. The absence of a mature male slowed down colonisation because the female and her offspring could not breed for a year.

A function was developed to estimate the number of tracking tunnels required to detect an establishment event and it provided a sobering picture of how difficult it can be to ascertain the presence of a small population with acceptable levels of certainty. Even if favourable detection characteristics are assumed the number of tracking tunnels needed to detect 5 or fewer stoats in 10,000 ha with 99% certainty exceeds 200 placed randomly.

4.3 DISEASES

Disease and pathogens in stoats in Great Britain

Biological control provides a possible long-term solution to control of stoat populations. However, little is known of the diseases and pathogens occurring in free-living stoat populations. This project was a first step towards describing the diseases that affect stoats in Britain, the source of the introduced population in New Zealand. Robbie McDonald, Michael Day, and Richard Birtles (University of Bristol, UK) adopted two approaches to the project. The first was to conduct a histopathological screening study of key organs looking for signs of inflammatory disease and neoplasia. The second employed culture and PCR techniques to identify arthropod-borne pathogens, such as *Bartonella, Borrelia,* and *Ehrlichia* that are carried by many wild mammals. Both studies were the first of their kind to be conducted on stoats.

They collected, fixed, and conducted gross post-mortem examinations of 50 adult stoats from five game estates in Britain. Slides from the organs of these animals were analysed for signs of pathology. Blood samples were also taken from approximately 100 stoats collected from ten game estates, and *Bartonella* spp. were cultured from these samples. A subset of 45 samples using PCR techniques to identify the species of arthropod-borne pathogens was also analysed. Preliminary results indicate the widespread presence of *Bartonella* spp., possibly including *B. henselae*, a significant human pathogen, and eight cases of *Borrelia* spp. No individuals were host to granulocytic *Ehrlichia*.

As a possible extension of this project they are considering the collection and analysis of blood samples and arthropod parasites, such as ticks and fleas, from New Zealand mammals, particularly stoats, but also ferrets, weasels, rats, and possums. The animals must be freshly killed (<24 hours, ideally less). Any people involved in intensive trapping, that could provide such samples should contact Robbie McDonald at the University of Waikato (07) 856-2889 ext. 6298 or e-mail: robbie.mcdonald@stoats.com.

Development of a protocol for the identification of pathogens from sick stoats in new zealand

Joseph O'Keefe and D. Tisdall provided instructions for the collection and testing of specimens and reporting of results required for a survey of pathogens associated with stoat diseases in New Zealand. It was recommended that:

- That someone is appointed to handle any samples, submissions and collation of results. To help this person, details of the selection of animals for inclusion and the submissions of samples and/or animals was provided, along with a list of organisations which are involved in veterinary diagnostics with resident pathologists.
- A full autopsy and examination for parasites was undertaken wherever possible.
- Laboratory testing including gross and microscopic examination, pathogen isolation, serology and molecular assays was carried out.
- Each submission should be assigned a unique identification with results incorporated into a project report and a database of archived material established.

4.4 BEST PRACTICE

Testing the efficiency of current stoat control during the predicted stoat population irruption (summer 1999/2000) in southern beech forest ecosystems

Peter Dilks and Barry Lawrence (DOC) tested the efficiency of Fenn trapping during a predicted stoat irruption. The investigation tested the efficiency of valley wide control of stoats using two techniques:

- One-off control during the summer of stoat irruption in the Dart (treatment) and Caples (non-treatment) Valleys, Otago
- Continuous low-level control in the Eglinton Valley, Fiordland

One-off control during a summer of stoat irruption in the Dart Valley

The findings from this study were:

Mohua or yellowhead at its nest hole.

- Perimeters enclosing up to 1 km^2 with trap tunnels at 100 m spacing significantly reduced stoat numbers. The evidence used to infer this was the decline in stoat trap catch, the decline in the treatment valley stoat tracking and the difference between the treatment and the non-treatment valleys.
- The predicted stoat irruption in the Dart or the Caples Valley during the summer of 1999/2000 did not occur. Therefore this method still has to be tested in a stoat irruption year.
- At the stoat activity levels indicated on the tracking tunnels, no predation of breeding mohua females occurred in the control or treatment valleys, and there was no significantly higher nest predation.
- While mohua nesting was occurring at the 'at risk period' (the period when the young stoats are emerging from the dens in early December) there was no difference in nest success between the two valleys that could be attributed to the trapping programme.

Continuous low-level control in the Eglinton Valley

Over the past two years continuous, low-intensity stoat control has been undertaken in the Eglinton Valley. The method used was traps (Mk VI Fenn) baited with hen eggs or meat and spaced at 200 m intervals along a 45 km line which runs the length of the valley and a short line of traps across the valley at the top and the bottom.

The findings from this study were:

- Low intensity stoat control using traps in the manner described above provides enough protection to markedly reduce stoat predation on breeding mohua and kaka.
- Kaka breeding success last year was the best recorded anywhere, with 80% of kaka nests producing fledglings. A 90% failure in breeding has been recorded for kaka in areas where there is no stoat control. Over the past two years, 25 kaka nests produced 55 fledglings. Only 5 nests failed due to predation and two adult females were killed.

- Mohua breeding success also appears to benefit from stoat control. In the 1990 stoat irruption 50% of the females were lost to predation in untrapped areas. During the summer of trapping, no nests have been lost to stoat predation, however there was a huge increase in rat numbers and the associated rat predation is a concern. If permanently higher rat populations are a result of continual stoat trapping then this would have serious consequences for many bird species. However, it seems more likely that the increase in rat numbers is coincidentally one of the periodic rat irruptions that has been recorded elsewhere in areas with no stoat control.

4.5 TOXINS

Evaluation of cholecalciferol as a new toxin for stoat control

Craig Gillies, Elaine Murphy (DOC), and Eric Spurr (Landcare Research)

Stoats were radio-tagged and monitored through cholecalciferol poisoning operations at two study sites—Pureora State Forest in the North Island and Craigieburn in the South Island. At both sites stoats were targeted using hen eggs laced with cholecalciferol which were placed in specially designed egg stations that prevented the eggs from being removed, but still enabled access by the study animals.

Interim results based on the radio tracking for both sites combined, suggest that at best the poisoned eggs killed 63% (12) of the 19 animals present in the study areas. However, at both sites mortality of the study animals was high prior to the poison eggs being put into the stations and new animals were still being caught right up to the commencement of the poison operation. The radio-tagged stoats that died during the cholecalciferol operations have yet to be analysed for evidence of cholecalciferol poisoning, so conclusions about the effectiveness of this toxin cannot be made until this is completed. Stoats were not eating the eggs at either site during the pre-baiting stage even though there was good evidence at Craigieburn that they were entering the stations. In order to get the study animals to eat the poisoned eggs before the scheduled completion date of the trials, a piece of fresh rabbit meat was used as an additional lure at Pureora and large (~10 mm) holes were punctured in the tops of the eggs at Craigieburn. Both techniques dramatically increased the numbers of eggs being taken but the effective field life of punctured eggs and rabbit meat is limited in terms of its attractiveness to stoats and it is not known whether puncturing the eggs affected the toxicity of the cholecalciferol.

Tracking tunnel indices were used to compare mustelid abundance at each treatment site with an associated non-treatment site before, during and after the cholecalciferol operations. These indices were unable to reveal any large differences in the proportions of lines tracked by stoats as a result of the cholecalciferol operations which suggests that the poisoned eggs may have had little impact on the local stoat populations or re-invasion of new animals was very rapid.

The second stage of this project will involve testing cholecalciferol in a commercial stoat bait formulation. However, due to the lack of a commercially available bait formulation this project will be deferred for a year to await the results of some of the new research that will be commencing this year with respect to baits.

4.6 ECOLOGY

Stoat habitat use and trapping impacts study

Des Smith, a MSc student at Otago University, has been determining the home range of stoats and the effectiveness of trapping as a stoat control strategy to protect takahe in Fiordland. Stoats were live captured and fitted with radio tracking devices attached to collars in order to track their movements to obtain information about home range and dispersal. The study will also look at the impact of kill trapping on the local stoat population and determine whether trapping in the valley floors is sufficient to protect takahe which occupy the snow tussock habitat above the tree line.

Two study areas were used for the 1999/2000 summer—the Mystery Burn (trapped area) and the William Burn (non-trapped area). A total of 13 stoats were caught and of these 9 were collared. Five collared stoats were released in the Mystery Burn and 4 collared stoats were released in the William Burn. The progress and fate of the collared stoats was recorded over a set period. The five stoats collared from the Mystery Burn were within close proximity of the DOC kill-trap line—traps spaced 200 m apart from the valley floor to the head of the basin—yet none of the collared stoats were caught in a kill trap. This raises questions as to the effectiveness of the kill trapping strategy used. Despite continued live trapping no more stoats were collared during February and March.

Spatial data collected will be analysed and, where possible, home range calculated and the types of habitat used identified. Consideration is being given to the feasibility of concentrating on one larger valley next summer and also the prospect of using tracking tunnels to explore the altitudinal differences in rodent abundance and comparing it to the spatial and dietary information collected on stoats. The age, sex and diet of stoats kill-trapped by DOC in three valleys in the Murchison Mountains will also be determined.

Stoat with radio collar.
Photo: John Dowding

5. Process for funding 2001/02

The Stoat Technical Advisory Group invites any organisation or individual interested in proposing new research within the high priority areas identified below to submit an expression of interest by **1 February 2001**. Authors of expressions of interest will either be asked in early March to submit full proposals, or they will be informed that their expression of interest was unsuccessful. Approximately $800,000 of the $1.631 million allocated for 2001/02 will be available for new projects.

Not all the expressions of interest will be able to be funded, and projects will be prioritised by relating their cost to the likely benefit of increasing the effectiveness of stoat control.

5.1 PRIORITY AREAS FOR STOAT RESEARCH FUNDING

1. Research into management and control of stoats

- Logistically feasible and scientifically meaningful monitoring methods
- New baits and lures
- Improvements to aid current best practise

2. Research into understanding the behaviour and ecology of stoats

- Stoat behaviour
- Breeding stoats in captivity
- Interactions with other pest animals

3. Innovative research that has the potential to increase dramatically the effectiveness of stoat control

5.2 EXPRESSIONS OF INTEREST

Expressions of interest for DOC stoat new initiative funding should be sent by mail or email to Elaine Murphy, Department of Conservation, Private Bag 4715, Christchurch (emurphy@doc.govt.nz) no later than **Thursday 1 February 2001.**

Expressions of interest **must** include the following information:

- Research leader and contact details
- Project title
- The research objective(s), which must be specific, time-bound, and measurable
- Proposed research (outlined in 1–2 paragraphs)
- Likely time frame to complete the research
- Estimated annual cost to complete the research

- Identify what other funds will, or may be, aligned with this project or other related work, and outline any collaborations or leverage benefits
- Demonstrate how the research can build on work already funded by the stoat programme (see Table 1), or is filling an identified gap
- Explain how it relates to current best practise for stoat control within DOC

For more information contact:
Elaine Murphy
Department of Conservation
Private Bag 4715
Christchurch
email: emurphy@doc.govt.nz