Northern Te Urewera Ecosystem Restoration Project

Annual Report

JULY 2004 - JUNE 2005

Department of Conservation
Te Papa Atawhai

Northern Te Urewera Ecosystem Restoration Project

Annual Report: July 2004 – June 2005

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Cover Photo: Possum scavenging at abandoned kereru nest
Courtesy Nga Manu Images

OUR VISION:

To acknowledge and nurture the mauri of the northern Te Urewera ecosystem

Summary

This report focuses on the management actions and outcomes for the ninth season of the Northern Te Urewera Ecological Restoration Project (NTUERP).

THE PROJECT

NTUERP is set in the northern part of the Te Urewera National Park and is focused on restoring and maintaining ecosystem processes within a large, forested landscape; our vision is to acknowledge and nurture the mauri of the northern Te Urewera ecosystem. Restoration is currently being attempted through the control of animal pests, principally possums, rats, stoats and deer, and the monitoring of the outcomes of pest control on native flora and fauna. The project is administered by the Department of Conservation (DOC) and is one of six official 'Mainland Islands'.

The management approach for the project is to carry out possum control over a large Background Area to allow for broad gains in ecosystem restoration, while more intensive management is done within smaller, distinct Core Areas. Currently, the Background Area is approximately 50 000 ha, with possum control done on a rotational basis; approximately one-third of the area is treated each year. There are five Core Areas covering approximately 7200 ha. A key aspect of the management strategy is to test a range of methods to improve capability for conservation managers.

PEST CONTROL

A total of 17 913 ha was treated for possums this season with an average residual trap-catch (RTC) of 4.5% over the Background Area (13 210 ha). The use of traps rather than toxins to control possums continues to be effective as well as being target-specific, low risk and can be expected to be sustainable technically and politically with a high level of community support. Setting aside development blocks to allow opportunities for less experienced workers is seen as a key tool in maintaining a pool of suitable workers where, in general, there are fewer and fewer people willing to undertake such work.

Rat trapping was done in five Core Areas encompassing 1550 ha; a total of 10, 793 rats were trapped. The objective of controlling rats to less than 5% tracking index in all five Core Areas was not met this season. The amount of resources available to achieve this objective, given the current management regime, was not sufficient. High frequency trapping (i.e. checks every 1 – 2 days) is effective at controlling rats, including at high densities, however this approach demands a high level of resources. Low-

frequency trapping appears to be effective at controlling (or maintaining) rats at low densities but not high densities. A trial showed that the A-Line rat control regime produced a gradient in rat abundance, with indices increasing from the ridge top trap line to 250m below the perimeter trap line at which point the management regime had no influence on rat abundance. Trapping success rates can be improved by increasing attention to trap set maintenance, reduction of animal interference, and improving bait type.

A total of 511 stoats were trapped this season. With the addition this season of 1050 ha in the Onepu Core Area, approximately 5800 ha are now encompassed by stoat trap lines (1088 trap sets). Preliminary results from a trial comparing Fenn and DOC 200 traps indicate that DOC 200s are more effective at catching stoats than single-set Fenn traps in wooden tunnels. Bead blasting and waxing of Fenn traps greatly improved condition, longevity and performance and similar treatments should be part of a management regime.

An area of 2530 ha (Otamatuna) was treated for deer. Forty nine deer and six pigs were killed during the year. Monitoring of the number of palatable seedlings in the treatment and non-treatment blocks showed that the number of palatable seedlings has decreased, indicating that not enough deer were being removed. A target number of deer to be removed from the treatment area needs to be set so that palatable seedling can regenerate.

CONSERVATION MONITORING

As yet, not enough information has been collected to determine whether the A-Line regime is sufficient to allow kokako to successfully nest. More information was collected on dispersal patterns of kokako showing that they tend to prefer establishing territories adjacent to other kokako rather than along ridgelines.

The kiwi population in Otamatuna/Mangaone Core Areas appears to have stabilised after recent predations by feral dogs: call counts this season are similar to the previous two years but less than the rate recorded prior to the predations in August 2002. Measures taken to reduce the threat of predation by feral dogs appear to have been successful.

The number of whio/blue duck pairs in Te Waiiti Stream, where there is pest control, has increased every year since monitoring began, including this season. Pair densities in the upper Tauranga, where there is no pest control, have remained constant over the last three seasons. Local flood events impacted greatly on whio productivity in the Te Waiiti this season as well as last season. If the frequency of such events increases, conservation of whio could be significantly affected. Within this project, further information on impacts of weather events, adult survival and juvenile survival needs to be collected.

Mistletoe abundance has remained constant at Otamatuna, but at Okopeka (no possum control) it appears that there is the beginning of a downward trend. These results are expected in an environment of continued low possum densities at Otamatuna and medium to high densities at Okopeka.

Trends of increasing deer densities and declining palatable seedling numbers have continued. The causes of deer increase at Otamatuna are probably a mixture of reduced contract hunting pressure within the deer control area, combined with reduced helicopter and private hunting. At Onepu, deer increases are probably due to the near cessation in helicopter hunting. For seedling recovery to improve at Otamatuna significantly increased hunting pressure is probably required.

Tawhero (=kamahi) canopy condition in all areas except Okopeka (non-treatment area) is relatively stable. At Okopeka the decline noticed following the 2002 measurement has halted and there is evidence of a slight recovery. Overall, possums appear to be having little impact on tawhero canopy over most of Te Urewera where possum control is occurring.

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1.0 Introduction

1.1 PURPOSE AND SCOPE OF REPORT

The purpose of this report is to communicate the management actions and outcomes associated with the Northern Te Urewera Ecosystem Restoration Project for the year 1 July 2004 to 30 June 2005.

The report is divided into five main sections:

1) Introduction: Information on the project and the site, the policy framework, and the vision and objectives for the project;

2) Management Approach: An overview of management concepts and terminology, as well as other relevant information;

3) Management & Research: This section highlights what we have learnt from the project this year. It gives an overview of the current management structure and details any areas of investigations and research;

4) Pest Control: Individual reports on animal pest control, including possum, rat, stoat and deer control;

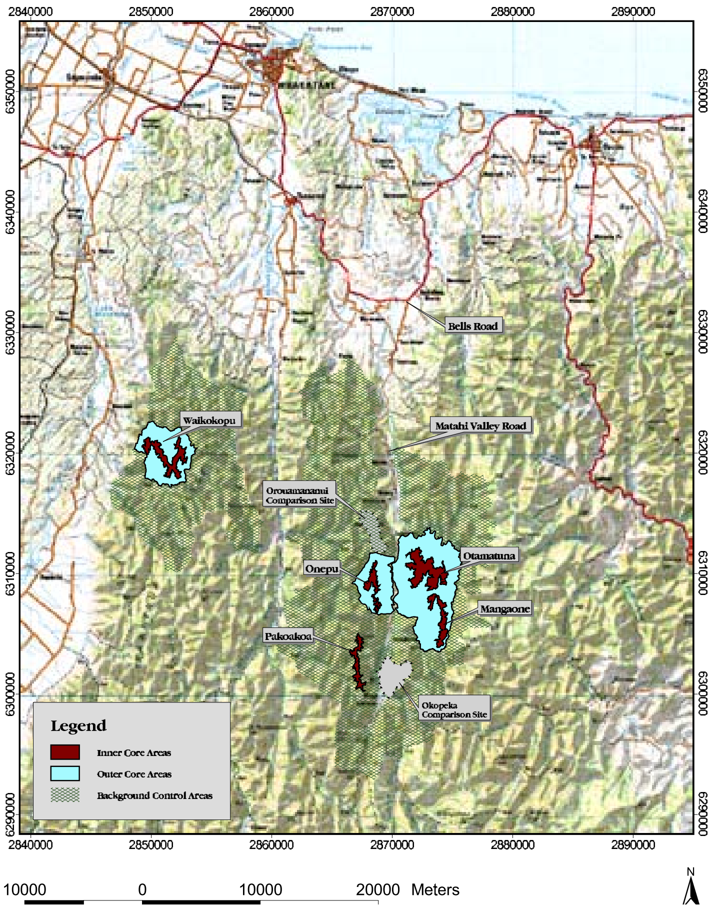
5) Conservation Monitoring: Individual reports on the outcomes on the ecosystem of our animal pest control. This section includes reports on kokako, kiwi, whio, mistletoe, canopy condition and deer impacts;

1.2 PROJECT OVERVIEW

The focus of the Northern Te Urewera Ecological Restoration Project (NTUERP) is restoring ecosystem processes within a large, broadleaf/podocarp-forest environment. This restoration is achieved principally by controlling animal pests, and monitoring the impacts of the animal pest control on the ecosystem.

NTUERP is one of six Department of Conservation (DOC) sites labelled as ‘Mainland Islands’: ‘islands’ of protected areas within a ‘sea’ of unprotected area. The Mainland Island concept was launched in 1995 and NTUERP was initiated in 1996. Prior to the establishment of the project, surveys in the late 1980s and early 1990s indicated that the forests of northern Te Urewera housed the largest known population of kokako, but populations were declining at an alarming rate. Protection of nesting kokako in the form of possum trapping was instigated by DOC staff and this work served as the precursor for the establishment of NTUERP. A strategic plan for the project was produced by Wildland Consultants (Shaw et al. 1996) and served as the foundation management document.

Figure 1.1 .Location and overview of the Northern Te Urewera Ecosystem Restoration Project showing principal road access, Background Areas, Inner and Outer Core Areas, and management comparison sites.



1.3 SITE DESCRIPTION

NTUERP is located within the northern section of Te Urewera National Park and lies c. 30km south of Whakatane and c. 30km SSW of Opotiki. The administrative and management base for the project is the Opotiki Area Office (Department of Conservation); the office and project are situated in the East Coast Hawke's Bay Conservancy and further support is provided by staff in the Conservancy Office in Gisborne. Figure 1.1 shows the location of NTUERP and the main management areas in the project. The principal road access for the project is via Bells and Matahi Valley Roads off State Highway 2, east of Taneatua.

Te Urewera National Park (212 673 ha) is part of the largest extant forest tract in the North Island which encompasses the Huiarau Range which divides the Hawke's Bay, Poverty Bay and the Bay of Plenty. The boundaries of NTUERP are more or less the National Park's eastern, northern and western boundaries and the Waikare River to the south. The forests to the south-west and east of the National Park boundary are part of the same forest tract and are largely under DOC management (Whirinaki Forest Park, Waioeka Conservation Area, Waioeka Gorge Scenic

Reserve, Urutawa Conservation Area and Raukumara Conservation Park).

Physically, the land is characterised by ridge after ridge of bush-clad ranges, rising from valley floors of significant rivers to over 900 m above sea level. The vegetation is characterised as semi-coastal lowland forest, being relatively homogeneous in nature and largely comprised of beech forest to the south and rimu/tawa forest to the north. Partly as a result of its size and management history, northern Te Urewera contains an assemblage of flora and fauna as complete as any in the North Island. This assemblage includes a number of rare and threatened species, such as mistletoe, tusked weta, kereru, kaeaea (falcon), kokako, kaka, kiwi, whio, long-tail bats and short-jawed kokopu. Most of these species require some form of active management to prevent their numbers diminishing.

The Tuhoe iwi are tangata whenua and have had a long association with the land. A significant proportion of the land adjoining northern Te Urewera National Park is owned by Tuhoe hapu; this includes several large blocks wholly surrounded by National Park.

1.4 PROJECT FRAMEWORK

Strategic direction for the project is set by various documents and acts of parliament. The most relevant acts of parliament are the Conservation Act 1987 and the National Parks Act 1980, as well as the Wildlife Act 1953. Relevant policies and plans set by the Department of Conservation are contained in publications including: Conservation General Policy, Department of Conservation Strategic Business Plan: restoring the Dawn Chorus, Statement of Intent, and General Policy for National Parks 2005, as well as the New Zealand Biodiversity Strategy. Regional conservation management is guided by the East Coast/Hawke's Bay Conservation Management Strategy. Further, specific strategic direction for Mainland Islands is guided by eight principles incorporating learning, communication, restoration, sustainability, and community participation.

1.5 PROJECT VISION AND MANAGEMENT OBJECTIVES

The vision for the Northern Te Urewera Ecosystem Restoration Project is:

To acknowledge and nurture the mauri of the northern Te Urewera ecosystem.

The term mauri can be translated to mean health and life-force and the challenge before managers of the project is that in order to nurture the mauri of northern Te Urewera, the restoration of the ecosystem must be as complete as possible (Shaw et al. 1996).

The four main management objectives for the project are listed below (Shaw et al. 1996, pp. 14-15):

1) To ensure the long-term sustainability of the northern Te Urewera

ecosystem, by undertaking management activities for the purpose of protecting the health and natural functioning of key components and processes in the northern Te Urewera ecosystem;

2) To maintain and restore threatened species populations;

3) To give effect to the Treaty partnership between the Department and tangata whenua throughout the planning and implementation of the ecosystem restoration programme;

4) To gain the support and co-operation of the wide community of interest (including the local residents, recreation, business, political, scientific, and education) in the ecosystem restoration programme; and to positively contribute to the wide community of interest in the immediate term and over the timeframe of the project.

The above objectives, which generally have a multi-year focus, are supported by annual objectives associated with particular aspects of management that are reported on in this document.

2.0 Management Approach

2.1 INTRODUCTION

The initial NTUERP Strategic Plan (Shaw et al. 1996) outlined an understanding that achieving restoration across the wider forest tract of 50 000--70 000 ha would require incremental effort. The stated intention was 'to start small, with one area of c.1300 ha (Otamatuna), get the techniques right, develop a cost-effective approach, and then to expand the intensive management programme systematically across the wider northern Te Urewera' (Shaw et al. 1996, p. 8).

The project's emphasis is on undertaking management trials designed to answer questions which are relevant to the continued and improved success of active ecosystem restoration in northern Te Urewera (Shaw et al. 1996). These management trials entail the development or testing of intensive and multi-pest control regimes within small defined study areas (e.g., Otamatuna), while carrying out possum control across the remainder of the 50 000 ha area for the purpose of enhancing forest/ habitat condition while attempting to 'hold the line' on biodiversity loss.

The establishment of the Otamatuna study area was the obvious starting point for the project, building on the annual possum control which had begun there in 1993, and kokako monitoring undertaken since 1991. Okopeka was established as the principal non-treatment study area for reference or comparative purposes. Further smaller-scale study areas, now referred to as Core Areas (see below), were selected in successive years.

2.2 MANAGEMENT CONCEPTS AND TERMINOLOGY

Two key terms are used to describe the broader management approach to ecosystem management within NTUERP: 'Background Area' and 'Core Area'.

As generally described above, the Background Area is a large, defined area (currently c.50, 000 ha) encompassing (but not limited to) the northern part of Te Urewera National Park where management allows some enhancement of forest/habitat condition; currently, this is achieved by possum control only (Fig 1.1).

Core Areas are small- to medium-sized, defined management areas within the Background Area, where the goal is to sustainably control to low levels, a range of animal pests to allow for ecosystem recovery and the dispersal of target species. As management techniques develop, the long-term intention is to have a matrix of Core Areas across the northern

Te Urewera landscape. Current Core Areas are shown in Figure 1.1. Management regimes for individual Core Areas differ according to the management objectives for each site.

To help gauge the effects of management on pest animals and native species, two comparison areas have been used within NTUERP. Okopeka (c.300 ha) was established in 1996 at the start of the project and is located on the eastern side of the Tauranga River and the northern side of the Otane Stream (Fig 1.1); no animal pest control is undertaken here. Orouamananui has an undefined boundary but is an area of ridge crest approximately three kilometres long north of the Onepu Core Area. It falls within the Background Area and possum control is undertaken periodically. Orouamananui was established in 2000/01 as a comparison site for kokako nesting success monitoring and has also been used as a Core Area comparison site for rat monitoring and for distance-sampling bird counts. The area containing the rat monitoring lines is indicated in Figure 1.1.

Core Areas are further divided into the Inner Core and Outer Core where the Inner Core is the area where rat control is undertaken and the Outer Core is the remainder of the Core Area.

Topographically, the current Inner Core Areas are situated around major ridge systems, including adjacent side-spurs. Most intensive pest control work is undertaken on lines which are cut and marked and run along the main ridges and spurs and also along sidle or contour lines. These sidle lines generally run 150m (on-the-ground) from the nearest ridge or spur trap line. The first sidle line below the ridge and spur tracks is termed the A-Line; the second (150m below the A-Line) is called the B-Line and so on. Currently, the most developed Core Area, Otamatuna, has a C-Line configuration, i.e. three sidle lines below the ridge and spur lines. Figure 2.1 illustrates the Core Area, Inner Core, Outer Core, and A-, B-Line (etc.), concepts.

Currently, there are five Core Areas located within NTUERP and these are referred to by the following names (either in conjunction with the words Core Area, or by the name alone): Otamatuna, Mangaone, Pakoakoa, Onepu and Waikokopu. Table 2.1 details the characteristics of management areas, including the types of pest control and monitoring.

Figure 2.1 Overview of the Otamatuna and Mangaone Core Areas showing Inner and Outer Cores, Ridge, A-, B-, and C-Lines, and Background Area

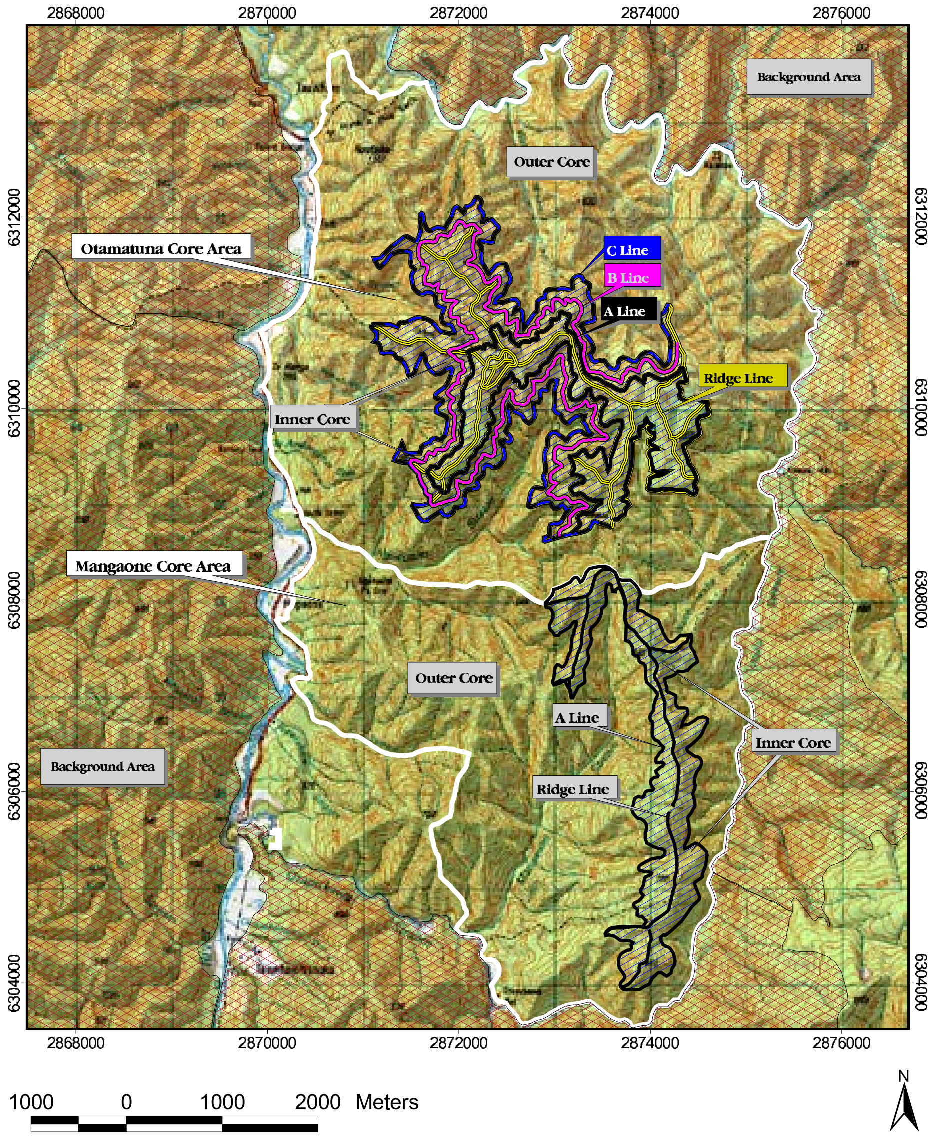


TABLE 2.1 MANAGEMENT PRACTICES AND CHARACTERISTICS OF MANAGEMENT AREAS WITHIN THE NORTHERN TE UREWERA ECOSYSTEM RESTORATION PROJECT, 2004/05

	MANAGEMENT AREA							
	OTAMATUNA	MANGAONE	ONEPU	WAIKOKOPU	PAKOAKOA	OKOPEKA	OROUAMANANUI	BACKGROUND AREA
Total Area (ha)	2530	1503	179	1782	185	c.300	–	c 50 000
Inner Core (ha)	577	232	179	377	185	–	–	–
Outer Core (ha)	1953	1271	–	1405	–	–	–	–
Year initiated	1996	1998	1997	1999	2003	1996	2000	1996
Management Regime	A-B-C Line (in Inner Core)	A-Line (in Inner Core)	A-Line	A(B)-Line	A-Line	Non-treatment	Background reference	Background area
Animal Pest Control								
Possums	✓	✓	✓	✓	✓		✓	✓
Rats	✓	✓	✓	✓	✓			
Stoats	✓	✓	✓	✓	✓			
Deer & Pigs	✓							
Animal Pest monitoring								
Possums	✓			✓	✓	✓		✓
Rats	✓	✓	✓	✓	✓		✓	
Deer	✓		✓					✓
Stoats								
Outcome monitoring								
Kokako	✓	✓	✓	✓	✓			
Kiwi	✓	✓						
Whio	✓	✓	✓					✓
Mistletoe	✓					✓		
Canopy Condition	✓					✓		✓
Understorey	✓		✓					

2.3 MANAGEMENT TECHNIQUES

Within NTUERP there is a strong emphasis on developing sustainable management techniques; by sustainable we mean that there will be no effects generated from current management that will adversely affect future management or the physical and socio-political environments. In particular, significant effort is put into improving the effectiveness of management techniques, particularly animal pest control.

As above, current animal pest control methods are principally the use of toxins and traps, and hunting (including using specialised dogs). Specific animal pest monitoring is currently undertaken for rats, deer and possums. Conservation monitoring is focused on vulnerable flora and fauna as an indication of the effectiveness of animal pest management. The labour used is a mix of DOC permanent and temporary staff members and contract employment.

Helicopters are frequently used and are considered essential for the current management effort as they provide an efficient means of moving people and equipment into remote locations.

2.4 INFRASTRUCTURE

On-site project infrastructure includes access tracks, management huts and campsites, animal traps, bait stations, permanent markers, and information panels.

The access tracks include some public walkway tracks, and are generally formed tracks that are kept free of obstacles (vegetation and windfalls), include benching in some instances, and are (usually) marked with permanent markers, mainly plastic triangles. The quality of the tracks varies considerably depending on their purpose (e.g. public track, bait station sidle line).

Tracks, kill-trap sites and bait station sites as well as monitoring lines and points are marked with plastic triangles. These are colour-coded for their various purposes (see below) and often have information written on them (e.g. trap numbers, line names, and track junctions). The main colours and their corresponding uses found within NTUERP are:

Orange:	Public track markers
Yellow:	Stoat and rat trap / bait station lines
Pink:	Kill-trap and bait station sites; mistletoe sites
Blue:	Rat monitoring lines

Back-country huts, purpose-built solely for the use of DOC staff and contractors, are located in each of the core areas (Otamatuna has two huts). The huts are supplied with gas for cooking, a wood fire for heating, a water supply and toilet. The two huts within Otamatuna also feature a 12-volt battery / solar power system from which internal lighting, VHF radios and other devices can be run. Adjacent to the huts are storage sheds of various nature in which materials such as tools, poisons and traps are stored. Helicopter access is handy to all huts. A number of campsites with various materials (e.g. tent flies, storage drums) also provide support for field workers. Public huts managed by the Department of Conservation are also used.

3.0 Project Management and Research

3.1 ANNUAL REVIEW

Good conservation gains continue to be made within the project; whio pair numbers in Te Waiiti have again increased this year, and kokako populations have at least remained stable. Further monitoring of kokako nesting effort in the A-Line Core Areas will determine if these regimes are sufficient to recover kokako. Likewise, for whio, more research is needed to fully understand the impact of current management for whio conservation. Kiwi numbers in the monitoring areas are also stable after the spate of dog kills in 2003 and 2004; this indicates that the measures taken to reduce the risks from dogs were effective. Monitoring of kiwi chicks to test the stoat trapping regime needs to continue as insufficient data has been collected to date. Possum control has benefited the mistletoe species *Peraxilla tetrapetala* in Otamatuna where abundances remain steady compared to non-treatment areas.

The wide-scale possum trapping programme is continuing to be effective. Possums are reduced to low levels allowing ecosystem recovery: tawhero/ kamahi canopy condition appears to have stabilised. Maintaining a core group of able trappers continues to be a concern for the future of this method. The use of development blocks to facilitate less-experienced trappers continues to receive positive feedback. Next season, increased effort will be directed into Core Areas to ensure that possums in these areas are kept to low levels. The use of a kill-trap regime is showing potential as an alternative to leg-hold trapping. Set-up costs are high but maintenance costs are lower, so costs per hectare should favour kill trapping after several years if results are acceptable.

The stoat trapping network has been expanded and some investigation has been made into the catch rates of Fenn traps and the newer DOC200 traps. In general, the regime appears to be working well with few stoats caught outside of the summer when young stoats disperse.

Results from rat control in Core Areas were somewhat disappointing this season. The objective to control rats to low levels in all five Core Areas was not achieved in any of them. Given the current level of resources it has been decided to consolidate our effort and attempt year-round control at Otamatuna and control during November to February in the other Core Areas, being the key period for kokako breeding. There is ongoing effort to improve our management effectiveness, particularly through organised trials.

Similar to the issue with rat control, deer control at Otamatuna requires increased attention. Monitoring of deer numbers has indicated that numbers have been increasing but more importantly, the number of palatable seedlings in plots has decreased again this season. The lower number of deer kills compared to other years reinforces the need to increase our effort to reduce deer numbers.

3.2 ADMINISTRATION

Key personnel involved in the project are listed below (Tables 3.3.1 and 3.3.2).

TABLE 3.3.1 KEY DEPARTMENT OF CONSERVATION STAFF INVOLVED IN THE NORTHERN TE UREWERA ECOLOGICAL RESTORATION PROJECT, 2004/05

OPOTIKI AREA OFFICE	
Kevin Cannell	Area Manager
Trish Edwards	Programme Manager, Business Services
Karen Kaukau	Ranger, Business Services
Andrew Glaser	Programme Manager, Biodiversity Assets
Hemi Barsdell	Ranger, Biodiversity Assets
Jane Haxton	Ranger, Biodiversity Assets
Cody Thyne	Ranger, Biodiversity Assets
Lindsay Wilson	Programme Manager, Biodiversity Threats
Daniel Baigent	Ranger, Biodiversity Threats
Shane Gebert	Ranger, Biodiversity Threats
Pete Livingston	Ranger, Biodiversity Threats
Rebecca Gibson	Ranger, Biodiversity Threats
Graeme Shaw	Programme Manager, Visitor Assets & Community Relations
Emily Buchan	Ranger, Biodiversity Assets and Community Relations
EAST COAST HAWKE'S BAY CONSERVANCY OFFICE, GISBORNE	
Chris Ward	Conservancy Advisory Scientist
John Lucas	Technical Support Officer, Threats
Don McLean	Technical Support Officer, Flora
Rhys Burns	Technical Support Officer, Fauna
RESEARCH, DEVELOPEMENT & IMPROVEMENT DIVISION	
Craig Gillies	Scientific Officer
Darren Peters	National Predator Officer
Elaine Wright	Terrestrial Sites Manager

TABLE 3.3.2 CONTRACTORS EMPLOYED BY THE DEPARTMENT OF CONSERVATION FOR THE NORTHERN TE UREWERA ECOSYSTEM RESTORATION PROJECT, 2004/05

NAME	KEY TASK
Wayne Looney	Contracted deer hunter
Perrin Brown	Contracted deer hunter
Jason Healy	Contracted deer hunter
Mike Dowden	Contracted deer hunter
Keith Beale	Core Area Pest Control
Arthur Sandom	Core Area Pest Control
Gaye Payze	Core Area Pest Control
Joe Rurehe	Core Area Pest Control
Kevin Marsden	Possum Control Contractor
Andy Marsden	Possum Control Contractor
Hepa Rako	Possum Control Contractor
Lyn Thyne	Possum Control Contractor
Gary Thyne	Possum Control Contractor
Gary Peratiaki	Possum Control Contractor
Colin Cartwright	Possum Control Contractor
Walter Kilgour	Possum Control Contractor
Michael Thrupp	Possum Control Contractor
John Williams	Possum Control Contractor
Malcolm McFarlane	Possum Monitoring Contractor
Glen Ballinger	Possum Monitoring Contractor

3.3 RESEARCH

This section is a summary of research projects undertaken within NTUERP that have run for part or all of the financial year being reported on. In general, the purpose of the research is to enhance management capability through improving knowledge and/or practices. Research includes ‘field trials’, which are investigations that have gone through a particular review process and also investigations that were undertaken in conjunction with other agencies where Departmental involvement has varied. Some projects have a multi-year focus and may not yet be completed, while others bridge reporting periods. More detail may be included in later sections in this report or in other documents referenced here.

INVESTIGATION TITLE	OPTIMISING THE MAINTENANCE CONTROL OF POSSUMS THROUGH ADAPTIVE MANAGMENT III STUDY SITES AND EXPERIMENTAL DESIGN
Researcher	Landcare Research *Manaaki Whenua*: (John Parkes, David Choquenot, David Forsyth)
Study Period	2001 onwards
Summary	An adaptive experimental management project for maintenance control of possums where treatment (possum control) at seven sites is based on monitoring cues. The cues chosen were frequency (2, 4 or 7 years), density indices (10% and 25% trap catch) and resource condition.
Report Section (s)	Section 4.2
Reference Documents & Files	Landcare Research Report: LC9900/74 Investigation number 2398

INVESTIGATION TITLE	COMPARISON OF POSSUM KILL-TRAP TYPES AT WAIKOKOPU
Researcher	DOC (Lindsay Wilson, Hemi Barsdell)
Study Period	August 2003 – September 2005
Summary	Three types of possum kill traps were trialed in the Waikokopu Core Area to compare catch rates. In total, 415 traps were used: 199 'Warrior', 118 'Connibear' (or 'Steve Allen') and 98 Sentinel. Generally, the traps were set out in a sequence of Connibear-Warrior-Sentinel-Warrior-Connibear, etc. Catch rates were higher for Connibear traps but these traps also had the highest spring-off rates; the most effective trap was the Sentinel.
Report Section (s)	Methods are detailed in section 4.2
Reference Documents & Files	OLDDM-960034 Waikok Kill Trap Presentation for Mainland

INVESTIGATION TITLE	AN INVESTIGATION INTO THE ABILITY OF RAT CONTROL MEASURES IN THE ONEPU CORE AREA TO EXTEND AN INFLUENCE ON RAT POPULATION DENSITIES BEYOND THE MARGINS OF THE CONTROL AREA
Researcher	Pete Fergusson
Study Period	April 2005 - December 2005
Summary	The study was conducted as part of a 2005 Royal Society Maths, Science and Technology Fellowship. The influence of rat control methods beyond the A-Line perimeter of the Onepu Core Area was measured using tracking tunnels where tracking tunnel lines were set at 50m inside the A-Line and also 50m, 150m, 250m and 350m outside the A-Line. Tracking rates were measured at six-weekly intervals from April to December 2005. The main conclusion was that the rat control regime produced a gradient in rat abundance, with indices increasing from the ridge top trap line to 250m below the perimeter trap line at which point the management regime had no influence on rat abundance.
Report Section (s)	See section 3.2 for further detail on methods
Reference Documents & Files	Unpublished report with above title: DOCDM-87196

INVESTIGATION TITLE	EFFICACY OF DOC 200 VERSUS MK 6 FENN TRAPS AT CATCHING STOATS
Researcher	DOC (Field trial) Lindsay Wilson, Craig Gillies, Darren Peters
Study Period	1 September 2004 – 1 March 2005
Summary	Trial involved placing 173 DOC 200 traps set in single set wood trap tunnels and 173 Mk 6 Fenn traps in single set wood trap tunnels alternately, 100m apart on lines in the Onepu Core Area. Between September 2004 and June 2005, 28 stoats were caught in Fenn traps and 51 stoats were caught in DOC200 traps.
Report Section(s)	4.4
Reference Documents & Files and	OLDDM-767156 DOC 200 vs Mk 6 Fenn Trap at Te Urewera, OLDDM-147264 Northern Te Urewera Trap Trial (data)

INVESTIGATION TITLE	EFFICACY OF DOC 200 VERSUS VICTOR PROFESSIONAL RAT TRAPS AT CATCHING RATS
Researcher	DOC (Field trial) Darren Peters, Craig Gillies, Lindsay Wilson
Study Period	1 November 2004 – 30 June 2006
Summary	70 single set DOC 200 traps in wooden tunnels and 70 single set Victor Professional Rat traps in current best practise coreflute tunnels were placed alternately every 25m along the marked and existing "A" trap line in the Mangaone Core Area. Both trap types were baited with white chocolate buttons. Checks were made daily, decreasing to monthly depending on capture rates. Trial is continuing to June 2006 and results will be presented in the relevant NTUERP Annual Report
Report Section(s)	Section 4.3
Reference Documents & Files	OLDDM-767157 [Field Trial Template], DOCDM-71806 [Report], DOCDM-84148 [Data]

4.0 Pest Control

4.1 INTRODUCTION

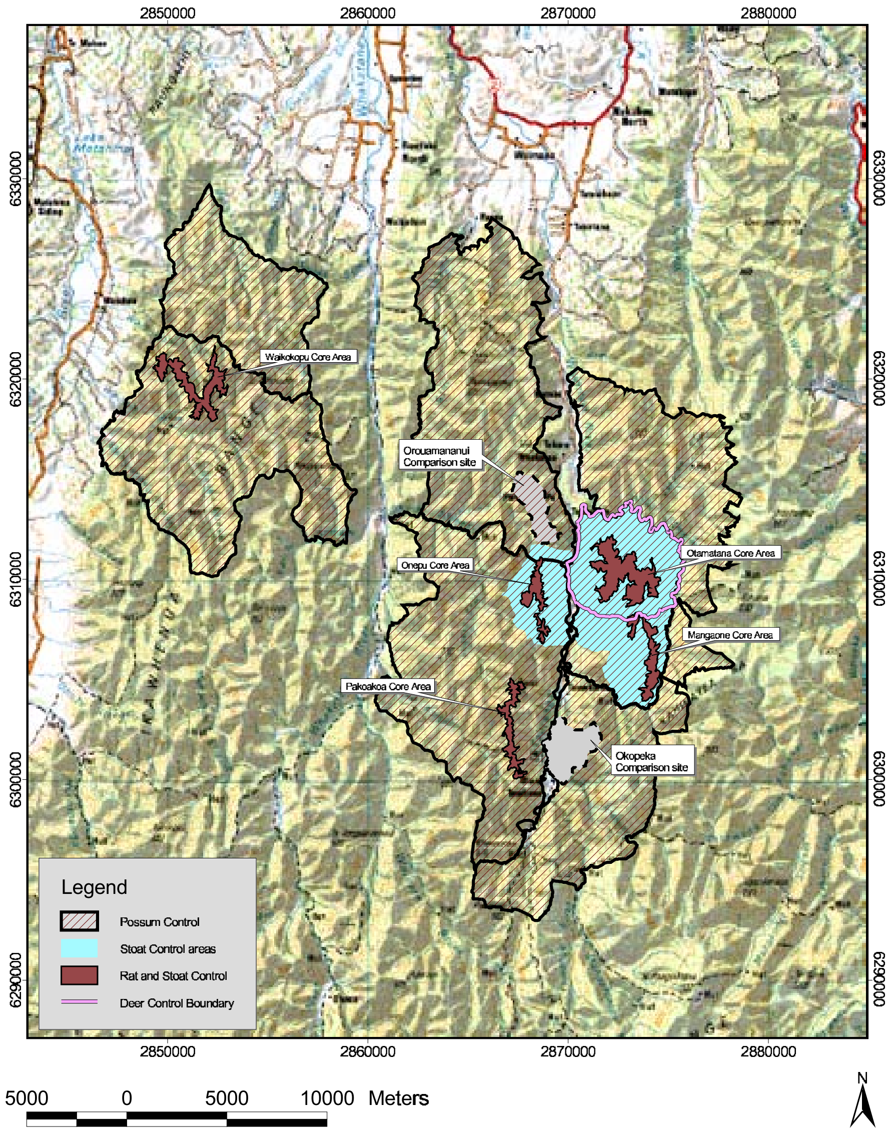
The control of animal pests is the principal means of achieving ecosystem restoration within northern Te Urewera. The animals targeted are possums, rats, stoats and deer. More information on individual species is given in the following sections.

The approach for pest control within northern Te Urewera is to manage animal pests at different scales according to their impacts, behaviour and available methodologies. Possums, which can have a devastating impact on natural ecosystems as browsers, competitors and predators are targeted on a large scale, c. 50 000 ha. In contrast, rats are managed on much smaller scales, c.200 - 600 ha areas within high-value biodiversity sites. Deer and stoats are managed on intermediate scales. However, animal pest control for different species is not performed in isolation; a range of animal pests are controlled at individual sites to enhance ecosystem functioning perhaps achieving synergistic effects.

Within NTUERP, the area in which large-scale possum control alone is undertaken is termed the Background Area. The sites of more intensive effort are termed Core Areas, the boundaries of which are determined by the limits of some pest control. Rat control is undertaken within centralised areas termed Inner Core Areas which are currently based around higher areas, i.e. main ridgelines and associated spurs. Outer Core Areas are usually bounded by the limit of stoat control. These boundaries are usually defined by topographical features, particularly waterways, or tracks (including roads). Currently, Core Areas cover c.5800 ha.

The areas in which different pest animals are targeted are shown in Figure 4.1.1. Possum control is done over the entire project area (c.50 000 ha) although not all this area is treated every year. Stoat control is undertaken in all Core Areas (5800 ha), although not in the Waikokopu Outer Core. There is no Outer Core for the Pakoakoa Core Area. Rat control is done in all Core Areas and covers c.1500 ha. Deer control is only done within the Otamatuna Core Area (2530 ha).

Figure 4.1.1 Overview of pest control within the Northern Te Urewera Ecosystem Restoration Project showing areas of possum, rat, stoat and deer control, and Core Areas and management comparison sites, 2004/05



4.2 POSSUMS

Lindsay Wilson

4.2.1 Abstract

Possum control is an integral part of the NTUERP strategy with around 50 000 ha treated on an approximate 3-yearly rotational basis to improve ecosystem condition. This season, 17 913 ha was treated for possums: 13 210 ha in the Background Area and 4703 ha in Core Areas; the Pakoakoa Core Area was treated as part of the Background Area. Possum control was achieved by using ground-based techniques, predominantly trapping but also using cyanide in paste or capsules. All control work was completed by contractors. An average residual trap-catch (RTC) of 4.5% was achieved over the Background Area this season; this is below the target of 5% RTC. A total of 16,792 possums were reported killed by contractors within the Background Area. While control was undertaken in all Core Areas, post-control monitoring was only done at Waikokopu where a 3.4% RTC was achieved in the Inner Core and a 13.5% RTC was achieved in the Outer Core. The use of a skilled group of contractors continues to achieve good results. The methods of control used are target-specific, low risk and can be expected to be sustainable technically and politically with a high level of community support.

4.2.2 Introduction

The Northern Te Urewera Ecosystem Restoration Project (NTUERP) commenced in 1996 and encompasses approximately 50 000 ha of the northern part of Te Urewera National Park. Possum (*Trichosurus vulpecula*) control has been undertaken by the Department of Conservation (DOC) in part of this area since 1992 with control initially focused on protecting vulnerable canopy species such as tawhero (kamahi; *Weinmannia racemosa*). However, in more recent years the impacts of possums on a variety of flora and fauna has been recognised and the conservation objectives have broadened towards ecosystem restoration. It is recognised that vulnerable species can tolerate only low possum densities and the current control strategy within NTUERP is to maintain possums at low to moderate densities by undertaking control within small blocks on a rotational basis.

One aerial 1080 operation was carried out in 1997 as an initial knockdown in the Southern Ikawhenua area. The control frequency within the Background Area is between two and four yearly where the frequency is determined by temporal and possum density triggers as part of the Landcare Research project 'Optimising the maintenance control of possums through adaptive management' (Section 3.2). Core Areas have traditionally been managed using toxins placed in bait stations. Toxins previously used in these areas have included brodifacoum, Pindone, cholecalciferol and cyanide, however, since 2000/01, cyanide and cholecalciferol have been the only toxins used. Currently, the principal control method is leghold trapping, although a combination of different kill traps have also been established along the main ridges and spurs within the Waikokopu and

Pakoakoa Core Areas.

Conservation outcomes of the possum control programme are assessed using the Foliar Browse Index method (Payton et al. 1997) to measure canopy condition, and monitoring of mistletoe species (*Peraxilla tetrapetala* and *Alepis flavida*) and northern rata (*Metrosideros robusta*) condition. Kokako (*Callaeas cinerea wilsoni*) nest monitoring and kokako population census have also been undertaken within Core Areas and reflect the combined effects of possum, rat (*Rattus rattus*) and stoat (*Mustela erminea*) control within these areas.

4.2.3 Objectives

The annual objectives for possum control within NTUERP are:

- To reduce possum densities within the Background Area to < 5% Residual Trap Catch during each treatment year.

- To maintain possums in Core Areas at < 3% Residual Trap Catch within the Inner Cores and < 5% Residual Trap Catch in the Outer Cores.

4.2.4 Methods

Within NTUERP, possum control is managed on two different scales: large-scale 'Background Area' and smaller--scale but more intensively controlled 'Core Areas' (see Section 2.0). For management purposes, the Background Area is split into six *management areas*: Northern and Central Ikawhenua; Northern and Southern Whakatane; and Northern and Southern Waimana. These areas are further divided into *clusters* and then subdivided into *monitoring blocks* of c.300 ha. The boundaries of monitoring blocks are mainly based on topographical features such as ridgelines and waterways. In total, the Background Area covers c.42200 ha with 148 blocks in 41 clusters. The number of blocks within each cluster (2-6) and the number of clusters within each area (5-10) varies.

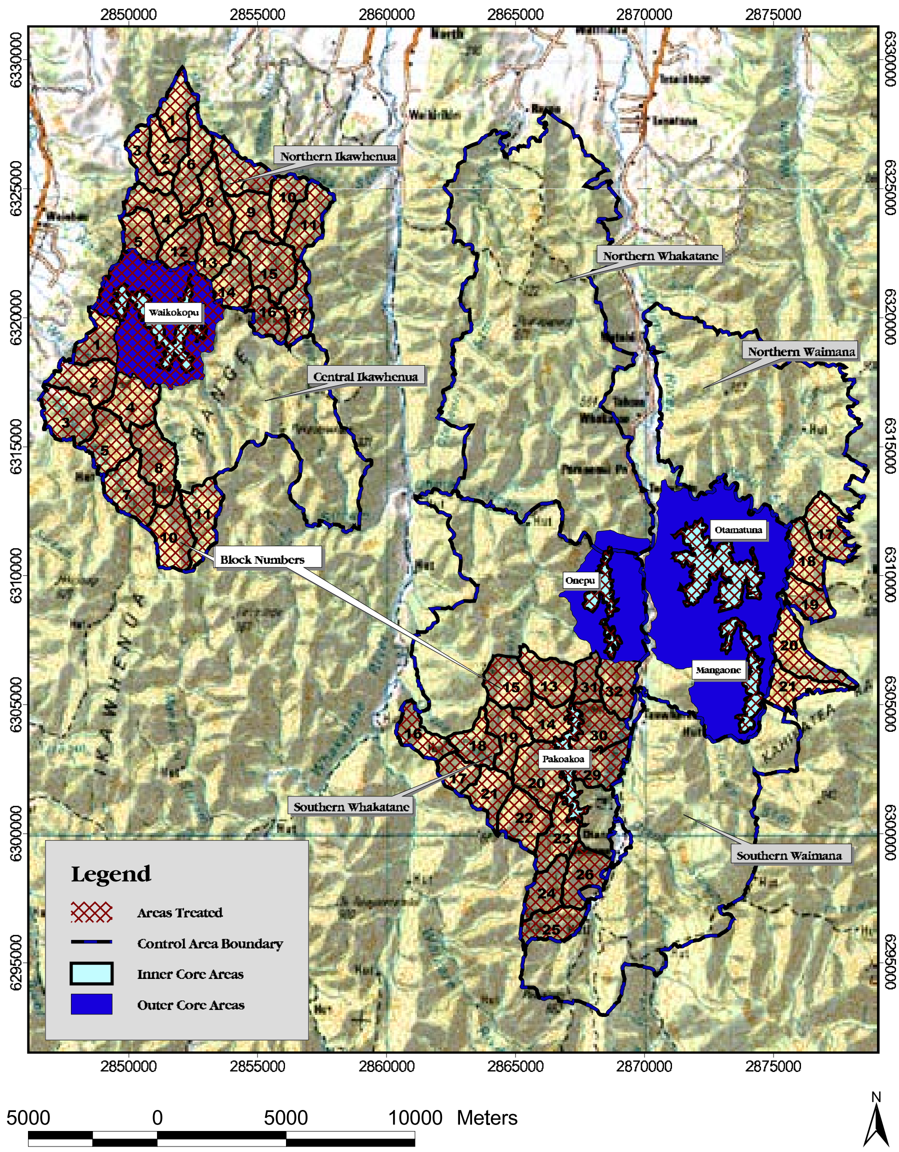
Within the Background Area, contractors were employed on performance-based contracts. Performance-based contracts were let to independent contractors through a tendering process where independent contractors work towards a target trap catch index using any approved trap, cyanide and cholecalciferol. Up to half the contract amount was paid as progress payments and the balance was paid upon achievement of the target index. Contract blocks were kept small (approximately 300 ha) and contractors were allocated clusters of three to four adjoining blocks. Contractors were selected using a competitive tendering process (for further detail refer to 'East Coast Hawke's Bay Animal Pest Management Tendering Procedure Manual for Animal Pest Contracts'; DME: HWKCO-22073). Two 'Skill Development' blocks were kept outside the tendering process and were used to assist the entry of a new contractor who did not have the experience specified by the tendering criteria. Figure 4.2.1 indicates where possum control was undertaken for the 2004/05 season. The main control method was trapping using Victor No. 1 leg-hold traps set against the base of a tree, or 350mm above ground level in Otamatuna and Mangaone Core Areas to minimise any impact on kiwi (*Apteryx mantelli*). While trapping was the predominant control method, cyanide poison, either as a paste (60% sodium cyanide) or Feratox (80% potassium cyanide, encapsulated and coated with cereal) was also used. These toxins were set either in a bait station or laid on the ground, except where a kiwi population exists (baits must then be in a container or 700 mm above ground). Cyanide was applied by approved operators (DOC staff or contractors employed by DOC). Pre-feeding with non-toxic bait (flour, cereal pellets or kibbled maize) sometimes preceded toxin application.

As part of the tendering process contractors submitted a timetable for controlling possums within each monitoring block. Contractors notified the Department once they considered possum densities had been reduced to below the control target, and post-control monitoring was then undertaken by monitoring contractors. If control targets were met within monitoring blocks, contractors were paid out to the value of that block. If post-control monitoring revealed that the possum density was higher than the control target, additional control work was undertaken by the contractor. Following any additional control work the block was re-monitored. Re-monitoring costs were recovered from the control contractor. Both the control contractors and monitoring contractors were regularly audited by DOC staff.

In addition to the Background Area, possums were controlled within the more intensively managed multi-pest control Core Areas: Otamatuna, Mangaone, Onepu and Waikokopu. Possum control within the Core Areas is mostly undertaken by contractors on prescriptive contracts. Here, contractors were paid a fixed amount for possum control undertaken in a prescribed manner, and equipment was supplied by the Department. Pakoakoa Core area was treated as part of the background control area comprising five blocks within the Southern Whakatane clusters. The treatment of Core Areas this year was not as intensive as previous years. Maintenance control was carried out within all the Core Areas using Feratox in bait stations and in bags stapled to trees. Feratox was also put out within the Inner Core Areas when possum interference occurred on the rat lines. Within the Otamatuna Inner Core Area, leg-hold trapping as well as Feratox was used to control possums. The intensive trapping regime in the Waikokopu Core Area was maintained with a series of kill taps set along main ridges and prominent spurs. Sentinel, Connibear and Warrior kill traps were set in a sequence of Connibear – Warrior – Sentinel – Warrior – Connibear etc. In total there were 389 kill traps used: 116 Connibear, 177 Warrior and 96 Sentinel traps (see Section 3.2). Trend monitoring was carried out at Otamatuna and Waikokopu Inner and Outer Core Areas; pre-control monitoring was done in both blocks in July, and post-control monitoring was done in Waikokopu (but not Otamatuna) in June. In previous years, trend monitoring may have been undertaken in other management sites either prior to control or in years where control was not undertaken.

The National Possum Control Agencies (NPCA) residual trap catch (RTC) protocol (2004) was used for all monitoring. However, the NPCA trap catch protocol is designed for large operational areas, not small blocks less than 500 ha in size as is the case in NTUERP; therefore minor variations to the protocol were implemented. Five lines of 10 traps were used to monitor each block (approximately 300 ha average size). This is less than the recommended minimum of 10 lines per block, but the subsequent total number of lines in each operational area is much larger than the recommended minimum giving good precision when each contract block is considered as a stratum. The appropriate number of lines recommended by the protocol was used in pre-control and trend monitoring. Monitoring lines are permitted to be located right up to the boundary of contract blocks, not the 200m minimum specified in the protocol.

Figure 4.2.1 Areas treated for possum control, including management control areas, possum blocks treated, and Inner and Outer Core Areas, northern Te Urewera, 2004/5



This variation was necessitated by the small block size; a 200m buffer would exclude a large portion of the block, including in many instances prime possum habitat along ridges. It is a common practice to use magnetic north as the standard trap line bearing. This can result in tactical control by contractors, especially where block shapes preclude a monitoring line being able to fit in some parts of the block. To avoid this, a random bearing is used for the monitoring lines within each contract block (this is allowed for in the protocol but seldom occurs).

4.2.5 Results

This season, possums were controlled over 17,913 ha; of this, 13,210 ha were in the Background Area and 4703 ha were in Core Areas (not including Pakoakoa Core Area). The Background Areas treated were: Central Ikawhenua (2239 ha), Northern Ikawhenua (4483 ha), Southern Whakatane (5103 ha) and Northern Waimana (1385 ha). Central Ikawhenua blocks CIKA B 6-11 were set to be treated this financial year, however, due to the ill health of one contractor these blocks have been carried over into the 2005/2006 control year. The Core Areas treated were: Otamatuna Inner Core (577 ha), Otamatuna Outer Core (1953 ha), Mangaone Inner Core (232 ha), Onepu Inner Core (179 ha), Waikokopu Inner Core (377 ha) and Waikokopu Outer Core (1405 ha).

An average RTC of 4.5% was achieved over the Background Area this season (Table 4.2.1). This is below the target of 5% RTC. A total of 16,792 possums were reported killed by contractors within the Background Area.

Pre-control monitors undertaken at Otamatuna resulted in 4.5% RTC in the Inner Core and 10.4% RTC in the Outer Core. No post-control monitoring was undertaken. The kill trapping regime within the Waikokopu Core Area (Inner and Outer Cores) continued with 741 possums killed. The pre-control monitor returned 8.1% RTC in the Inner Core and 22.9% RTC in the Outer Core. The post-control monitor resulted in 3.4% RTC in the Inner Core and 13.5% in the Outer Core. No RTC monitoring was undertaken this year at Onepu or Mangaone. Possum RTC indices in Core Areas from 2000/01 to 2004/05 are shown in Table 4.2.2.

Possum RTC results per block are recorded on WGNHO-150660, covering the years 1998/99 – 2004/05.

TABLE 4.2.1 PRE- AND POST-CONTROL RESIDUAL TRAP CATCH RESULTS FOR POSSUMS IN MANAGEMENT AREAS WITHIN THE BACKGROUND AREA, NORTHERN TE UREWERA, 2000/01 TO 2004/05

Management Area	2001/01		2001/02		2002/03		2003/04		2004/05	
	Pre-	Post-	Pre-	Post-	Pre-	Post-	Pre-	Post-	Pre-	Post-
Northern Ikawhenua	12.1	2.4	NC		19.6	3.4	NC			4.4
Central Ikawhenua		2.0	NC		21.2		20.6	3.8		3.5
Northern Whakatane	16.1			2.8	NC			3.1	NC	
Southern Whakatane	NC		14.5	3.6		3.1	NC			3.8
Northern Waimana	NC		32.7			3.9	NC			4.2
Southern Waimana	28.3			3.9	NC		NC		NC	

NC:- no possum control undertaken within this area for that season

TABLE 4.2.2 TREND (PRE-CONTROL) AND POST-CONTROL RESIDUAL TRAP CATCH RESULTS (%) FOR POSSUMS IN CORE AREAS, NORTHERN TE UREWERA, 2000/01 TO 2004/05

CORE AREA	2000/01		2001/02		2002/03		2003/04		2004/05	
	Trend	Post	Trend	Post	Trend	Post	Trend	Post	Trend	Post
Otamatuna Inner Core					5.7				4.5	NM
Otamatuna Outer Core	6.5		5.7						10.4	NM
Mangaone Inner Core					✓				—	NM
Mangaone Inner Core									—	NM
Onepu Core Area									—	NM
Waikokopu Inner Core	✓								8.1	3.4
Waikokopu Outer Core	✓							22.9	22.9	13.5
Pakoakoa Core Area							20.2		—	3.8 (✓)

✓ Core area worked and monitored as part of the enclosing background area.

NM No post-control monitoring undertaken

Results for outcome monitoring of kokako (Section 5.2), mistletoe (Section 5.5) and canopy condition (Section 5.7) are presented in relevant sections in this report.

4.2.6 Discussion

Sustained, intensive possum control is an essential element of the NTUERP project and it is vital that possums continue to be maintained at low densities if the objectives of ecosystem restoration are to be attained.

Good results were achieved this year with targets being achieved in the Background Control Area. The use of tendered performance-based contracts using ground control techniques continues to be effective.

An increase in funding levels for this financial year, through the Biodiversity Strategic Fund, allowed almost all scheduled work to be completed. However, a Conservancy shortfall saw a cut in the core possum budget. The result of this cut was the loss of control work being done on two blocks within the Southern Whakatane, these being put aside as skill development blocks. The purpose of these blocks being to give less experienced contractors the opportunity to gain experience and potentially become eligible for future tendered work. With an aging possum control workforce, these blocks should be seen as priority for funding in the future.

Core Areas will continue to have ongoing intensive multi-pest management to achieve the desired conservation outcomes. Not all Core Areas were treated intensively this year and resource priorities precluded monitoring at all sites. The kill trap possum control regime being trialed at Waikokopu continues to produce a reduction in the possum density. The possum density in the Outer Core remained above the target level of 5% RTC; the downward trend provides cautious optimism that this approach may ultimately prove effective. A priority for next year should be to ensure all Core Areas receive intensive possum control and are monitored post-treatment.

4.2.7 Recommendations

- The practice of keeping some monitoring blocks outside the tendering process for skill development purposes should be continued.
- In 2005/06, all Core Areas should receive intensive possum control and be monitored post-control.
- Consideration should be given to further testing the concept of longer term maintenance control contracts.

4.2.8 Acknowledgements

Thanks to all the ground-based possum hunters: Colin Cartwright; Gary Peratiaki; Jon Williams; Lyn Thyne; Marina Geary; John Parker; John Yearbury; Gary Thyne; KLM Holdings; Trap 'n' Track; and Walter Kilgour; contractors undertaking post-control RTC monitoring Malcolm McFarlane; and helicopter support: Waimana Helicopters, and Central Helicopters, Opotiki. Also Shane Gebert, Pete Livingstone, Rebecca Gibson and Dan Baigent, DOC Opotiki, for contract and data management and enthusiastic support.

4.3 RATS

Dan Baigent

4.3.1 Abstract

Rat control within NTUERP during 2004/05 was undertaken over 1500 ha in five Inner Core Areas. The management objective was to control rats to below 5% tracking index year-round in Core Areas. In total, 7014 single-set trap sets were used with most (99%) being Victor Professional rat traps set in coreflute tunnels, and the remainder (n=70) being DOC 200 traps set in wooden boxes. Traps were placed as single sets, mostly at 25m apart on lines approximately 150m apart. The number of trap check rounds varied between sites. Relative abundance monitoring was undertaken in all five Core Areas. In total, 10793 rats were trapped. Management objectives were not met in any of the Core Areas: tracking indices were generally at moderate levels except at Waikokopu in January (2%) and Onepu in February (6%). The establishment of a Core Area co-ordinator should improve focus on rat control in 2005/06. Results indicate that low-frequency trapping is only effective at controlling rats when they are at low levels of abundance. Trapping success rates may be improved by: increasing attention to trap set maintenance; reduction of interference, particularly by possums and pigs; and improving bait type, including longevity of bait.

4.3.2 Introduction

The ship rat (*Rattus rattus*) (rat) is the most uniformly distributed of the three rat species present on the New Zealand mainland (Innes 1990). They are the only species to have been trapped within NTUERP and therefore the target species for rat control. Ship rats have been clearly identified as significant predators and competitors of native fauna (Brown 1994) and as such are a major threat to the northern Te Urewera ecosystem.

Rat control within NTUERP commenced in 1996 and was focused in the Otamatuna Core Area where control was primarily intended to protect birds during their breeding seasons. The effect of rat control (in conjunction with possum (*Trichosurus vulpecula*) and stoat (*Mustela erminea*) control) was measured by monitoring kokako (*Callaeas cinerea wilsoni*) and robin (*Petroica australis longipes*) breeding success with ongoing pest control and pest monitoring. Since 1996/97 the area treated for rat control has increased as Core Areas have been developed. Previously, poisons such as brodifacoum, Pindone and Cholecalciferol (Chole) have been utilised in rodent control at specific times of year. In recent years, control methods have evolved in response to social and ecological sensitivity (in regards to the use of toxins) as well as past results. Current control is predominantly achieved through trapping, though continued efforts have been made to investigate the effectiveness of currently registered rodent toxins.

The decision to develop trapping methodologies has created an environment of innovation and adaptation where different trapping techniques and management regimes have been, and continue to be, investigated. Some investigations often follow a particular process and are called Field Trials while other trials are less formal; in general these investigations are often referred to as trials. DOC has *best practice* methods that are improved and updated regularly. For large-scale rat control best practice has often been derived from the methods refined within this project. However, because of the scale of the project, the nature of trialing different control methods and the limitations of resources, it is not possible to have best practice control methods in place at every site at any one time. Rather, it is usual that a particular area or number of traps at a site may not yet be upgraded or be part of an investigation, and so at any one time within the project there will be a range of trap set types both within and between the Core Areas. Relevant trap and tunnel designs, including current best practice, are shown in Appendix 4.3.1.

Within this section of the report, control methods and results for each Core Area are detailed and these may include details of investigations. However, a more complete description of methods and analysis of results for investigations will be contained within another section (Section 3.0) or as a separate report that will be referenced.

4.3.3 Objectives

- To maintain rat tracking indices at under 5% year-round in Otamatuna, Onepu, Mangaone and Waikokopu Inner Core Areas, and Pakoakoa Core Area
- To assess the effectiveness of rat control techniques

4.3.4 Methods

During the 2004/05 season, rat control was undertaken in the five Inner Core Areas (Otamatuna, Mangaone, Onepu, Waikokopu and Pakoakoa) along ridge, spur and A-, B- and C- lines where applicable (Section 2.0). In total, approximately 1550 ha were enclosed by rat control lines (Fig 4.3.1 and 4.3.2). Current best practice for rat trapping is shown in Appendix 4.3.1.

Distances between traps varied at different Core Areas (see below); however, the vast majority of traps were 25m apart along control lines, with a maximum of 50m spacings along a small number of internal (non-perimeter) lines. Control lines were designed to be approximately 150m apart, although in practice, due to vegetation and general topography, distances between some lines may have been greater than 150m. Traps were generally placed as 'single sets', that is, one trap within a cover per site.

Trap checks were completed by either contractors or DOC staff. Contractors were required to maintain the infrastructure including parts of the track network, to certain standards as well as checking and re-baiting traps, distributing poison and replacing broken or lost traps. Emphasis was placed on quality of work and audits were completed throughout the year checking aspects such as trap set-off weight, trap condition, bait condition and track maintenance.

Figure 4.3.1 Location of rat control lines including trial sites, in the Otamatuna, Mangaone, Onepu and Pakoakoa Core Areas, northern Te Urewera, 2004/05

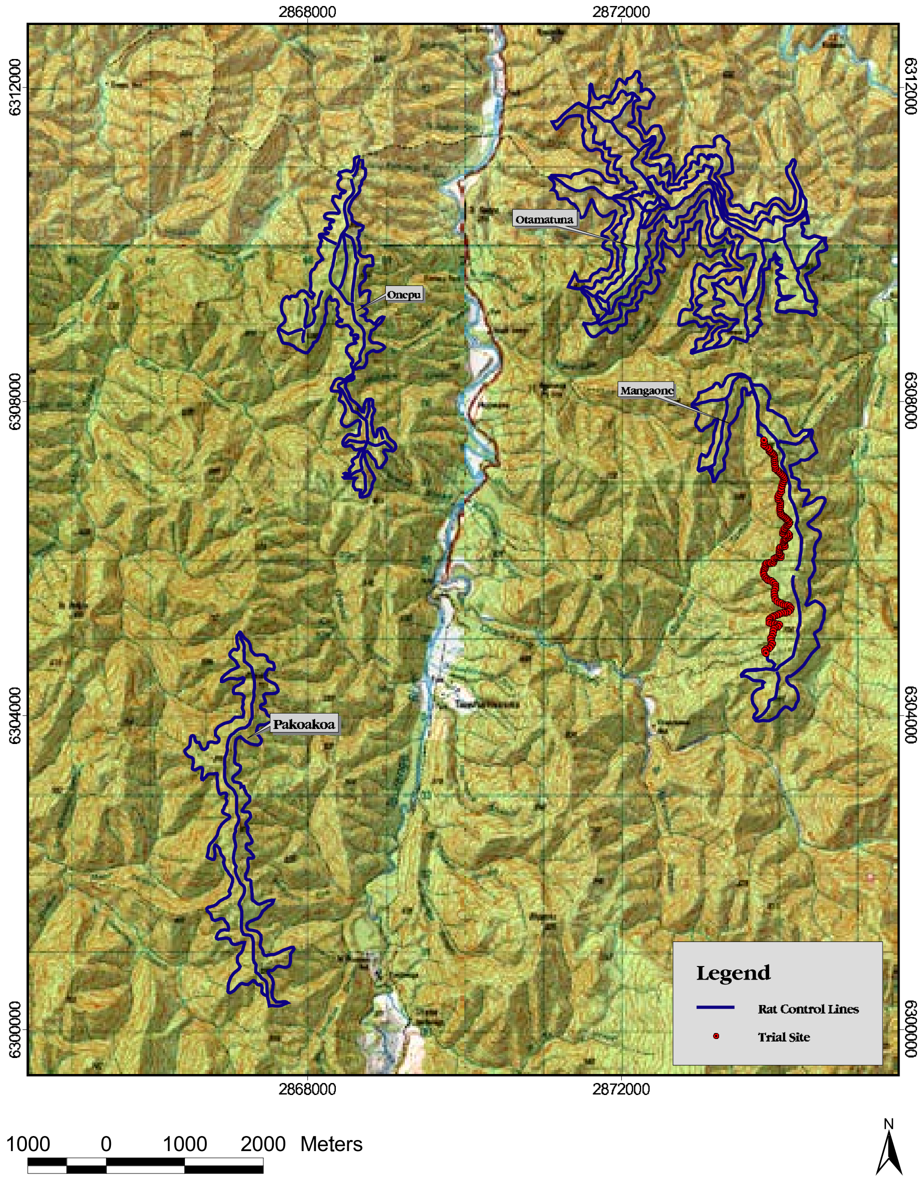
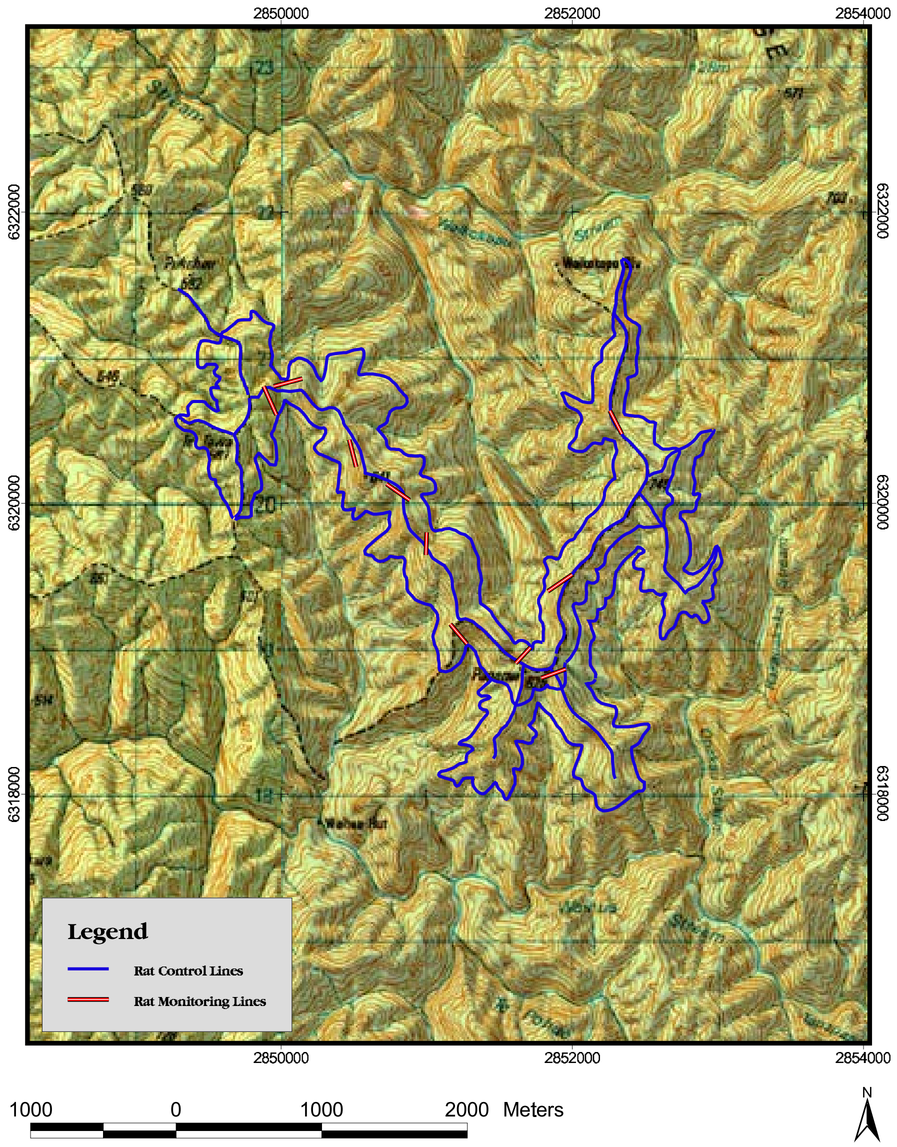


Figure 4.3.2 Location of rat control lines and rat monitoring lines in the Waikokopu Core Area, northern Te Urewera, 2004/05



Relative abundance monitoring for rats was undertaken in each of the five Core Areas as well as the Oruamananui non-treatment site (Fig 4.1.1). Methods generally followed the DOC best practice (Gillies and Williams (2002); HAMRO-66179) where tracking tunnels using food colouring on a sponge and baited with peanut butter were set 50m apart on marked lines. All core areas had 50 tracking tunnels; Otamatuna had five lines of 10 tunnels, however due to the narrow shape and size of the other four Core Areas, the tunnels were laid out on 10 lines of five tunnels each.

Otamatuna

The Otamatuna Inner Core Area is set up on a C-Line system although part of the area has an A-Line configuration (Section 2.0). Approximately 577 ha are encompassed by the perimeter of the Inner Core boundaries. A total of 2218 'Victor Professional' rat traps (1037 on perimeter lines, 1181 on internal lines) predominantly set in plastic coreflute tunnels were used in single sets (Appendix 4.3.1). Traps were baited with either peanut butter or a combination of peanut butter and white chocolate.

From May 2005, 50 wooden tunnels were placed alternately with the existing plastic coreflute (current best practice) tunnels along two rat lines (Topline, Tawai Ridge). These wooden tunnels replaced the existing tunnels. During June and July 2005 another 50 tunnels were placed on the Tawai C-Line and were added to every alternate existing tunnel site as a side by side comparison. The new paired traps were not opened this season: the trial will commence in 2005/06.

The distances between trap sites remained the same as previous years, with the traps on the ridges and A-Line having 50m spacings and the traps on the B- and C- lines having 25m spacings.

Twenty-one full (every trap) rounds of trap checks were completed during 2004/05. Twelve of these clearances were completed by contractors approximately four-weekly from 1 July. Two extra rounds (one July, one early September) were undertaken by contractors as a result of high rat numbers. From 30 May 2005, an intensive 'knockdown' effort of seven rounds was undertaken by DOC staff, volunteers and contractors. Contractors also undertook one extra clearance of the perimeter lines (approximately half the trap total) during December.

To monitor rat abundance, rat tracking was undertaken five times during the year: August and November 2004, and January, April and May 2005; the May monitor was undertaken before the 'knockdown' period.

Mangaone

The Mangaone Inner Core Area is set up with an A-Line configuration (Fig 4.3.1). A total of 1032 'Victor Professional' rat traps set in coreflute tunnels were placed at 25m intervals. Of these, 713 were placed on the A-Line (perimeter), while 319 were situated internally, along the ridges and spurs. Traps were baited with either peanut butter or a combination of peanut butter and white chocolate.

The above regime was changed for the trial comparing DOC 200 and Victor Professional traps. Seventy of each trap type were placed alternately along a section of the A-Line (Mangaone A North, Mangaone A South) for a period of approximately 6 months (September 2004 - March 2005). The DOC 200s were placed in wooden trap tunnels and the Victor traps were set in the current best practice coreflute tunnels. The trial was designed and the data analysed by Craig Gillies and Darren Peters (Research Development & Improvement Division, DOC) and run in conjunction with the Opotiki Area Office. The results of the trial will be reported on in 2007. The traps were baited with white chocolate only.

During the 2004/05 season 12 rounds of trap checking were completed commencing 1 July and finishing early May 2005. Rat tracking indices were measured in August and November 2004, and January and March 2005.

Onepu

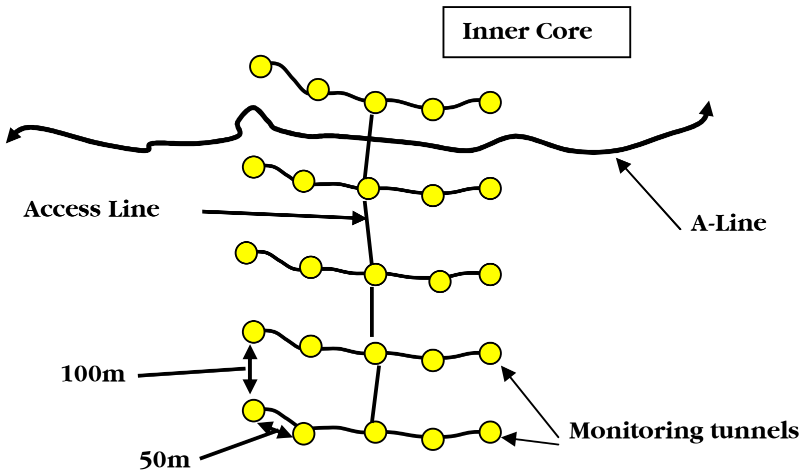
Rats in the Onepu Inner Core Area were controlled using an A-Line configuration (Section 2.0) encompassing approximately 179 ha (Fig 4.3.1). In total, 1079 'Victor Professional' rat traps were set in coreflute tunnels. The traps were spaced at 25 m, with 686 traps set on the A-Line (perimeter), and the remaining 393 on internal or ridge lines.

In 2004/05, 15 rounds were completed by contractors commencing on 1 July 2004. Fourteen of these rounds were undertaken as planned with an extra round added during the season in February. The last round was done in June. Traps were baited with either peanut butter or peanut butter and white chocolate presented together. Rat monitoring was undertaken in August and November 2004, and February, March and June 2005.

In addition to the standard relative abundance monitoring, a transect line trial based around the northern portion of the Onepu Inner Core Area was initiated in February 2005. This study was undertaken by Pete Fergusson under a Royal Fellowship scholarship with the aim of determining the extent of the effect of the current control methods on the rat population outside of the Onepu Inner Core Area A-Line.

To measure the extent of the control, 10 sets of 25 tunnels were randomly located around the Onepu A-Line. Each set of 25 tunnels consisted of five lines of five tunnels each, with each line running roughly parallel to the A-Line but set at approximately 100m apart as measured on the ground. The first line was positioned 50m inside the A-Line with the lowest line positioned approximately 350m below the A-Line (Fig 4.3.3).

Figure 4.3.3 Tracking tunnel configuration for each set of 25 tunnels used by Fergusson at Onepu Core Area, northern Te Urewera, 2004/05



'The Trakka' (Connovations Ltd) tracking cards housed in coreflute tunnels were used for all monitoring in this project, and methods generally followed DOC best practice (Gillies and Williams 2002: HAMRO-66179). The study commenced in February 2005 and continued to December 2005, with a monitor completed approximately once every five weeks. A full report on the outcomes of this investigation will be available from the Opotiki Area Office upon completion.

Waikokopu

Waikokopu Inner Core Area has a full A-Line with a partial B-Line set up (Fig 4.3.2) encompassing approximately 377 ha. In total, 1715 'Victor Professional' rat traps were used, spaced at 25m and housed within coreflute tunnels. Some tunnels were modified during the season to allow the traps to be attached to a wooden base and be removed from the front of the tunnel, alleviating the need to remove tunnel securing pegs when checking traps.

Chest-high tree sets from the previous year were removed and set as ground sets, as a reaction to higher non-target catch rates (birds), and higher spring-off rates.

The 2004/05 season trapping regime consisted of 10 rounds conducted at approximately four-week intervals, commencing in August and finishing in May. Traps were baited with either white chocolate, or a combination of peanut butter and white chocolate.

During this season, rat abundance monitoring was undertaken in July and November 2004, and January and March 2005.

Pakoakoa

Pakoakoa rat control is based on an A-Line system (Section 2.0) encompassing 185 ha; 970 'Victor Professional' rat traps were in place at the start of the season. The traps were housed in coreflute tunnels with wooden bases. Traps were set 25m apart on control lines with 737 traps set on the perimeter and 233 on internal lines (Fig 4.3.1).

The 2004/05 management regime consisted of 10 rounds of trap clearances commencing in July and ending in April. Traps were baited with either peanut butter or a combination of white chocolate and peanut butter.

Rat tracking indices were undertaken in August and October 2004, and January and March 2005.

4.3.5 Results

The objective of reducing and maintaining rat abundance to below 5% tracking index year-round was not achieved in any of the core areas.

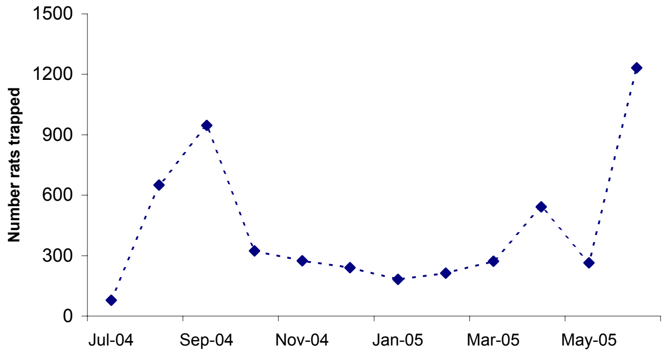
In total, 10793 rats were trapped over the year within the five Core Areas (1550 ha) representing a 217% increase compared to the 2003/04 season. More rats were trapped in all Core Areas. To achieve this, a total of c.103500 trap clearances were made (an increase of 138% from the 2003/04 season).

Additional data for all areas can be obtained from the Opotiki Area Office.

Otamatuna

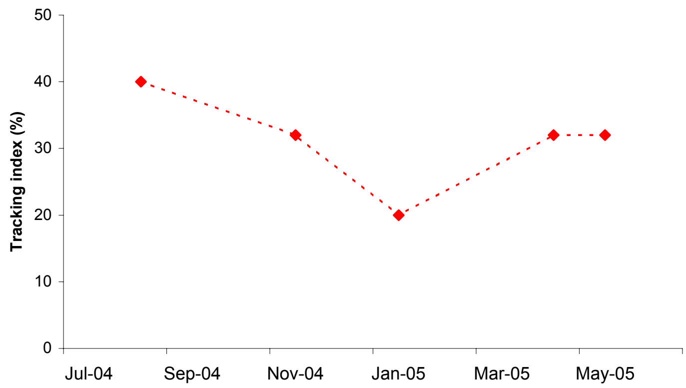
In total, 5219 rats were trapped at Otamatuna during the 2004/05 season (Fig 4.3.4). This compares to 1677 rats trapped last season. Non-target captures included 749 mice, four stoats and seven birds: four robins, one fantail (*Rhipidura fuliginosa*), one thrush (*Turdus philomelos*) and one blackbird (*Turdus merula*).

Figure 4.3.4 Number of rat captures per month at Otamatuna Core Area, Northern Te Urewera, 2004/05



Monitoring (tracking) results from August 2004 to July 2005 are shown below in Figure 4.3.5.

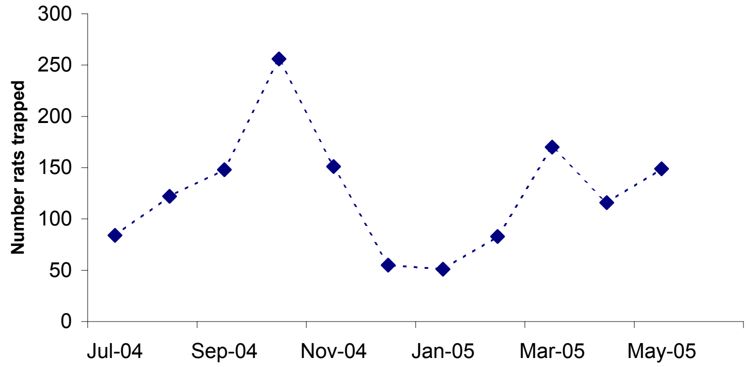
Figure 4.3.5 Relative abundance of rats in the Otamatuna Core Area, northern Te Urewera, August 2004 – July 2005.



Mangaone

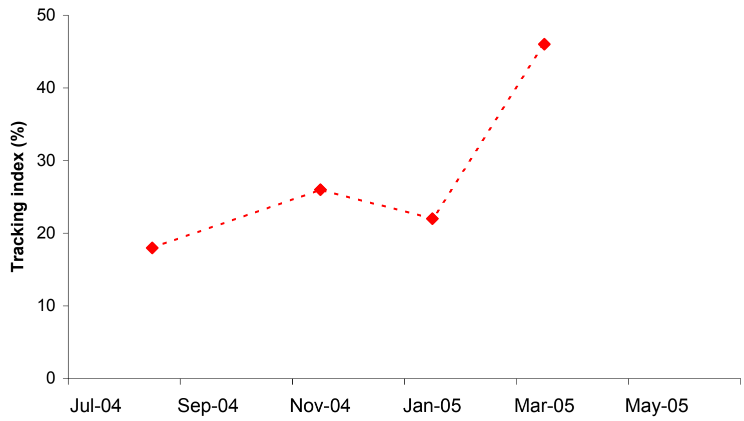
In total, 1385 rats were trapped at Mangaone during the 2004/05 season (see Figure 4.3.6) compared to 1181 trapped last season. Non-target captures included 57 mice, 4 stoats and 10 birds (7 robins, 3 blackbirds).

Figure 4.3.6 Number of Rat Captures per month at Mangaone Core Area, northern Te Urewera, 2004/05



Rat tracking indices obtained through the year are shown in Figure 4.3.7. The lowest index (18%) was recorded in August.

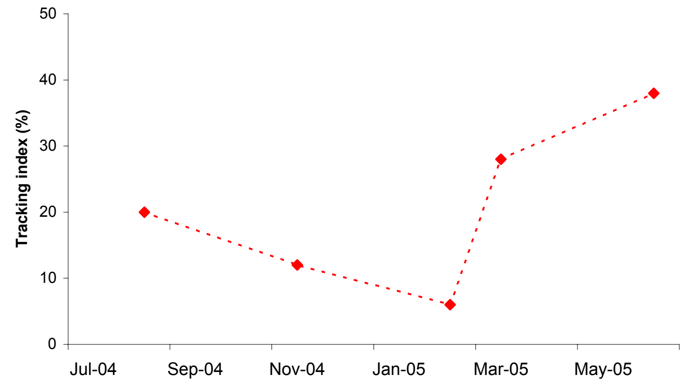
Figure 4.3.7 Relative abundance of rats in the Mangaone Core Area, northern Te Urewera, August 2004 – March 2005.



Onepu

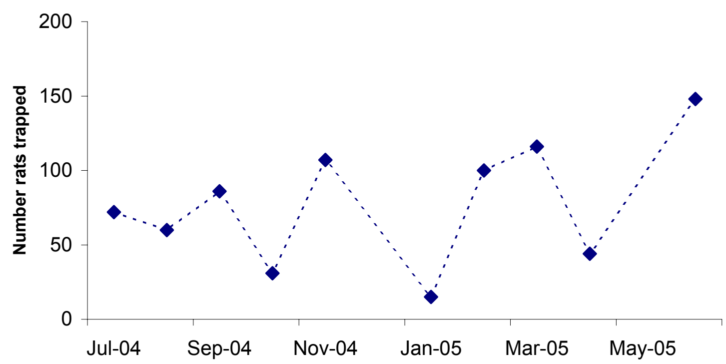
Figure 4.3.8 shows the relative abundance of rats within the Inner Core. The lowest index was recorded in February (6%) and the highest (38%) was recorded in June.

Figure 4.3.8 Relative abundance of rats in the Onepu Core Area, northern Te Urewera, August 2004 – June 2005.



In total, 866 Rats were trapped at Onepu during the 2004/05 season (see Figure 4.3.9) compared to 685 trapped in the 2003/04 season. Non-target captures included 184 mice, 18 stoats and 9 birds: 6 robins and 3 blackbirds.

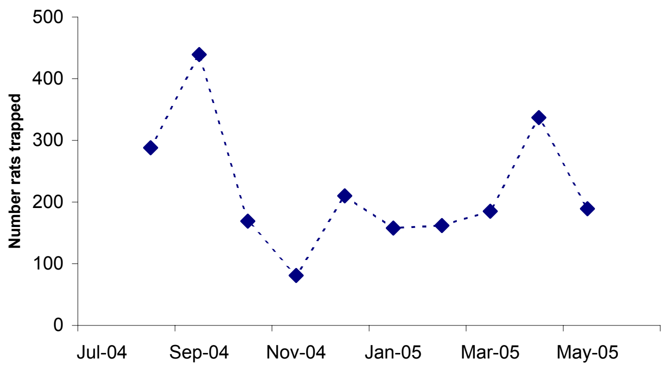
Figure 4.3.9 Number of Rat Captures per month at Onepu Core Area, northern Te Urewera, 2004/05



Waikokopu

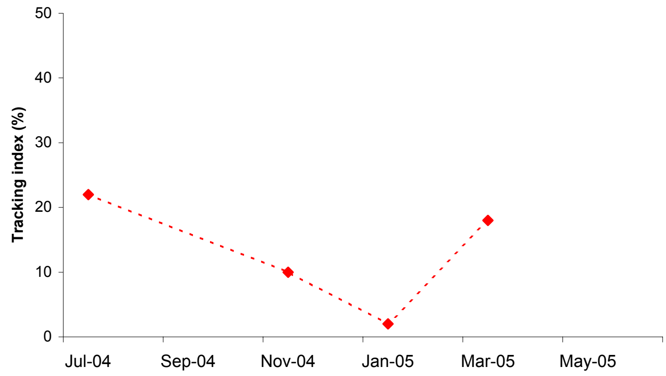
In total, 2218 rats were trapped at Waikokopu during the 2004/05 season (see Figure 4.3.10) whereas 1070 rats were trapped in 2003/04, an increase of 207%. Non-target captures included 800 mice, 6 stoats and 15 birds.

Figure 4.3.10 Number of rat captures per month at Waikokopu Core Area, northern Te Urewera, 2004/05



The lowest index (2%) in the Waikokopu Core Area was recorded in January (see Figure 4.3.11).

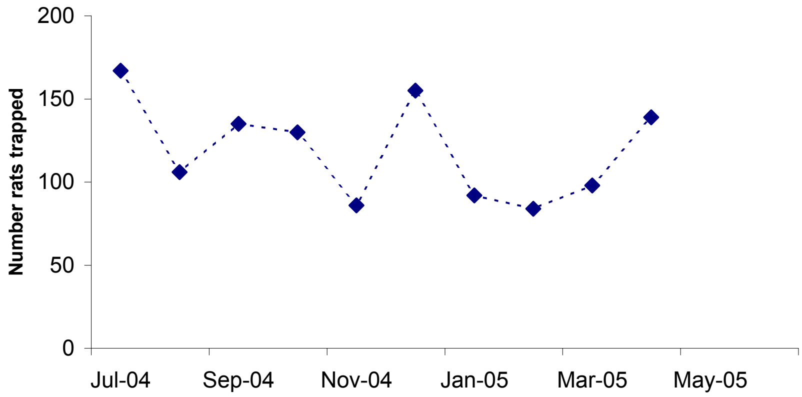
Figure 4.3.11 Relative abundance of rats in the Waikokopu Core Area, northern Te Urewera, July 2004 – March 2005



Pakoakoa

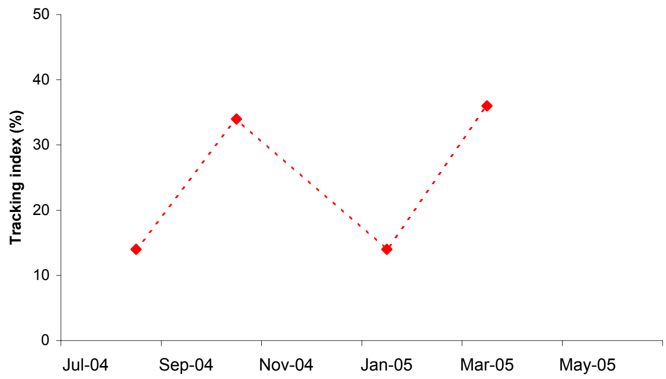
In total, 1192 Rats were trapped at Pakoakoa during the 2004/05 season (see Figure 4.3.12) which compares to 395 rats trapped during 2003/04. Non-target captures included 51 mice, 11 stoats and 1 bird (1 Robin).

Figure 4.3.12 Number of Rat Captures per month at Pakoakoa Core Area, northern Te Urewera, 2004/05



Tracking indices taken in the Pakoakoa Core Area showed that rats were not controlled to low levels (<5% tracking index) (see Figure 4.3.13).

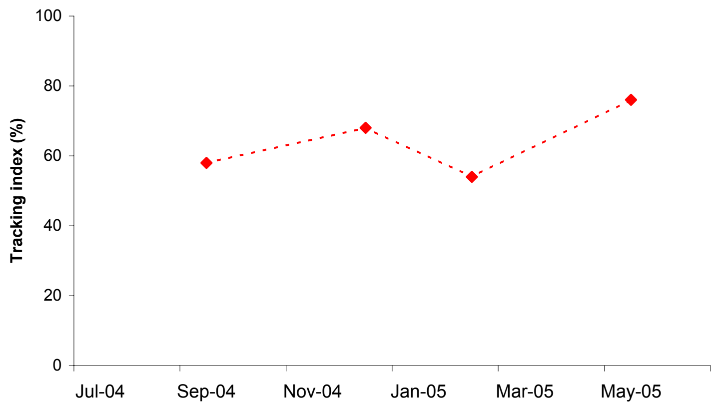
Figure 4.3.13 Relative abundance of rats in the Pakoakoa Core Area, northern Te Urewera, August 2004 – March 2005



Oruamananui

Oruamananui continued to be the comparison site for rats. Biennial possum control is undertaken in this block with the most recent treatment occurring during 2003/04. Figure 4.3.14 below shows the tracking index results for Oruamananui where rats continue to be present in high numbers.

Figure 4.3.14 Rat tracking indices at Orouamananui comparison site, northern Te Urewera, 2004/05



4.3.6 Discussion

A high level of management co-ordination is needed to achieve the target results for rat control within NTUERP. The task is complex, as there are five separate areas where rat control is undertaken, each with different logistical demands. As rat control within NTUERP has increased, demands on staff time have also increased. The trapping-only approach requires more co-ordination and effort compared to using toxins. There was no permanent staff member dedicated to co-ordinating rat control until late in the 2004/05 season, when a new position was created. The creation of this new position should allow a strong focus on achieving the management objectives in future seasons.

The 2.2-fold increase in the number of rats trapped this season compared to last season (with a 1.4 fold increase in trap clearances) may be due to more attention being given to the finer points of trapping. In particular, an improved system for identifying problems within the trapping regime was implemented; for example, replacing an adequate number of traps (when needed).

It appears that the management effort required for reducing rat abundance (as indicated by tracking indices) in the Waikokopu Core Area is substantially less than in other Core Areas; fewer trapping rounds are needed to reduce tracking indices to below 5%. However, the tracking results appear anomalously low as trap-catch rates are similar to other Core Areas. The most likely explanation is that in this case trapping rates are more indicative of rat abundance and that the tracking indices under-represent mean rat abundance. This may be explained by the location of the tracking lines which, although they were randomly located, are generally closer to internal (or ridge) control lines than perimeter lines. Trapping rates on the perimeter lines are generally higher due to re-invasion by rats from outside the Core Area.

Other factors which may be influencing rat control at Waikokopu are: the lack of wide-scale stoat control may allow rat numbers to be maintained at a lower level than if stoats were controlled; and the use of pre-feed for possum control. Kill traps for possum control are sited along main ridges and spurs. The traps were pre-fed with 'Smooth-in-a-tube' (Connovations Ltd) which rats may be attracted to and therefore increase the chance that they encounter rat traps which also follow these ridge and spur lines.

Under the current trapping layout, high frequency trapping (where traps are checked on a 1-2 day rotation) may be effective at controlling rats at high (as well as low and medium) levels of abundance. Low frequency trapping is less effective at controlling rats, although when rat numbers are at low levels, low-frequency trapping is generally adequate to maintain these low levels. Statistical analysis of historical and current data indicates that similar levels of management can achieve different control results (as indicated by relative abundance monitoring and trap catch rates) during different periods of the year (Chris Ward, DOC, Gisborne Conservancy Office, pers. comm.). Low frequency trapping may be most effective during periods when rat abundance is low. Results from this project have shown that, at times, low frequency trapping is able to reduce or maintain rats at low levels during the October-December period, but not during other times of the year. This indicates that rats may naturally be at their lowest levels of abundance during this time and management regimes could be adapted to account for this.

Bait types were identified as a specific area that needed attention for future control. Baits used (peanut butter and white chocolate combinations) were attractive to non-target species (mice and ants) which could remove baits entirely without springing the trap. It was also found that bait was going mouldy in an unacceptably short period of time. Baits often deteriorated more rapidly when old bait or portions of old bait were left on the trap treadle. Due to this research was undertaken to find alternative bait types. From this, Fera-feed pre-feed (Connovations Ltd) proved superior in terms of basic longevity as well as reduced poaching from the non-target species. As a result, for the upcoming season, Fera-feed pre-feed will be added to the currently-used baits. Further trials will be conducted to improve this area.

The continued auditing of contractors was identified as a major aspect in maintaining the continual effectiveness of rat control. Having alternate rounds of different bait types provided the easiest method of making sure the contractors had checked areas. Attention during auditing was given to ensuring contractors replaced all traps no longer capable of catching efficiently, and in particular identifying less obvious faults often associated with deteriorating traps.

Interference of rat traps by predominantly possums and pigs (*Sus scrofa*) continues to be a significant factor in reducing trapping effectiveness: during one round of trap checks at Otamatuna approximately one-third of all traps had been interfered with. Interference includes animals taking baits and usually springing the traps; removing the treadle and often rendering it useless; knocking covers over and away from the traps; and moving the traps themselves. Typically, interference will occur periodically most likely related to times when possums and pigs re-establish after control work. Pigs tend to move around and through areas and are often attracted to both possum carcasses and baits where possum and also rat control is occurring. Interference is reduced by possum control operations and by contract hunters killing pigs at Otamatuna.

4.3.7 Acknowledgements

This season's rat trappers: Dan Baigent, Keith Beale, Ross Hurrell, Joe Ruruhe, Pete Fergusson, J.J Cornwell and volunteers during Otamatuna knockdown. Also: Environment BOP for funding for Pakoakoa; all DOC Opotiki staff for continued efforts with the Core Areas in contractor and data management and field work, and DOC staff from outside the area for their support with the Otamatuna knockdown; Chris Ward for continued support with data analysis; Darren Peters and Craig Gillies for their efforts and support with trials in the area.

4.4 STOATS

Rebecca Gibson and Greg Moorcroft

4.4.1 Abstract

Within NTUERP there are currently 1088 trap sets for stoat control encompassing 5810 hectares. The majority of trap sets (67%) are double-set Fenn traps set in a wire cage tunnel. A trial comparing single-set Fenn traps in wooden tunnels and single DOC200 traps in wooden tunnels was implemented over 1232 ha encompassing the Onepu Core Area. Fenn traps from the Otamatuna/Mangaone stoat trapping area (4013 ha) were bead blasted and waxed, improving condition, longevity and performance. The total number of stoats trapped throughout NTUERP was 501, including 43 caught in rat traps and 18 in possum kill traps; most captures were in the summer months. Captures in the Otamatuna/ Mangaone area increased by 35% compared to the previous year. Preliminary results from the Fenn/DOC 200 trial indicate that DOC 200 traps are more effective at catching stoats than single-set Fenn traps in wooden tunnels. No outcome monitoring of young kiwi was undertaken this year due to a staff vacancy.

4.4.2 Introduction

Three members of the mustelid family (Mustelidae) are established in New Zealand: the stoat (*Mustela erminea*), the ferret (*M. furo*) and the weasel (*M. nivalis vulgaris*). All three species were introduced in the late nineteenth century in an attempt to control rabbits; however, they soon extended their range beyond the distributions of rabbit populations and into those of native fauna (King 1990). The threat of mustelids, particularly stoats, to extant fauna is now well-recognised, with mustelids being responsible for the widespread decline and, in some cases, possible extinction, of a number of native bird species (King 1984; Elliot and O'Donnell 1988; Beggs and Wilson 1991; O'Donnell 1996). Hole-nesting birds such as kaka (*Nestor meridionalis*) are particularly vulnerable (Beggs and Wilson 1991), and stoats have now been identified as the major predator of young kiwi (*Apteryx mantelli*) (McLennan et al. 1996). Mustelids, then, pose a significant threat to natural ecosystem processes.

Trapping results within NTUERP indicate that stoats are by far the most common of the three mustelid species present in the area and management of mustelids within NTUERP is therefore focused on this species. As such, stoats are the target species for animal pest control and this work is generally referred to as stoat control although other mustelid species may be caught.

Control for stoats within NTUERP began with the project's inception in 1996/97. Work was initially concentrated at Otamatuna Core Area where 1100 ha was managed with a trapping and toxin regime (it was assumed stoats would be secondarily-poisoned by preying on poisoned rodents) (Beavan et al. 1999). As the project developed, stoat control was initiated in other Core Areas and the principal means of control was rationalised to trapping. Trap set design has evolved, particularly in regard to cover type; however, the principal trap used has remained the Fenn trap, usually placed in double sets under a wire mesh cover (see Appendix 4.4.1).

A successful joint application in 2001 by DOC and the Eastern Bay of Plenty branch of the Royal Forest and Bird Society (Forest and Bird) to Environment Bay of Plenty's Environment Enhancement Fund allowed a significant expansion of stoat trapping within NTUERP. In total, over 4000 ha of contiguous area was subsequently controlled with the addition of 1500 ha surrounding the Mangaone Core Area. The funding also allowed for the addition of c. 90 traps in the Te Waiiti Stream specifically for the protection of whio (*Hymenolaimus malacorhynchos*). For management and administration purposes (including reporting requirements), the total area of stoat control was separated into DOC and 'EBOP' blocks; however, the boundaries of both areas were rationalised so that the EBOP block now contained previously established stoat lines within the Otamatuna Core Area, and the DOC area now contained lines newly established under the EBOP funding. This meant that stoat lines within the EBOP area were all serviceable from the road, whereas the DOC lines were generally serviced from huts, one to two hours walk from the road. The DOC block was further divided into Otamatuna and Mangaone areas meaning there were three 'sub-areas' within the one contiguous block; however, in terms of the management within NTUERP, the stoat trapping area is referred to in terms of the Otamatuna and Mangaone Core Areas. Data from DOC and EBOP trapping is collated by the Opotiki Area Office. Trapping for stoats has also been established in other Core Areas (Waikokopu (1999) and Pakoakoa (2003)) as resources have allowed.

Trap lines within NTUERP were established according to a 'best guess' approach on what might be adequate for controlling stoats; stoats roam widely for prey so traps need to be set over large areas at regular-enough spacings so stoats have a reasonable chance of encountering a trap in any particular period. Placement of traps was limited by management and practical constraints such as funding for trap purchase and servicing of traps, and topography within management areas.

Within NTUERP different trapping techniques and management regimes for stoat control have been, and continue to be, investigated (e.g. see Beavan et al. 1999). Some investigations (or trials) follow a particular process and are called Field Trials, while other trials are less formal. Because of the scale of the project, the nature of trialing different control methods and the limitations of resources, it is not possible to have best practice control methods in place at every site. Rather, it is usual that a particular area or number of traps at a site may be part of an investigation or not yet upgraded, and so at any one time there will be a range of trap set types both within and between the Core Areas.

Within this section of the report, control methods and results for stoat control are detailed, and these may include details of investigations. Further details of investigations are contained in Section 3.2 or as a separate report that is referenced.

4.4.3 Objectives

The aim for annual stoat control is to protect native species from depradation. The current indicator species for stoat control is kiwi (Section 5.3) as young kiwi (chicks and juveniles) are very vulnerable to stoat predation (McLennan et al. 1996).

The annual objectives for stoat control within NTUERP are:

- To enable at least 50% of monitored kiwi chicks and juveniles to reach 1000g in weight
- To assess the effectiveness of stoat control techniques used in investigations

4.4.4 Methods

Control of stoats was achieved by setting kill traps on tracks (or lines). These control lines were generally set on prominent topographical features such as ridges, spurs, rivers and streams. Pink triangles with the trap name inscribed were used to mark trap sites. At the end of June 2005, a total of 5810 ha was encompassed by stoat control lines, with control in place in four blocks: Otamatuna/Mangaone/EBOP (4013 ha), Pakoakoa (185 ha), Onepu (1232 ha) and Waikokopu (377 ha) (see Figure 4.4.1).

The most commonly used trap set is shown in Appendix 4.4.1, and generally consists of two Mark 6 Fenn traps (Fenn & Co., UK) set under a wire-mesh tunnel with a clear plastic sheet cover, and baited with a hen egg placed between the traps. In total, 1261 trap sites were used for stoat control within NTUERP in 2004/05. Fenn traps were used at 1040 sites, where 867 were double-set Fenns and 173 were single Fenns set in wooden boxes. DOC200 traps (Curtis Springs and DOC) were the other trap type used (Table 4.4.1). Hen's eggs were used to bait all traps: eggs were purchased by the contractor, to ensure freshness, and contractors were subsequently reimbursed by the Department. Eggs were replaced every six weeks during warmer months and every eight weeks during cooler months.

Figure 4.4.1 Stoat trapping lines in the Otamatuna, Mangaone, Onepu and Pakoakoa Core Areas, northern Te Urewera, 2004/05. Stoat trapping lines serviced with Environment Bay of Plenty (EBOP) funding are indicated, while lines in the Waikokopu Core Area are not shown.

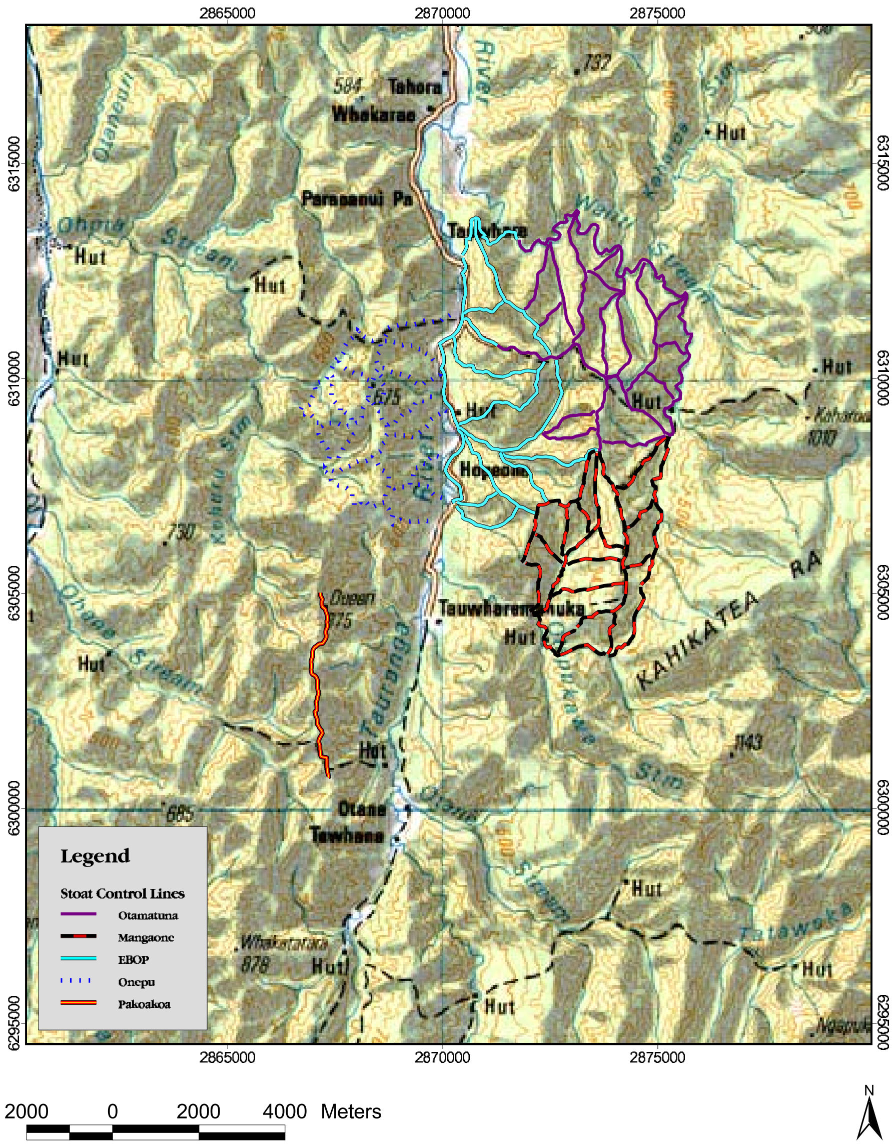


TABLE 4.4.1 NUMBER AND TYPE OF TRAP SETS FOR STOATS IN CORE AREAS, NORTHERN TE UREWERA, 2004/05

CORE AREA		NUMBER OF TRAP SITES	TRAP SPACINGS (M)	TYPES AND NUMBERS OF TRAP SETS (TRAP TYPE, TRAPS/SET, COVER TYPE)
Otamatuna/Mangaone				
Otamatuna	304			
EBOP	256	817	150	817 Fenn double set wire mesh
Mangaone	257			
Onepu		346	100	173 Fenn, single set, wooden box 173 DOC200, single set, wooden box
Pakakoa		50	100	50 Fenn, double set, wire mesh
Waikokopu		48	200	48 DOC200, single set, wooden box
TOTAL		1261		867 FENN, DOUBLE SET, WIRE MESH 173 FENN, SINGLE SET, WOODEN BOX 223 DOC200, SINGLE SET, WOODEN BOX

Distances between control lines varied according to topography (Fig 4.4.1). The distances between trap sets ranges from 100m to 200m, with the majority (65%) set at 150m (Table 4.4.1).

A significant maintenance of Fenn traps in Otamatuna and Mangaone (but not the EBOP area) was carried out at the beginning of the 2004/2005 season. Traps were sent to Auckland on a rotational basis, to be bead-blasted at a cost of approx $3 per trap, and then waxed, using paraffin wax. The waxing was carried out at Hukutaia Honey's dipping facility. This allowed the traps to be set a lot finer and to increase life expectancy

Trap checks were undertaken by contractors or DOC staff. The frequency of checks varied at each site and with the time of the year. Due to the timing of the waxing process, traps were placed back at Otamatuna and Mangaone during October 2004. Rounds were conducted at two-weekly intervals from this point until the end of February 2005, after which traps were checked on a monthly basis until the end of May 2005. Traps within the EBOP area were not removed for waxing and were checked on a two-weekly rotation from July 2004 through to the end of June 2005. Pakoakoa was checked, in conjunction with the rat trapping rounds (approximately 4-weekly), from August 2004 through to late March 2005.

This season, the total trapping area within NTUERP was significantly expanded with the addition of 173 DOC 200 and 173 Fenn traps around the Onepu Core Area. This was due to the implementation of a field trial developed at a national level to compare the effectiveness of DOC 200 and Mk 6 Fenn traps for catching stoats. Single DOC 200 and Fenn Mk 6 traps were each set in wooden boxes and placed alternately at 100m spacing along main topographical features throughout 1500 ha (Fig 4.4.1). The set up and first checks occurred in September 2004 with trap checks continuing on a monthly basis until December 2004 and then two weekly until early March 2005. Monthly checks were continued to the final round which was completed in May 2005.In addition to the stoat traps in the Waikokopu Core Area, the possum kill traps set along main ridges and spurs (Section 4.2) were set to target stoats in December 2004 and January 2005. Traps were baited with salted venison in December and salted rabbit in January.

4.4.5 Results

In total, 511 stoats were trapped in the five Core Areas within NTUERP (Table 4.4.2). This total includes 53 stoats trapped in Victor Professional traps set for rats (Section 4.3) and 18 stoats caught in kill traps set for possums at Waikokopu (Section 4.2). Captures from 2004/2005 season compared with the 2003/2004 season have increased by 35% at Otamatuna/ Mangaone: the results in this area are comparable as the amount of trapping effort and number of traps present is the same as the previous year.

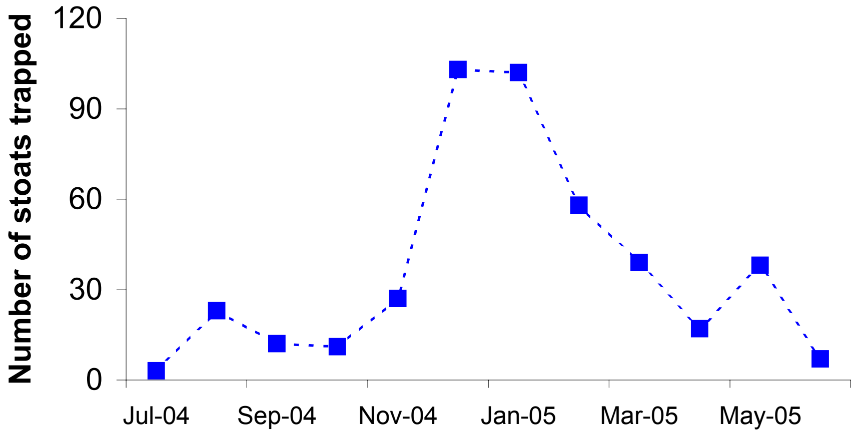
TABLE 4.4.2 NUMBER OF STOATS TRAPPED IN CORE AREAS, NORTHERN TE UREWERA, 2004/2005

CORE AREA	SUB-AREA	SUB-TOTAL	NO. STOATS TRAPPED IN 'STOAT' TRAPS	NO. STOATS TRAPPED IN 'RAT' TRAPS	NO. STOATS TRAPPED IN 'POSSUM' TRAPS	NO. SOTATS TRAPPED IN EACH CORE AREA
Otamatuna/ Mangaone	Otamatuna	66		4		
	EBOP	122	299			307
	Mangaone	111		4		
Onepu			79	18		97
Pakoakoa			43	16		59
Waikokopu			19	11	18	48
TOTALS			440	53	18	
GRAND TOTAL				511		

Of the 18 stoats caught in possum traps in the Waikokopu Core Area, 17 were caught following baiting with salted venison (December 2004) or salted rabbit (January 2005).

The majority of stoats (60%) were caught in the summer months particularly December and January (Fig 4.4.2). It should be noted that there is less management effort during the winter months.

Figure 4.4.2 Total number of stoats trapped per month in 'stoat' traps within Core Areas, northern Te Urewera, 2004/05



Preliminary results from the trial comparing Fenn traps and DOC200 traps indicate that DOC200 traps are more effective than single-set Fenn traps (Table 4.4.3). Full results of this trial can be found at HAMRO-100032.

TABLE 4.4.3 THE NUMBER OF STOATS, RATS AND BY-KILL, AND WHETHER THE TRAP WAS SET AND THE BAIT WAS PRESENT FOR THE TRIAL COMPARING FENN TRAPS AND DOC200 TRAPS, ONEPU CORE AREA, NORTHERN TE UREWERA, SEPTEMBER 2004 TO 30 JUNE 2005

TRAP TYPE	NO. STOATS TRAPPED	NO.RATS TRAPPED	NO.OTHER SPECIES TRAPPED	TRAP SET, BAIT PRESENT	TRAP SET, BAIT TAKEN	TRAP SPRUNG, BAIT PRESENT	TRAP SPRUNG, BAIT TAKEN
Fenn	28	60	61	1629	0	12	3
DOC 200	51	82	84	1568	0	29	0
TOTALS	79	142	145	3197	0	41	3

4.4.6 Discussion

The significant changes to this year's stoat trapping operations were the maintenance of traps, and the implementation of the trial comparing catch rates of DOC200 traps and singe-set Mk 6 Fenn traps.

Comments from the contractors using the re-waxed traps in Otamatuna and Mangaone are very positive; the ability to set the trap more easily and finer is apparent. Whether this has played a part in the increase in stoat captures from the previous year cannot be determined from this year's data alone. Catch rates are also influenced by management factors (such as trap condition, number and spacing of traps, and frequency of trap checks), and seasonal and yearly fluctuations in stoat abundance principally caused by variations in abundances of their prey, and trapping history at a site.

The trial to test the effectiveness of DOC 200 traps versus Mk6 Fenns indicates DOC200 traps are more effective at trapping stoats than single-set Fenn traps in wooden boxes. This trial will continue into the 2005/2006 season. DOC200 traps have other advantages such as being easier to set and having an instant kill, however as stoat skulls are usually smashed, animals cannot be aged.

No monitoring of young kiwi was undertaken this season due to a staff vacancy. There are likely to be considerable benefits to the ecosystem through the removal of over 500 stoats from the wider northern Te Urewera; however, the effectiveness of the stoat trapping regime within NTUERP for protecting kiwi has yet to be fully tested and monitoring of kiwi chicks and juveniles should continue.

4.4.7 Recommendations

- Maintain a regular maintenance programme of Fenn traps
- Continue monitoring kiwi as a measure of the effectiveness of the stoat trapping regime

4.4.8 Acknowledgements

A big thank-you to Keith Beale, Joe Rurehe and Ross Hurrell (DOC contractors, Opotiki Area Office) and Arthur Sandom (Environment BOP/ Royal Forest & Bird Society Inc. contractor) for their dedication to trapping stoats this season. Many thanks to Hikutaia Honey, especially Alan and Mike for allowing us to wax the Fenn traps for free, and stopping Becs getting blown up on the odd occasion.

Thanks also to Darren Peters (RD&I, Wellington) for setting up the Onepu trial and Craig Gillies (RD&I, Hamilton) for his comprehensive database development.

4.5 DEER CONTROL

Greg Moorcroft and Shane Gebert

4.5.1 Abstract

Deer control continued for the ninth consecutive year within the Otamatuna Deer Control Area. The objective was to control deer to low enough levels to allow the regeneration of palatable seedlings. An area of 2530 ha was treated by ground-based contract hunters using indicator dogs. Forty nine deer and six pigs were killed during the year. Monitoring of the number of palatable seedlings in the treatment and non-treatment blocks showed that the number of palatable seedlings has decreased, indicating that not enough deer were being removed. Counts of faecal pellets on monitoring lines also indicated that deer numbers were increasing. Key recommendations are: to set a minimum number of deer to be removed from the treatment area so that palatable seedling can regenerate; to increase hunting effort to achieve the target number; and that the associated annual monitoring of deer impacts and deer densities is continued.

4.5.2 Introduction

Forest structure in the Te Urewera National Park has been modified by introduced mammals including red deer (*Cervus elaphus scoticus*) and pigs (*Sus scrofa*) which are common throughout (Allen et al. 1984); ungulates have caused major changes in the shrub and small tree tier (Bockett 1999) and therefore are a major threat to ecosystem restoration within northern Te Urewera.

Previously, within northern Te Urewera, deer control had been limited to recreational hunting and commercial deer recovery; however, with the instigation of NTUERP, an outcome-focused control regime using dedicated hunters was implemented. To date this regime has been undertaken at one site, the Otamatuna Core Area. Red deer (deer) were first controlled within NTUERP, at Otamatuna, in 1997/98 and control has continued every year to present. Rusa (*Cervus timorensis*) are locally common within northern Te Urewera but not known to be present within the current management area (L. Wilson, Department of Conservation, pers. comm. 2005). The Otamatuna Core Area (2530 ha) is bounded by the Te Waiiti Steam in the north and east, the Tauranga River on the west, and the Ngutuoha Stream, the Wall Track and the Koaunui Track on the south. The area in which deer are controlled (Otamatuna Deer Control Area) has the same boundaries as above except part of the southern boundary runs down the Waiohinekaha stoat line instead of the Koaunui Track (Fig 4.5.1).

The impacts of deer are quantified using a technique that measures the number of palatable seedlings (in various height classes) within permanent plots. Also, deer abundance is measured using a relative index of the number of deer faecal pellets in permanent plots. These methods and the outcomes of the monitoring are examined in another section within this report (see Section 5.6).

4.5.3 Objectives

The management objective for deer control in the Otamatuna Deer Control Area was:

- To achieve a reduction in the deer population within the management area to enable the increased establishment and survival of palatable understorey plant species

4.5.4 Methods

Deer within the 2510 ha Otamatuna Deer Control Area (Fig 4.5.1) were primarily controlled by ground hunting undertaken by contractors using indicator dogs, with some incidental shooting by DOC staff encountering animals (not using dogs). All dogs used by contractors had passed DOC training qualifications and were also trained for ground-bird (kiwi) aversion. Animals were stalked and shot using high-powered rifles. Pigs were also hunted if incidentally encountered.

Contractors generally hunted in 10-day units, and were required to focus hunting effort at certain times of the year (spring and during the autumn 'roar') when deer are more conspicuous. Hunters were contracted on a basis of completing either a certain number of deer kills or a number of hunting hours and hunters could only kill a nominated maximum number of deer within 300m of the Te Waiiti stream. The contractors were required to carry a Global Positioning Satellite receiver (GPS) (Garmin Etrex) which was usually supplied by the Department. Instructions on the setup and use of GPS were given to all hunters (see WGNHO-242588) including keeping the GPS face-up in a place that allows the best possible contact with satellites. The GPS was kept on continuously during hunting to record tracking data, and kill locations were recorded as waypoints. An accurate record was kept of the number of hours spent hunting and the number of animal kills. The number of encounters was also recorded. While hunting, as well as using the GPS, hunters recorded details of their work in a waterproof notebook. These details were entered onto a datasheet daily, including a map of where the hunter had worked. Data from GPS units was downloaded at the Opotiki Area Office after each unit of hunting time. The right-hand jawbone of any animals killed was required to be removed from the animal and brought in to the Opotiki DOC office; this enabled kills to be verified and data on population structure to be collected.

Four hunters or hunting companies were used this season: Wayne Looney, Perrin Brown, Jason Healy and Mike Dowden.

4.5.5 Results

A total of 49 deer and six pigs were killed in the Otamatuna Deer Control Area this season. DOC staff accounted for 24% (n=12) of the deer kills; all of these were shot in the Te Waiiti Stream while two staff were conducting surveys for whio (*Hymenolaimus malacorhynchos*). Contract hunters spent 482 hours hunting to achieve the 37 deer and six pig kills. One hunter withdrew from his contract after his dog was injured. The location of deer and pig kills and GPS tracking points are shown in Fig 4.5.1. Table 4.5.1 shows the hunting effort and results for the Otamatuna Core Area from 1997/98 to 2004/05.

Figure 4.5.1 Location of management huts, deer and pig kills and GPS tracking data from contractor hunters, in the Otamatuna Deer Control Area, northern Te Urewera, 2004/05

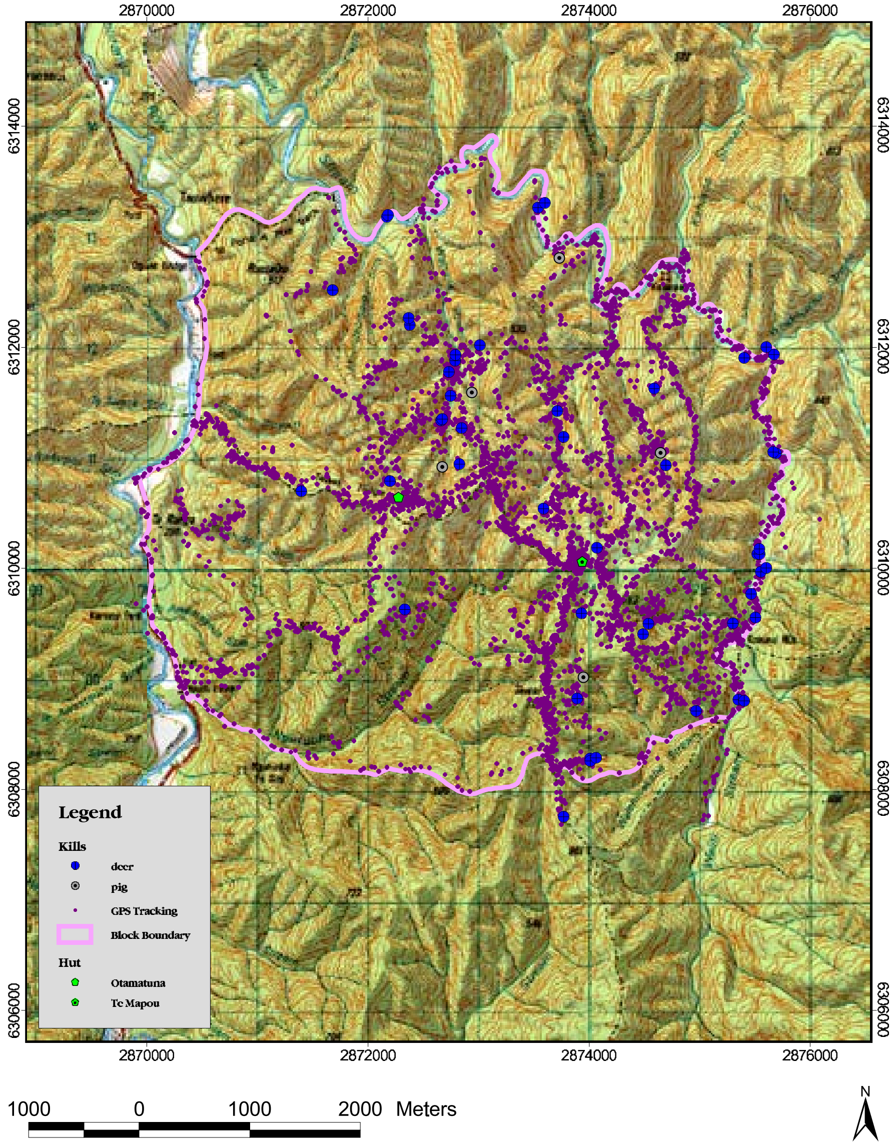


TABLE 4.5.1 HUNTING EFFORT AND NUMBER OF KILLS FOR DEER AND PIGS HUNTED BY CONTRACT HUNTERS AND DOC STAFF IN THE OTAMATUNA DEER CONTROL AREA, NORTHERN TE UREWERA, 1997/98 – 2004/05

FINANCIAL YEAR	HOURS HUNTED (CONTRACTORS)	NO. OF ANIMALS KILLED BY DOC CONTRACTORS		NO. OF ANIMALS KILLED BY DOC STAFF		TOTAL NO. OF ANIMALS KILLED	
		DEER	PIGS	DEER	PIGS	DEER	PIGS
1997/98	not available	29	0	12	1	41	1
1998/99	665	66	8	2	0	68	8
1999/00	1240.5	87	29	6	6	93	35
2000/01	1072	74	6	0	0	74	6
2001/02	847	44	10	0	0	44	10
2002/03	693	24	21	3	3	27	24
2003/04	740	43	4	0	0	43	4
2004/05	482	37	6	12	0	49	6
TOTAL	-	404	84	35	10	439	94

4.5.6 Discussion

The monitoring of deer impacts and deer densities using seedling/pellet lines (Section 5.6) indicates that deer densities have been increasing since 2000/01. This corresponds to a reduction in the number of deer removed from the block since this time. In the four years from 1997/98 to 2000/01 276 deer were shot, compared with 163 deer in the four years from 2001/02 to 2004/05. The conservation gains measured in the earlier period appear to have been lost in the latter period (Section 5.6). Increased hunting effort is therefore required to reduce deer densities and improve the forest condition within the Otamatuna Deer Control Area; however it is not known what specific number of deer need to be removed in any one year in order for the forest condition to improve. It is recommended that a minimum number of deer kills be set, and the appropriate level of management effort to achieve this number be implemented. Assuming that the target will be achieved, ongoing monitoring will determine if the new threshold is adequate.

The GPS data of hunting effort indicates that more effort was spent in parts of the Core Area nearer to accommodation (huts), compared with, for example, areas closer to the road (except for access routes). This is partly a result of the current lack of accommodation in the valley floor (a Ranger Base burned down in 2003) and so hunters may favour more accessible parts of the area (SG, pers. obs.). If accommodation was available on the roadside, there may be more uniform hunting effort over the block.

The number of deer killed by DOC staff represented a relatively high proportion of the total number of deer killed. All were chance encounters as staff were undertaking other work, but as all of these were in the Te Waiiti Stream, the importance of the riverine habitat for deer is illustrated. Contract hunters were contractually limited to how much hunting effort they could spend in the Te Waiiti; since deer can often be more easily hunted in main streams and rivers, it was thought hunters may favour these habitats rather than targeting deer throughout the Core Area. The high number of deer in the Te Waiiti is likely a reflection of the changing pressure from local recreational hunters. It is probable that fewer animals are taken in this area as there are more restrictions for using dogs within the National Park (see Section 5.3 for more detail), and there is no longer a commercial market for wild-caught venison.

The use of GPS allows managers to more accurately determine the amount and extent of hunting effort, more accurately show kill locations, and allows for improved auditing, for example verifying kills. There are, at times, inaccuracies in the use of GPS, mainly due to poor satellite coverage, but the benefits outweigh the negatives and overall the system continues to be effective.

4.5.7 Recommendations

- Determine a minimum number of kills for deer control in the Otamatuna Deer Control Area over a financial year
- Increase hunting effort within the Otamatuna Deer Control Area to achieve the minimum number of kills
- Continue associated monitoring of deer impacts and deer densities
- Investigate options for improving the uniformity of hunter effort across the Otamatuna Core Area
- Continue with the use of Global Positioning Satellite receivers for tracking hunter effort and kills

5.0 Conservation Monitoring

5.1 INTRODUCTION

Conservation or outcome monitoring measures the effects of management on selected ecosystem components. Particular animals or plants were selected for monitoring because they have significant conservation value, i.e. they may be threatened or at risk, or they have particular characteristics that inform about the success or failure of management. Monitoring methods that measure changes in some aspect of the population of the plant or animal are usually established, but may be adapted to fit local circumstances.

Table 5.1.1 identifies what components of the ecosystem were monitored during 2004/05, methodology and monitoring rationale (assessment of management action).

TABLE 5.1.1 CONSERVATION MONITORING OVERVIEW FOR NORTHERN TE UREWERA ECOSYSTEM RESTORATION PROJECT, 2004/05

ECOSYSTEM COMPONENT	MONITORING METHOD	ASSESSMENT TARGET (MANAGEMENT ACTION)
Kokako	Survey, census, breeding success	Rat and possum control; A-Line management regime
Whio	Survey	Stoat control
Kiwi	Call-rate survey, chick survival (transmitters)	Stoat control
Mistletoe	Mistletoe and host condition; mistletoe abundance	Possum control
Forest understorey (palatable seedlings)	Counts of seedlings in plots	Deer control
Forest canopy	Foliar Browse Index (canopy condition)	Possum control

Kokako monitoring was done in the Otamatuna, Onepu, Pakoakoa and Waikokopu Core Areas; Whio monitoring was done in two sites with pest management (Te Waiiti Stream and lower Tauranga River) and a non-treatment site (upper Tauranga River); Kiwi monitoring was done in the Otamatuna/Mangaone stoat control area; Mistletoe monitoring was undertaken in the Otamatuna Core Area and the Okopeka non-treatment area; Palatable seedlings were counted in both the deer control area (Otamatuna) and a comparison area (Onepu); Forest canopy condition was done throughout the Background Area as well as in the Okopeka non treatment area.

Previous outcome monitoring includes measuring northern rata condition, five-minute bird counts, and North Island robin survival and breeding success.

5.2 KOKAKO

Cody Thyne & Jane Haxton

5.2.1 Abstract

Kokako were primarily monitored within NTUERP as an indication of the effectiveness of pest control programmes. The potentially more economical A-Line regime and general population trends are of particular interest. Nest monitoring was conducted this season at Onepu and Pakoakoa Core Areas, with census or survey results obtained for Pakoakoa, Waikokopu and Otamatuna Core Areas. Within Otamatuna, the Inner Core perimeter line survey was introduced to monitor an index of kokako abundance in the Outer Core. In addition to this survey, three key ridges were monitored and surveyed to provide a base-line indicator of ridgeline dispersal. Thirty pairs and eight singles were detected on or below the perimeter line in the Otamatuna Core Area. Six pairs and four singles were located during the three-ridges surveyed. Onepu nest monitoring this year revealed a nesting success rate of 20% from 11 monitored pairs. Nest monitoring of five pairs at Pakoakoa Core Area was undertaken with one fledgling produced and a nesting success rate of 25%. Two failed nests were located outside the Core Area; the feasibility of extending the Core Area boundary to incorporate nesting areas outside the Inner Core Area should be investigated. The 2004/05 census results obtained from Waikokopu Core Area revealed a population of four pairs, eight singles and one juvenile. It is recommended that pre-breeding season surveys and nest monitoring is undertaken at Waikokopu and Pakoakoa in the upcoming season and the surveys at Otamatuna be repeated.

5.2.2 Introduction

The northern Te Urewera was surveyed during 1992/93 to assess the distribution and density of kokako (*Callaeas cinerea wilsoni*). A total of 625 kokako were located, making this the largest known kokako population. However, more recent surveys within northern Te Urewera indicated that in areas without intensive pest control, kokako populations were in decline (Jones et al. 1999). Kokako are vulnerable to predation by introduced pests, especially at nest sites where eggs and chicks are taken by rats, possums and mustelids. This vulnerability makes kokako a suitable indicator species to measure the effectiveness of pest control programs.

'Adaptive management' trials conducted over three central North Island kokako populations (Mapara, Kaharoa and Rotoehu), measured pest animal densities, kokako nesting success and kokako population trends (Innes et al. 1998). From this data, low possum and rat densities were identified as necessary to reverse kokako decline. Bait station technology (based on the successful Mapara model) was introduced to northern Te Urewera in an attempt to reverse the downward trend of the kokako population. This work became the precursor for the establishment of the Otamatuna Core Area in 1996.

The Northern Te Urewera Ecosystem Restoration Project (NTUERP) officially began in late 1995. By the summer of 1996/97, an intensive bait station operation in the Otamatuna study area had commenced. The northern Te Urewera has an on-going possum trapping program over approximately 50 000 hectares. At the end of the 1997/98 financial year, possums had been reduced to less than 5% residual trap catch (RTC) over 33 700 hectares (Wilson, 1999). To achieve the long-term objective of restoring kokako in situ across the northern Te Urewera, the concept of more strategically located 'Core Areas' is being investigated. These Core Areas, sites of more intensive management within the larger area of possum control, may be a more cost-effective method to restore the northern Te Urewera than large-scale intensive pest control. A limited bait station regime, consisting of three parallel bait lines, 150 meters apart and centred along ridge crests, was installed in the Onepu study area during the summer of 1996/97. This bait station regime was termed the 'A-line'. In the 1999/2000 season NTUERP moved away from toxin based rodent control in favour of a more environmentally-friendly trapping based approach. At present there are four intensively managed A-line Core Areas within NTUERP (see section 2.0 for more detail). Each of these Core Areas is surveyed biennially to measure change in the kokako population and to assess the effectiveness of intensive pest control within each area. Nest monitoring is currently being undertaken in some of the A-line Core Areas to determine the productivity of kokako under a trapping-based pest control regime.

Research in the northern Te Urewera has national implications for other large forest tracts, where it is important to preserve existing populations of kokako and other passerine species, and to maintain behavioural characteristics (e.g. song dialects) and genetic diversity, in a cost-effective manner. Northern Te Urewera kokako recovery will continue to be a major contribution towards the long-term national goal of recovering kokako to 1000 pairs by the year 2020.

5.2.3 Objectives

- To undertake censuses to determine kokako population trends within Pakoakoa and Waikokopu Core Areas
- To monitor kokako nesting success in Pakoakoa and Onepu Core Areas
- To gain baseline information on kokako distribution outside the Otamatuna Inner Core Area

5.2.4 Methods

Census

Standard census methods were used as described by Flux and Innes (2001). Kokako territories within northern Te Urewera are predominantly ridge-focused, therefore survey effort was concentrated within Core Areas, along ridge and spur habitat and along rat trapping lines located 150m below the main ridge. Local kokako dialect was recorded using a directional microphone and broadcasted through amplified mini disc players to attract or locate kokako throughout the survey period. GPS positions were taken for all kokako located and the status of all birds was recorded i.e., pair, single, banded or unbanded. All juveniles encountered were also recorded. Waikokopu was surveyed in April 2005 and Pakoakoa in October 2004.

Nest Monitoring

Nesting success of kokako pairs was monitored at the Onepu and Pakoakoa Core Areas. Monitoring methods followed Flux and Innes (2001). Pairs were followed looking for evidence of nesting behaviour. Playback calls were used if birds were not located using non-interactive methods. Observations confirming a nest or chick present included: an absence of one of the adults, unusual or secretive behaviour by adult, carrying of nest material, wing displays, mutual feeding or chick calls. All pairs located were monitored for nesting behaviour. Nests were monitored by visiting nesting sites approximately once per week, but not more than 10 days apart. A nest was deemed as successful when one or more fledglings were observed. Pairs were followed from 1 November for signs of nesting until the onset of moult indicated the end of the breeding season.

Otamatuna Inner Core Perimeter and Three Ridges Surveys

Within the Otamatuna Core Area, the walk-through survey technique (Flux and Innes 2001) was used to survey the Inner Core perimeter (the outermost line of rat control was termed the perimeter). The entire perimeter and significant spurs and ridges below the perimeter extending approximately 200m were surveyed and all birds encountered recorded. Only birds that were located on and below the perimeter were recorded (Fig 5.2.1). The survey was conducted in May and June 2005.

In addition, three ridges to the north of the Otamatuna Inner Core Area were surveyed 7-17 September 2004 to provide base-line information on kokako population levels on ridgeline habitat beyond the Core Area boundaries. Survey methods followed Flux and Innes (2001) with surveying commencing at the perimeter boundary and continuing to approximately the 300m contour mark at the end of the ridge (Fig 5.2.1).

Figure 5.2.1 Location of survey routes, and kokako pairs and singles observed for the Otamatuna Inner Core Perimeter and Three Ridges Surveys, northern Te Urewera, 2004/05

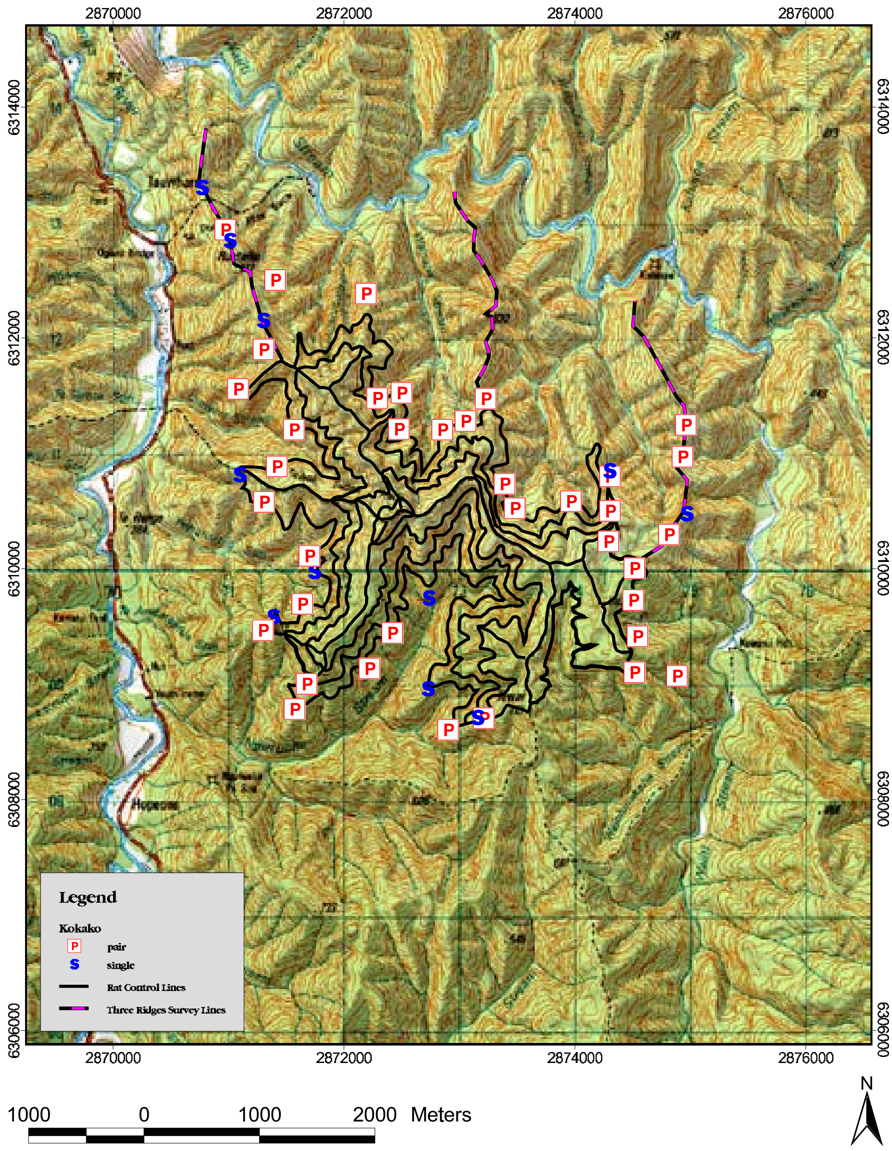


Figure 5.2.2 Locations of territorial kokako and monitored kokako nests in the Pakoakoa Core Area, northern Te Urewera, 2004/05

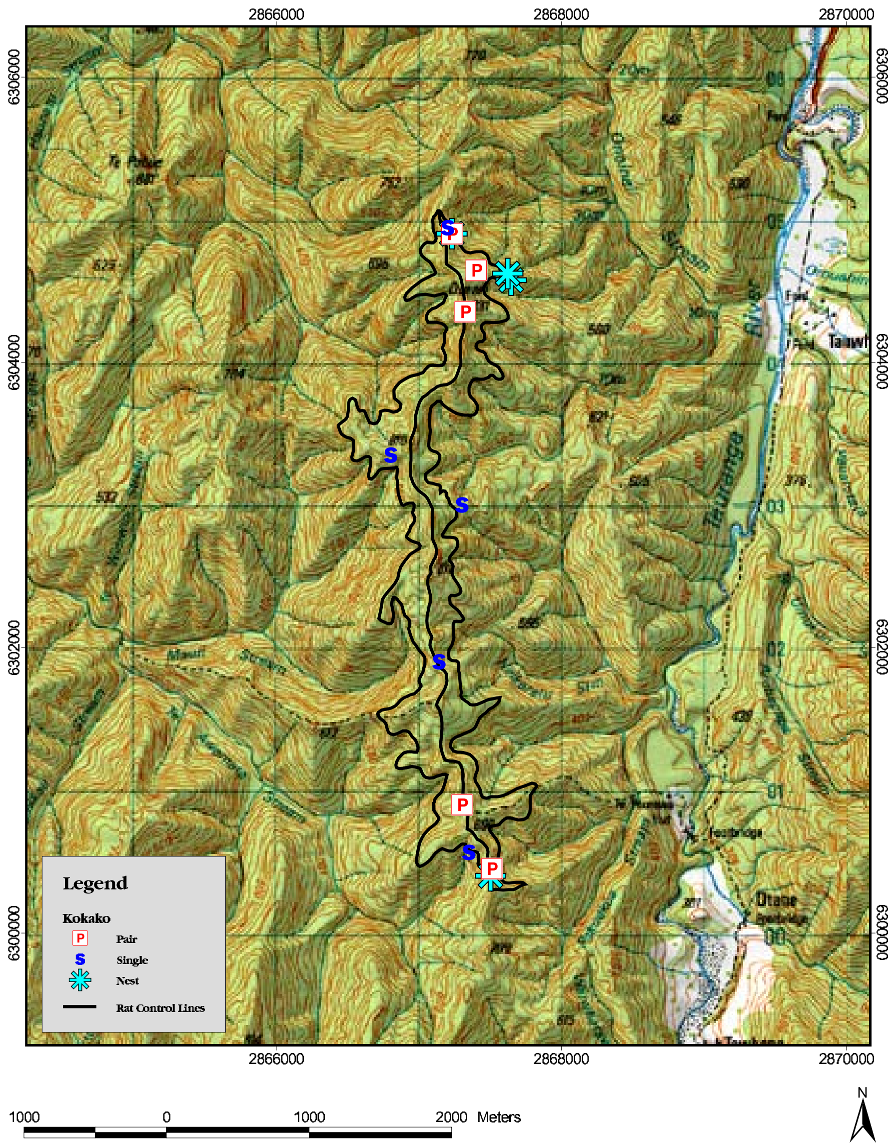
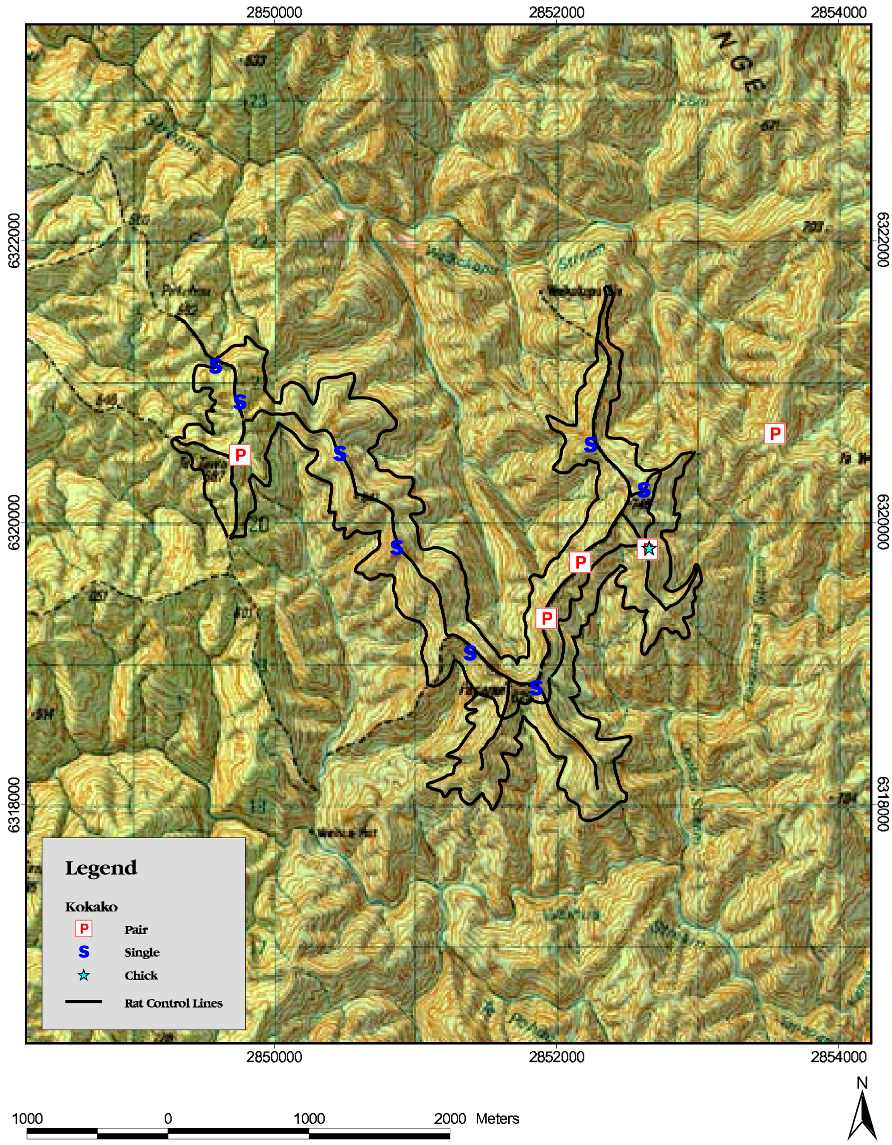


Figure 5.2.3 Location of territorial kokako in the Waikokopu Core Area, northern Te Urewera, 2004/05



5.2.5 Results

Census

Waikokopu Core Area census results from 1995/96 to 2004/05 show a fluctuating population at low density. This year's census undertaken in April 2005 revealed four pairs and eight singles (Fig 5.2.3). One chick was seen accompanying one of the pairs.

A brief census was undertaken in the Pakoakoa Core Area in October 2004: five pairs and five singles were located (Fig 5.2.2). No further pairs were located through the term of the breeding season (when nest monitoring was undertaken).

Nest Monitoring

Of the eleven pairs monitored within the Onepu Core Area, six pairs made 10 confirmed nesting attempts (Table 5.2.1). Two pairs fledged chicks; one pair succeeded in fledging two chicks on their first attempt and did not attempt to re-nest. The other successful pair fledged three chicks on their second attempt. All other nesting attempts failed, giving a nesting success rate of 20 percent.

Of the five pairs present at Pakoakoa, three attempted to nest. One pair succeeded in fledging one chick and all other nesting attempts failed, including the second nesting attempt of one of the pairs. This gave a nesting success rate of 25 percent. All the nest failures occurred at an early stage of development (incubation or early brooding). All pairs were observed in moult and the breeding season was concluded as of 31 March 2005. On the 30 March it was observed that a single kokako, located near the Pakoakoa hut, was accompanied by a juvenile.

TABLE 5.2.1 MONITORING EFFORT AND OBSERVED NESTING SUCCESS AT ONEPU AND PAKOAKOA CORE AREAS, NORTHERN TE UREWERA, 2004/05

CORE AREA	PAIRS	NESTING PAIRS	KNOWN NESTING ATTEMPTS	KNOWN SUCCESSFUL NESTS	CHICKS FLEDGED FROM MONITORED NESTS	NESTING SUCCESS RATE	FLEDGLINGS PER NESTING ATTEMPT
Onepu	11	6	10	2	5	20%	0.50
Pakoakoa	5	3	4	1	1	25%	0.25

Otamatuna Inner Core Perimeter and Three Ridges Surveys

During the Otamatuna Inner Core perimeter survey, a total of 30 pairs and eight single birds were located (Fig 5.2.1). Although surveying for chicks was not part of the survey outcome, seven chicks were observed with five pairs.

A total of six pairs and four singles were detected on the three ridges north of the Otamatuna Core Area (Fig 5.2.1). Previous broad-scale dispersal surveys carried out in 2001 detected three pairs and four singles on these ridges collectively. In 2004, three pairs and three singles were detected on Ogilvies Ridge, an increase of one pair from 2001. Three pairs and one single were detected on Kaharoa ridge.

5.2.6 Discussion

Otamatuna

With current resources and methods, the population of kokako within the Otamatuna Inner Core area is too large to accurately measure. The purpose of the Outer Core distribution survey was to establish a baseline from which to measure changes in the abundance of kokako in the Otamatuna Outer Core Area. As the density of territorial kokako within the Inner Core increases (due to intensive pest control) towards carrying capacity, it is likely that 'spill-over' will occur and the numbers of kokako located in the Outer Core will increase.

As the Otamatuna population increased (from 8 pairs in 1994 to 95 pairs in 2004) it was widely expected that kokako would have spread along the ridges in preference to the faces and gullies below the ridgelines. A dispersal study at Otamatuna undertaken in 2003 found that birds tended to disperse on average 1.4km from their natal territories. Furthermore, they prefer to settle adjacent to other kokako rather than strike out into the surrounding forest (Innes, 2004). The results from this year's survey strengthens the hypothesis that kokako tend to form territories in close proximity to other kokako rather than dispersing to new areas of what had been considered optimal habitat (i.e. ridgelines). The surveys will need to be repeated annually to continue building the baseline data, and it may be several seasons until any trends become apparent.

Onepu

The purpose of the nest monitoring at Onepu was to measure the effectiveness of the trapping-only A-Line pest control regime. The nest monitoring results indicated a nesting success rate of 20 percent which is considered low; in comparison, nest monitoring of 11 pairs at Otamatuna in 1998/99 showed a nesting success rate of 67%, however this was under a different management regime (use of Pindone over a wider area) (see Beaven et al. 2000). Rat indices were moderate at the beginning of the season with 12% tracking index in late November (Section 4.3), and an average across the season of 9%. This result is not considered adequate to allow kokako to breed successfully (Flux and Innes, 2001) and the results from this season support this. The majority of nest failures occurred at the early stages of nest development; the exact cause of all these failures could not be ascertained without retrieving nests, however, with higher than desired rat indices it may be assumed that rats were a significant factor in the poor results gained at Onepu this season. The monitoring suggests if similar results occur in subsequent years the kokako population at Onepu cannot be sustained or enhanced. This is, however, the first year of intensive monitoring since 1999/2000 when rat trapping was first introduced as a control method. Nest monitoring will continue at Onepu to gain further data in order to better understand how well the management regime protects kokako.

Stoat predation may also be a factor for the low nesting success: in the 2000/01 season it appeared stoats were responsible for eight of 17 nest failures at Otamatuna; investigations found stoat droppings and feather trails from nest sites indicating that stoats were the predator responsible (Hudson & Jones, 2001). However, during this season stoat control at the Onepu Core Area was initiated (see Section 4.4) which should increase the security of the population by reducing the predation risk to not only eggs and chicks but also nesting females. This has extended the Core Area to 1053 ha, although rat trapping was still only done within the 179 ha Inner Core. It is anticipated that stoat control will help halt any decline in pair numbers and increase nesting success.

Pakoakoa

Rat indices were high at the beginning of the season with a result of 34% in late October and an average throughout the season of 25% (Section 4.3). Flux and Innes (2001) deem it necessary to reduce rat and possum abundance indices to low levels (<5%) in order for kokako to breed successfully. This was not achieved and it is assumed that high pest levels decreased the likelihood of kokako and other forest birds nesting successfully. It should be noted that only three nesting attempts were made by the five resident pairs and that two of these attempts occurred approximately 200m outside the Inner Core Area boundary (Fig 5.2.2). An egg shell had been located from under one of these nests and from close examination it was determined that the egg had probably been predated by an avian predator (John Innes, Landcare Research, pers. comm. 2005).

The sighting of a juvenile bird with the single located at the Pakoakoa Hut site is encouraging. The Core Area may have gained a new pair and this will be verified by the beginning of the 2005/06 breeding season.

Waikokopu

A total of four pairs and eight single birds were located during this census, a decrease of three pairs but an increase of four singles since 1999/2000. Three territories previously occupied by pairs were now found to be occupied by single birds. This decline in pair numbers suggests either an ageing population with natural mortality of birds, and/or the predation of females on the nest, most probably by stoats (G. Jones, Department of Conservation, pers. comm. 2002). The structure of the population may be skewed and dominated by male birds, with some pairs being perhaps male-male pairings. This is a well documented phenomenon in remnant kokako populations. It will likely take several years for the population to recover (given that management efforts allow the population to recover). Even with sufficient management to allow recovery the population is vulnerable to stochastic events. More in-depth monitoring is required at this site to determine the effectiveness of pest management, and accurately determine the causes of nest failure. Such monitoring should also reveal information about the population structure at this site.

One chick was observed accompanying a pair. This was the only juvenile observed at the time of census. Rat tracking indices were 10% at the start of November and tracking indices recorded over the remainder of the breeding season indicated that rats were not controlled to less than 5% until mid January 2005 (Section 4.3). These results indicate that rat numbers may have limited the opportunity for kokako to successfully breed this season at Waikokopu.

Past rat tracking results showed that indices have been largely maintained below the target 5% over the past five breeding seasons. Despite this, kokako have not increased in number as anticipated and shown in other regions. The kokako population has remained static over the last three years and remains highly vulnerable.

5.2.7 Conclusion and Recommendations

Pest numbers were higher than hoped for in all of the Core Areas (Sections 4.2 & 4.3). The level of rat indices have been addressed by staff and some new management techniques and additional effort is to be employed to keep index results to the 5% targets. Changes to stoat trapping in Waikokopu planned for 2005/06 season may influence the success of breeding output with 250 trap sets to be placed throughout the Core Area (Section 4.4)

Future nest monitoring should focus on the two small core areas, Pakoakoa and Waikokopu, as these are the more vulnerable populations. With little known about these populations' age and structure an effort to answering key questions should be implemented. More intensive methods (e.g. attaching bands and/or transmitters to birds) are required to help reveal the limited success of these kokako populations under current management regimes.

It is recommended to:

- Continue annual nest monitoring at Waikokopu and Pakoakoa Core Areas
- Complete a pair survey in Waikokopu and Pakoakoa Core Areas prior to the breeding season
- Investigate the feasibility of extending Core Area boundaries at Onepu and Pakoakoa to incorporate nesting areas currently outside the Inner Core Areas
- Repeat the Otamatuna Inner Core perimeter and Three Ridges surveys
- Undertake the biennial census at Onepu and Mangaone Core Areas

DME numbers of independent 2004/2005 reports:

Haxton, J.; Thyne, C. 2005a: Onepu Core Area Nest Monitoring 2004/05. Department of Conservation, Opotiki Area Office, (unpublished) WGNHO 41695

Haxton, J.; Thyne, C. 2005b: Pakoakoa Core Area Nest Monitoring 2004/05 Department of Conservation, Opotiki Area Office, (unpublished) WGNHO 50198

Thyne, C. 2005: Waikokopu kokako census 2004/05. Department of Conservation, Opotiki Area Office, (unpublished) WGNHO 220454

5.3 NORTH ISLAND BROWN KIWI

Greg Moorcroft

5.3.1 Abstract

Kiwi were monitored within NTUERP as a means of evaluating the effectiveness of wide-scale stoat control. Monitoring of kiwi is done by using transmitters and call counts within a 4100 ha area (Otamatuna and Mangaone Core Areas). Currently, six kiwi have transmitters attached; no losses were recorded and one female was caught this season. No breeding monitoring was undertaken this year due to staff shortages. The kiwi population appears to have stabilised after recent predations by feral dogs: call counts in May this season (2.58/hour) are similar to May 2004 (2.5/hour) and May 2003 (2.58/hour) but less than the rate recorded prior to the predations in August 2002 (4.77/hr). Measures taken to reduce the threat of predation by feral dogs appear to be successful; this includes a change in Conservancy policy where all dogs permitted for hunting on DOC-administered land must have been certified for avian (kiwi) aversion. Future priorities include increasing the sample size of monitored birds and maintaining the emphasis on reducing the threat from feral dogs.

5.3.2 Introduction

Kiwi are monitored in the Otamatuna/Mangaone Core Areas (c. 4100 ha) as an indication of the effectiveness of the stoat trapping regime (Section 4.4).

North Island brown kiwi (*Apteryx mantelli*) (kiwi), the only kiwi species currently extant in northern Te Urewera, have a "Seriously Declining" conservation rating (Hitchmough, 2002). At unmanaged sites on the mainland they are declining at an average rate of 5.8% per year (approximately halving every decade) with as few as 6% of young kiwi reaching adulthood (McLennan et al. 1996). The principal cause of decline is intense predation of kiwi in their first six months of life by stoats (*Mustela erminea*) and cats (*Felis catus*); 50% of mortalities are caused by predators, chiefly stoats (McLennan et al. 1996). By approximately six months of age, kiwi have reached sufficient size (c.1000g) to ward off attacks by stoats. In addition to the threats to young kiwi, predation of adult kiwi by dogs (*Canis familiaris*) and ferrets (*Mustela furo*) can cause catastrophic local declines in populations (e.g. Taborsky 1988; Pierce & Sporle 1997)

From early-2003 a series of deaths of monitored kiwi as well as evidence from field sign showed that significant numbers of kiwi within northern Te Urewera were being killed by feral dogs. From a total of 17 kiwi with transmitters on in January 2003, 14 had died or had likely been killed by May 2004. Eight of these deaths were confirmed or likely as a result of dog predation and four other deaths were further possibilities of dog predation. A series of measures including hunting and live trapping as well as bird-aversion training for dogs and advocacy has currently reduced the threat to kiwi from dogs in the northern Te Urewera.

5.3.3 Objectives

The objectives of kiwi management within NTUERP for the 2004/05 season were:

- To monitor the fate of kiwi chicks and juvenile kiwi until birds reach 1000g
- To monitor the survivorship of territorial kiwi
- To track the fate of non-territorial sub-adult kiwi
- To monitor the population of kiwi within the Otamatuna and Mangaone Core Areas

5.3.4 Methods

All processing of kiwi follows practices outlined in the Kiwi Best Practice Manual (Robertson & Colbourne 2003).

Adult kiwi were captured with the use of specialised dogs during the day or at night, or using playback of kiwi calls to lure kiwi to a site for hand capture. An adult transmitter (Sirtrack Ltd or Kiwitrack Ltd) was attached to one leg allowing kiwi to be monitored remotely for up to one year. Adult kiwi were generally only handled once annually to minimise stress levels and in order to monitor natural breeding rates. Signals from territorial birds with transmitters were checked at least once per month throughout the year, more often during breeding months.

From late June, the positions of individual male kiwi were checked regularly using telemetry from regular locations. A compass bearing and signal strength were recorded. Consistency in the direction of bearings from the regular monitoring points indicated that the male had started to incubate eggs. A 'close fix' of the nest location was gained by tracking the kiwi to within a few metres although the distance varied according to access and likelihood of disturbance to the bird. A close-fix allowed the nest site to be inspected if the site was abandoned by the male. The nest site and an access trail were marked using flagging tape and pegs with reflective tape.

Nests were checked after approximately 85 days of incubation by staking them out at night. Any chicks found were fitted with a chick transmitter attached to one leg. Chicks were re-located every two weeks to monitor their progress and change their transmitter band to accommodate the increasing girth of their leg. When weighing approximately 800g, a larger more powerful juvenile transmitter was attached, and when birds weighed 1000g, an adult transmitter was attached.

When kiwi weighed approximately 1200-1300 g (and their leg was of sufficient size) a permanent metal band containing a unique identifying number was attached. Most monitored kiwi in NTUERP have an 'R'-sized band attached, but some females have legs that are too large for these bands; in these cases an 'RA'-sized band was fitted.

Transponders (Allflex Ltd.) have been used since 2002. These are small

(11.1 x 2.1 mm) units consisting of a microchip contained within an inert coating. A unique 14-digit code is ascribed to each unit and these codes are read at close-quarters by a dedicated scanner. Transponders, where used, were inserted subcutaneously, posterior to the left wing, by a trained operator.

After sub-adult kiwi were fitted with adult transmitters, they were tracked down every three to six months for band or transmitter replacement, until evidence of breeding was found. Aerial support, using helicopters or fixed-wing aircraft fitted with the appropriate radio-telemetry equipment, was essential in the rough terrain of northern Te Urewera.

Kiwi call counts were undertaken at Otamatuna/Mangaone during May 2005. The Kiwi Call Survey method as described in Robertson & Colbourne (2003) was used. Kiwi calls were counted from six permanent sites with good listening coverage, during the first two hours of darkness, for four nights each site (see Figure 5.3.1 for call count site locations). A range of environmental conditions were scored, and kiwi heard were recorded by sex, bearing and distance; other animals heard were also noted.

5.3.5 Results

The total number of kiwi alive, with transmitters attached at 1 July 2004 was five; by 30 June 2005 this figure had increased to six (Table 5.3.1). No birds were lost from the monitoring sample and one bird, a female, was captured during the period.

TABLE 5.3.1 FATE OF KIWI WITH TRANSMITTERS WITHIN NORTHERN TE UREWERA, 2004/05

	MALE	FEMALE	UNKNOWN	TOTAL
Alive 1 July 2004	4	1	0	5
Number deaths	0	0	0	0
Number losses [1]	0	0	0	0
Number captures	0	1	0	1
Alive 30 June 2005	4	2	0	6

[1] 'Number losses' includes any loss of ability to monitor that was not due to death

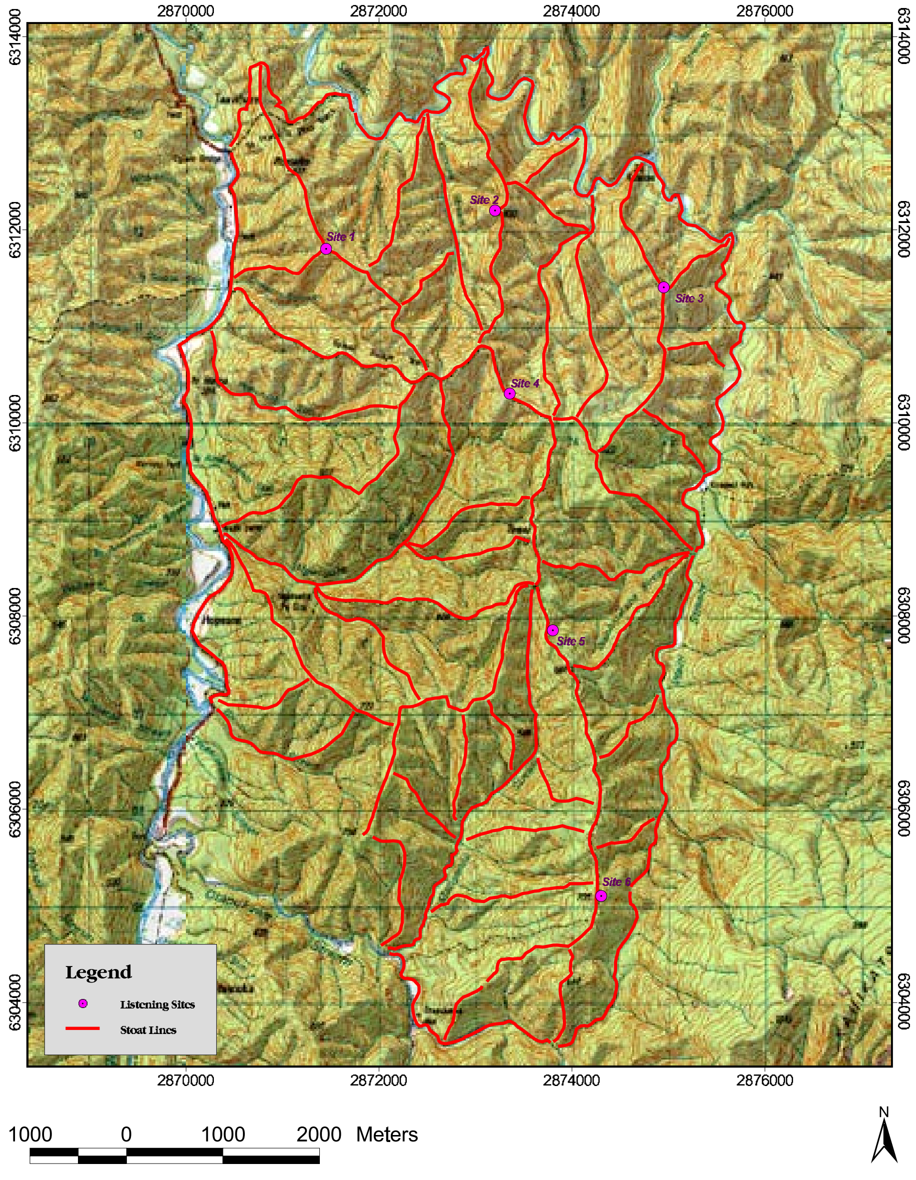
No nest monitoring was undertaken during the 2004/05 season due to staff vacancies. Transmitters on adult kiwi were changed as necessary by DOC staff with appropriate skills.

Population monitoring using call counts indicated that the population has remained stable for the previous two years but may still not be at the level prior to the series of adult deaths caused by a dog incursion in 2003 (Table 5.3.2).

TABLE 5.3.2 NUMBER OF CALLS HEARD PER 48 HOURS OF LISTENING AND CALL RATES OF NORTH ISLAND BROWN KIWI IN OTAMATUNA AND MANGAONE CORE AREAS, NORTHERN TE UREWERA, 2001 - 2005

YEAR	FEMALE CALLS	MALE CALLS	TOTAL CALLS	CALL RATE (CALLS/HOUR)
August 2001	25	204	229	4.77
May 2003	19	109	128	2.58
May 2004	9	112	121	2.50
May 2005	24	105	129	2.69

Figure 5.3.1 Location of kiwi listening sites and kiwi monitoring area in northern Te Urewera, 2004/05



5.3.6 Discussion

The monitoring of North Island brown kiwi within NTUERP is in a re-building phase following both the killing of kiwi by feral dogs, and changes in personnel. Currently, there are few birds with transmitters, and more need to be caught to increase the sample size. The appointment of a new staff member should facilitate this and enable intensive monitoring, including the monitoring of young kiwi, to continue.

Since the kiwi deaths, a range of measures to protect kiwi from dogs have been taken. After support from local people, particularly iwi, had been gained, 33 dogs were removed from the wider area by shooting and trapping. Live capture traps were set along the Matahi Valley Road and then at four locations within the Kiwi Management Area (Otamatuna, Te Mapou and Mangaone Huts and the top of the Wall Track). Traps were checked by staff and contractors on a daily basis when traps were open. Trapping was effective (12 dogs were removed) but required a large commitment of staff and contractor time. A recent development of a remote device that indicates, via the DOC VHF radio system, when a trap has been triggered should make dog live-trapping in remote areas a more effective tool.

Advocacy for kiwi protection was increased including the attendance of local pig hunting club meetings. Increased effort was put into checking that hunters had valid permits, and several prosecutions resulted from this operation. More signage was erected re-affirming that no hunting dogs are allowed in the Otamatuna and Mangaone Core Areas (only DOC contract hunters are allowed in the Otamatuna Core Area). Apart from the Otamatuna and Mangaone Core Areas, dogs can only legally be used for hunting in the northern section of the Te Urewera National Park from 1 May to the Friday before Labour Weekend. The most significant change for kiwi protection was the formation of a Conservancy policy for the use of dogs on conservation land. As previously, no dog may be taken onto DOC-administered land without a permit; however, obtaining a permit for hunting dogs now requires both the dogs and the handler to have undergone a certification process for avian aversion (which is focused on kiwi). The permitting process was enhanced with the development of an electronic database which contained hunter's details. It remains very difficult to thoroughly police any restrictive measures (such as permits) but raising the awareness of the threat to kiwi from dogs is an important part of this work.

Having a regular DOC presence in main access areas contributes to policing and compliance; however, this presence, especially during weekends, has been reduced in recent years after the ranger base on Matahi Valley Road burned down.

Judging from the survival of kiwi currently with transmitters, and the lack of field sign, including sightings, it appears the threat to kiwi from feral dogs has been reduced for the time being. It is clear though that this type of episode can easily re-occur, especially considering the land tenure around the National Park and practices of some local hunters: it is difficult to control illegal practices over a large area especially with many points of entry to the National Park from private land. It is apparent that advocacy for kiwi coupled with effective contingency methods in case of another dog-killing episode are very important to maintaining a viable population of kiwi in northern Te Urewera.

Monitoring young kiwi (chicks and juveniles) is an intensive exercise but one that potentially shows the effectiveness of the stoat trapping regime at Otamatuna and Mangaone. It is estimated that a sample of 10 breeding males will provide an adequate sample of kiwi chicks. Other kiwi with transmitters, i.e. females, non-breeding adults and sub-adults allows other aspects of kiwi ecology such as sub-adult dispersal distances, adult survival (especially in regards to dog kills) and adult longevity, to be measured.

5.3.7 Recommendations

- Continue to monitor kiwi within NTUERP as a measure of the effectiveness of stoat control
- Increase the sample size of kiwi with transmitters to include 10 breeding males
- Maintain advocacy and other techniques to reduce the threat of predation by feral dogs
- Support research for alternative methods for controlling feral dogs

5.3.8 Acknowledgements

Rhys Burns monitored kiwi in NTUERP from 1999 to 2004; Jane Haxton organised transmitter changes and monitoring during the staff changeover period; Tamsin Ward-Smith, Willie Waitoa and Hemi Barsdell changed transmitters on adult kiwi.

5.4 WHIO

Andrew Glaser

5.4.1 Abstract

Whio or blue duck were monitored within the NTUERP as a potential measure of the effectiveness of the stoat trapping regime, and to measure population trends and characteristics. Monitoring was undertaken in three sites; two where predator control is undertaken (Te Waiiti and lower Tauranga) and at one site which serves as a comparison or non-treatment site (upper Tauranga). Twenty one pairs in Te Waiiti produced 52 juveniles of which 23% fledged (0.57 juveniles per pair). None of the 21 juveniles produced by the 11 pairs in the lower Tauranga fledged. The eight pairs in the upper Tauranga produced 19 juveniles of which 47% fledged (1.3 juveniles per pair). A significant localised flood event occurred in the lower reaches of the Waimana catchment affecting Te Waiiti and lower Tauranga more than the upper Tauranga. One new adult was banded and seven juveniles were fitted with transponders. Eight dispersed juvenile whio were observed with the most distal observation being c.19km from the natal area. Further information on impacts of weather events, adult survival and juvenile dispersal and survival needs to be collected to better understand the population dynamics and to ensure long-term viability of the population through management.

5.4.2 Introduction

Whio or blue duck (*Hymenolaimus malacorhynchos*) are a 'nationally endangered' (Hitchmough 2002) ancient species of water fowl that have adapted to live year-round in New Zealand's forested rivers and streams. Habitat of whio includes lowland forest rivers and streams in intact riparian forests, which are usually of high quality with good to moderate stability, moderate gradients and low transport of fine sediments (Collier 1993). Whio occupy an ecological niche in the upper trophic level within New Zealand riverine ecosystems and serve as an indicator of riverine ecosystem health and completeness (Adams et al. 1997).

Threats to the remaining whio populations are perceived to be habitat loss/disturbance, direct human impact, competition, predation and population fragmentation. More recently, predation of whio by stoats (*Mustela erminea*) has been shown to be the main contributing factor in their decline (Adams 2000; Holmes 2000; Willans et al. 2001).

Te Waiiti Stream is within the boundaries of NTUERP and represents an unmodified North Island riverine system where intensive mustelid control is being undertaken. It is one of six areas nationally that are currently undertaking research by management into the effects of predators on whio populations. These projects may collectively assist in defining the requirements of whio conservation and meet key objectives of the Blue Duck Recovery Plan (Adams et al. 1997).

Te Waiiti Stream forms the northern and eastern boundaries of the Otamatuna Core Area (2530 ha) which was the initial study area within

NTUERP. Intensive mustelid control has been conducted in Otamatuna for nine consecutive years from August 1996 (see Section 4.4 for further details on stoat control).

Whio monitoring within Te Waiiti Stream has been conducted for five consecutive years following the gathering of baseline data in January 1999. Whio monitoring in Te Waiiti Stream primarily focuses on adult survival, pair productivity and survivorship of juveniles to fledging, which may provide a measure of the effectiveness of stoat trapping within the riverine system. Juvenile recruitment, dispersal and population dynamics are also studied through the ongoing banding of this population.

The upper Tauranga River is unmodified with similar terrain and vegetation cover to the Te Waiiti Stream. There is no control for stoats in the immediate vicinity of the upper Tauranga, and as such this site serves as a comparison or non-treatment site for the Te Waiiti Stream. The upper Tauranga has also been surveyed four times previously (1996, 2000, 2001, and 2002) as 'one-off' walk-through surveys of another catchment within the Opotiki Area. The lower Tauranga study site has stoat control lines in areas on both sides of the river and is considered a 'protected' site for whio (Fig 5.4.1).

As well as the survey work undertaken by DOC staff, whio sighting and reports received from staff, contractors and the general public year have also been recorded.

5.4.3 Objectives

- Monitor whio population dynamics, survival and productivity in the Te Waiiti Stream as a measure of the effectiveness of pest control within riverine systems
- Develop management techniques for protecting and enhancing whio populations
- Determine the nature and extent of juvenile dispersal and settlement
- Monitor the upper Tauranga River whio population including juvenile productivity/survival and recruitment as a comparative non-treatment site to the Te Waiiti Stream
- Monitor the lower Tauranga River whio population including juvenile productivity/survival and recruitment

5.4.4 Methods

Survey

The following methods are standard techniques and tools as described in the best practice manual 'Managing Blue Duck, A Manual of Field Techniques and Practices' produced by the Blue Duck (Whio) Recovery Group (2004). The 'walk-through survey' method was used to determine the number of whio present on all waterways surveyed this season. Whio are most active in early morning and late evening when feeding on the main water flows, so emphasis was placed on surveying the river at these times. Surveys were conducted 2-3 hours after dawn until no later than 10 am, and evening surveys from 4 pm until an hour before dark. Between December and late January is the preferred time to survey, when adults with young are likely to be found together on main rivers. This also gives an indication of the number of juveniles available for recruitment into the adult population. The locations of survey sites are shown in Figure 5.4.1.

Te Waiiti Stream

The Te Waiiti stream study area consists of the main stream from the junction of the Tauranga-Waimana River to the 'upper forks'. Walk-through surveys were conducted throughout the breeding season on a fortnightly basis to assess productivity and juvenile survivorship until the juveniles fledged. The first surveys were conducted on 12 October 2004 and the last on 26 January 2005. The entire 18 km of stream systems of the Te Waiiti valley was surveyed on 24-27 January 2005. Each section of stream was surveyed at least twice at different times to verify the result. A German short-haired pointer (GSP) dog was used for the walk-through survey so that most birds within the river system were found. This also helped verify the result and was invaluable during specific banding expeditions to locate birds in hiding. Whio were banded as they were encountered during the January survey.

Kaharoa

Surveys were not conducted in the Kaharoa Stream (a tributary of the Te Waiiti Stream) as they have been during previous years due to the limited number of staff.

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Tauranga River

Two sections of the Tauranga River (= Waimana River above the Te Waiiti Stream junction) were used as study sites for monitoring whio. The upper Tauranga study site runs from the junction of the Tauranga River and the Tawhana Stream up the main stem of the river to the junction with the Mangatoatoa Stream. The Lower Tauranga study site consists of the section of the main Tauranga River from the junction of the Te Waiiti Stream to the junction of the Tauranga with the Otapukawa Stream.

The upper Tauranga River (one of the main tributaries of the Waimana catchment headwaters in Te Urewera National Park) was surveyed to act as a non-treatment area for comparison with the Te Waiiti Stream. Walk-through surveys were conducted throughout the breeding season on a fortnightly basis to assess productivity and juvenile survivorship until the juveniles fledged. The first surveys were done on 15 August 2004 and the last on 11 January 2005.

The lower Tauranga was surveyed fortnightly by using a kayak. The first surveys were done on 14 October and the last on 30 January.

The whio indicator dog was not used to survey either of these areas and no banding was undertaken at these sites.

Juvenile Dispersal

No juvenile dispersal surveys were undertaken this season due to the limited number of juveniles produced. Only incidental encounters of dispersed banded juveniles were recorded during other monitoring surveys. Band combinations were recorded as well as the location and social status (i.e. pair, territory holding); often information received was limited as some attributes could only be ascertained by multiple encounters.

Whio Capture and Banding

Banding of the Te Waiiti Stream population was undertaken for the fifth season during the January survey just prior to juveniles fledging. Whio were captured by stretching a double drop of butterfish net across a waterway and then herding the whio downstream into the net. All territory holding birds were banded with a metal band and a colour band combination. Pairs were given a mirroring band combination (if possible), with metal bands and colours on the opposite legs due to the differing position of the metal band for each sex. Juveniles in the Te Waiiti system had transponders inserted under their skin, one centimetre from the top of their keel bone; significant wear of the metal bands in this river system renders them ineffective at providing identifying information after a two year period. Also, juvenile birds may disperse and never be encountered again, making it unlikely that bands will ever be removed or changed. The metal bands could potentially put birds at risk if the metal band develops sharp edges. Juveniles will at least be identified if they return to Te Waiiti natal origin and are able to be caught and then scanned.

When a bird was captured, standard measurements were taken from all birds; head/bill, upper bill length, tarsus length, wing length, and weight.

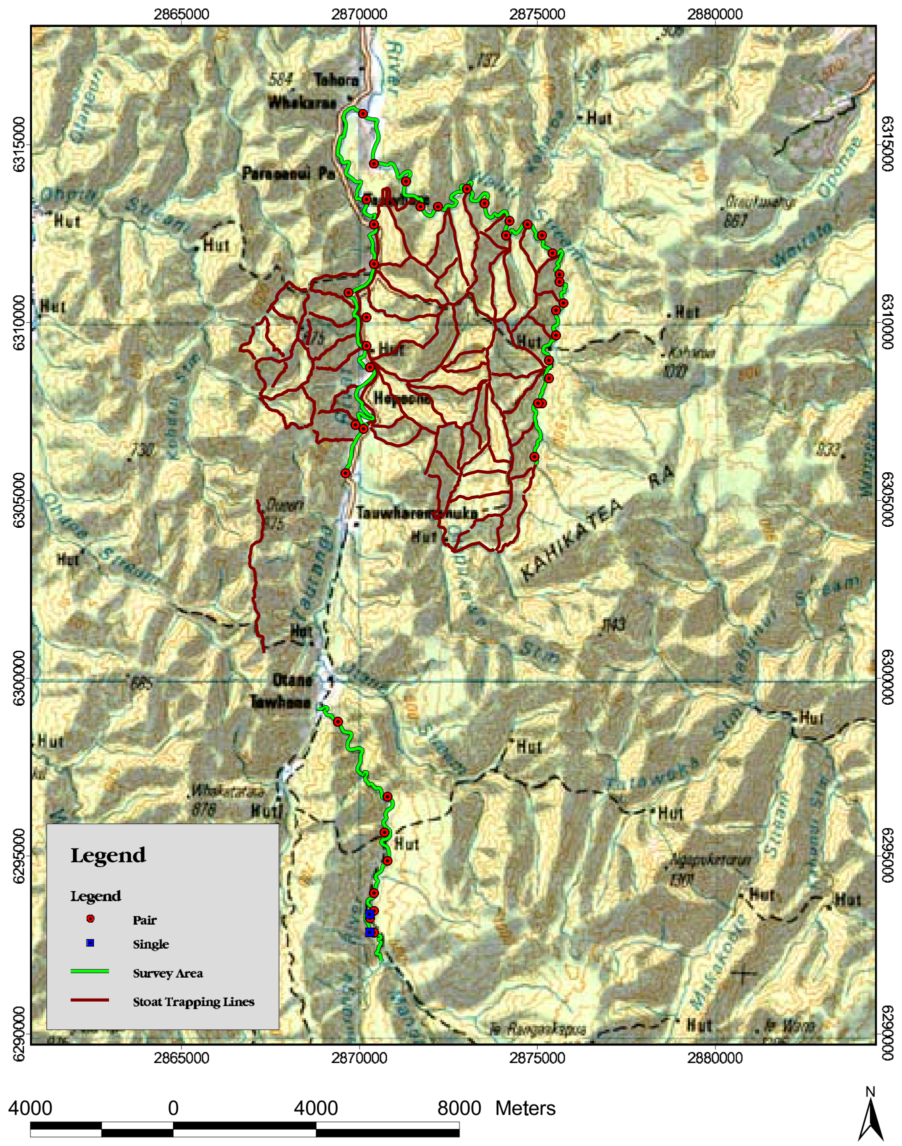
Sexing and Age Classification

Adult birds encountered were sexed by the type of calls they produced or by the size variation between the birds of a pair. Males 'whistle' when approached and are generally larger, while females emit a 'rattley growl' and generally have a smaller body size. Juvenile birds do not generally call in the company of their parents but just 'peep', although during capture they may call sometimes. If the sex of the captured birds was unable to be determined by the above methods, sex was determined through cloacal examination. Distinguishing adult from juvenile birds was ascertained through a variety of characteristics, e.g. the colour of the bird's iris, colour of the bill, plumage, or obvious size difference. Juveniles have a dark brown iris while an adult's iris is yellow. The adults have a pale yellow pinkish bill, while juveniles have a pale blue/grey colour. Adult birds also have their entire chest daubed with chestnut plumage which may be more extensive and heavier in colour in the male, while the juvenile is very pale blue/grey with small flecks of chestnut. There presently is no way of aging adults in the field other than by categorising 'old birds' as those having bare wing spurs.

Reported Sightings

Sightings of whio were reported at various times of the year during the course of unrelated work by staff or by the public. These chance encounters when walking waterways were recorded on a spreadsheet in the Opotiki Area Office. In most cases these recorded sightings are one-off encounters with whio in short sections of river.

Figure 5.4.1 Whio survey areas, whio pair and single territory locations, and stoat trapping lines in the northern Te Urewera, 2004/05



5.4.5 Results

Surveys

Te Waiiti Stream

During this season's monitoring in the 18 km of the Te Waiiti Stream a total of 21 territorial pairs and 52 juveniles were found. Of these, 17% (n=12) of the juveniles were known to have fledged (Table 5.4.1, Appendix 5.4.1). The total number of independent whio seen by the end of the season was 54; 21 pairs, no singles and 12 fledged juveniles. Six of the 21 pairs fledged chicks (Appendix 4.3.3 & 4.3.5). Mean juvenile production was 0.57 per pair (Table 4.3.2). The number of known fledglings was low compared to previous years due to a significant flood event in early January when class I-III juveniles were present on the river.

Adult numbers have increased by 5% (one more territorial pair) compared to last season. There has been a 250% increase in pair numbers on Te Waiiti stream since January 1999 with a mean annual increase of 25% (Table 5.4.1). The mean territory length was 900m of stream per pair; pair density was 1.2 pairs per kilometre compared to 1.1 last season and 0.3 in January 1999. The Te Waiiti pair density for this season is almost double that of the mean pair densities from the nationally monitored waterways (Godfrey et. al. 2003).

No survey of the Kaharoa Stream was undertaken this season. Surveys in January 1999 found two birds in this stream and three pairs in 2000.

TABLE 5.4.1 MONITORING DATA FOR WHIO IN THE TE WAIITI STREAM, NORTHERN TE UREWERA, 1999 - 2004/05

	SURVEY DISTANCE	PAIRS	SINGLES	PAIRS PRODUCING JUVENILES	JUVENILES PRODUCED	FLEDGED JUVENILES
Jan 1999	18km	6	4	-	-	18
Dec 2000	18km	11	0	-	-	20
2001/02	18km	13	1	12	51	47
2002/03	18km	15	1	12	48	46
2003/04	18km	20	7	1	6	1
2004/05	18km	21	0	13	52	12
TOTAL	-	-	-	-	157	144

Upper Tauranga

During this season's monitoring in the upper Tauranga a total of eight pairs of whio and two single males were found. Five of the eight pairs produced 19 juveniles of which 47% (n=9) fledged (Table 5.4.2). The mean territory length was 1250m per pair; the pair density was 0.8 pairs per kilometre. Mean juvenile production for the total number of pairs present was 2.4 juveniles per pair (Table 5.4.2), and a mean of 1.3 fledglings per pair (Appendix 5.4.2).

Adult numbers appear to have increased since 1996, from eight to 18 birds, however, there was significantly more survey work undertaken over the past three seasons and one more kilometre surveyed so results between earlier less-intensive surveys are not directly comparable with the later surveys (Table 5.4.2).

TABLE 5.4.2 MONITORING DATA FOR WHIO IN THE UPPER TAURANGA RIVER, NORTHERN TE UREWERA, 1996 - 2004/05

DATE	SURVEY DISTANCE	PAIRS	SINGLES	PAIRS PRODUCING JUVENILES	JUVENILES PRODUCES	JUVENILES FLEDGED
March 1996	9km	4	0	–	–	1
March 2000	9km	4	2	–	–	2
May 2001	9km	3	0	–	–	0
April 2002	9km	5	1	–	–	0
2002/03	10km	6	2	4	19	18
2003/04	10km	5	1	2	5	2
2004/05	10km	8	2	5	19	9

Lower Tauranga

During this season's monitoring in 14 kilometres of the lower Tauranga a total of 11 pairs of whio were found. Five of the 11 pairs produced 21 juveniles of which none were known to have fledged (Table 5.4.3 & Appendix 5.4.3). The mean territory length was 1270m per pair; the pair density was 0.8 pairs per kilometre. Mean juvenile production for the total number of pairs present was 1.9 per pair. Of the 22 adults encountered on the lower Tauranga six were banded as juveniles from the Te Waiiti.

TABLE 5.4.3 MONITORING DATA FOR WHIO IN THE LOWER TAURANGA RIVER, 2004/05

DATE	DISTANCE	PAIRS	SINGLES	PAIRS PRODUCING JUVENILES	JUVENILES PRODUCED	JUVENILES FLEDGED
2004/05	14km	11	0	5	21	0

Banding and Population Dynamics

Banding

Banding has now been undertaken for the fifth consecutive year, to determine the population dynamics of the Te Waiiti river system. A total of 130 individuals have been marked: 123 individual whio have been banded (49 adults and 74 juveniles) and seven juveniles have had transponders inserted since December 2000 (Tables 5.4.4, 5.4.5; Appendix 5.4.5). During this season eight new birds were marked; one adult was banded and seven juveniles had transponders inserted.

TABLE 5.4.4 NUMBER OF ADULT WHIO BANDED IN TE WAIITI STREAM, NORTHERN TE UREWERA, 2000/01 – 2004/05

	00/01	01/02	02/03	03/04	04/05	TOTAL
Males	6	7	5	5	0	24
Females	6	7	4	6	1	25
TOTAL	12	14	9	11	1	49
New territorial pairs[1]	7	6	2	2	0	17

[1] total includes two paired sub-adult birds

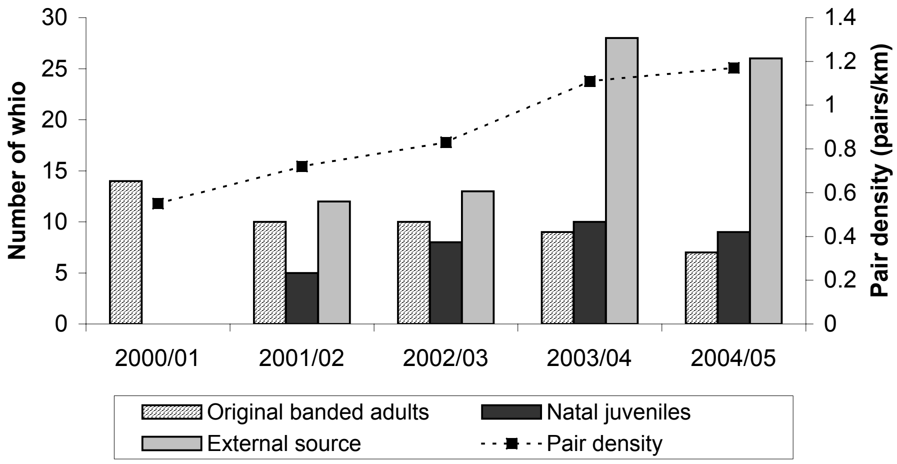
TABLE 5.4.5 NUMBER OF JUVENILE WHIO MARKED USING BANDS OR TRANSPONDERS IN TE WAIITI STREAM, NORTHERN TE UREWERA, 2000/01 – 2004/05

	00/01	01/02	02/03	03/04	04/05	TOTAL
Males	7	6	19	1	4	37
Females	7	14	20	0	3	44
TOTAL	14	20	39	1	7	81

Population Dynamics

The adult population banding data indicates that the total adult population has had a turnover or territorial abandonment of 46% over the past five years. Adult female turnover (59%) is higher than that of males (41%). Of the 14 territorial whio banded in 2000/01 (the first year of banding), 50% were present during this season. Two of the original seven pairs banded in 2000/01 have remained monogamous; the remainder have either swapped partners or taken new unbanded birds as a mate or are no longer present. The adult population has increased considerably since 2000/01 with the majority of adults coming from outside the Te Waiiti as unbanded birds; 10 completely new pairs have formed and 17 individuals formed pairs with previously territorial birds. The population this season consisted of: 17% from birds banded in 2000/01 (original banded adults); 21% from natal juveniles recruited into the population; and 62% from birds sourced outside of the Te Waiiti (external source) (see Figure 5.4.2).

Figure 5.4.2 Pair density, and the origin of banded territorial whio for the Te Waiiti stream, northern Te Urewera, 2000/01 – 2004/05



Twenty one percent (n=16; 10 females, 6 males) of the 74 banded juveniles have been recruited back into their natal system. Of these, 50% have bred and successfully produced juveniles, two within their first year. During this season, nine natal juveniles were found in the Te Waiiti (Table 5.4.7). Of these, six were 2000/01 juveniles, two were 2001/02 juveniles and one was a 2002/03 season juvenile. The six 2000/01 juveniles included two birds (both males) that had been encountered throughout all intervening seasons, one (female) that had been missing for two years then returned, and three (one male and two females) that were not seen for three years before returning to their natal origin. The 2001/02 juveniles (two females) had been encountered throughout and the 2002/03 juvenile (male) returned after one year's absence.

TABLE 5.4.7 RECRUITMENT, PAIRING AND BREEDING SUCCESS OF JUVENILE WHIO[1] IN THE TE WAIITI STREAM, NORTHERN TE UREWERA, 2001/02 - 2004/05

	01/02	02/03	03/04	04/05
Natal juveniles recruited [2] (%)	35	23	14	12
Natal juveniles paired (%)	21	12	8	12
Natal juveniles that bred (%)	21	9	0	8

[1] Banded birds only. All juvenile whio were banded in Te Waiiti Stream

[2] Number of juvenile whio that are present in Te Waiiti territories in any one year divided by the total number of previously banded whio. Not all birds have stable territories; some birds move in and out of the study population and may be present in one year but not necessarily in another year.

There was one sibling-sibling pairing encountered over the past year.

Te Waiiti Stream Juvenile Dispersal

No juvenile dispersal surveys were conducted this season due to the limited number of fledglings produced within the Te Waiiti. However eight banded juveniles were encountered outside their natal origin during other survey work (see Appendix 5.4.4 for all dispersed juvenile whio encountered since 2002). All eight juveniles were found within the Waimana catchment. One of the juveniles was banded in the 2001/02 season and had paired. The bands of one juvenile were not able to be positively identified so its precise territorial origin on Te Waiiti Stream is not known. The other six juveniles encountered were banded in 2002/03. Six of the birds encountered were females; one was a male while the other bird's sex was unknown. All except one of the Te Waiiti natal juveniles were paired; two juveniles had paired together. Two of the pairs were known to have produced juveniles.

The most distal banded juvenile observed this season was 18.8 km from its natal origin. The furthest juvenile dispersal recorded to date is 20.5 km (Figure 5.4.2). A total of 25 (33%) banded juveniles have been found outside their natal origin; 12 of these are known to have paired and seven known to have fledged chicks. The gender split favours the females with 14 females and seven males; the sex of four birds was not able to be determined.

There appears to be some significant movement of juveniles in the first year, one juvenile (W-RM) was encountered in the Waioeka (11.5 km away) the year after the banding yet has paired up with another banded juvenile (WM-B) in the Tauranga (2.5 & 6.5 km away from their natal origin, respectively). Similarly another bird (M-BG) was encountered 14.3 km away from its natal origin with a group of two other whio and had returned to the Te Waiiti the following season.

One bird (M-WR) encountered in the Tauranga this season was previously a territory holding bird in the Te Waiiti and has now been displaced. This bird was a single bird and looked extremely motley. Another one of the Te Waiiti dispersed juveniles (YM-W) was found within the non-treatment area (18.8km away) and had produced chicks, none of which survived. Figure 5.4.3 shows dispersal movements of selected juvenile whio.

Figure 5.4.3 Locations of dispersed juvenile whio, banded in the Te Waiiti Stream, northern Te Urewera 2001/02 – 2004/05. Locations of birds that were seen more than once are indicated.

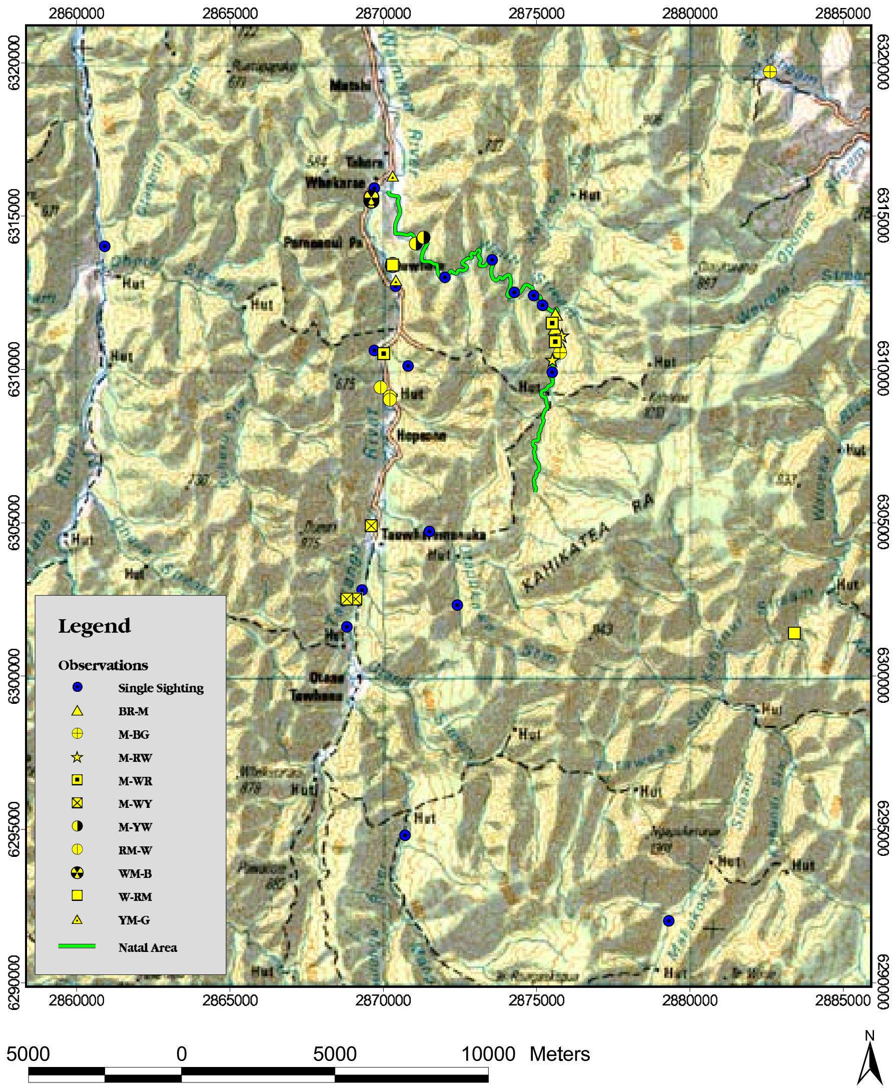
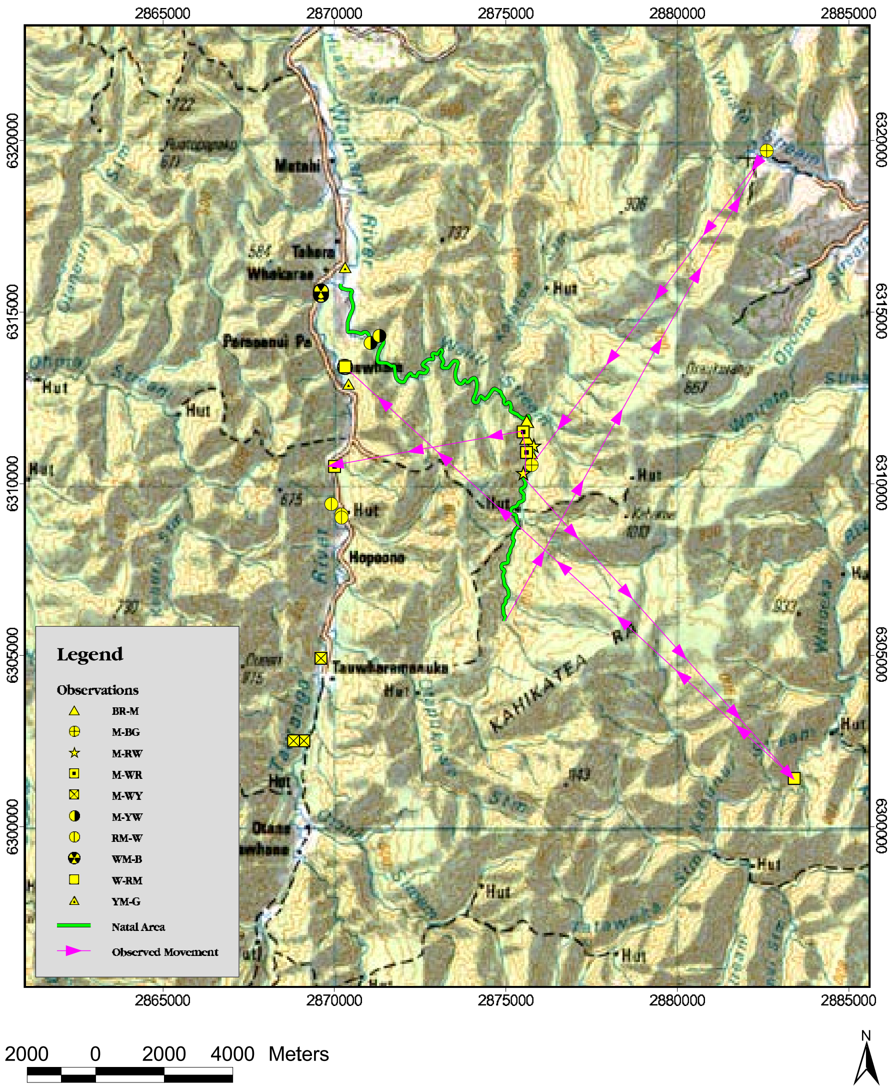


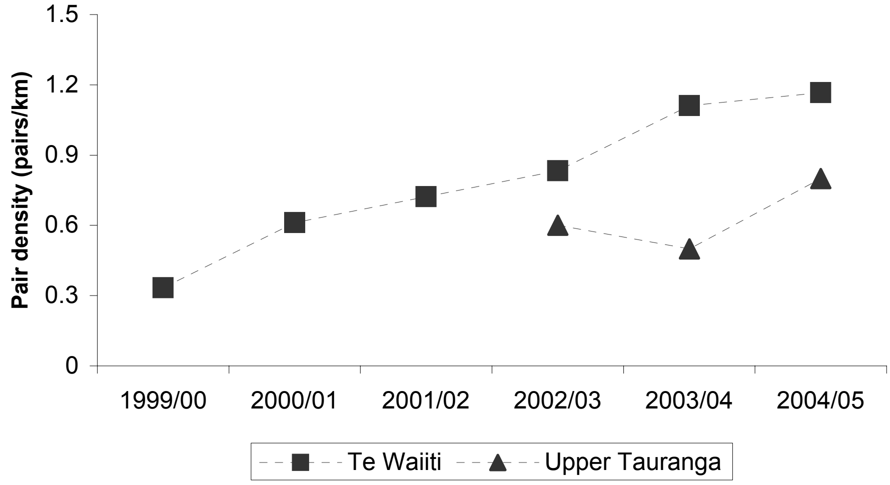
Figure 5.4.4 Locations and movements of selected dispersed juvenile whio observed on multiple occasions, northern Te Urewera, 2001/02 – 20004/05



Treatment versus Non-Treatment

Pair density in the Te Waiiti has increased every year since monitoring began in the 1999/2000 season. In years where comparable monitoring was undertaken, pair densities in the upper Tauranga have remained relatively constant (Fig 5.4.5).

Figure 5.4.5 Pair density of whio in the Te Waiiti and Upper Tauranga Streams, northern Te Urewera, 1999/00 – 2004/05



Productivity of whio in the northern Te Urewera for the 2004/05 season is shown in Table 5.4.8. Pair density (number of pairs per kilometre) in Te Waiiti is higher than both the upper and lower Tauranga. A similar proportion of pairs in the Te Waiiti and the upper Tauranga produced young. However, compared to the Te Waiiti, a greater proportion of pairs fledged young and a greater proportion of young fledged in the upper Tauranga.

TABLE 5.4.8 PRODUCTIVITY OF WHIO IN THE TE WAIITI, UPPER TAURANGA AND LOWER TAURANGA, NORTHERN TE UREWERA, 2004/2005

STUDY SITE	SURVEY DISTANCE	NUMBER TERRITORIAL PAIRS	PAIR DENSITY (PER KM)	PROPORTION OF PAIRS PRODUCING CHICKS (%)	NUMBER OF KNOWN CHICKS PRODUCED	PROPORTION OF PAIRS FLEDGING YOUNG (%)	NUMBER KNOWN FLEDGED YOUNG	PROPORTION YOUNG FLEDGED (%)	FLEDGLINGS PER TOTAL NO.PAIRS
Te Waiti	18	21	1.17	62	52	29	12	23	0.57
Upper Tauranga	10	8	0.8	63	19	38	9	47	1.13
Lower Tauranga	14	11	0.79	45	21	0	0	0	0

A comparative analysis of the Te Waiiti and the upper Tauranga River since 2001 is shown in Table 5.4.9. The mean pair density is higher in Te Waiiti Stream although both pair densities are higher than the mean national pair density of monitored whio populations (0.59 pairs per km; Godfrey et al. (2003)). A greater proportion of pairs in the Te Waiiti breed, although mean juvenile production per pair and the mean number of fledglings per pair are similar for both sites. A greater number of fledglings have been produced in the Te Waiiti although the mean proportion of young fledged is similar.

TABLE 5.4.9 COMPARATIVE ANALYSIS OF KEY POPULATION PARAMETERS FOR THE TE WAIITI (2000/01 - 2004/05) AND THE UPPER TAURANGA RIVER (2002/03 – 2004/05), NORTHERN TE UREWERA

STUDY SITE	SURVEY DISTANCE	MEAN TERRITORIAL PAIRS	MEAN PAIR DENSITY (PER KM)	MEAN PAIRS BREEDING (%)	MEAN JUVENILES PRODUCED PER PAIR	MEAN FLEDGLINGS PER PAIR	MEAN KNOWN CHICKS PRODUCED	MEAN KNOWN FLEDGED YOUNG	MEAN YOUNG FLEDGED (%)
Te Waiiti	18km	14.3	0.79	68 [1]	2.3	1.7	39.3	26.5	56
Upper Tauranga	10km	6.3	0.63	46	2.3	1.5	19	9	60

[1] In 2003/04 river levels were too high to count pairs that bred (only one known) therefore the data has been excluded

5.4.6 Discussion

The 2004/05 breeding season was three weeks late compared to previous seasons. Clutches only started to appear on the river on 18 October, when in previous seasons at this time the majority of broods were present.

The productivity of whio in the Te Waiiti was once again impaired by a flood event which occurred this season on 1 January. This flood event may not have had the same effect had the breeding season not been later than usual; this season, juveniles were at a more vulnerable life stage at the time of the flood. The flood events are thought to not only impact directly on juvenile whio, causing fragmentation of broods and hypothermia, but also indirectly by severely limiting their food source, which would normally be flourishing at this time of year. The flood event this season was localised to the lower reach of the Waimana catchment; the upper Tauranga rose approximately 400 millimetres compared to 2.75m in the Te Waiiti (AG, pers. obs.). It was expected that productivity would be higher in the Te Waiiti where there is pest management; however, results indicate that productivity for the Te Waiiti was lower than the upper Tauranga, as a direct result of the flood event. Limited juvenile survival will affect the adult replacement and this has the potential to have a significant impact on the long-term viability of whio. If the frequency of these environmental stochastic events increases there may be an acceleration in whio decline particularly in sites where predators are not managed.

At times, data collection in the lower Tauranga was severely hampered by the river conditions. Use of a kayak for monitoring whio (in the lower Tauranga) appeared to be less effective for monitoring due to the increased disturbance to whio by the observer. Increasing use of the river by members of the public for recreational purposes may have contributed to fewer whio encounters later in the season.

The increased number of pairs in the monitored sites is an encouraging sign for the whio population in northern Te Urewera. From these results, it is reasonable to assume that there is some benefit to whio from the c.5200 ha of stoat trapping in the vicinity of Te Waiiti and the lower Tauranga, although it is still unclear what the exact nature of these benefits are as pair numbers in both the treatment and non-treatment sites have increased. To more accurately determine the effects of management on the whio population the impacts of pest animals and whio population dynamics need to be investigated. The agents of whio decline in northern Te Urewera need to be identified and management regimes needed to offset any decline need to be tested. The extent of juvenile survival, dispersal and recruitment, as well as adult survival needs to be determined to establish the scale for management to secure the whio population.

Results from this season indicate that adult turnover in the Te Waiiti is perhaps higher than may be expected. However, the fate of the birds that have disappeared is not known and, as above, is an aspect that needs to be investigated. It is a positive sign that although adult birds are disappearing, they are being replaced at a greater rate than they are disappearing. However, these newly established birds are sourced from outside the Te Waiiti (i.e. they are unbanded): where these birds come from and the vulnerability of the greater whio population, are further aspects that need to be investigated.

Whio demand a scale and magnitude of management like no other species in New Zealand. This is because of their linear distribution at low densities across an expansive landscape of river systems in combination with complex spatial population dynamics. They require institutional management of these habitats because no offshore island provides the quality of the habitat required nor do they offer large enough river systems to encompass their population demographics.

The monitoring data gathered to date from the Te Waiiti and Tauranga population indicates the complexity of whio management and highlights the need for further monitoring and research to define the long-term trends and to establish the necessities to provide security for whio. Because of the resource demands of monitoring and the difficulty of monitoring the fates of both juvenile and adult whio, the use of transmitters is needed to accurately gain the information required.

It is recommended that:

- We increase our understanding of whio population dynamics, particularly adult survival, and juvenile dispersal and survival
- More data is collected on local weather events that may affect whio

5.4.8 Acknowledgements

I would like to thank the following people and organisations for their continued support over the years of the whio monitoring programme in the Opotiki Area;

Environment Bay of Plenty, Dave Paine, Craig Mills, Jillian Houghton, Taiana Torea-Allan, Paki Te Pou, Sonny Biddle, Forest and Bird, Arthur Sandom, Opotiki College, Debbie McKillop, Tauranga Polytechnic, Paddy Stewart, Leigh Glaser, Hemi Barsdell, Jane Haxton, Pete Livingston, Greg Moorcroft, Lindsay Wilson, Rhys Burns, Brenda Baillie, Murray Williams, Nic Etheridge, Dave King, Tiki Hutchings, Dave Wilson, Peter Rudolf, Pete

Shaw, Grant Jones, Michelle Gutsell, Mike Paviour, Cody Thyne, Tiriana Penemene, Lyn Thyne, Colin Cartwright, Keith Beale, Ross Hurrell, Ivor Yockney, Lester Bridson, Lenka Matauesk and Uli Toene.

5.5 MISTLETOE MONITORING

Hemi Barsdell

5.5.1 Abstract

Monitoring this year was conducted at Otamatuna and Okopeka. Monitoring at both sites measured mistletoe abundance as well as host tree and mistletoe health. These measures are compared to possum densities to ascertain the impact of different possum densities on mistletoe with a long term view of restoring mistletoe throughout northern Te Urewera. Mistletoe abundance has remained constant at Otamatuna, but at Okopeka it appears that there is the beginning of a downward trend. These results are consistent with that expected in an environment of continued low possum densities at Otamatuna and medium to high densities at Okopeka. Ongoing monitoring is required to clarify the effect of possums on mistletoe at these two sites.

5.5.2 Introduction

Within the context of the Northern Te Urewera Ecosystem Restoration Project (NTUERP) mistletoe species are monitored to identify what level of management is required for maintaining and enhancing mistletoe populations throughout the northern Te Urewera. Mistletoe species are also used as an indicator of forest health as they are highly susceptible to possum (*Trichosurus vulpecula*) browse (Ogle, 1995). It is expected that with the reduction of possums to low levels, mistletoe abundance will increase and individual mistletoe will be healthy, thus indicating a healthy forest and a healthy ecosystem.

Red mistletoe, or pirirangi (*Peraxilla tetrapetala*) and *Alepis flavida* (yellow-flowering mistletoe) are the two mistletoe species that are monitored within the NTUERP. Pirirangi is hosted primarily upon *Quintinia serrata* (quintinia) but is also present on red beech (*Nothofagus fusca*) and hard beech (*Nothofagus truncata*). *Alepis* is also hosted on red and hard beech.

Possum control at Otamatuna began in 1992, particularly for protection of kokako. Since the establishment of NTUERP in 1996 Otamatuna has had a history of intensive multi-pest control, where possums have been retained at low levels. Pirirangi (hosted on quintinia) was first monitored at Otamatuna in 1995/1996 and annual monitoring up to and including 1999/2000 provided a baseline from which subsequent monitoring could measure changes in abundance. Baseline establishment needs to be done over at least two consecutive seasons as pirirangi have been known to not flower every year. Monitoring at Okopeka began in 1999/2000 and by the end of the 2000/01 season a population baseline had been established. Okopeka is the non-treatment control block where possum densities have remained at around 25-30% residual trap catch. In the past, monitoring at these two sites has focused primarily on measuring changes in pirirangi abundance (see Figure 5.5.1 for site locations). Monitoring at these two sites this year also focused on measuring pirirangi and host tree health.

5.5.3 Objectives

Management objectives for the 2004/05 year were to:

- Monitor the abundance of pirirangi at Otamatuna and Okopeka
- Monitor pirirangi and host tree health at Otamatuna and Okopeka

5.5.4 Methods

Abundance Monitoring

During the establishment of the population baseline, host quintinia trees were searched in areas where pirirangi was known. Individual trees that were searched, whether or not mistletoe was present, were marked with a metal tag. Tagged quintinia that were found to host pirirangi are classified as *known hosts*, and tagged trees that were searched but did not host pirirangi were classified as *potential hosts.*

As well as a metal tag, known hosts are also marked with pink plastic triangles which are marked with the labels of the pirirangi hosted in that tree. Mistletoes are numbered sequentially with an 'M' prefix, for example M37, M38. If a host tree contains more than one mistletoe then each mistletoe is labelled with the same number but given an alphabetical suffix to further distinguish them, for example M37a, M37b. Locations of pirirangi on the host tree were identified using photographs with sufficient detail to indicate where mistletoe are on the tree itself and to distinguish between individual mistletoe on the same tree. Photographs were collated and kept on file (WGNHO-218292 (Otamatuna) and WGNHO-218029 (Okopeka)). Locations of tagged quintinia were mapped.

During abundance monitoring, known and potential hosts were searched for pirirangi by ground searching for flower remnants and leaves, and using binoculars for thorough visual searches of the host tree canopy. Only quintinia with metal numerical tags were searched. Searching occurred at the height of their flowering season from mid-December to late January when pirirangi are most conspicuous.

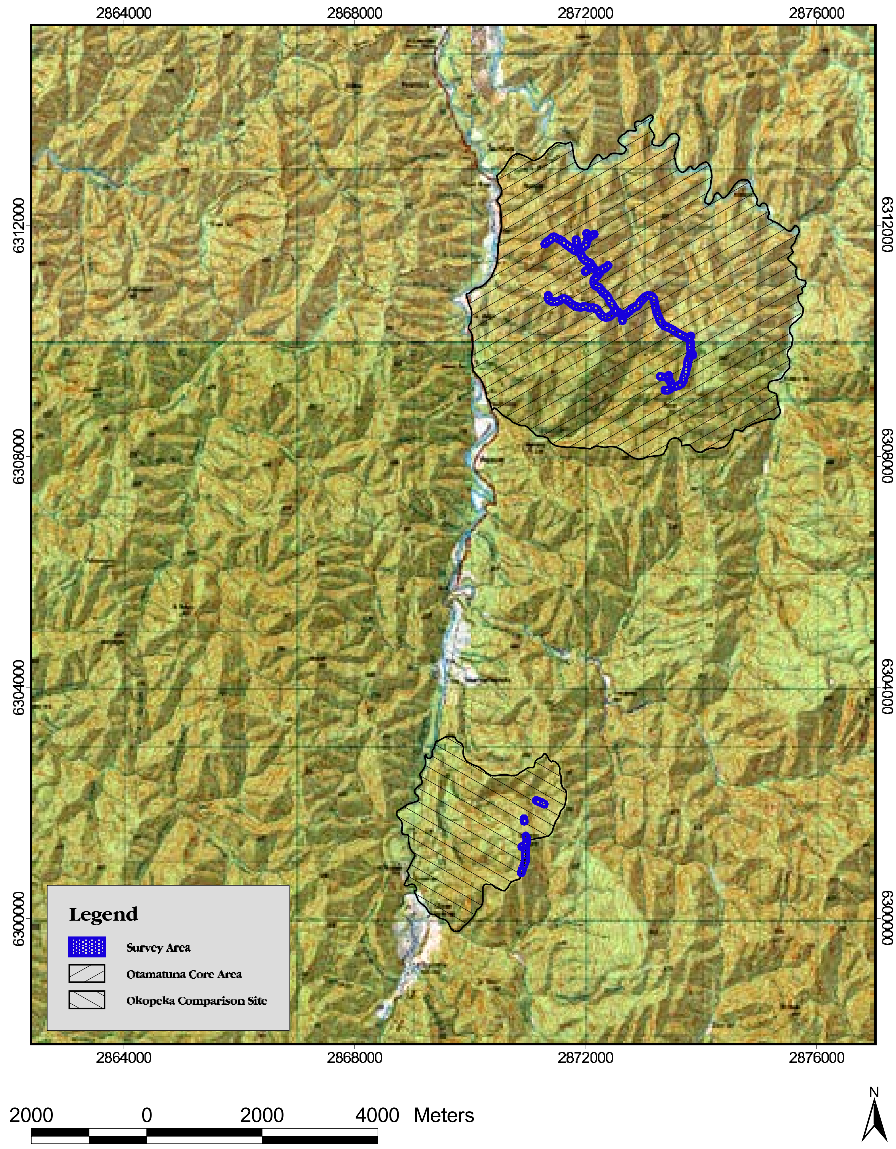
If a pirirangi was located on a quintinia which was not previously known to host a pirirangi plant, then the quintinia was recorded as a 'new host'. New pirirangi were classified into one of the two following categories:

> Partially recovered: *Non-flowering* pirirangi discovered in the current season
>
> Recovered: *Flowering* pirirangi discovered in the current season. Partially recovered plants discovered in previous seasons that flowered for the first time in the current season were also included in this category.

A third category applied for known plants that died during or between the monitoring periods:

> *Dead*: known plants that were alive in previous seasons but were found to have died by the current season.

Figure 5.5.1 Location of study sites including survey areas for mistletoe/pirirangi monitoring, northern Te Urewera, 2004/05



Pirirangi and Host Tree Health Monitoring

Monitoring of mistletoe and host tree health was done using an adaptation of the DOC best practice for monitoring Loranthaceous mistletoes (Knightbridge 2002). Measurements were taken between mid-December and late January and only plants that were clearly visible from the ground were scored. Pirirangi were scored from a designated viewing point (Mistletoe View Point or MVP) which were often marked using pink triangles labelled with MVP and the corresponding mistletoe label. The location details of the MVP in relation to the base of the host tree were listed below the photo of each plant. Binoculars (10x50) were used to view plants during scoring.

Measurements are separated into two sections: host tree and pirirangi.

For the host tree, date, species, tag number and diameter at breast height (DBH) were recorded and then the tree was scored on dieback, foliar density and the presence of borer.

Dieback (DB) is the conspicuous presence of dead branches or branchlets, but not recently defoliated live twigs. Only branches or branchlets that were dead at the time of monitoring were scored. Dieback was scored on the following scale:

0: Nil	affecting <5% of the canopy
1: Light	affecting 5-25% of the canopy
2: Moderate	affecting 26-50% of the canopy
3: Heavy	affecting 51-75% of the canopy
4: Severe	affecting 76 -100% of the canopy
X: Unable to score	

Foliar Density (FD) was scored by selecting the appropriate category in the 10-point Foliage Cover Scale (Appendix 5.5.1). The trunk, major branches, areas of the canopy that are dead, or foliage within range of ground browsing animals was not included.

The presence of borer insect holes in the lower trunk of each host tree was recorded using the following scale:

0: No borer present

1: borer present, very few holes

2: a moderate number of holes

3: many holes present

For mistletoe health scoring, the number and the size of the mistletoe on each host was recorded, and each mistletoe was scored for foliar density, dieback, possum browse, insect browse and the presence of flowers and fruit. Foliar density and dieback were scored in the same way as for host tree health.

Mistletoe size was measured by firstly estimating the horizontal distance between the widest points of the plant no matter where on the plant those points were, and secondly estimating the vertical distance between the highest and lowest points of the plant no matter where on the plant those points were. Some leeway in movement away from the MVP (c.5m) was allowed in order to obtain the most representative measurements.

Possum browse (PB) and insect browse (IB) were scored according to the scale below. Possum and insect browse were distinguished as described in Payton et al. (1997).

0: Nil	No Browse
1: Light	1-25% of plant affected
2: Moderate	26-50% pf plant affected
3: Heavy	51-75% of plant affected
4: Severe	76-100% of plant affected

Flowers and fruit were scored according to the scale below. Flowers included those starting from green buds or shoots through to mature opened flowers.

0: Nil

1: Rare

2: Occasional

3: Common

4: Heavy

X: unable to score

Flowering histories and present classifications can be found on file or at DME WGNHO-242470. The photos can be accessed through the Department of Conservation's document management system (DME) reference numbers.
FBI field sheets can be found ON DOC file WGNHO-207714.

5.5.5 Results

Pirirangi abundance at Otamatuna and Okopeka is shown in Tables 5.5.1 and 5.5.2. Pirirangi abundance at Otamatuna has remained at a constant level since 1999/2000 when the baseline was established. At Okopeka there has been a decline in pirirangi abundance since monitoring began 2000/01.

TABLE 5.5.1 PIRIRANGI ABUNDANCE AT OTAMATUNA CORE AREA, NORTHERN TE UREWERA, 1999/2000 - 2004/05

YEAR	TAGGED QUINTINIA	KNOWN HOSTS	PIRIRANGI	MEAN PIRIRANGI PER HOST	OCCUPANCY RATE [1] (%)
1999/2000	421	52	87	1.67	12.35
2000/2001	421	52	93	1.79	12.35
2001/2002	420	51	95	1.86	12.14
2002/2003			Not monitored		
2003/2004					
2004/2005	417	49	92	1.88	11.75

[1]Proportion of tagged quintinia that host pirirangi

TABLE 5.5.2 PIRIRANGI ABUNDANCE AT OKOPEKA, NORTHERN TE UREWERA, 2000/01 - 2004/05

YEAR	TAGGED QUINTINIA	KNOWN HOSTS	PIRIRANGI	MEAN PIRIRANGI PER HOST	OCCUPANCY RATE [1] (%)
2000/2001	148	11	19	1.72	7.43
2001/2002	147	19	19	1.90	6.80
2002/2003			Not monitored		
2003/2004			Not monitored		
2004/2005	146	9	13	1.44	6.16

[1]Proportion of tagged quintinia that host pirirangi

Table 5.5.3 compares host and mistletoe health between Otamatuna and Okopeka.

TABLE 5.5.3 MEAN HOST AND MISTLETOE HEALTH SCORES AT OTAMATUNA AND OKOPEKA, NORTHERN TE UREWERA, 2004/05

SITE	HOST			MISTLETOE					
	n	FOLIAR DENSITY (0-100)	DIEBACK (0-100)	n	WIDTH (M)	HEIGHT (M)	FOLIAR DENSITY (0-100)	DIEBACK (0-4)	POSSUM BROWSE (0-4)
Otamatuna	49	70.8	0.54	49	1.14	1.02	51.9	0.94	0.4
Okopeka	7	59.3	0.71	13	0.74	0.78	59.6	0.23	0.31

TABLE 5.5.4 POSSUM RESIDUAL TRAP CATCH RESULTS AT OTAMATUNA INNER CORE AND OKOPEKA, NORTHERN TE UREWERA, 1996/97 – 2004/05

	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05
Otamatuna Inner Core	25.00	0.70	2.40	1.70					4.50
Okopeka	26.80				24.50				

5.5.6 Discussion

Since the establishment of the population baseline in 1999/2000 at Otamatuna, pirirangi abundance has remained static. There has been minimal change in the occupancy rate, the number of known hosts, and the number of pirirangi. It is likely that possums have had some effect on pirirangi at Otamatuna and this is reflected through the average dieback score and the presence of possum browse. Overall, however, the current level of possum control appears to be sufficient for maintaining this population.

Pirirangi abundance at Okopeka has declined to a greater extent than at Otamatuna and it appears that there is the beginning of a downward trend emerging. Some possum browse was noted at Okopeka, but on average foliage cover is thicker and there is less dieback than those at Otamatuna. Host tree health at both sites appears to be sufficient for supporting pirirangi.

The reduction in the number of pirirangi at Okopeka this year was due to the loss of six pirirangi which were hosted upon the same tree. When these plants were last observed in 2000/2001 and 2001/2002 the host tree was noted to be deteriorating. The degeneration of this host tree is likely to have caused the loss of these pirirangi.

Currently, the effect of differing possum densities on mistletoe abundance and health at the above sites is not entirely clear. Further monitoring is required in future years to clarify the effect of the different possum densities in order to achieve the long term aim of restoring mistletoe across northern Te Urewera.

5.5.7 Recommendations

- Continue pirirangi monitoring at Otamatuna and Okopeka

5.6 DEER IMPACTS

Dave Wilson

5.6.1 Abstract

This was the seventh year in which seedling/pellet transect lines have been used to monitor relative deer abundance and impacts on palatable understorey plants. Sampling showed that trends indicated by last year's data, of increasing deer densities and declining palatable seedling numbers, have continued. The two events are highly likely to be linked. The causes of deer increase at Otamatuna are probably a mixture of reduced contract hunting pressure within the deer control area, combined, with reduced helicopter and private hunting pressure in surrounding buffer areas. At Onepu, deer increases are probably due to the near cessation in helicopter hunting. For seedling recovery to improve at Otamatuna significantly increased hunting pressure is probably required.

5.6.2 Introduction

Red deer (*Cervus elaphus*) have been shown to impact on the regeneration of favoured understorey plant species and to greatly reduce the density of these species within the forest types of the northern Te Urewera (Section 4.5). This was the seventh year in which seedling/pellet transect lines have been used to measure changes in deer densities and impacts within the Otamatuna Core Area. Deer control operations within Otamatuna began in 1998 and are undertaken over a 2500 ha area.

Pellet lines established by the former New Zealand Forest Service (NZFS) were measured for the ninth consecutive year in both Otamatuna and the greater Onepu/Ohora/Pohatu catchment where no deer control is undertaken. This study site serves as a non-treatment or control site for the Otamatuna Core Area.

5.6.3 Objective

- To determine the impacts of deer on palatable seedlings

5.6.4 Methods

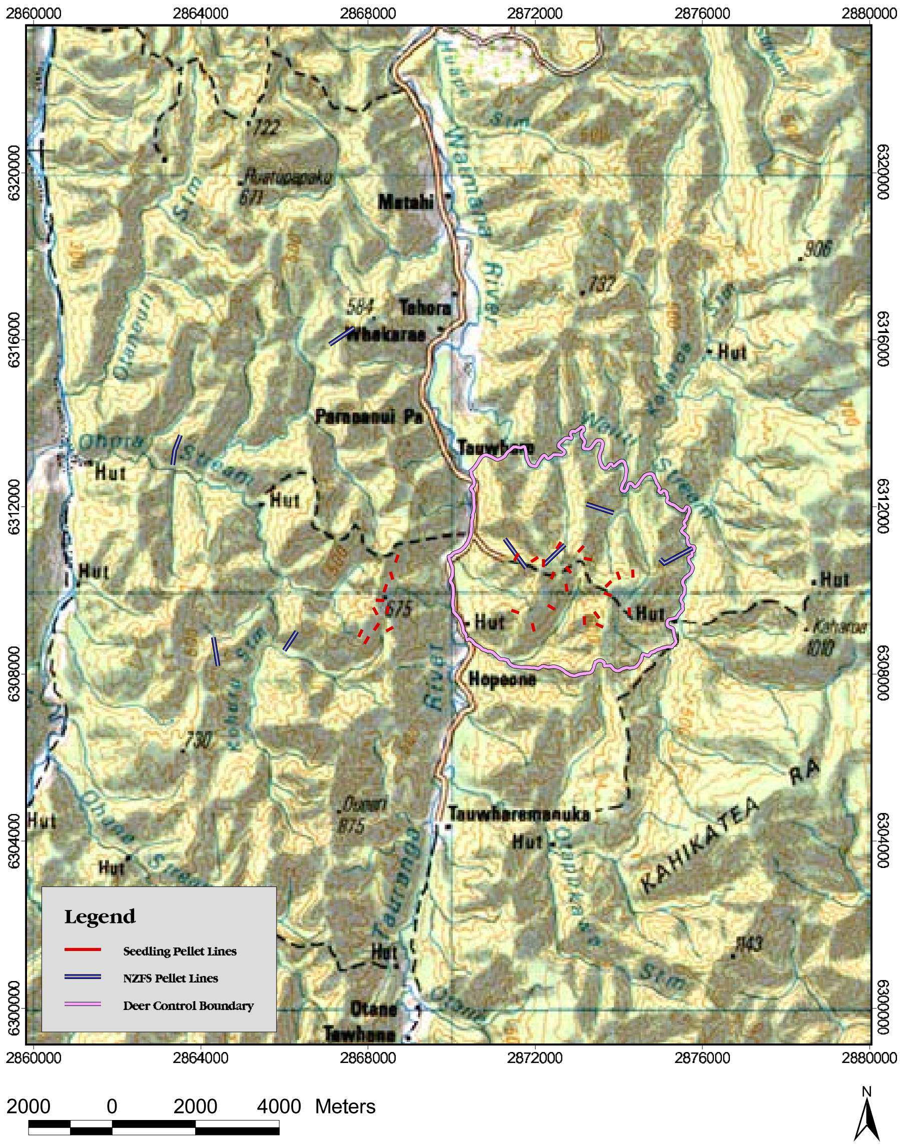
Seedling/pellet transects were established within the bait station grids of both Otamatuna and Onepu Core Areas in November 1998. These lines, which were permanently marked, were re-measured in every subsequent year up to and including 2004 (Figure 5.6.1).

The seedling/pellet method is fully described in Beaven et al. (2000). In summary, 20 plots spaced at 10 metre intervals were set on randomly placed, 200m transect lines. Each plot is 1.26m in radius, giving an area of 5m². Therefore each transect line measures a total area of 100m². In each plot, all tree and shrub species were measured and seedlings with a diameter at breast height (DBH) of <2cm were put into height classes of: <15cm, 16-45cm, 46-75cm, 76-135cm, and >135cm. All animal droppings or pig rooting present in a plot was recorded. The sampling unit for this method is each line.

The methodology behind NZFS pellet lines is also described in a previous NTUERP annual report (Beaven et al. 1999, p. 25). Briefly, the method consists of compass courses set from stream bed to ridge crest with a 1.26m radius plot every 10 metres where the presence or absence of deer pellets is recorded for each plot. Four lines were measured in each area and measuring occurred in December 2004 and January 2005 (Figure 5.6.1).

All tests for statistical significance were carried out using two-tailed paired sample T-test with 95% confidence limits.

Figure 5.6.1 Location of seedling/pellet lines, New Zealand Forest Service pellet lines and the deer control boundary, northern Te Urewera, 2004/05



5.6.5 Results

NZFS Pellet Lines

The results for the past nine years are shown in Figure 5.6.2. The results show that counts in both areas are continuing the upward trend that began in 2000/01. The results for Onepu are the highest recorded in nine years of measurements.

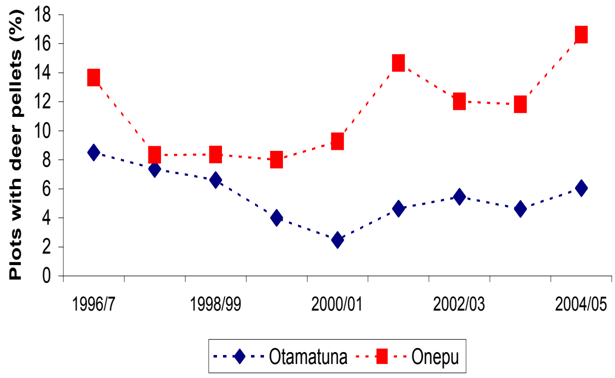


Figure 5.6.2 Mean proportion of plots containing deer pellets for New Zealand Forest Service monitoring lines at Otamatuna and Onepu Core Areas, northern Te Urewera, 1996/97 - 2004/05

These figures need to be interpreted carefully as each study area only has four lines present and there is considerable margin for statistical error. As such, no statistical testing was carried out as the small sample sizes and natural variability between years make the value of these tests somewhat dubious. However, the ongoing upward trend (over what is now becoming a significant period of time) in both areas over an extended period is probably a reasonable reflection of deer density.

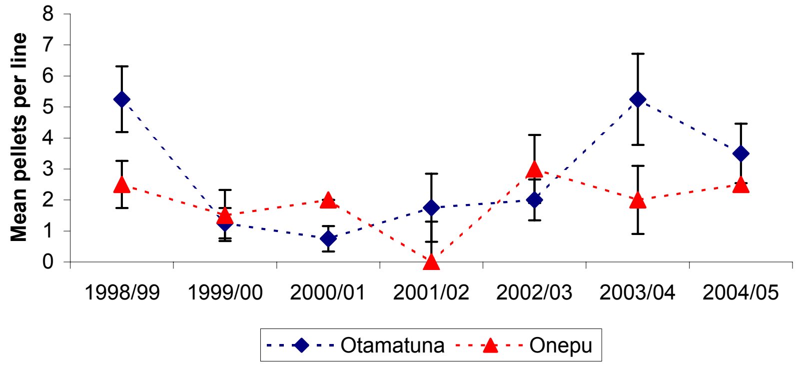
Seedling/Pellet Transects

After seven years of measurements the results shown are now beginning to show strong trends which are now likely to reflect real long-term changes. The results of pellet and seedling counts will be presented individually.

Pellet Counts

The results of the deer pellet counts for seven years for both Otamatuna and Onepu are shown in Figure 5.6.3. Error bars show standard error of the mean.

Figure 5.6.3Mean proportion per transect line of plots with deer pellets. Otamtuna and Onepu Core Areas, northern Te Urewera, 1998/99-2004/05



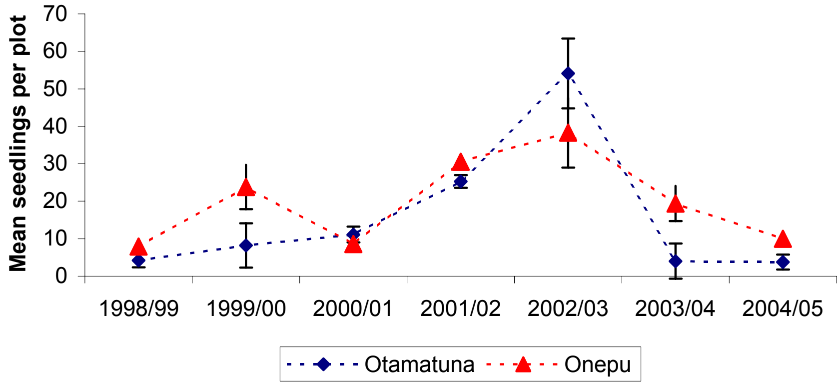
The overall pattern at Otamatuna has been a decline in deer abundance indices from 1998/99 until 2000/01 and then increasing abundance since. The slight decline between 2003/04 and 2004/05 was not statistically different (Paired Sample T-Test where P=0.26). Despite this small drop in pellet counts the 2004/05 count was still the second highest recorded since the initial count in 1998/99, and followed directly behind the high count of 2003/04. It is likely this result is part of an ongoing upward trend in pellet counts since their nadir in 2000/01. The counts at Onepu remain within the (relatively low) range of prior counts using this method.

Seedlings

The absolute numbers of larger seedlings present is still low on a species by species basis. To increase the sample size the results for the most abundant palatable species have been added together for each year to create a larger sample size for comparison purposes. The species used were *Coprosma grandifolia, C. lucida, C. tenufolium, Fuchsia excorticata* (fuchsia) *Geniostoma ligustrifolium* var. *ligustrifolium* (hangehange), *Melicytus ramiflorus* (mahoe) and *Schefflera digitata* (pate). Note that fuchsia was used in similar comparison in prior reports but was mistakenly left off the species list.

Figure 5.6.4 shows the total number of palatable seedlings in all height classes over 15 cm at both Otamatuna and Onepu between 1998 and 2003. All error bars show standard error of the mean.

Figure 5.6.4 Mean number of palatable seedlings greater than 15cm per transect line at Otamatuna and Onepu Core Areas, northern Te Urewera, 1998 -2005



As Figure 5.6.4 shows there was a trend of increasing densities of larger palatable seedlings in both monitored areas between 1998 and 2002. However in the year between 2002/03 and 2003/04 the numbers of palatable seedlings greater than 15cm at Otamatuna decreased markedly to levels similar to seedling densities in 1998 when measuring began. In the 2004/05 a further small decline in palatable seedling densities was recorded. There was also a smaller decrease in both 2003/04 and 2004/05 for palatable seedling densities at Onepu over the same period although the densities there stayed slightly above the 1998 levels.

Paired sample T-tests (two-tailed test with 95% confidence) between results from 2002/03 and 2003/04 showed a significant decrease in number of palatable seedlings present at Otamatuna ($P<0.01$). However, the small decline between 2003/04 and 2004/05 was not significant ($P=0.86$). There was no significant difference in seedling levels between 1998 and the 2003/04 measurements ($P=0.87$) or 1998 and 2004/05 ($P=0.72$). These results showed that the significant increases in palatable seedlings recorded in the years up to 2002/03 have been nullified by the sharp decrease in seedling densities between the 2002/03 and 2003/04 measurements with no significant change in the following year.

Paired sample T-test for Onepu showed that for the same comparisons above, the decrease between 2002/03 and 2003/04 was not significant ($P=0.11$) nor was the decrease between 2003/04 and 2004/05 ($P=0.11$). There was, however, a significant decrease in the number of large palatable seedlings present at Onepu when comparing 2002/03 and 2004/05 ($P=0.008$). There is now no overall difference in large palatable seedling densities between 1998 and 2004/05 ($P=0.38$).

The abundance of palatable seedlings in each height class is shown in Figures 5.6.5a – 5.6.5e.

Figure 5.6.5a Total number of palatable seedlings (mean number of seedlings per line) <15cm at Otamatuna and Onepu Core Areas, northern Te Urewera, 1998-2003

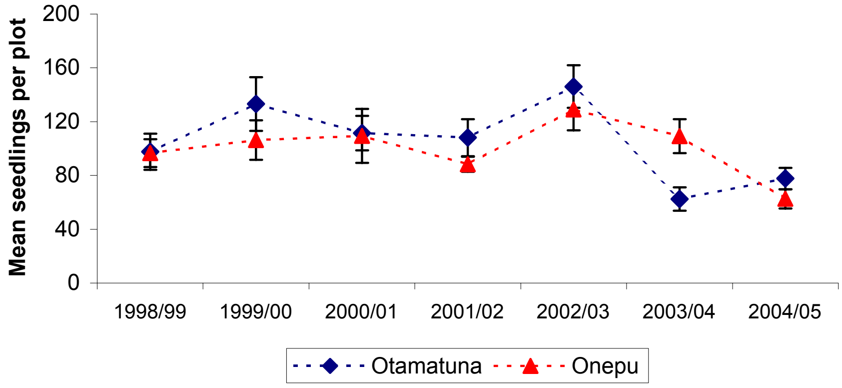


Figure 5.6.5b Total number of palatable seedlings (mean number of seedlings per line) 16-45 cm at Otamatuna and Onepu Core Areas, northern Te Urewera, 1998-2003

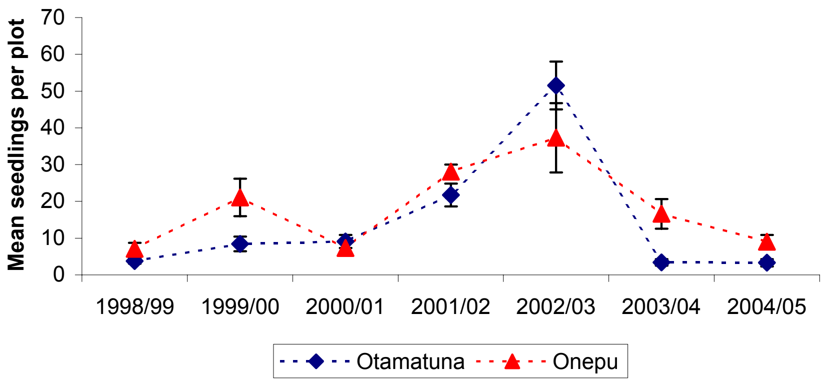


Figure 5.6.5c Total number of palatable seedlings (mean number of seedlings per line) 46-75 cm at Otamatuna and Onepu Core Areas, northern Te Urewera, 1998-2003

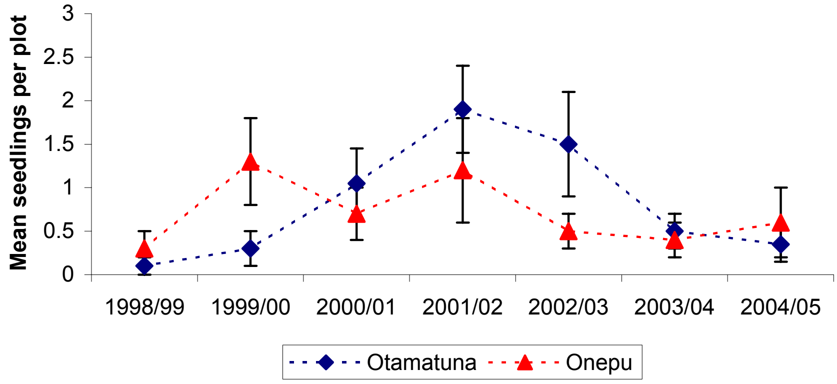


Figure 5.6.5d Total number of palatable seedlings (mean number of seedlings per line) 76-135 cm at Otamatuna and Onepu Core Areas, northern Te Urewera, 1998-2003

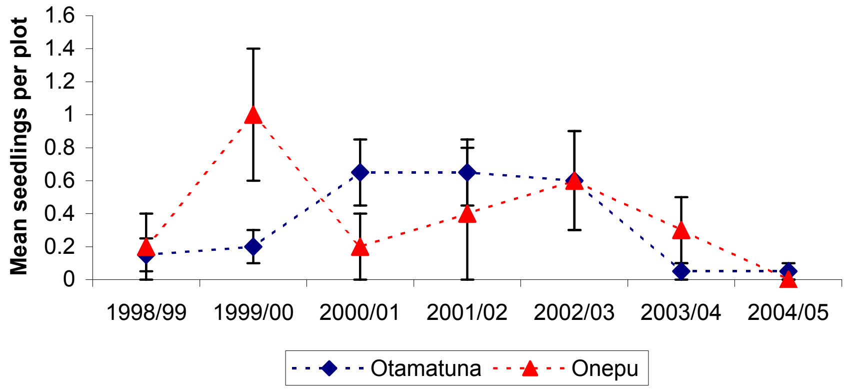
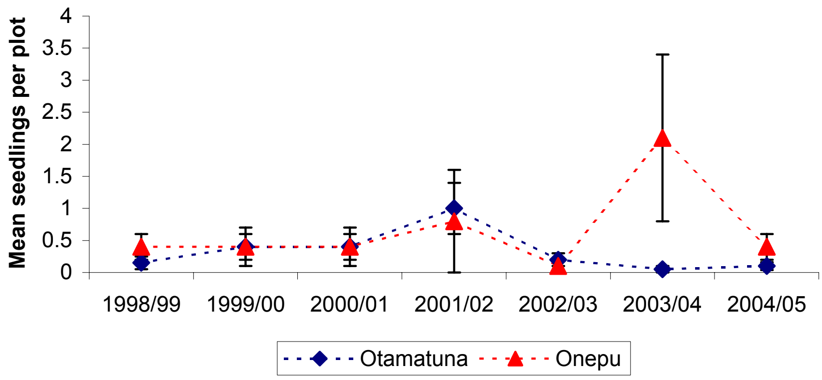


Figure 5.6.5e Total number of palatable seedlings (mean number of seedlings per line) >135 cm at Otamatuna and Onepu Core Areas, northern Te Urewera, 1998-2003



Tables 5.6.1 and 5.6.2 show the results of paired sample T-tests for 1998/99 v. 2004/05 and 2003/04 v. 2004/05 for Otamatuna and Onepu respectively. Significant value calculated at 95% level.

TABLE 5.6.1 COMPARISON OF PALATABLE SEEDLING DENSITIES AT OTAMATUNA CORE AREA, NORTHERN TE UREWERA

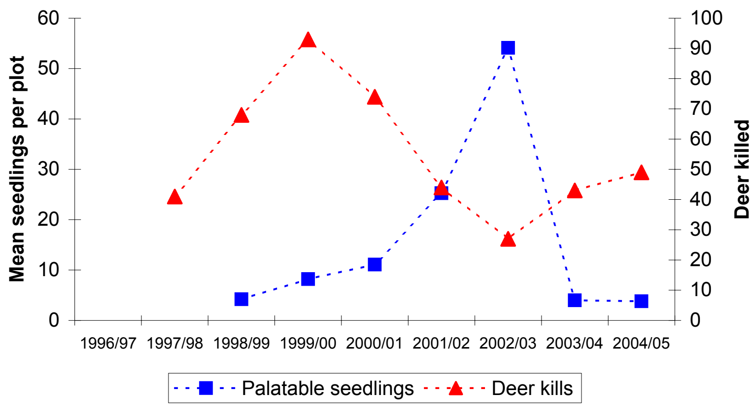
	2003/04 v. 2004/05		1998/99 v. 2004/05	
Height Class (cm)	**P value**	**Sig.Dif Y/N**	**P value**	**Sig.Dif Y/N**
0-15	0.10	N	0.12	N
15-45	0.93	N	0.59	N
45-75	0.48	N	0.26	N
75-135	1	N	0.43	N
>135	0.58	N	0.72	N

TABLE 5.6.2 COMPARISON OF PALATABLE SEEDLING DENSITIES AT ONEPU CORE AREA, NORTHERN TE UREWERA

	2003/04 v. 2004/05		1998/99 v. 2004/05	
Height Class (cm)	**P value**	**Sig.Dif Y/N**	**P value**	**Sig.Dif Y/N**
0-15	0.01	Y (Decrease)	0.01	Y (Decrease)
15-45	0.13	N	0.30	N
45-75	0.71	N	0.56	N
75-135	0.19	N	0.34	N
>135	0.23	N	0.78	N

The results show that there is now little difference in seedling densities between the original measurements in 1998 and the latest results. This is despite seedling densities being much higher for some height tiers in the intervening years. The overall number of seedlings recorded in height classes above 45cm has been small every year with the 2004/05 measurement again showed only low numbers.

Figure 5.6.6 Number of palatable seedlings per plot (all height classes >15cm) and number of deer killed in the Otamatuna Deer Control Area, northern Te Urewera, 1998/99 - 2004/05



Palatable seedling counts for all height classes increased when the number of deer killed was 68 or greater, but decreased after the number of kills was 44 or less (Fig 5.6.6).

5.6.6 Discussion

The results from this year's measurements are similar to the results from 2003/04 with the overall trend in both study areas being increasing deer pellet counts and a decreasing number of palatable seedlings in all height classes.

Otamatuna deer densities have probably been increasing since 2001/02 (when a zero pellet count was obtained on the seedling/pellet transect method when hunting effort in the control area decreased (initially due to injury to the main hunter and then a new hunter with reduced hunting days). This increase in deer density is reflected in the results of both deer monitoring methods used at Otamatuna. It is likely that the present level of hunting effort is insufficient to keep deer densities low enough to achieve regeneration of palatable understorey species. In the initial years of control, approximately 200 days effort per year were spent on deer control; this level has now dropped to less than 100 days per year. Concurrently, there has also been a large decline in hunting pressure using helicopters in the surrounding areas (principally due to current low venison prices) and from a small group of highly successful local hunters who have used dogs. To again reduce deer densities to a level where palatable seedling densities increase will likely require a significant increase in the number of days spent hunting on Otamatuna (with a corresponding reduction in deer densities).

The declines in seedling counts in both areas over the past two years were not surprising given increases in relative abundance indices. We believe that declines in palatable seedling densities are as a result of these small increases in deer abundance. Furthermore, it appears that deer densities must be held at low levels for several years to enable increases in palatable seedling densities.

Management-wise, it is unfortunate that aerial deer recovery has ceased at Onepu and surrounds as the decline in seedlings at Otamatuna has occurred concurrently with Onepu. It is likely that if helicopter recovery was still occurring seedling density would be static or increasing at Onepu (due to the high vulnerability of the area to helicopter shooting) and declining at Otamatuna due to reduced deer harvest in that area (due to insufficient hunting effort).

The seedling counts at Otamatuna suggests that all previous understorey recovery has now been largely negated which reinforces the need to have a high and consistent level of hunting pressure. One tactical approach could be higher targeting of hinds, especially prior to and just after fawning (November/December). This coincides with the spring hunting period when deer are more vulnerable to hunting due to changes in feeding behaviour. Extra hunting pressure should be added over this period as each hind shot effectively removes two deer (i.e. future offspring) from the block. Consideration also should be given to increasing hunting pressure in the Te Waiiti Stream. It is almost certain that many deer from within the control block feed in this stream over the spring period and this area could also act as an effective buffer from deer immigration from surrounding forest. This area was previously hunted extensively by highly effective local hunters who used dogs to bring the deer down to the river. However these hunters are now less active and increased restrictions on dogs (and policing of previous dog rules (Section 5.3)) have also meant a large reduction in hunting over the productive spring hunting period. At the present level of ground-hunting effort at Otamatuna, there are probably not enough hunting days to remove a large enough number of deer to allow a significant reduction of deer densities and a corresponding increase in seedling densities. For effective seedling recovery the number of hunting days probably needs to be increased significantly.

The long-term impact of the cessation of aerial hunting on deer and vegetation dynamics across the Te Urewera (and other large forested areas) remains largely unknown and needs to be investigated. The long-term future of these forests may depend on our understanding these processes

As deer densities in both blocks increase from previous low densities, the abundance of palatable seedlings has significantly decreased to levels approaching that at the start of control operations at Otamatuna. The changes at Otamatuna are largely due to changes in the nature of the DOC control whereas on Onepu they can largely be attributed to the decline of the aerial venison recovery industry. For control at Otamatuna to reduce deer densities sufficiently to allow successful vegetation recovery, a significant increase in hunting effort and perhaps some change in hunting methodology to reflect changes in the background pattern of deer population dynamics in Te Urewera is needed.

5.6.7 Recommendations

- Increase hunting effort within the Otamatuna Core Area to reduce deer densities to levels where palatable seedling densities increase
- Consider allowing more hunting effort in the Te Waiiti Stream to reduce migration of deer from this area into the Otamatuna Core Area

5.6.8 Acknowledgments:

Special thanks to Rebecca Gibson who braved a wet day to grovel around counting seedlings. Also, thanks to the staff of DOC Opotiki, in particular Lindsay Wilson and Shane Gebert. Thanks to Wayne Looney, who carried out much of the hunting this year, for freely giving his time and information on his perceptions of what was occurring on the hill. Thanks to Tiki Hutching for transport and vehicle protection arrangements.

5.7 CANOPY CONDITION

Dave Wilson

5.7.1 Abstract

The results of Foliar Browse Index measurements in 2003 and 2004 continued the trend established since the first measurements in 1998, with the tawhero (=kamahi) canopy condition in all areas except Okopeka (non-treatment area) being relatively stable. At Okopeka the decline noticed following the 2002 measurement has halted and there is evidence of a slight recovery. These changes at Okopeka may have been the result of an increase in possum numbers prior to 2002 and then a decrease following hunting (for fur) after that date. Overall, possums appear to be having little impact on tawhero canopy over most of Te Urewera where possum control is occurring.

5.7.2 Introduction

Foliar Browse Index (FBI) scoring has been used in northern Te Urewera since 1998 to assess changes in canopy cover of trees species vulnerable to possum (*Trichosurus vulpecula*) browse. In the period 1998 - 2004 the foliage cover parameter has provided the most consistent and verifiable data and that is what this report concentrates on. The ability of FBI to show large changes in some of the other parameters (especially browse) was severely limited as the FBI scoring system was not available until well after the northern Te Urewera possum control program was fairly advanced and possum densities had been heavily reduced.

Experience in the northern Te Urewera showed that kamahi (*Weinmannia racemosa*) was the most useful indicator species and it is on this species that this report focuses. Kamahi is a preferred food of possums although compared with some other species is perhaps somewhat more tolerant of browse. As the majority of Te Urewera canopy is made up of tawa (*Beilschmiedia tawa*) which is also a possum food (but one less favoured and probably more browse tolerant than kamahi), a healthy kamahi foliage canopy is likely to be indicative of good health in most of the common canopy species.

5.7.3 Objective

- To determine the impact of possums on the canopy condition of forest in northern Te Urewera

5.7.4 Methods

The location of the Foliar Browse Index (FBI) lines and operational areas in northern Te Urewera, including the non-treatment area, are shown in Figure 5.7.1.

The methodology used in scoring trees followed Payton et al. (1997). The foliage cover is scored using a cue card to estimate percentage of total tree area with canopy cover. All other results are recorded on data sheets but they are not presented or discussed in this report.

Data presentation on the graphs in this year's report has changed somewhat with graphs now showing calendar years as opposed to DOC financial years as was previously the case.

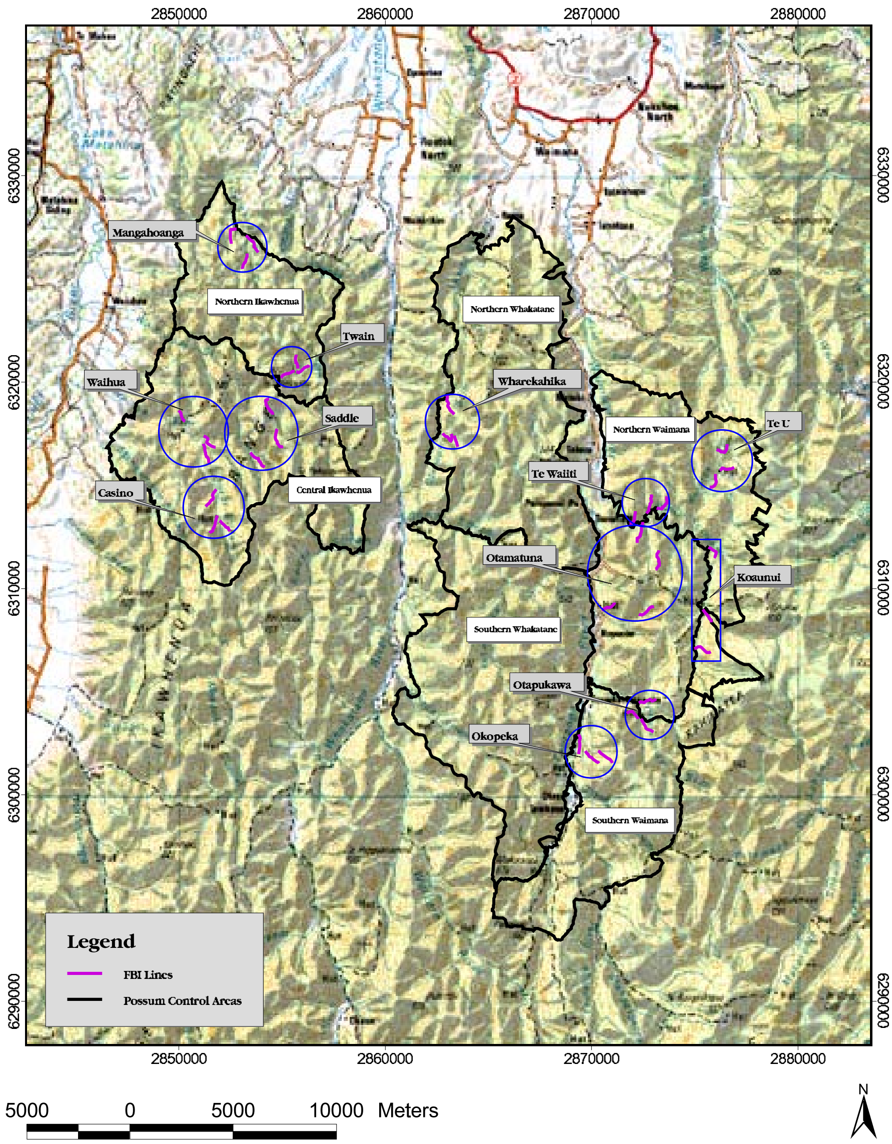
In this report data was analysed in a slightly different way from the years prior to 2002 (but in the same way the report produced in that year) with results of some of the means and standard errors altering slightly from reports prior to 2002. Over the four recordings taken at many sites, various trees or monitoring lines were missed by observers in one year or other but then may have recorded in subsequent years. If trees were discarded from the data set after being missed once the sample size would be significantly reduced. As such, only trees that are definitely dead or have not been recorded for three consecutive measurements were removed from the data set. When a tree was missed for a year that tree was removed for that year only. This has meant that the actual number of trees graphed and analysed has altered between years. This variable sample size has meant that there were some small changes in the figures for canopy cover. The changes in data made it impossible to used paired sample t-tests (the method used in the past) to compare data sets; instead, t-tests assuming unequal variances were used. Table 5.7.1 shows the areas where FBI has occurred and associated information.

All measurements were taken from February to September in the year measured.

TABLE 5.7.1 LOCATION OF AND YEAR MEASURED FOR FOLIAR BROWSE INDEX LINES IN NORTHERN TE UREWERA, 1998-2004

LOCATION	OPERATIONAL AREA	YEARS MEASURED
Saddle	Central Ikawhenua	1998, 2000, 2001, 2002, 2003, 2004
Waihua	Central Ikawhenua	1998, 2000, 2001, 2002, 2003, 2004
Casino	Central Ikawhenua	1998, 2000, 2003, 2004
Twain	Northern Ikawhenua	1998, 1999, 2000, 2002, 2003, 2004
Mangahoanga	Northern Ikawhenua	1998, 1999, 2000, 2002, 2003, 2004
Wharekahika	Northern Whakatane	1999, 2000, 2002, 2003, 2004
Te U	Northern Waimana	1998, 1999, 2000, 2002, 2003, 2004
Te Waiiti	Northern Waimana	1998, 1999, 2000, 2002, 2003, 2004
Koaunui	Northern Waimana	1998, 1999, 2000, 2002, 2003, 2004
Otamatuna	Central Waimana	1998, 2000, 2001, 2002, 2003, 2004
Okopeka	Southern Waimana	1998, 1999, 2000, 2002, 2003, 2004
Otapukawa	Southern Waimana	1998, 1999, 2000, 2002, 2003, 2004

Figure 5.7.1 Location of groups of Foliar Browse Index monitoring lines within possum control areas and non-treatment area (Okopeka), northern Te Urewera, 2004/05



5.7.5 Results

Results for each area for each year are graphed in Figures 5.7.2a – 5.7.2e. Error bars show standard error.

Figure 5.7.2a Foliage cover of kamahi in Central Ikawhenua, northern Te Urewera, 1998 - 2004

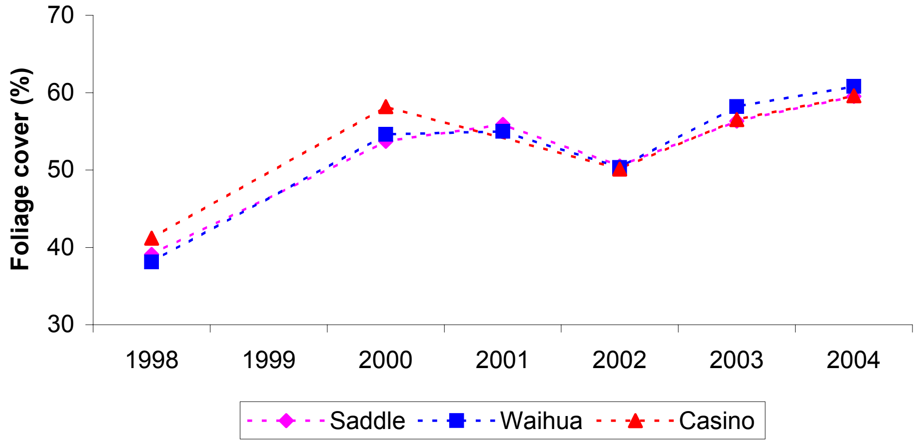


Figure 5.7.2b Foliage cover of kamahi in Northern Ikawhenua, northern Te Urewera, 1998 - 2004

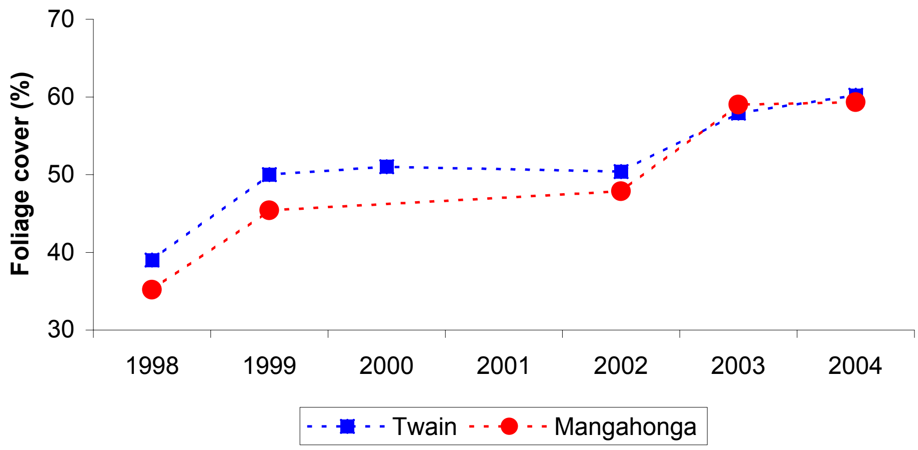


Figure 5.7.2c Foliage cover of kamahi in Southern Waimana, northern Te Urewera, 1998 - 2004

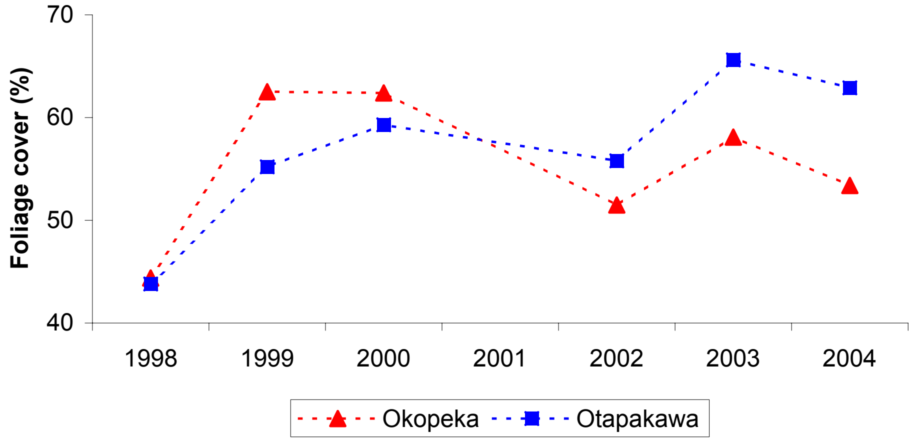


Figure 5.7.2d Foliage cover of kamahi in Northern Waimana and Otamatuna, northern Te Urewera, 1998 - 2004

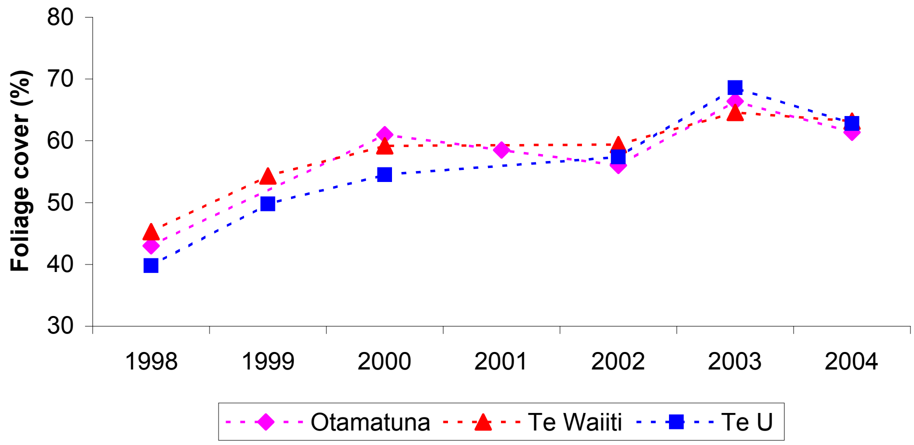
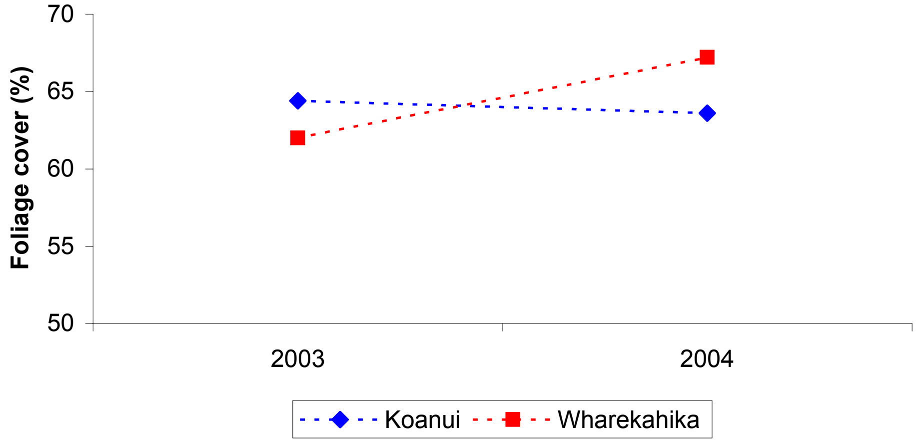


Figure 5.7.2e Foliage cover of kamahi in Koaunui and Wharekahika, northern Te Urewera, 1998 - 2004



The results for all areas showed a large increase in canopy cover between measurements carried out prior to spring 1998 and subsequent measurements. All of these changes were statistically significant (Beaven et al. 1999). In the subsequent period (1998-2004), no area has ever recorded a lower mean canopy cover than was recorded in that period. Most areas have also shown to be remarkably stable since, with little change in mean canopy covers between measurements.

After a large decrease in canopy condition in Okopeka between 1999/00 and 20001/02 it was recommended this non-treatment area be monitored closely. Subsequent measurements have shown that the decline in the years between 2000 and 2002 has not continued and there have been slight increases in canopy cover in that area. Between 2002 and 2003 there was a significant increase (P=0.007). There was a non-significant decline in canopy cover between 2003 and 2004 (P=0.07). However this decline meant that by 2004 there was no significant change in canopy cover at Okopeka over that which was present in 2002 (P=0.40).

5.7.6 Discussion

All monitored and operational areas show a similar pattern of a significant increase in kamahi canopy cover between measurements carried out prior to the spring 1998 and all those carried out subsequently. The latest two years of measurements appear to show a relatively similar pattern to those of previous years since 1998.

A long-term trend is emerging of relatively steady levels of canopy cover following initial low levels during the first year of measurements. The cause of the low level in the first year is uncertain but given the similarities of the patterns found in all operational areas, the non-treatment area of Okopeka and in monitored trees in the Mangatutara catchment of the Motu River (D. Wilson, pers. obs., 2005) it appears that a background environmental factor may have been the major cause of the low levels in the 1997/1998 and winter of 1998/99 year. Over that period it was noted that trees were heavily damaged by insects and that there was exceptionally heavy flowering and fruiting (which may have meant less of the tree energy was being spent on growing leaves).

It appears that the slight variations in canopy densities between years (in areas apart from Okopeka) are likely to be caused by environmental factors. Therefore, possums, when maintained at relatively low densities, are only having a very limited and perhaps relatively unimportant role in year to year variations.

Although the possum non-treatment area of Okopeka initially followed a similar pattern to elsewhere there was a decline of mean FBI from 62% to 51% between 2000 and 2002. A missed year of monitoring in 2001 meant it was unable to establish whether this was a downward trend or a one-off decline. Subsequent measurements have shown a stabilization or slight increase in foliage cover at Okopeka. However, the indices of canopy health have not yet reached those measured prior to the 2002 decline. Subsequent to the 2002 measurement it was discovered that a large amount of illicit (and later legal) possum hunting for fur had occurred at Okopeka and possum densities at Okopeka are likely to be considerably reduced from pre-2002 levels. This decline in possum density may account for halting the decline in canopy cover. In 2000, the possum density was 27% RTC and it is likely to have been considerably lower since then. Further monitoring over the next few years may clarify the pattern that is occurring at Okopeka and perhaps clarify the causes behind it.

Although Otamatuna has had lower possum densities for a longer period than surrounding areas it has not been noticeably better in kamahi canopy cover. This suggests that kamahi is a relatively robust possum browse species that is not seriously impacted by very low to low possum densities. The pattern of relatively stable canopy cover throughout Te Urewera winter 1998 suggests that trees are not being seriously impacted by present levels of possums. If severe impacts were occurring it would be expected that canopy cover would be declining.

As suggested previously (Burns et al. 2002), areas surrounding NTUERP such as the Waiotahi Valley are showing visual evidence of much greater possum damage than the northern Te Urewera where possums are controlled. However, this anecdotal evidence would require some formal monitoring to confirm.

As suggested in prior reports it is likely that canopy cover increased significantly over the period of the early-mid 1990's when Te Urewera possum control was initiated but the recovery of the canopy may have been largely completed by the time formal FBI monitoring was established. Evidence for this (from the formerly-used canopy-loss scoring method) was presented in Beaven et al (1999). Anecdotally, the wide-spread success of the NTUERP possum control is clear, with the largely uniform green canopy seen today comparing starkly with the dominant grey colour of heavily browsed trees apparent in the late 1980s and early 1990s (DW, pers. obs.)

5.7.7 Conclusions

The patterns observed in prior measurements of the FBI scoring method have continued through the measures of 2003 and 2004 with canopy cover remaining relatively stable. The decline observed at Okopeka in 2002 has stabilized and increased slightly. The cause of this decline and subsequent recovery is uncertain but may be related to changes in possum densities in this area.

5.7.8 Acknowledgements

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8.0 Appendices

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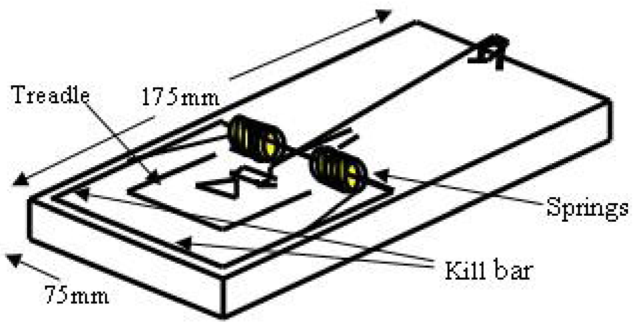
Appendix 4.3.1 Best practice method for rat trapping (June 2005)

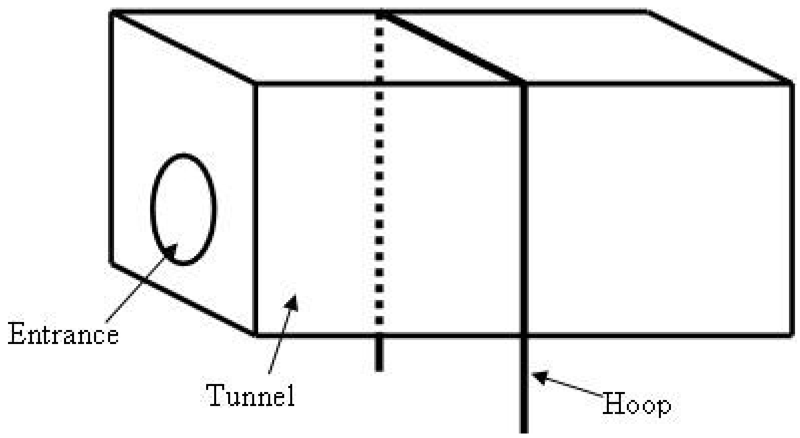
The current best practice for trapping rats over a large scale was developed within NTUERP, and is as follows:

A Victor Professional rat trap is set in a coreflute tunnel which is pinned down by a wire hoop. The Victor Professional rat snap trap is stained using general wood stain to extend its functional life (prevent excess moisture soaking into trap) before being used in the field. A hole is drilled in the trap (as close to the centre as possible without affecting the functioning parts of the trap), enabling it to be pegged to the ground using a short length (approximately 200mm) of straight steel rod with one 90° bend approximately 50mm from one end.

This variety of trap is baited on a treadle system (weight of the animal springs the trap), with a combination of white chocolate and peanut butter. All baits are placed on the treadle to ensure focus of approach is aimed at the trigger mechanism (treadle).



The current best practice tunnel used for housing this trap is made from coreflute, with internal dimensions of approx H150mm/L300mm/W95mm. The entrance to this tunnel is situated at one end with a diameter of 50mm, the bottom of which is approx 25mm above the base. A wire 'hoop' is placed over the tunnel to secure it in place. The length of this hoop depends on the nature of the ground on site and how much is needed to firmly secure the tunnel. During the control rounds the hoop is lifted and the tunnel removed to gain access to the trap.



Appendix 4.4.1 Wire-mesh stoat trap cover design

The trap set consists of two Mark VI Fenn traps placed on the ground, with a white hen's egg placed on the ground between the traps (Fig 4.4.1.3). The traps and egg are covered by a wire mesh tunnel with internal baffles between the traps and the end of the tunnel (Figs 4.4.1.1 and Fig 4.4.1.2). The wire mesh tunnel is itself covered by a semi-opaque plastic cover, although the ends of the tunnel are not covered (Fig 4.4.1.1). The wire mesh cover and traps are pegged down so there are no gaps.

Galvanised steel mesh with an internal grid size of 10mm x 10mm is used for the tunnel cover. The wire strands are approximately 1mm thick and therefore each square is approximately 12mm (grid + two wire strands). The cover without baffles can be cut as one piece with the ends of the tunnel being 15 squares wide and high, and the length of the tunnel being 57 squares long; the sides and the top are therefore 15 squares by 57 squares. The baffles are the same dimensions as the tunnel ends (15 squares each way) and are set 16 squares along the length of the tunnel. Access holes are cut into the ends of the tunnel and the baffles; holes in the ends are 5 squares wide and deep, and holes in the baffles are 5 holes wide and 6 holes deep. The wire mesh tunnel and plastic cover are attached or held together with lengths of twist-ties put in appropriate places so as to close the cover without any gaps.

Appendix 4.4.1 (cont'd)

Figure 4.4.1.1 Exterior of wire mesh tunnel with plastic cover

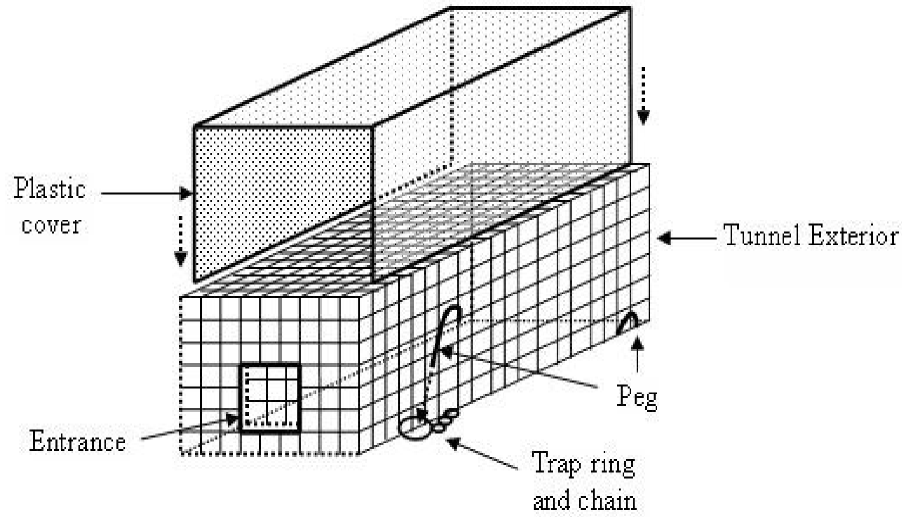


Figure 4.4.1.2 Arrangement of internal baffles

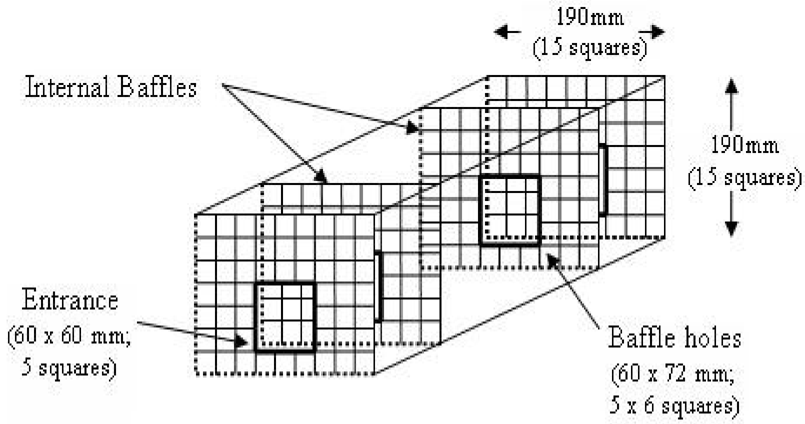
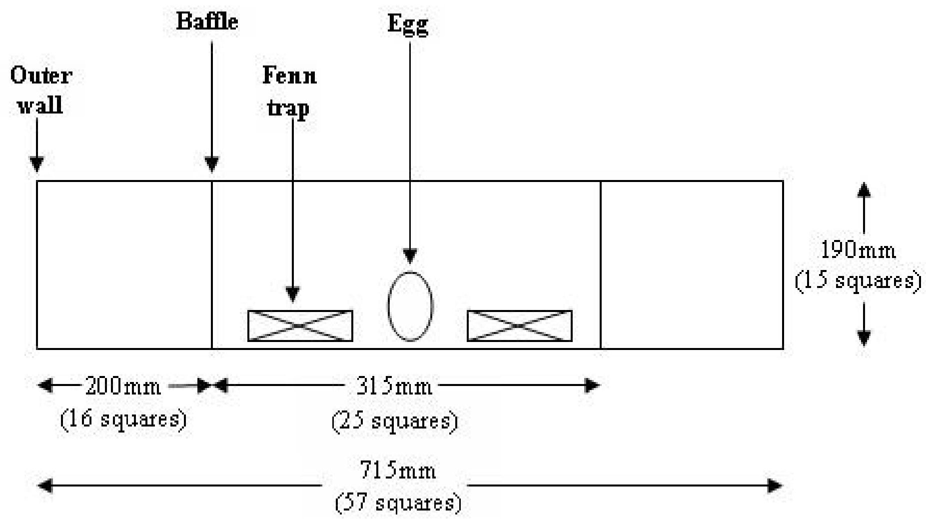


Figure 4.4.1.3 Cross section of trap set for wire mesh tunnel



Appendix 5.4.1 Monitoring data for whio in the Te Waiiti Stream, upper Tauranga River and lower Tauranga River, northern Te Urewera, 2004/05

Te Waiiti Stream

TERRITORY NUMBER	GRID REFERENCE	NUMBER ADULTS	NUMBER JUVENILES PRODUCED	NUMBER JUVENILES FLEDGED	NUMBER OF SURVIVING WHIO
1	W16 704 144	2	2		2
2	W16 713 139	2			2
3	W16 717 132	2	2		2
4	W16 722 132	2			2
5	W16 730 137	2			2
6	W16 735 133	2	4	1	3
7	W16 742 128	2			2
8	W16 741 124	2			2
9	W16 747 127	2			2
10	W16 751 124	2			2
11	W16 754 119	2	4		2
12	W16 756 113	2	4		2
13	W16 756 111	2			2
14	W16 757 105	2	7	3	5
15	W16 755 103	2	1		2
16	W17 755 089	2	5	2	4
17	W17 753 089	2	5	2	4
18	W17 753 084	2	3		2
19	W17 750 077	2	5	3	5
20	W17 750 077	2			2
21	W17 749 062	2	5	2	5
TOTAL		42	52	12	54

Upper Tauranga River

TERRITORY NUMBER	GRID REFERENCE	NUMBER ADULTS	NUMBER JUVENILES PRODUCED	NUMBER JUVENILES FLEDGED	NUMBER OF SURVIVING WHIO
1	W17 694 988	2	4	2	4
2	W17 708 967	2			2
3	W17 707 957	2	5	3	5
4	W17 708 949	2	2		2
5	W17 704 940	2	4	4	6
6	W17 704 935	2			2
7	W17 703 934	1			1
8	W17 703 933	2			2
9	W17 703 929	1			1
10	W17 704 929	2	4		2
TOTAL		18	19	9	27

Lower Tauranga River

TERRITORY NUMBER	GRID REFERENCE	NUMBER ADULTS	NUMBER JUVENILES PRODUCED	NUMBER JUVENILES FLEDGED	NUMBER OF SURVIVING WHIO
1	W16 701 158	2	0	0	2
2	W16 702 134	2	0	0	2
3	W16 702 131	2	0	0	2
4	W16 704 127	2	4	0	2
5	W16 704 116	2	4	0	2
6	W16 697 108	2	0	0	2
7	W17 702 093	2	0	0	2
8	W17 703 087	2	4	0	2
9	W17 699 071	2	0	0	2
10	W17 702 071	2	4	0	2
	W17 702 071	2	4	0	2
TOTAL		22	21	0	22

Appendix 5.4.4 Observations of dispersed juvenile whio banded in the Te Waiiti Stream, northern Te Urewera, 2000/01 – 2004/05. Some birds were observed more than once, sometimes at different locations. Dispersal distance is from banding location if known, otherwise from centre of natal area.

BANDS	DATE SEEN	DATE BANDED	BANDING LOCATION	RIVER/STREAM & CATCHMENT FOUND	GRID REFERENCE	DISPERSAL DISTANCE
3 banded birds	2/2/02			Otapukawa / Waimana	W17 724 023	11km
M-BG	12/4/02	19/12/01	Upper forks	Waiata / Waioeka	W16 826 197	143km
RG-M	31/0/02	2/2/01	Whakapirau	Otapukawa / Waimana	W17 715 047	8km
YM-G	17/1/03	16/12/02	Waipapa	Ogilvies / Waimana	W16 703 163	9.6km
YM-G	13/12/03	16/12/02	Waipapa	Ogilvies / Waimana	W16 704 129	2.5km
RM-W	24/1/03	13/11/01	Te Pona	Tauranga / Waimana	W17 699 094	4.3km
M-WY	2/2/03	13/11/01	Te Pona	Tauranga / Waimana	W17 691 025	11km
M-WY	7/3/03	13/11/01	Te Pona	Tauranga (Tauwharemanuka) / Waimana	W17 691 025	11km
M-WY	13/10/03	13/11/01	Te Pona	Tauranga (Tauwharemanuka) / Waimana	W17 696 049	8.5km
W-GM	24/2/03	3/12/02	Waiohinekaka	Tauranga / Waimana	W17 688 016	8.7km
GB-M	24/2/03.	28/11/01	Kouanui	Makakoere / Waioeka	W17 793 920	20km
1 banded bird	6/3/03			Tauranga / Waimana	W17 697 159	2.8km
3 banded birds	6/3/03			Waimana (concrete bridge) / Waimana	W16 688 223	8km
RM-W	6/3/03	13/11/01	Te Pona	Tauranga (Lions Hut)/ Waimana	W17 702 091	4.5km
W-BM	7/3/03	21/12/01	Waipapa	Tauranga (Ox Bow) / Waimana	W17 693 028	11.6km
W-RM	8/3/03	17/12/02		Kahunui / Waioeka	W17 834 014	11.3km
M-W?	26/3/03		(Te Pona?)	Waikokopu / Rangitikei	W16 507 222	20.5km
R-GM	3/4/03	3/12/02	Waiohinekaka	Te Waiti / Waimana	W16 749 124	4.5km
RW-RM	15/6/03	15/1/03	Totaras	Whakatane / Whakatane	W16 609 140	15.2km
YM-YR?	31/5/03	15/1/03?	Kouanui	Pohatuatua / Waimana	W16 708 101	4.5km
WM-B	11/12/03 23/1/04	4/2/03	Te Pona	Orouamananui	W16 696 155	3km
M-WR	21/7/04	2/2/02	Totara	Tauranga On the Road (Rifle Range)	W17 700 105	5.5km
RM-W	14/10/04	13/11/01	Te Pona	Tauranga (Below Lions)	W17 702 090	3.7km
YM-W	15/10/04	16/12/02	Waipapa	Tauranga (Hydro)	W17 707 948	18.8km
WM-B	18/10/04	4/2/03	Te Pona	Tauranga (Above 9 mile)	W16 703 134	2.5km
W-RM	18/10/04	17/12/02	Kouanui	Tauranga (above 9 mile)	W16 703 134	6.5km
YM-B	13/12/03	16/12/02	Manuka	Tauranga (Ogilvies)	W16 704 127	3.8km
BM-WR	2/12/04	15/01/03	Whakepirau	Tauranga (Rifle range)	W16 697 106	5.9km
1 banded bird	20/1/05			Waimana (concrete bridge)	W16 682 221	8km

Appendix 5.4.5 Records of whio marking using bands and transponders in northern Te Urewera 2000/01 - 2004/05

NO.	LOCATION	GRID REFERENCE	DATE BANDED	SEX	AGE	STATUS AT BANDING	METAL BAND #1	METAL BAND #2	METAL BAND #3	BAND COMB.	TRANS-PONDER NUMBER
1	Te Pona	W16 716 135	12/20/2000	F	A	Pair	S-79701	L-35078		M-W	
2	Te Pona	W16 716 135	12/20/2000	M	A	Pair	S-79702	L-35077		W-M	
3	Te Pona	W16 716 135	12/20/2000	M	J	Clutch	S-79703			GW-M	
4	Te Pona	W16 716 135	12/20/2000	M	J	Clutch	S-79704			YW-M	
5	Te Pona	W16 716 135	12/20/2000	F	J	Clutch	S-79705			M-BW	
6	Te Pona	W16 716 135	12/20/2000	F	J	Clutch	S-79706			M-RW	
7	Te Pona	W16 716 135	12/20/2000	F	J	Clutch	S-79707			M-OW	
8	Te Pona	W16 716 135	12/20/2000	F	J	Clutch	S-79708	L-35082		M-WW	
9	Waipapa	W16 727 136	12/20/2000	M	A	Pair	S-79709			B-M	
10	Waipapa	W16 727 136	12/20/2000	F	A	Pair	S-79710	L-35054		M-B	
11	Upper Forks	W17 750 066	12/21/2000	M	A	Pair	S-79711	L-35063		Y-M	
12	Upper Forks	W17 750 066	12/21/2000	F	A	Clutch	S-79713	L-35083		M-Y	
13	Upper Forks	W17 750 066	12/21/2000	F	J	Clutch	S-79712			M-GY	
14	Upper Forks	W17 750 066	12/21/2000	F	J	Clutch	S-79714			M-RY	
15	Last Grass	W16 712 141	2/1/2001	M	A	Pair	S-79715	L-35079		-M	
16	Last Grass	W16 712 141	1/02/2001	F	A	Pair	S-79716			M-	
17	Below Kaharoa	W16 744 124	1/02/2001	M	A	Pair	S-79717			RB-M	
18	Below Kaharoa	W16 744 124	1/02/2001	F	A	Pair	S-79718			M-BR	
19	Above Kaharoa	W16 750 123	1/02/2001	F	A	Pair	S-79719			M-WG	
20	Above Kaharoa	W16 750 123	1/02/2001	M	A	Pair	S-79720			WG-M	
21	Whakapirau	W16 753 119	2/02/2001	M	S		S-79721			RG-M	

NO.	LOCATION	GRID REFERENCE	DATE BANDED	SEX	AGE	STATUS AT BANDING	METAL BAND #1	METAL BAND #2	METAL BAND #3	BAND COMB.	TRANS-PONDER NUMBER
22	Whakapirau	W16 753 119	2/02/2001	M	S		S-79722	L-35081		GR-M	
23	Gorge	W16 757 110	2/02/2001	F	S		S-79723			M-RG	
24	Gorge	W16 757 110	2/02/2001	M	S		S-79724	L-35073	L-35067	BR-M	
25	Gorge	W16 757 110	2/02/2001	M	S		S-79725			YR-M	
26	Totara Flats	W16 756 105	2/02/2001	M	S	Pair	S-79726	L-32276		WR-M	
27	Totara Flats	W16 756 105	2/02/2001	F	S	Pair	S-79727			M-WR	
28	Koaunui Hut	W17 755 096	2/02/2001	M	S		S-79728			RY-M	
29	Te Pona	W16 716 135	13/11/2001	F	J	Clutch	S-79729	L-35080		M-YW	
30	Te Pona	W16 716 135	13/11/2001	F	J	Clutch	S-79730			M-GW	
31	Te Pona	W16 716 135	13/11/2001	M	J	Clutch	S-79731			WB-M	
32	Te Pona	W16 716 135	13/11/2001	F	J	Clutch	S-79732			M-WB	
33	Te Pona	W16 716 135	13/11/2001	F	J	Clutch	S-79733			M-WY	
34	Te Pona	W16 716 135	13/11/2001	F	J	Clutch	S79734			RM-W	
35	Te Pona	W16 716 135	13/11/2001	F	J	Clutch	S-79735			BW-M	
36	Koaunui	W17 757 089	28/11/2001	M	J	Clutch	S-79736			RW-M	
37	Koaunui	W17 757 089	28/11/2001	M	J	Clutch	S-79737			BY-M	
38	Koaunui	W17 757 089	28/11/2001	F	A	Pair	S-79738			M-YG	
39	Koaunui	W17 757 089	28/11/2001	M	A	Pair	S-79739	L-35086	L-35069	YG-M	
40	Koaunui	W17 757 089	28/11/2001	M	J	Clutch	S-79740			GB-M	
41	Koaunui	W17 757 089	28/11/2001	M	J	Clutch	S-79741			WY-M	
42	Koaunui	W17 757 089	28/11/2001	F	J	Clutch	S-79742			M-YR	
43	Koaunui	W17 757 089	28/11/2001	F	J	Clutch	S-79743			M-BY	
44	Koaunui	W17 757 089	28/11/2001	M	J	Clutch	S-79744			YB-M	

NO.	LOCATION	GRID REFERENCE	DATE BANDED	SEX	AGE	STATUS AT BANDING	METAL BAND #1	METAL BAND #2	METAL BAND #3	BAND COMB.	TRANS-PONDER NUMBER
45	Upper Forks	W17 750 069	19/12/2001	F	J		S-70664	L-35090		M-BG	
46	Totara	W17 755 097	20/12/2001	M	A	Pair	S-70665	L-35087		R-RM	
47	Totara	W17 755 097	20/12/2001	F	A	Pair	S-70666	L-35062		RM-R	
48	Totara	W16 756 104	20/12/2001	M	A	Pair	S-70667			R-WM	
49	Totara	W16 756 104	20/12/2001	F	A	Pair	S-70668	L-35088		WM-R	
50	Gorge	W16 755 113	20/12/2001	M	A		S-70669	L-35098		RB-M	
51	Gorge	W16 755 113	20/12/2001	F	J		S-70670			RM-B	
52	Mapou	W16 741 123	21/12/2001	F	J	Clutch	S-70671			M-YB	
53	Mapou	W16 741 123	21/12/2001	M	A	Pair	S-70672			Y-YM	
54	Mapou	W16 741 123	21/12/2001	F	A	Pair	S-70673	L-35061		YM-Y	
55	Mapou	W16 741 123	21/12/2001	F	J	Clutch	S-70674	L-35099		WM-Y	
56	Mapou	W16 741 123	21/12/2001	F	J	Clutch	S-70675			RM-Y	
57	Matawhero	W16 736 129	21/12/2001	M	A	Pair	S-70676	L-35075		R-YM	
58	Matawhero	W16 736 129	21/12/2001	F	A	Pair	S-70677	L-35076		YM-R	
59	Waipapa Spur	W16 730 138	21/12/2001	M	A		S-70678	L-35055		B-BM	
60	Waipapa Spur	W16 730 138	21/12/2001	F	J		S-70679			W-BM	
61	Kaharoa	W16 748 132	30/01/2002	F	A	Pair	S-70680			GM-G	
62	Kaharoa	W16 748 132	30/01/2002	M	A	Pair	S-70681			G-GM	
63	Waipapa Stream	W16 225 131	2/12/2002	F	J	Clutch	S-79745			BM-Y	
64	Waipapa Stream	W16 225 131	2/12/2002	M	J	Pair	S-79746			R-BM	
65	Waipapa Stream	W16 225 131	2/12/2002	F	A	Pair	S-79747			G-BM	
66	Waipapa Stream	W16 225 131	2/12/2002	M	J	Clutch	S-79748			BM-R	

NO.	LOCATION	GRID REFERENCE	DATE BANDED	SEX	AGE	STATUS AT BANDING	METAL BAND #1	METAL BAND #2	METAL BAND #3	BAND COMB.	TRANS-PONDER NUMBER
67	Waipapa Stream	W16 225 131	2/12/2002	M	J	Clutch	S-79749			Y-BM	
68	2nd to Last Fork	W17 751 069	2/12/2002	M	A	Pair	S-79750			G-RM	
69	2nd to Last Fork	W17 751 069	2/12/2002	F	A	Pair	S-79651			RM-G	
70	Above Waiohinekaha	W17 751 077	3/12/2002	F	J	Clutch	S-79652			GM-B	
71	Above Waiohinekaha	W17 751 077	3/12/2002	F	A	Pair	S-79653			GM-W	
72	Above Waiohinekaha	W17 751 077	3/12/2002	M	A	Pair	S-70654			W-GM	
73	Above Waiohinekaha	W17 751 077	3/12/2002	M	J	Clutch	S-70655			Y-GM	
74	Above Waiohinekaha	W17 751 077	3/12/2002	M	J	Clutch	S-70656			R-GM	
75	Above Waipapa Spur	W16 732 135	16/12/2002	F	J	Clutch	S-70657			YM-G	
76	Above Waipapa Spur	W16 732 135	16/12/2002	F	J	Clutch	S-70658			YM-W	
77	Above Waipapa Spur	W16 732 135	16/12/2002	M	J	Clutch	S-70659			G-YM	
78	Above Waipapa Spur	W16 732 135	16/12/2002	M	J	Clutch	S-70660			B-YM	
79	The Manuka	W16 742 127	16/12/2002	F	J	Clutch	S-70661			YM-B	
80	The Manuka	W16 742 127	16/12/2002	M	J	Clutch	S-70662			Y-RM	
81	The Manuka	W16 742 127	16/12/2002	F	J	Clutch	S-70663	L-33601		GY-M	

NO.	LOCATION	GRID REFERENCE	DATE BANDED	SEX	AGE	STATUS AT BANDING	METAL BAND #1	METAL BAND #2	METAL BAND #3	BAND COMB.	TRANS-PONDER NUMBER
82	The Manuka	W16 742 127	16/12/2002	F	J	Clutch	S-70682	L-35093		M-GR	
83	The Manuka	W16 742 127	16/12/2002	F	J	Clutch	S-70683			GM-R	
84	The Manuka	W16 742 127	16/12/2002	F	J	Clutch	S-70684			GM-Y	
85			16/12/2002	M	J	Clutch	S-70685			R-GM	
86			16/12/2002	M	A	Clutch	S-70686			B-WM	
87	Below Koaunui Hut	W17 755 095	17/12/2002	M	J	Clutch	S-70687			W-RM	
88	Below Koaunui Hut	W17 755 096	17/12/2002	F	J	Clutch	S-70688			RM-G	
89	Below Koaunui Hut	W17 755 097	17/12/2002	M	J	Clutch	S-70689			G-WM	
90	Below Koaunui Hut	W17 755 098	17/12/2002	M	J	Clutch	S-70690			B-RM	
91	Below Koaunui Hut	W17 755 099	17/12/2002	F	J	Clutch	S-70691			WM-G	
92	Kaharoa Forks	W16 748 127	18/12/2002	M	J	Clutch	S-70692			B-GM	
93	Kaharoa Forks	W16 748 127	18/12/2002	M	A		S-70693	L-35097		W-WM	
94	Kaharoa Forks	W16 748 127	18/12/2002	M	J		S-70694			Y-WM	
95	Kaharoa Forks	W16 748 127	18/12/2002	F	J		S-70695			GM-W	
96	Whakapirau Stream	W16 756 120	18/12/2002	F	A		S-70696	L-35066		WM-W	
97	Whakapirau Stream	W16 756 120	18/12/2002	M	J	Clutch	S-70697			W-YM	
98	Whakapirau Stream	W16 756 120	18/12/2002	M	J		S-70698			RW-BM	
99	Whakapirau Stream	W16 756 120	18/12/2002	F	J		S-70699			BM-W	
100	Whakapirau Stream	W16 756 120	18/12/2002	M	J		S-70700			BW-RM	

NO.	LOCATION	GRID REFERENCE	DATE BANDED	SEX	AGE	STATUS AT BANDING	METAL BAND #1	METAL BAND #2	METAL BAND #3	BAND COMB.	TRANS-PONDER NUMBER
101	Whakapirau Stream	W16 756 120	18/12/2002	F	J		S-73595			M-GB	
102	Totara Flat	W16 755 103	15/01/2003	F	A		L-32277			WM-RW	
103	Totara Flat	W16 755 103	15/01/2003	F	J		L-32278			WM-RB	
104	Totara Flat	W16 755 103	15/01/2003	M	J		L-32279			RW-RM	
105	Totara Flat	W16 755 103	15/01/2003	F	J	Clutch	L-35053			WM-RY	
106	Above Whakapirau	W16 755 115	15/01/2003	F	J	Clutch	L-35054			YM-WR	
107	Above Whakapirau	W16 755 115	15/01/2003	F	J	Clutch	L-35055			BM-WR	
108	Te Pona	W16 713 136	4/02/2003	F	J	Clutch	L-35071			WM-B	
109	Te Pona	W16 713 136	14/02/2003	F	J		L-35056			WM-WR	
110	Te Pona	W16 713 136	14/02/2003	M	J		L-35057			RW-WM	
111	Toetoe Flats	W17 750 077	17/12/2003	M	A	Pair	L-35058			RY-RM	
112	Toetoe Flats	W17 750 077	17/12/2003	F	A	Pair	L-35059			RM-RY	
113	Toetoe Flats	W17 750 077	17/12/2003	M	J	Clutch	L-35060			L-M	
114	Gorge	W16 757 110	18/12/2003	F	A		L-35072	L-35068		RM-RB	
115	Whakapirau	W16 756 117	18/12/2003	M	A		L-35074	L-35065		WB-WM	
116	Below Te Pona	W16 712 136	16/02/2004	M	A	Single	L-35091			RG-RM	
117	Below Manuka	W16 733 135	16/02/2004	M	A	Pair	L-35092			RB-RM	
118	Below Te Mapou	W16 740 124	16/02/2004	F	A	Pair	L-35094			WM-WG	
119	Below Te Mapou	W16 740 124	16/02/2004	M	A	Pair	L-35095			WG-WM	
120	Kaharoa Forks	W16 740 127	17/02/2004	F	A		L-35096			WM-WY	
121	Above Koaunui	W16 753 084	18/02/2004	F	A		L-35085	L-35070		YM-YG	
122	2nd to Last Forks	W16 749 074	18/02/2004	F	A	Single	L-35084			YM-BG	
123	Above Waiohinekaha	W17 751 080	24/01/2005	F	J						
124	Above Waiohinekaha	W17 751 080	24/01/2005	M	J						

NO.	LOCATION	GRID REFERENCE	DATE BANDED	SEX	AGE	STATUS AT BANDING	METAL BAND #1	METAL BAND #2	METAL BAND #3	BAND COMB.	TRANS-PONDER NUMBER
125	Waiohinekaha	W17 753 086	24/01/2005	F	J						
126	Waiohinekaha	W17 753 086	24/01/2005	M	J						
127	Totaras	W17 755 103	25/01/2005	F	J						
128	Totaras	W17 755 103	25/01/2005	M	J						
129	Totaras	W17 755 103	25/01/2005	M	J						
130		W17 751 123	25/01/2005	F	A		L-35064			WM-BR	

Appendix 8.1 File numbers for Department of Conservation reports and documents

REFERENCE NUMBER	FILE NAME (DESCRIPTION)	RELEVANT SECTIONS
HWKCO-22073	East Coast Hawke's Bay animal Pest Management Tendering Procedure for Contractors	4.2
HAMRO-66179	Using tracking tunnels to monitor rodents and mustelids	4.2
HAMRO -100032	DOC200 vs Fenn Onepu stoat trap trial	4.4
WGNHO-242588	Instructions to hunters for Garmin Etrex GPS use	4.5
WGNH0-41695	Onepu Core area (kokako) nest monitoring 2004/05	5.2
WGNHO-50198	Pakoakoa Core Area (kokako) nest monitoring 2004/05	5.2
WGNHO-220454	Waikokopu kokako census 2004/05	5.2
WGNHO-218292	Location diagram for monitored mistletoes - Otamatuna	5.4
WGNHO-218029	Location diagram for monitored mistletoes - Okopeka	5.4
WGNHO-242270	Flowering history and classifcation of monitored mistletoes	5.4
WGNHO-207714	FBI field sheet for mistletoe monitoring	5.4
DOCDM-77260	Foliar Cover scale for mistletoe monitoring	5.4