Te Urewera Mainland Island

Annual Report: July 2008 - June 2009

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EAST COAST BAY OF PLENTY CONSERVANCY

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OUR VISION:

TO ACKNOWLEDGE AND NURTURE THE MAURI OF THE NORTHERN TE UREWERA ECOSYSTEM

Ecological Management & Restoration *Linking science and practice*

GLOBAL RESTORATION NETWORK

Te Urewera Mainland Island: an Australasian top 25 site

Kiwi management in this project was supported by the BNZ Save the Kiwi Trust

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Cover Photo: Ship rat (*Rattus rattus*) predating a blackbird (*Turdus merula*) nest.
Photo courtesy of Nga Manu Images

Summary

This report focuses on the management actions and outcomes for the thirteenth season of Te Urewera Mainland Island (TUMI) [*Note*: This project was previously referred to as the Northern Te Urewera Ecosystem Restoration Project (NTUERP)].

THE PROJECT

TUMI is one of six official 'Mainland Islands' which are projects that incorporate three themes of learning, biodiversity and community within their goals; a key point of difference of these projects is their mandate to improve management capability for ecosystem restoration. The project is set in the northern part of Te Urewera National Park and is focused on restoring and maintaining ecosystem processes within a large, podocarp-broadleaf forest landscape. This restoration is currently being achieved through the control of animal pests, principally possums, rats, stoats, and the monitoring of native flora and fauna to gauge the benefits of this pest control.

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 there are five Core Areas covering approximately 9905 ha, while the Background Area is 40 000 ha although management is not undertaken across this entire area every year.

In October 2008, TUMI was selected as one of the top 25 ecological restoration projects in Australasia by a panel of experts working within the Global Restoration Network (see Australasia's top 25 restoration projects).

ANNUAL REVIEW

See Section 3.1 (Annual Review) and Section 3.2 (Looking Forward) for a review of management issues within the project.

Three research projects were undertaken within the project area this season (Section 3.4), two of these being led by Landcare Research / Manaaki Whenua and one by the Department. The results for a field trial comparing stoat catch rates of DOC200 traps (in wooden boxes) and double-set Fenn traps (under wire mesh covers) are presented in Section 4.4.

ANIMAL PEST CONTROL (SECTION 4.0)

Trapping as the principal form of animal pest control continues to be a successful approach and remains a significant point of difference between this and other restoration projects. Pest animals were managed over a total of 12 685 hectares this season. Most of the work was done in the five Core Areas, Otamatuna, Mangaone, Onepu, Pakoakoa and Waikokopu, which encompassed a total of 9905 hectares. Six animal pests were directly targeted in Core Area: 9905 ha of possum control, 7851 ha of stoat control, 4037 ha of cat control, 2494 ha of deer control and 1555 ha of rat control. Limited pig control was undertaken in part of Otamatuna Core Area.

Possum control was undertaken over a total of 12 685 hectares including 9905 hectares in the Core Areas and 2780 in the Background Area. Control targets (<5% residual trap catch index) were met in both Core and Background Areas. All Core Areas now have a network of 'Sentinel' kill traps for possum control. Rats were controlled in the five Inner Core Areas (total 1555 ha). At Otamatuna where rats are controlled year-round, the highest abundance index recorded was 6%. In the other four Core Areas, rats were controlled on a seasonal basis: rat monitoring targets (<5% tracking index) were generally met in the Mangaone, Waikokopu and Pakoakoa Core Areas but not at Onepu where only one index was below the target of 5%. A total of 79 deer were killed in the Otamatuna Core Area (2494 ha). Numbers of palatable seedlings in the understorey were significantly higher at Otamatuna than at Onepu (non-treatment site). A network of 85 Connibear-type traps for cat control was maintained and checked through the season. No cats were caught in these traps although two juvenile cats were caught in Fenn traps in Te Waiiti Stream.

A new method for dog control was being investigated this season. Seven remote-alert swing-door dog trap systems were developed with funding from the Bank of New Zealand Save the Kiwi Trust. Staff have been testing systems (e.g. bait longevity, battery life, trap reliability) to further develop the technique. Three feral dogs were shot by staff or contractors this season. The presence of feral dogs remains a significant threat to kiwi and also whio (an incubating female was killed on the nest by a feral dog in 2007/08).

CONSERVATION MONITORING (SECTION 5.0)

This season, monitoring to assess the effects of pest control was undertaken for kokako (nesting success), kiwi (chick survival and population trends), whio (survival and nesting success), mistletoe (recruitment rate and plant health), abundance of palatable seedlings and the condition of the forest canopy.

There are an estimated 180 kokako pairs in areas under management: this represents more than 20% of the national total. Pair numbers are still low in three of the Core Areas, Waikokopu (7), Pakoakoa (6) and Onepu (14), but have increased at Mangaone (44) and Otamatuna (estimated 112). Four kiwi chicks caught at nests were fitted with transmitters this year where their survival was monitored to assess the effectiveness of the stoat control regime. One of these chicks was killed by a stoat. Kiwi population monitoring indicated that call rates are similar now (2.5 calls/hour) to those in 2004/05 however anecdotal evidence indicated that in the Otamatuna and Mangaone Core Areas more kiwi are present now than five years ago. Mistletoe monitoring was done at four sites looking at the recruitment rate and health of *Peraxilla tetrapetala* and *Alepis flavida*. Possum control (especially 1- or 2-yearly) has improved the health and abundance of mistletoe. The condition of canopy species (mainly tawhero/kamahi) was significantly better in areas with possum control (both Core and Background) than in the comparison site. Whio monitoring this season included the use of transmitters to gain better information on nest and adult mortality. Results revealed that adult whio, especially females, are very vulnerable to predation during their moult period.

COMMUNITY AWARENESS (SECTION 6.0)

Activities to raise the awareness of the project and involve community members were undertaken throughout the year. Children from the Waimana School enjoyed an overnight trip to Otamatuna Hut; an overnight walk as part of the 'Birds-a-Plenty' festival involved 13 people; several local, national, and international volunteers have been involved in activities such as kokako nest monitoring, rat tunnel replacement, and stoat and rat trapping; TUMI hosted a group of tutors and students from the first national ranger trainee programme currently under development in New Caledonia. During 2008 a visit was made by two US Army personnel from the Oahu Military Base in Hawaii who spent several days in TUMI seeking advice, and acquainting themselves with a large scale pest control operation. As a result, several hundred DOC200 traps have been dispatched to Hawaii to assist in the control of mongoose and rats.

Interpretation panels along the Ngutuoha Nature Trail have been redesigned and replaced in both Te Reo and English versions. It is envisaged that the track will become the most accessible roadside entry point into the Mainland Island for day visitors.

The dog trap, designed in-house by Greg Moorcroft, was presented to attendees of the North Island Kiwi Hui, and received much interest and positive feedback. Several staff members continue to provide advice to recovery groups and training programmes within the department: Andrew Glaser - Leader, Whio Recovery Group; Advisor- National Predator Dog Programme; Cody Thyne and Jane Haxton - Advisors & Members, Kokako Recovery Group; Daniel Baigent – Auditor, NPCA, and Trainer – DOC pest management training course.

Contents

1.0 Introduction

This report focuses on the management actions and outcomes for the thirteenth season of Te Urewera Mainland Island (TUMI) [*Note*: This project was previously referred to as the Northern Te Urewera Ecosystem Restoration Project (NTUERP)].

Te Urewera Mainland Island is a significant project administered and managed by New Zealand's Department of Conservation. Established in 1996, it is one of six sites in the country officially designated as a 'Mainland Island'. These sites have particular guiding principles under the three themes of *Learning*, *Biodiversity* and *Community*; however, it is the learning aspect of Mainland Islands in particular that sets them apart from restoration projects.

In October 2008, Te Urewera Mainland Island was selected as one of the Top 25 Ecological Restoration projects in Australasia by the Global Restoration Network (see Australasia's top 25 restoration projects).

The project is located around the northern part of Te Urewera National Park, south of Whakatane in the Eastern Bay of Plenty (Figure 1.1). Te Urewera National Park (212 673 ha) (gazetted 1953) is part of the largest extant tract of native forest in the North Island. 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. In the northern part of the National Park, the vegetation is classed as semi-coastal lowland forest, being relatively homogeneous in nature with rimu and northern rata emerging over a tawa and tawhero (=kamahi) canopy, which itself is dominant over a diverse broadleaf sub-canopy. Beech species are more common in steeper and higher altitude areas. The climate is mild with warm summers and cool winters with rainfall averaging 2000 – 2400 mm per annum.

The forests of northern Te Urewera contain an assemblage of flora and fauna as complete as any in the North Island; all of the North Island forest bird species present on the mainland (except weka) are found there and at least 650 varieties of plants have been noted. This assemblage of species 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.

Ngai Tuhoe are tangata whenua and are intricately connected with the land and its values. A significant proportion of the land adjoining Te Urewera National Park is owned by Tuhoe hapu; this includes several large blocks wholly surrounded by National Park.

The project has an operational area of 50 000 ha, however management effort across the project varies according to the site (see Section 2.0).

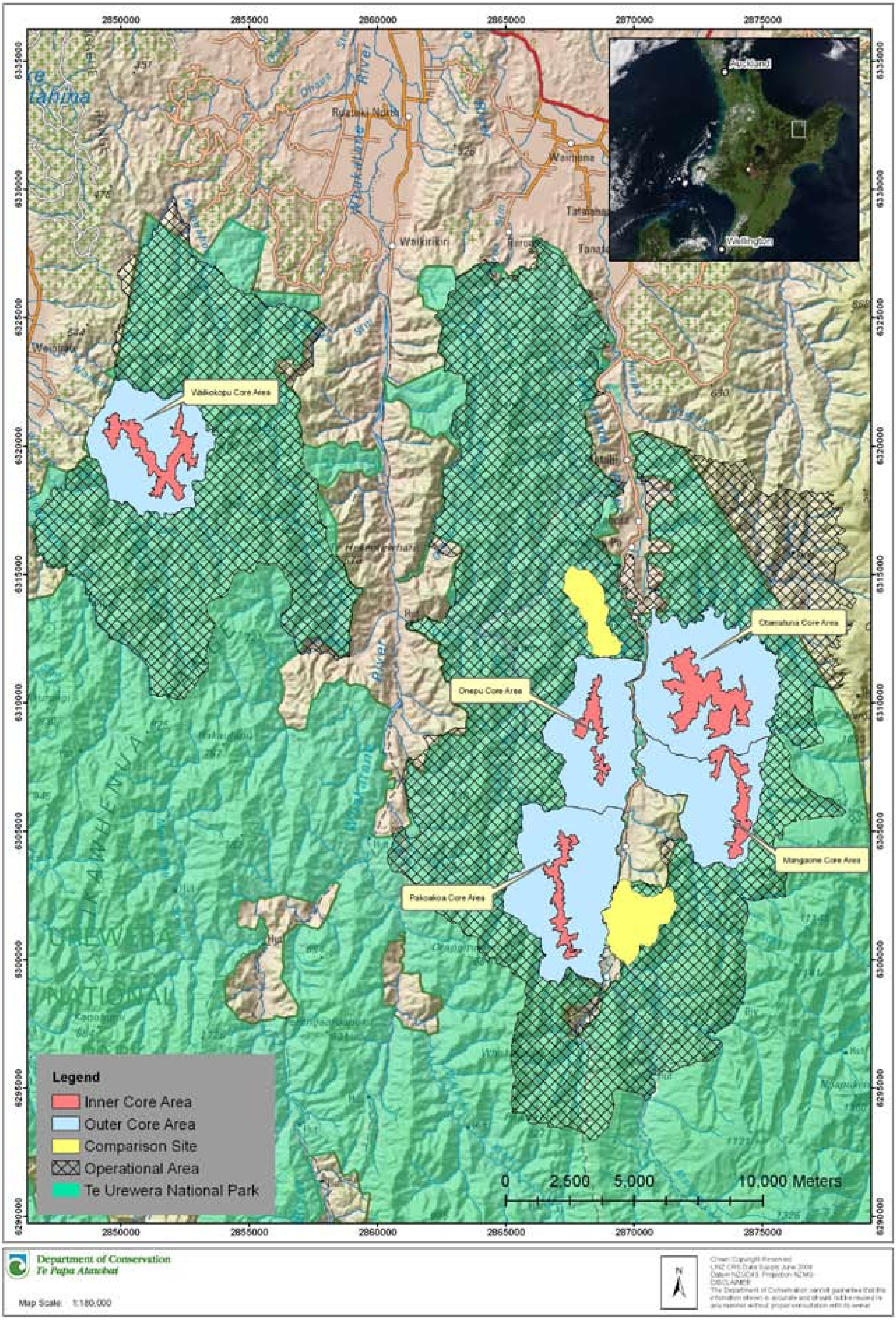

Figure 1.1 Location and overview of Te Urewera Mainland, 2008/09

Within Te Urewera Mainland Island, the restoration of ecosystems and ecosystem processes is principally achieved by mitigating the 'threats' posed by introduced mammals (pests) that are widespread throughout the forest habitat. In northern Te Urewera the animal pests of greatest concern are the brush-tailed possum (*Trichosurus vulpecula*), the ship rat (*Rattus rattus*), the red deer (*Cervus elaphus scoticus*), and the stoat (*Mustela erminea*). Feral cats (*Felis catus*), feral dogs (*Canis familiaris*) and pigs (*Sus scrofa*) are also present and can have significant ecological impacts.

Effective ecosystem restoration in this project requires ongoing, intensive and targeted control of key animal pests. Consequently, much of the management effort within the project is directed at controlling animal pests and monitoring the outcomes of pest control on components of the ecosystem. It is through the manipulation or 'testing' of our management actions that we learn how to improve our effectiveness and capability for ecological restoration.

Two comparison sites (Okopeka and Orouamananui) have been established where particular aspects of interest (e.g. rat abundance, possum abundance, mistletoe health) can be compared between areas of treatment (Background Area and Core Areas) and non-treatment (comparison) sites.

2.0 Management Approach and Terminology

Over the first 12 years of the project, the initial concepts and actions proposed in the first strategic plan (Shaw et al. 1996) have evolved into an approach that is termed the *Background Area / Core Area* concept. Here, more intensive pest control is undertaken in Core Areas and habitat enhancement through possum control is carried out in the larger Background Area (see below).

Previous management decisions within Te Urewera Mainland Island have brought us to the point where we are now focused on using traps as the principal animal pest control mechanism, although hunting and some toxins are also used. Pest control is therefore ground-based and together with the mainly-trapping style highlights a significant **point of difference** between this project and others where regimes such as broad-scale aerial 1080 operations or anti-coagulant bait station regimes are often used. Further, the management approach sits within the mandate of the Mainland Island to learn about how to restore ecosystems where the costs and benefits may be compared to other methods.

2.1 THE 'BACKGROUND AREA / CORE AREA' CONCEPT

At the outset of the project, it was clear that it would be beyond practical and financial resources to achieve restoration of 50 000 ha in one initiative. Restoration must therefore be undertaken strategically, in an integrated, incremental and synergistic manner where the outcomes can add to our knowledge of ecological values, processes and relationships as the project progresses. The knowledge gained can then be applied in a practical, cost-effective manner to achieve restoration of a much larger area. The stated intention was 'to start small…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 learning aspect of Mainland Islands would be expressed through the development and testing of intensive and multi-pest control regimes within small defined study areas (called Core Areas). Within Core Areas, as well as the learning outcomes, it was expected that there would be significant conservation gains. Concurrently, possum control would be carried out across the remainder of the 50 000 ha area (termed the Background Area) for the purpose of enhancing forest/habitat condition in an attempt to 'hold the line' on biodiversity loss.

As management techniques develop, the long-term intention is to have a matrix of Core Areas within a Background Area encompassing the northern Te Urewera landscape and beyond, allowing for the conservation of both individual species and the ecosystem as a whole. The locations of current Core Areas and the boundary of the Background Area are shown in Figure 1.1 and a schematic representation of the Core Area concept is shown in Figure 2.1. This figure illustrates the large-scale application and benefits of the approach: here, layers of smaller but increasingly intensive management effort are shown to be nested within larger areas of management effort where *beneficial interaction* can occur between the sites. Intensive pest control in Core Areas will have an *area of benefit* for certain native fauna extending beyond the boundaries of pest control, and this will complement the benefits gained from Background Area pest control. The area of benefit is characterised by the dispersal of species into areas with low level or no pest control where some successful reproduction may occur. Beneficial interaction is characterised by the dispersal of species between intensively-managed sites, allowing for genetic transfer and population continuity.

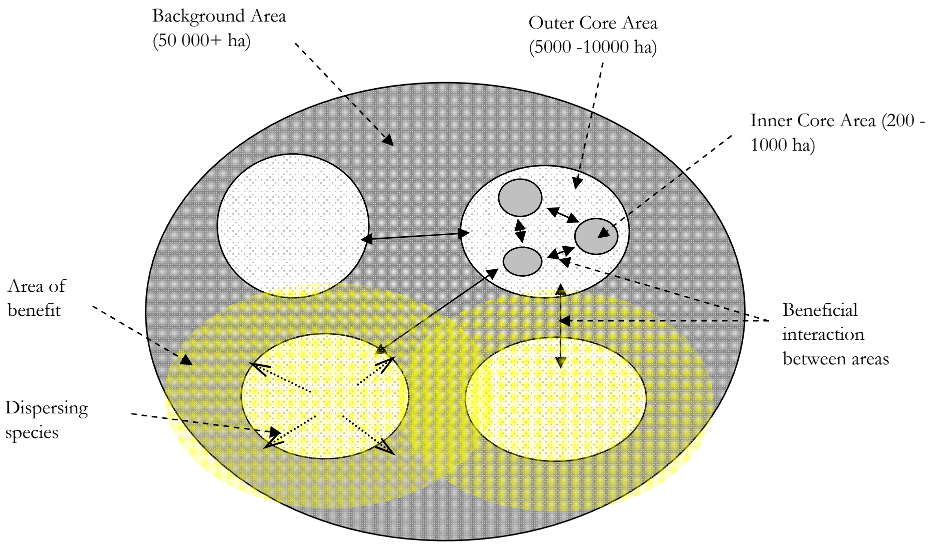

Figure 2.1

Schematic representation of the Background Area / Core Area Management Approach for Te Urewera Mainland Island

2.2 MANAGEMENT CONCEPTS AND TERMINOLOGY

To help gauge the effects of management on pest animals and native species, two *comparison areas* have been used within TUMI. 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. Oruamananui 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. Oruamananui was established in 2000/01 as a comparison site for kokako nesting success monitoring and was used as a comparison site for distance-sampling bird counts. Non-treatment rat monitoring is usually undertaken here several times per season. The area containing the rat monitoring lines is indicated in Figure 1.1.

A Core Area is defined as being the extent of the area where intensive animal pest control of some kind is undertaken. In the past this area was largely determined by the outermost stoat control lines; however, in recent years *annual* possum control (compared to >1 year control) has been undertaken over an increasingly larger area. Therefore, the boundaries of Core Areas have changed to reflect this and now encompass these areas. Further, due to differing and evolving management regimes within Core Areas, control regimes for *different pest species* within Core Areas do not necessarily encompass the same area. The obvious example is rat control which is undertaken on smaller scales than stoat, deer and possum control; the area where rat control is undertaken is termed the *Inner Core Area*. In comparison, stoat and possum control, which is undertaken in all five Core Areas, requires a broad scale approach. Often, the extent of Core Area possum and stoat control is aligned; however, this is not always the case. As above, the Core Area boundary is set by the *outermost* limit of intensive pest control. The area contained within the Core Area boundary but outside of the Inner Core (rat control area) is termed the *Outer Core*.

Topographically, the current Inner Core Areas are situated around higher-altitude ridge systems, including adjacent side-spurs (rather than valley and stream floors). Most intensive pest control work is undertaken on marked tracks that run along the main ridges and spurs, and along sidle or contour lines. These sidle lines generally run parallel to other trap lines with the first sidle line below the ridge and spur tracks termed the *A-Line*; the second (below the A-Line) called the *B-Line*, and so on. Currently, the most developed Core Area, Otamatuna, (mostly) 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- (etc.) Line concepts.

Currently, there are five Core Areas located within TUMI 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 within the project, including the types of pest control and monitoring undertaken this season.

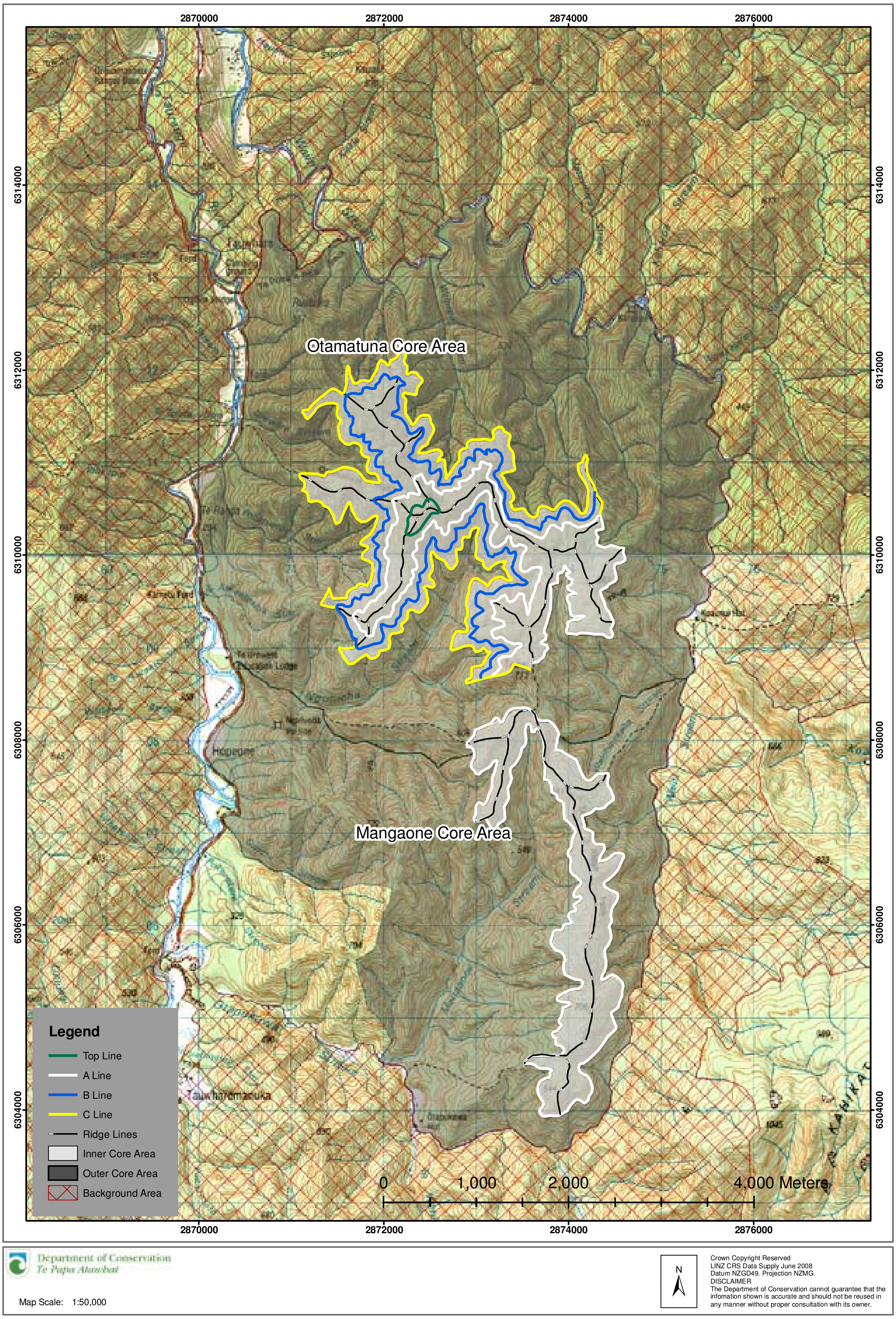

Figure 2.2 Overview of the Otamatuna and Mangaone Core Areas (Te Urewera Mainland Island) showing Inner and Outer Cores, Ridge, A-, B-, and C-Lines, and Background Area, 2008/09

Table 2.1 Management practices, and characteristics of management areas within Te Urewera Mainland Island, 2008/09

	Management Area							
	Otamatuna	Mangaone	Onepu	Waikokopu	Pakoakoa	Okopeka	Orouamananui	Background Area
Total Area (ha)	2494	1543	1666	1862	2340	c. 300	-	c. 40 000
Inner Core (ha)	557	232	179	375	212	-	-	-
Outer Core (ha)	1937	1311	1487	1487	2128	-	-	-
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 (in Inner Core)	A(B)-Line (in Inner Core)	A-Line (in Inner Core)	Non-treatment	Background Reference	Background Area
Animal Pest Control								
Possums	✓	✓	✓	✓	✓		✓	✓
Rats	✓	✓	✓	✓	✓			
Stoats	✓	✓	✓	✓	✓			
Deer	✓							
Cats	✓	✓						
Dogs	✓	✓						
Pigs	✓							
Animal Pest Monitoring								
Possums	✓	✓	✓	✓	✓	✓		✓
Rats	✓	✓	✓	✓	✓		✓	
Deer	✓		✓					✓
Outcome Monitoring								
Kokako				✓	✓			
Kiwi	✓	✓						
Whio	✓	✓						✓
Mistletoe	✓				✓	✓	✓	✓
Canopy condition	✓					✓		✓
Understorey	✓		✓					
5-minute bird counts								
Rata condition								
Long-tailed Bats								

3.0 Project Management and Research

3.1 ANNUAL REVIEW

In October 2008, Te Urewera Mainland Island was selected as one of the Top 25 Ecological Restoration projects in Australasia by the Global Restoration Network (see Australasia's top 25 restoration projects). The inclusion of TUMI underlines both the significance of the place (ecologically) and the management efforts being made here, particularly in regard to the role of the project as a learning site and the large-scale management approach.

The field components of the Outcome Based Investment projects (see Section 3.4) undertaken in conjunction with Landcare Research were initiated this year with seed fall traps and a climate station installed in the Otamatuna Core Area. Other outcomes associated with the projects are being derived from other work done within TUMI and another Intermediate Outcome project is being undertaken in the project operational area. The gathering of environmental information (such as climate data and seeding effort) in conjunction with the management outcomes should enable better understanding for ecosystem management both within TUMI and elsewhere.

One of the key challenges for learning through research-by-management is being able to manage the operations so that data can be collected consistently. For example, poor performances from contractors or contractor availability can significantly affect the outcomes of pest control operations. This season, attempts to include more local labour in pest control operations (particularly stoat control) met with mixed results. Although there were gains in aspects such as community relations, standards in ecosystem protection and learning outcomes were reduced (although not significantly).

There has been increased focus on the protection and recovery of whio over the past two seasons. This, in part, has been facilitated by the appointment of one of the key project staff members (Andrew Glaser, Programme Manager (Biodiversity Assets)) into the role of Recovery Group Leader role and the development of a revised Whio Recovery Plan. In addition the use of close-order monitoring using transmitters (and the use of video cameras over the previous two seasons) has improved the understanding of the threats to whio in the forests and waterways of northern Te Urewera. TUMI is now regarded as one of the eight national 'security sites' for whio protection and emphasises the value as this site as an important 'place' for ecosystem restoration and learning.

Pest control effort is still very much focused on reducing the threats from possums, rats and stoats, particularly in Core Areas. Understanding the long-term impacts of deer and knowing how to manage them effectively also remains a high priority, while the challenge of managing cats, dogs and pigs is coming more to the forefront.

Improving rat control has been a significant focus this season, particularly through reducing the interference of pigs (and to a lesser extent possums) on rat traps. In general the strategy of using Feracol® as an agent to reduce populations to low levels and then use a trapping network to maintain those low levels is working well.

The direction for control of possums over the past several seasons has been consolidated with the focus this season being on meeting management targets in Core Areas. This has largely been achieved by the continued development of kill trap regimes using 'Sentinel' traps leading to effective methods for controlling possums annually over nearly 10 000 ha.

3.2 LOOKING FORWARD

The last day of this reporting period, 30 June 2009, was the final day of the administrative structure under which the project has been managed for most of its duration. As of 1 July 2009, the East Coast Hawke's Bay Conservancy was disbanded with part of the Conservancy going to each of the Wellington and Bay of Plenty Conservancies. The project operational area now falls under the jurisdiction of Te Urewera Area Office based at Murupara within the new East Coast Bay of Plenty Conservancy administered from Rotorua. The majority of project staff remain based in an office in Opotiki, sharing space with staff from the new Gisborne Whakatane Area Office.

As well as the internal Departmental changes, there are potentially significant changes in the way the current Te Urewera National Park is managed. Ngai Tuhoe iwi are currently in negotiation with the Crown to reach a settlement regarding historical injustices. Future management of the area in which the project is set will inevitably be in conjunction with Tuhoe in some form. It is uncertain at this stage what this will mean for the project, however it is anticipated that much of the work currently being done will continue, and increased emphasis will be placed on interacting with Tuhoe including fostering local involvement. The nature of the Department's relationship with Tuhoe will be vital to the long-term continuance of the project.

There is a strong desire to maintain the project as a learning site (compared to a project focused on ecosystem restoration). Learning is the principal point of difference between Mainland Islands and other projects; specific resources are put into activities where the main objective is to improve conservation knowledge and practices. Underscoring the value of learning both to internal as well as external stakeholders will be key to achieving this.

Linked to the issues mentioned above is the need to improve the holistic management of the project. A completed strategic plan should serve as a foundation document to improve both the planning environment and to meet new needs (in particular, interaction with Tuhoe). Management of other Mainland Islands (Trounson, Boundary Stream and Rotoiti) incorporates a Strategic Advisory Group and a Technical Advisory Group, and these have been proposed for TUMI in the draft strategic plan. Probably out of all Mainland Island projects, TUMI is the most complex, particularly in terms of its scale, the number of work sites and the type of work being undertaken (in particular, the trapping approach). With the anticipated need to work with Tuhoe, there will have to be mechanisms put in place to achieve this. It is clear that some co-ordinating and oversight groups are needed to ensure that the project Vision and Goals (set down in the draft strategy) are being met.

As mentioned in the previous section, the potential of the use of possum kill traps to achieve our conservation goals more efficiently than previously, offers exciting opportunities in the coming years. Establishing more areas under kill trap regimes will enable both our learning and conservation objectives to be met. In 2009/10, trials examining kill trap regimes will be undertaken to learn exactly what level of management is needed to achieve our targets. Beyond this, the intention is to establish regimes over larger amounts of the Background Area as funding permits.

Where Background Area possum control is undertaken another aspect to management is also being considered: one strategy put forward is to form a corridor of control from southeast to northwest across the northern Te Urewera. This corridor would link the current Core Areas accessed from the Waimana Valley through to the Whakatane River and on to the Waikokopu Core Area in the Ikawhenua Range. There would be increased effort in the Whakatane River valley, and links would be made to any other ecosystem protection work that may be established there. This strategy would fit well within the Background Area / Core Area management approach. Further, increasing the amount of work in the Whakatane River Valley should enhance opportunities for local employment.

Establishing kill trap regimes for possums links strongly into other outcomes we are trying to achieve. In particular, there are obvious synergies with using the same trap lines for both possum and stoat traps. For example, stoat trapping is necessary to secure whio in the northern Te Urewera, but because of the extended nature of riverine habitat, and wide-ranging nature of stoats, adequate protection of whio requires stoat trapping over a large area. Trapping both possums and stoats (with different traps) on the same lines will enable us to achieve increased conservation outcomes (for the same costs) than by doing these tasks separately. As TUMI has been labelled one of eight national security sites for whio, finding means to achieve security is of high priority.

Also looming close on the horizon is the introduction of new technologies. TUMI will be used as a test site for a multiple-kill trap (for stoats and rats) which has potential to also reduce costs, or in other words, again, increase conservation outcomes for the same costs.

As above (Section 3.1), the impact of pigs through rat trap interference continues to be of concern. The two obvious strategies are to either construct a rat trap set capable of excluding pigs from interference, or to remove pigs from the area of concern. Both have their merits, and generally for conservation managers it is a question of available resources to achieve either end, or even both. As an introduced mammal pigs have an effect on the integrity of natural ecosystems, although arguably not as significantly as other introduced mammals such as rats, possums and stoats. Within this project, reducing and maintaining rat abundances at low levels is a high priority and work will continue to go into developing a pig-proof rat trap. Pig control is still deemed necessary and more work will be done on developing methods for control that are both effective and sustainable. In particular, working with tangata whenua (who view pigs as a resource) will be key to achieving that goal.

The mainly-trapping approach will be maintained within the project over the short to medium term, and we will continue to examine trap types and means of using trapping as an effective conservation methodology. There are clear benefits, not just for other managers within DOC, but particularly with community groups where the use of toxins may not be as acceptable or even suitable (for example for stoat control). In 2009/10 a trial comparing catch rates of single- and double-set DOC200s will improve knowledge for stoat control, as previous trials conducted here have done.

3.3 ADMINISTRATION

Department of Conservation staff and contractors involved in the project are listed in Tables 3.3.1 and 3.3.2.

Table 3.3.1 Key Department of Conservation staff involved in Te Urewera Mainland Island, 2008/09

Opotiki Area Office	
Fiona Hennessy	Area Manager (acting)
Mark Davies	Area Manager (acting)
Andy Bassett	Area Manager (acting)
Rhonda Sauer	Ranger, Business Services
Moana Smith-Dunlop	Ranger, Business Services (part)
Andrew Glaser	Programme Manager, Biodiversity Assets
Hemi Barsdell	Ranger, Biodiversity Assets
Jane Haxton	Ranger, Biodiversity Assets
Cody Thyne	Ranger, Biodiversity Assets
Greg Moorcroft	Ranger, Biodiversity Assets
Lindsay Wilson	Programme Manager, Biodiversity Threats
Daniel Baigent	Ranger, Biodiversity Threats
Shane Gebert	Ranger, Biodiversity Threats
Pete Livingstone	Ranger, Biodiversity Threats
Anastacia Kirk	Ranger, Biodiversity Threats
Lisa Loughlin	Ranger, Community Relations & Visitor Assets
Dennis Rutter	Ranger, Visitor Assets
East Coast Hawke's Bay Conservancy Office, Gisborne	
Kerry Hogan	Conservation Support Manager
Chris Ward	Conservancy Advisory Scientist
Dave Carlton	Technical Support Officer, Threats
Rhys Burns	Technical Support Officer, Fauna
Research and Development Division	
Craig Gillies	Scientific Officer
Darren Peters	National Predator Officer
Elaine Wright	Terrestrial Sites Manager

Table 3.3.2 Contractors and temporary staff employed by the Department of Conservation in Te Urewera Mainland Island, 2008/09

Name	Key task
Wayne Looney	Contracted deer hunter
Jason Healy	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
Lenny Sparks	Core area pest control
Ian (Jinx) Te Pou	Core area pest control
Grant Jones	Possum control contractor
Kevin Marsden	Possum control contractor
Andy Marsden	Possum control contractor
Keith Rogers	Temporary worker (Visitor Assets)
Mana Gemmel	Temporary worker (Visitor Assets)
James Conway	Temporary worker (Biodiversity)
Tim Allerby	Temporary worker (Biodiversity)

3.4 RESEARCH

This section is a summary of research projects undertaken within TUMI 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 DOC investigations that have gone through a particular review process, and also investigations that were undertaken in conjunction with other agencies (where the level of Departmental involvement varies). 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	Efficacy of DOC 200 versus Mk 6 Fenn traps at catching stoats (Onepu Core Area)
Researcher	DOC (Field trial) Lindsay Wilson, Craig Gillies, Darren Peters
Study Period	1 September 2004 – 30 April 2007
Summary	The relative efficacy of single set DOC200 traps (in wooden tunnels) to that of single set Fenn traps (in wooden tunnels) at catching stoats (*Mustela erminea*) was tested. 173 of each trap type were set alternately every 100m along trap lines at Onepu Core Area in the Northern Te Urewera Mainland Island. 146 stoats were caught in the DOC200 traps and 90 in the Fenn traps between September 2004 and April 2007. The proportion of DOC200 traps that caught a stoat, or stoats, was significantly greater than the proportion of Fenn traps that caught a stoat, or stoats. It was recommended that practitioners should consider the DOC200 as an effective alternative to the Fenn Mk 6 trap.
Report Section(s)	4.4
Reference Documents & Files	OLDDM-767156 DOC 200 vs Mk 6 Fenn Trap at Te Urewera OLDDM-147264 Northern Te Urewera Trap Trial (data) DOCDM-239920-OPOWAC Onepu DOC200vFennMk6 trial FINAL report [Report Title: Animal Pest Field Trial Report for the efficacy of single set DOC200 traps versus single set Fenn Mk 6 traps set in wooden tunnels in the Te Urewera Mainland Island]

Investigation Title	Quantify gains in natural character from 'extensive' possum control
Researcher	Landcare Research (Caroline Thompson)
Study Period	2004 – 2010
Summary	Study compares condition (tree mortality and growth rates) of conservation assets (forest trees) that have been subject to infrequent (4 – 7 years) or no possum control. In May 2006, 13 lines (108 plots) were established in Te Kaharoa region where possum control is undertaken, and 16 lines (101 plots) were established in the Waiotahi Valley (no possum control). Tawa, kamahi (possum palatable) and rewarewa (non-palatable) were marked and scored within these plots. Trees will be re-measured after a four-year period.
Report Section(s)	4.2
Reference Documents & Files	Landcare Investigation number 3670

Investigation Title	Outcome-Based Investments (OBI)
Researcher	Landcare Research in collaboration with DOC and others
Study Period	Eight to 12 years from 2007

Summary

OBIs are long-term science funding investments by FRST and partner organisations. There are three outcome-based investment headings:

1. Defining New Zealand's Land Biota
2. Ecosystem Resilience
3. Sustaining & restoring biodiversity

Within each OBI there are a series of intermediated outcomes (IOs). TUMI is being used as a study site for two IOs in the Ecosystem Resilience OBI:

IO1: Reducing threats to forest ecosystem processes (protecting biodiversity);

IO2: Reducing threats to forest ecosystem processes (prioritising pest control).

Under IO1, two projects have been initiated gathering information on: forest dynamics through seed fall monitoring; and the local climate. Sixty five seed fall traps targeting 7 species (Hall's totara, supplejack, rimu, miro, red beech, tawa and hinau) were placed in the Otamatuna Core Area 20-23 May 2008. Seeds will be collected quarterly and sent to Canterbury University (under contract) for counting. In July 2009, in association with NIWA, a climate station was installed at Te Mapou hut in the Otamatuna Core Area. The station measures wind speed and direction, rainfall, temperature, relative humidity, solar radiation and barometric pressure.

Information from Mainland Islands, including TUMI, is being used to inform on IO3 'Increase effectiveness of conservation flagships' in the Sustaining and Restoring Biodiversity OBI. In particular, as part of a suite of 'iconic' species, kokako populations will be monitored to best understand ways to increase the effectiveness of this recovery and novel methods for establishing new populations.

In addition, the southern part of the TUMI operational area is being used as a study site for multi-pest dynamics project under the IO2 listed above.

Report Section(s)	No other sections in this report refer to seed traps and the climate station. Monitoring of kokako is reported on in Section 5.2.
Reference Documents & Files	http://www.landcareresearch.co.nz/research/collab_initiatives.asp

4.0 Animal Pest Control

4.1 INTRODUCTION

The control of animal pests is the principal means of achieving ecosystem restoration within Te Urewera Mainland Island and also the area in which most learning is achieved. Currently, the animals targeted are possums, rats, stoats, deer, cats, pigs and dogs. 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 hectares. In contrast, rats are managed on much smaller scales, c.200 – 600 hectares in areas within high-value biodiversity sites. Deer and stoats are managed on intermediate scales (c. 1200 ha – c. 4000 ha). 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 and achieve synergistic effects.

Within TUMI, 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 that are currently based around higher-altitude areas, i.e. main ridgelines and associated spurs. Outer Core Areas are usually bounded by the limit of annual possum control. These boundaries are defined by topographical features, particularly waterways, or tracks (including roads). For further information on the terms used, see Section 2.2. Currently, Core Areas cover 9905 hectares.

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. Annual possum control in Core Areas was done over 9905 hectares; stoat control was undertaken in all Core Areas over 7851 hectares; rat control work was undertaken in all the Core Areas and encompassed 1555 hectares; deer control was done only within the Otamatuna Core Area (2494 ha); and lower-intensity control for cats and dogs occurred in the adjacent Otamatuna and Mangaone Core Areas (4037 ha). Low level pig control was undertaken in the Otamatuna Core Area.

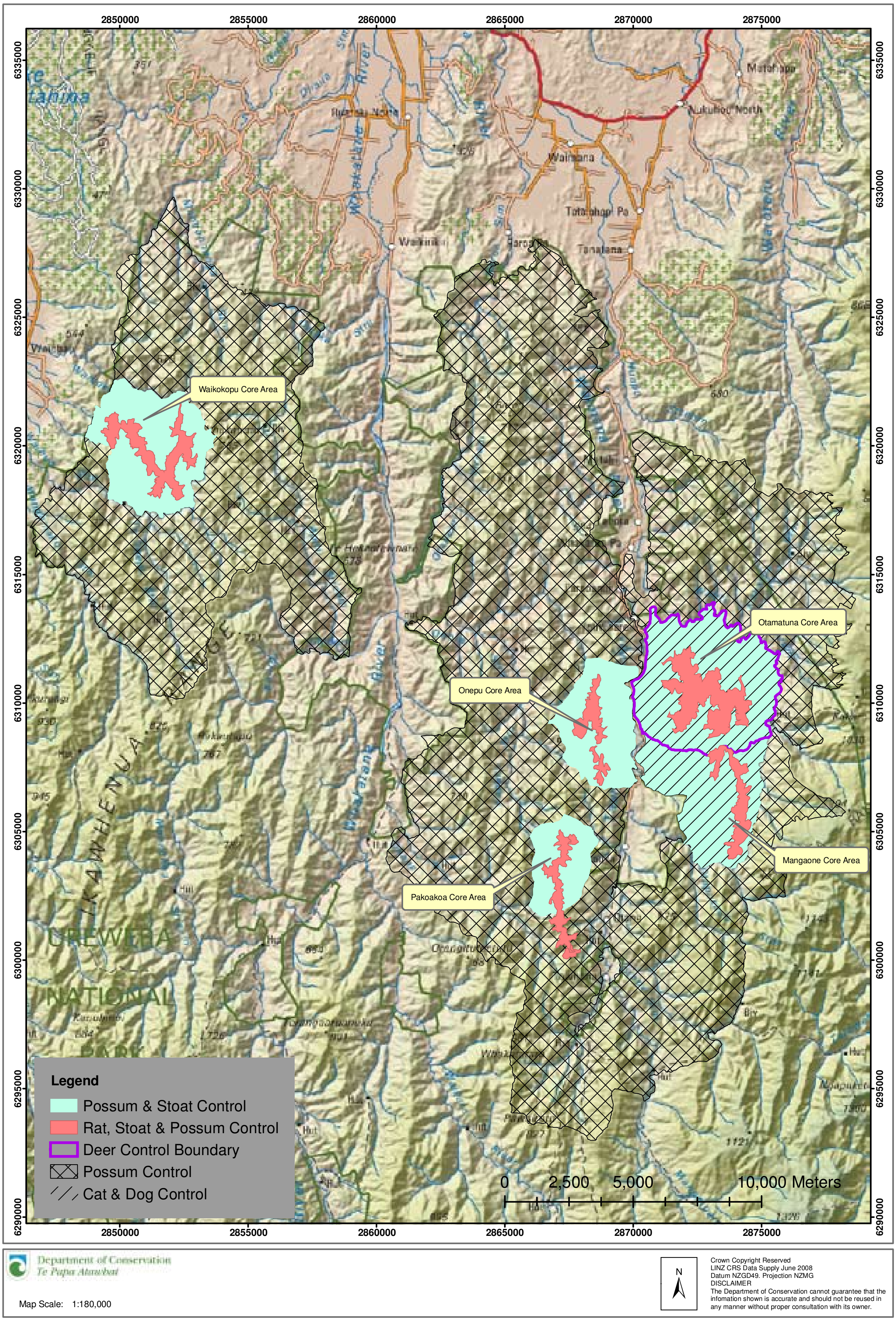

Figure 4.1.1 Overview of pest control within the Te Urewera Mainland Island showing areas of possum, rat, stoat, deer, cat and dog control, Core Areas and management comparison sites, 2008/09

4.2 POSSUMS (DAN BAIGENT, ANASTACIA KIRK AND GREG MOORCROFT)

4.2.1 Introduction

Possum control is central to ecosystem restoration in northern Te Urewera and is generally undertaken within two types of areas: *Background Area* and *Core Areas* (see Section 2.0). More intensive management of pest animals (including annual possum control) is undertaken in Core Areas while blocks for possum control in the Background Area are generally managed on a greater than one year rotation.

Core Areas were previously managed with a variety of toxins placed in bait stations, such as brodifacoum, Pindone, cholecalciferol and cyanide. Since 2000/01, the only toxins applied have been cyanide and cholecalciferol, thereby eliminating the use of persistent toxins in the local environment.

In recent years, the testing of kill-trap regimes has shown that these traps are comparable to leg-hold trapping for achieving conservation outcomes and over the longer term are more cost-effective. Kill trap networks have now been established in all five Core Areas.

Previously within the Background Area (40 095 ha) (= project operational area (50 000 ha) less the Core Areas) the principal means of control was the use of leg-hold (i.e. live) trapping undertaken by contractors. In recent years more emphasis has been placed on possum control in Core Areas thereby decreasing the amount of area controlled in the Background Area. However, as in Core Areas, use of kill traps (and potentially other trap types) will likely enable a greater proportion of the Background Area to be managed in the future.

Conservation outcomes of the possum control programme are assessed using the Foliar Browse Index method (Payton et al. 1997) to measure canopy condition (Section 5.7), and by monitoring the condition of two mistletoe species, *Peraxilla tetrapetala* and *Alepis flavida* (Section 5.5). Nest monitoring and population censuses of kokako (*Callaeas cinerea wilsoni*) have also been undertaken within Core Areas to gauge the effectiveness of combined possum, rat (*Rattus rattus*) and stoat (*Mustela erminea*) control (Section 5.2).

4.2.2 Objectives

The annual objectives for possum control within TUMI were:

- To reduce possum densities within part of the Background Area to less than 5% Residual Trap Catch Index during each treatment year.
- To maintain possums in Core Areas at less than 5% Residual Trap Catch Index RTC).
- To investigate options within the Mangaone Core Area relating to cost reductions in possum control using kill traps.

4.2.3 Methods

Possums were controlled in all five Core Areas (Otamatuna, Mangaone, Onepu, Pakoakoa and Waikokopu) (9905 ha) and a small part of the Background Area (2780 ha), a total of 11350 hectares (Figure 4.2.1).

All five Core Areas have a network of 'Sentinel' kill traps (Pest Control Research, Christchurch, New Zealand), and are divided into Inner Core (the extent of rat control) and Outer Core Areas.

Possums in Otamatuna, Pakoakoa, Onepu and Waikokopu Core Areas were controlled by contractors on performance-based contracts, while workers at Mangaone worked under a prescriptive contract (see below).

The preference in those Core Areas managed under performance-based contracts is to reduce possum numbers to below 5% RTC before November of each year to enhance breeding success of kokako and other forest birds.

The effectiveness of possum management is assessed using the Residual Trap Catch Index (RTC).

Within the five Core Areas there are a total of 29 blocks that range in size from 178 ha to 449 ha with an average size of 341 ha. The arrangement of blocks and further control methods (if appropriate) in each of the Core Areas is listed below:

Otamatuna

- Otamatuna Core Area (2494 ha) (7 blocks total) is split into the Inner Core (557 ha) and Outer Core (1937 ha) Areas. The Inner Core is split into two blocks, East (284 ha) and West (273 ha).
- The Outer Core is split into five blocks: Otamatuna Outer Core 1 (389 ha), Otamatuna Outer Core 2 (365 ha), Otamatuna Outer Core 3 (399 ha), Otamatuna Outer Core 4 (399 ha) and Otamatuna Outer Core 5 (385 ha).

Onepu

- Onepu Core Area (1666 ha) (5 blocks total) is split into the Inner Core (179 ha) and Outer Core (1487 ha) Areas.
- The Outer Core is further split into four blocks: Onepu Outer Core 1 (349 ha), Onepu Outer Core 2 (361 ha), Onepu Outer Core 3 (377 ha) and Onepu Outer Core 4 (400 ha).

Mangaone

- Mangaone Core Area (1543) (5 blocks total) is divided into the Inner Core (232 ha) and Outer Core (1311 ha) Areas.
- There are four blocks in the Outer Core: Mangaone Outer Core 1 (199 ha), Mangaone Outer Core 2 (396 ha), Mangaone Outer Core 3 (319 ha) and Mangaone Outer Core 4 (397 ha).

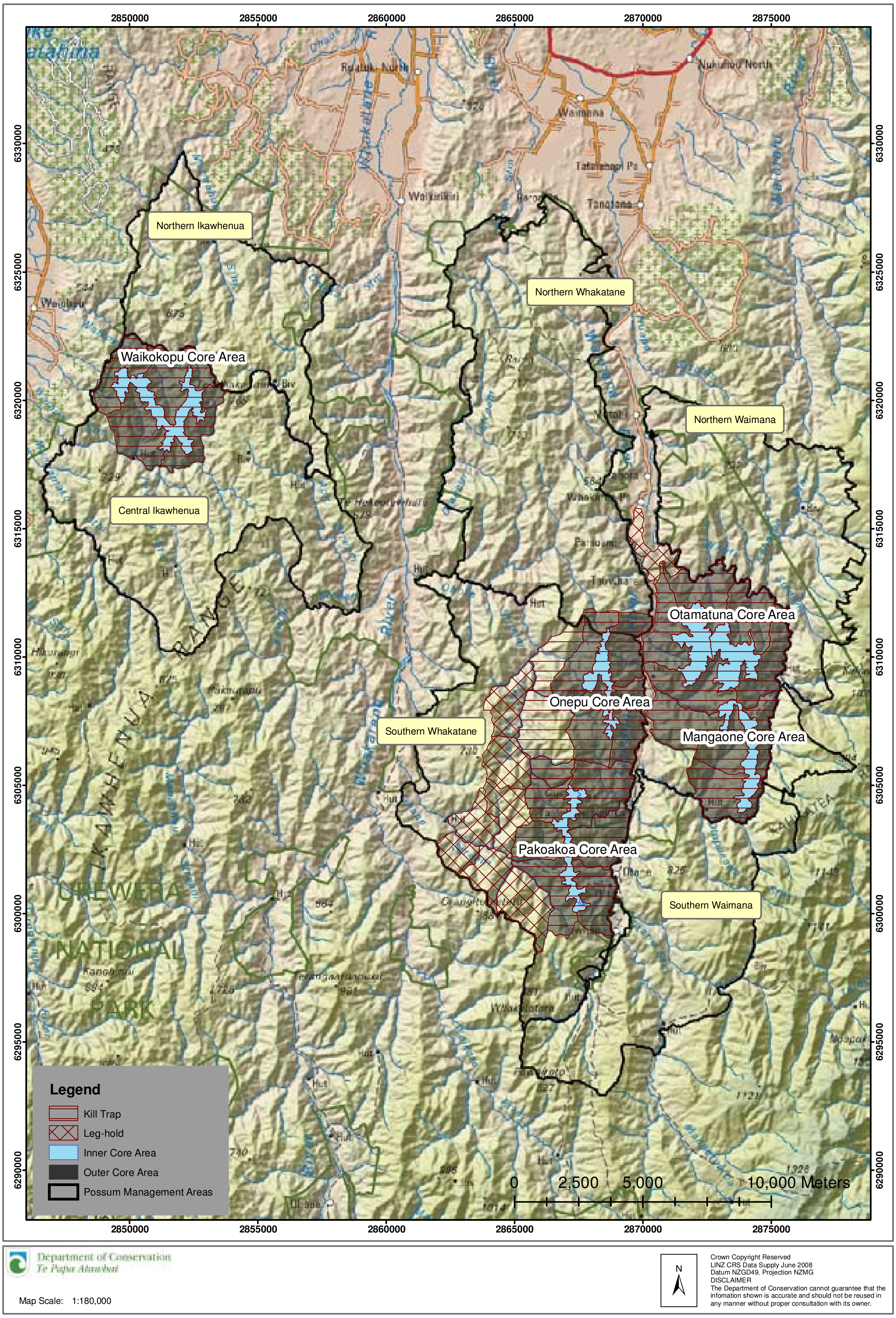

Figure 4.2.1 Areas controlled for possums, Te Urewera Mainland Island, 2008/09

- This season, both the Inner Core and Outer Core were controlled under the same contract. Sentinel possum kill traps were spaced every 75m along stoat control lines (stoat traps are spaced every 150m) (Section 4.4). Possum traps were checked and baited concurrently with the stoat trap checks; 14 checks were made throughout the season, including fortnightly checks from mid-November to mid-March (see Section 4.4).
- Traps were baited with 'Smooth-in-a-tube'® (Connovation Ltd) and the same product was used as a lure on the trunk leading up to trap and at suitable places between trap sites.

Pakoakoa

- Pakoakoa Core Area (2340 ha) (7 blocks total) is divided in to the Inner Core (212 ha) and Outer Core (2128 ha) Areas.
- There are six blocks in the Outer Core: Pakoakoa Outer Core 1 (443 ha), Pakoakoa Outer Core 2 (381 ha), Pakoakoa Outer Core 3 (338 ha), Pakoakoa Outer Core 4 (338 ha), Pakoakoa Outer Core 5 (258) and Pakoakoa Outer Core 6 (370 ha).

Waikokopu

- Waikokopu Core Area (1862 ha) (5 blocks total) is divided up into the Inner Core (375 ha) and Outer Core (1487 ha) Areas.
- The Outer Core Area is further divided into four blocks: Waikokopu Outer Core 1 (449 ha), Waikokopu Outer Core 2 (299 ha), Waikokopu Outer Core 3 (424 ha) and Waikokopu Outer Core 4 (315 ha).

Background Area

- The Background Area (40 095 ha) is divided up into six management areas: Northern and Central Ikawhenua, Northern and Southern Whakatane and Northern and Southern Waimana. Each of these management areas is divided into clusters which are further divided into blocks which are the basic management units for possum control.
- Possum control in the Background Area was achieved by letting contracts for particular blocks. These contracts were tendered for by interested parties which were scored under particular criteria. Contractors were given performance targets (less than 5% Residual Trap Catch index) and were limited to particular types of trap and toxins (cyanide paste or pellets and Feratox® (Connovation Ltd)).
- At the start of the season the goal was to control possums over 4051 ha: blocks 3-8, 15, 17-19, 21-22 in the Southern Whakatane Area (3651 ha in total); Block 12 in Northern Whakatane (400 ha); and Block 0 in Northern Waimana (211 ha). Two adjoining blocks (one each in Northern (Block 14) and Central (Block 12) Ikawhenua) totally an additional 560 hectares were labelled as possibilities for control, contingent upon external funding.

4.2.4 Results

Of the planned 13 956 hectares to be controlled, by the end of the year, 11 350 hectares were managed for possums: 9905 hectares in Core Areas and 2780 hectares in the Background Area. Blocks 3 – 5 in the Southern Whakatane Area, and Block 12 in Northern Whakatane were not controlled. No external funding was obtained, so Block 14 in Northern Ikawhenua and Block 12 in Central Ikawhenua were also not controlled.

All the blocks in the Core Areas, including Inner and Outer Core Areas were controlled, however two of the 23 blocks were not assessed (i.e. no RTC monitoring was completed) (see Appendix 9.2). Figure 4.2.1 indicates where possum control was undertaken this season.

The mean RTC was 3.1% over all the Core Areas and 3.5% over all the blocks in the Background Area. Mean RTC figures for each Core Area and each Background Area Management Area are given in Table 4.2.1.

The mean RTC in Inner Core Areas was 1.9% over the six blocks (Appendix 9.2).

The mean RTC in the Outer Core Areas was 3.4%. Of the 20 blocks monitored, the results in six were above the target of 5% (maximum 8.8%; Appendix 9.2).

The total number of possums trapped from all blocks was approximately 3500.

From the 14 rounds of stoat trap checks done in Mangaone, 739 possums were removed from the Sentinel kill traps. RTC index monitors were done at the end of September for one of the two Inner Core blocks and in June for the two of the four Outer Core blocks that were done (Table 4.2.1 and Appendix 9.2).

Table 4.2.1 Mean Residual Trap Catch indices (RTC) following possum control in Te Urewera Mainland Island, 20008/09

Area Type	Area Name	Mean RTC
Background Area	Northern Waimana	0.0
	Southern Whakatane	3.9
Core Area	Mangaone	4.9
	Onepu	2.1
	Otamatuna	2.4
	Pakoakoa	3.9
	Waikokopu	2.7

4.2.5 Discussion

The temporary shift in emphasis from Background Area to Core Area possum control over the past several years (Sections 3.1 and 3.2) continued this year. The majority of possum control was conducted in Core Areas and most performance targets were achieved. This has allowed the understanding behind kill trapping for possums to continue in TUMI's priority areas, where in the future these learnings can be applied to both the Background Area of TUMI and potentially other projects interested in using this technique.

The use of kill traps as the principal control method for possums represents a significant change from two years ago when the use of leg-hold traps was the predominant method. Kill-trapping performance has been and continues to be tested under either prescriptive or performance contracts in the Mangaone, Otamatuna, Pakoakoa and Onepu Core Areas. Within Waikokopu it has been tested using both techniques, first prescriptive then performance. It is clear that kill trapping for possums has significant advantages over leg hold trapping (e.g. less skill is required; see comment below) and although many questions have been answered, we do not yet have enough information establish a comprehensive prescription for possum control using kill-traps in this forest type.

Within the Mangaone Core Area, the possum management regime focused on lowering contractor costs by aligning the setup of kill traps with stoat control (i.e. possum traps were set out along stoat control lines). This arrangement meant that there were lower trap densities in the Outer Core Area (approximately 0.4 trap/ha at Mangaone compared with >0.7 trap/ha in other Core Areas). However, the management regime at Mangaone was setup in this manner so we could better understand the timelines involved in reducing possum numbers using different trap densities and comparing costs between the differing regimes. To allow for many variables in the learning process, this work was undertaken as a pilot study pre-empting an official trial, (where areas would be set-up using a prescriptive method implemented from these learnings). Specific data to date at Mangaone (after 1 year) shows a significant reduction in possum abundance. Although 5% targets were not reached in one of the two blocks monitored (the two blocks were reduced from 13.54% to 3.45% and 14.76% to 7.2%), the total cost to achieve this was approx 25% of the normal costs attributed to reducing the possum RTC to below 5% (approx $5/ha under prescriptive control for year 1 compared to $20/ha under performance control for year 1). If year two of this method realises a further reduction so that monitoring results in all blocks are below 5%, the total cost attributed would be 33% of the costs of undertaking this control on performance contract.

Other Core Areas remaining under performance contract met their targets. The key for the future is to now fine tune the methodology of kill trapping to make the prescriptive option as viable.

While factors such as baits and placement of traps are important, a key point to understand with the use of kill traps for possums (compared to using leg-hold traps) is that it generally *takes longer* to achieve the target indices and this is possibly the most important management factor to consider.

Where leg hold traps are concerned, contractors must be on site daily and when the contract is completed (usually within a short time-frame) possum numbers begin to increase again. Previously within this project due to the cost of kill trapping, budget levels and the desire to undertake possum control over a large area, possum blocks in the Background Area were not controlled each year. In these cases, a 'rollercoaster' of possum abundance eventuated, where possum numbers reached moderate to high levels before control was once again undertaken. Some ecological gains would accrue when possum abundances were low but, however the gains would be and even damage would occur as possum numbers built up. With the use of kill traps, long term results are the key focus. When possum numbers have been reduced to low levels the financial input to keep possum densities low is minimal, allowing for annual control and consistently low possum levels over time.

One contract was terminated this year and this was the primary reason that not all background blocks were controlled to below target levels.

4.2.6 Conclusions and Recommendations

Conclusions:

- Kill trapping for possums is a viable large scale control tool.
- Kill trapping should become the primary control tool for possums within TUMI.

It is recommended:

- To focus on developing a prescription for this form of kill trapping.
- That cost analysis and further research should be undertaken to examine the potential benefits for doing possum control using kill traps under prescriptive rather than performance contracts.

4.2.7 Acknowledgements

Gaye Payze and Arthur Sandom (Waimana Pest Control)

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John Yearbury

DOC staff at the Opotiki Area Office, ECHB Conservancy office, RDI and all others who helped along the way.

4.3 RATS (DAN BAIGENT)

4.3.1 Introduction

Management regimes for the 2008/09 season were generally a replication of those from the previous season, as operational targets (result monitoring) had been met and outcome monitoring results for kokako survivorship (used as an indicator species) had improved from previous years.

Following the registration of cholecalciferol (chole) as a rodenticide, it is now used as for the control of rats within TUMI project. In areas where rat control is seasonal, and compared to trapping-only regimes, there is some evidence that residual cholecalciferol (left in the field from previous operations) minimises the increase in rat density during the period in which no control is being undertaken. Pre-control monitoring within rat management areas appears to have reduced by as much as 20% compared to some years where no toxins were used.

Within TUMI, rat control has continued to be focused around socially acceptable and sustainable methods rats principally through the use of kill traps and acute toxins.

4.3.2 Objectives

- To maintain rat tracking indices at less than 5% year-round in the Otamatuna Inner Core Area.
- To maintain rat tracking indices at less than 5% during the period 1 November to 28 February (kokako breeding season) in the Onepu, Mangaone, Pakoakoa and Waikokopu Inner Core Areas.
- To assess the effectiveness of rat control techniques.
- To continue investigating the viability of cholecalciferol as a control tool to complement trapping.

4.3.3 Methods

Rat control was undertaken in the five Inner Core Areas: Otamatuna, Mangaone, Onepu, Pakoakoa and Waikokopu. Rat control at Otamatuna is year-round but seasonal at the other four sites. See below for management regimes. (See Section 2.3 for explanation of Core Area layouts).

Within TUMI, rat tunnel design has evolved from a variety of coreflute tunnels to the current best practice arrangement of wooden tunnels with either mesh or polycarbonate tunnel ends. Currently, Otamatuna, Mangaone and Onepu have wooden tunnels in place, while Pakoakoa and Waikokopu have coreflute tunnels.

Within the tunnels, 'Victor Professional', 'Ka Mate' or 'DOC200' traps were used to trap rats. Traps were spaced at either 25 or 50m intervals on all control lines.

Result monitoring using run-through tracking tunnels (Gillies and Williams 2002) was undertaken at all five sites and one comparison (non-treatment) site periodically through the year. At Otamatuna there are five lines of ten tunnels, while at the other five sites there are 10 lines with five tunnels each, meaning there are 50 tunnels in each of the areas.

Best practice rat trapping currently consists of using a Victor® Professional rat trap (Victor, USA) covered by a tunnel to guide target animals and help exclude non-target species. For trap layout and tunnel construction for the Victor Professional rat trap housed in either a wooden or coreflute tunnel, contact the Department of Conservation (DOCDM-103712).

For the purpose of this report, the following terms are defined:

Knockdown: The first *period* of control during which rat abundance indices are significantly reduced.

Initial knockdown: The first rat control undertaken during a season following an extended period with no control (usually in reference to those areas managed under seasonal control).

In total, there were 6450 traps in place at the five Core Area sites, with three types of traps under two types of tunnels used (Table 4.3.1)

Table 4.3.1 Number and type of rat traps and tunnels used in Core Areas, Te Urewera Mainland Island, 2008/09

Core Area	Victor Professional in wooden tunnel	Victor Professional in coreflute tunnel	Ka Mate in wooden tunnel	DOC200 in wooden tunnel	Total
Otamatuna	2312				**2312**
Mangaone	962			70	**1032**
Onepu	905		174		**1079**
Pakoakoa		1193			**1193**
Waikokopu		834			**834**
Total	**4179**	**2027**	**174**	**70**	**6450**

Otamatuna

- 557ha of ridge and A-, B-, and C- line control
- Traps spaced at either 25m (B- and C- lines) or 50m (ridge and A-lines) intervals
- 25 trapping rounds were undertaken at approximately two-weekly intervals
- Feracol® (Connovation Ltd) (active ingredient: cholecalciferol) used on control lines to control rats during periods where interference by pigs was reducing trapping effectiveness.

Mangaone

- 232 ha of ridge and A- line control
- Traps spaced at 25m intervals
- Feracol® used on control lines as a knockdown tool
- (Following knockdown), 11 trapping rounds at two-weekly intervals from 24 September to 11 February.

Onepu

- 178 ha of ridge and A- line control
- Traps spaced at 25m intervals
- There were 22 trapping rounds done between 19 August and 19 February (26 weeks)
- No toxins were used at this site.

Pakoakoa

- 212 ha of ridge and A- line control with 2 trapping extensions to the north and south
- Traps spaced at 25m intervals
- Feracol® used on control lines as a knockdown tool
- 13 trapping rounds between 9 September and 15 February
- Feracol® was distributed along spurs and on unmarked sidle lines in particular areas beyond the boundaries of rat control where kokako pairs have been known to nest.

Waikokopu

- 200 ha of ridge and A-, B- line control (less than in previous seasons)
- Traps spaced at 25m intervals
- Feracol® used on control lines as a knockdown tool
- 10 trapping rounds undertaken at approximately two-weekly intervals from 5 October to 2 April
- Feracol® was distributed along spurs and on unmarked sidle lines in particular areas beyond the boundaries of rat control where kokako pairs have been known to nest.

4.3.4 Results

See Appendix 9.3 for rat abundance tracking results for each of the Core Areas and Oruamananui Comparison Site.

Indices recorded at Otamatuna were below 5% for five of the six monitoring nights; the exception was an index of 6% recorded in December. In contrast, the lowest index recorded at Oruamananui was 76% in February.

Rat monitoring indices at Waikokopu and Pakoakoa Core Areas were maintained at less than 5% for the target period. Indices at Mangaone were reduced to 4% by September and maintained at less than 5% until the end of February when an 8% index was recorded.

Target indices were not maintained throughout the season at Onepu Core Area; only one index (4% in December) was recorded below 5%.

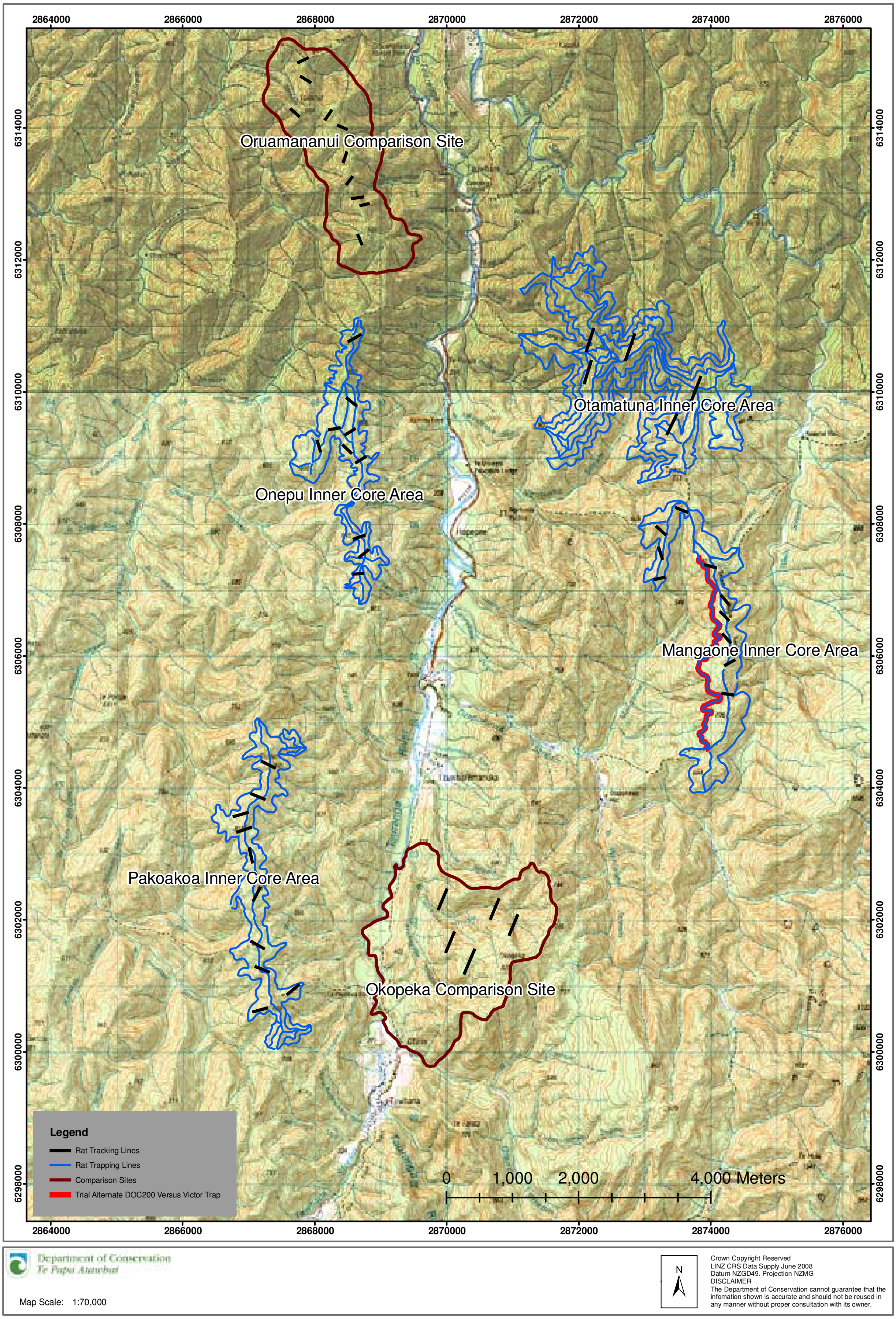


Figure 4.3.1 Location of rat control lines including trial sites and monitoring lines, in the Otamatuna, Mangaone, Onepu and Pakoakoa Core Areas, Te Urewera Mainland Island, 2008/09

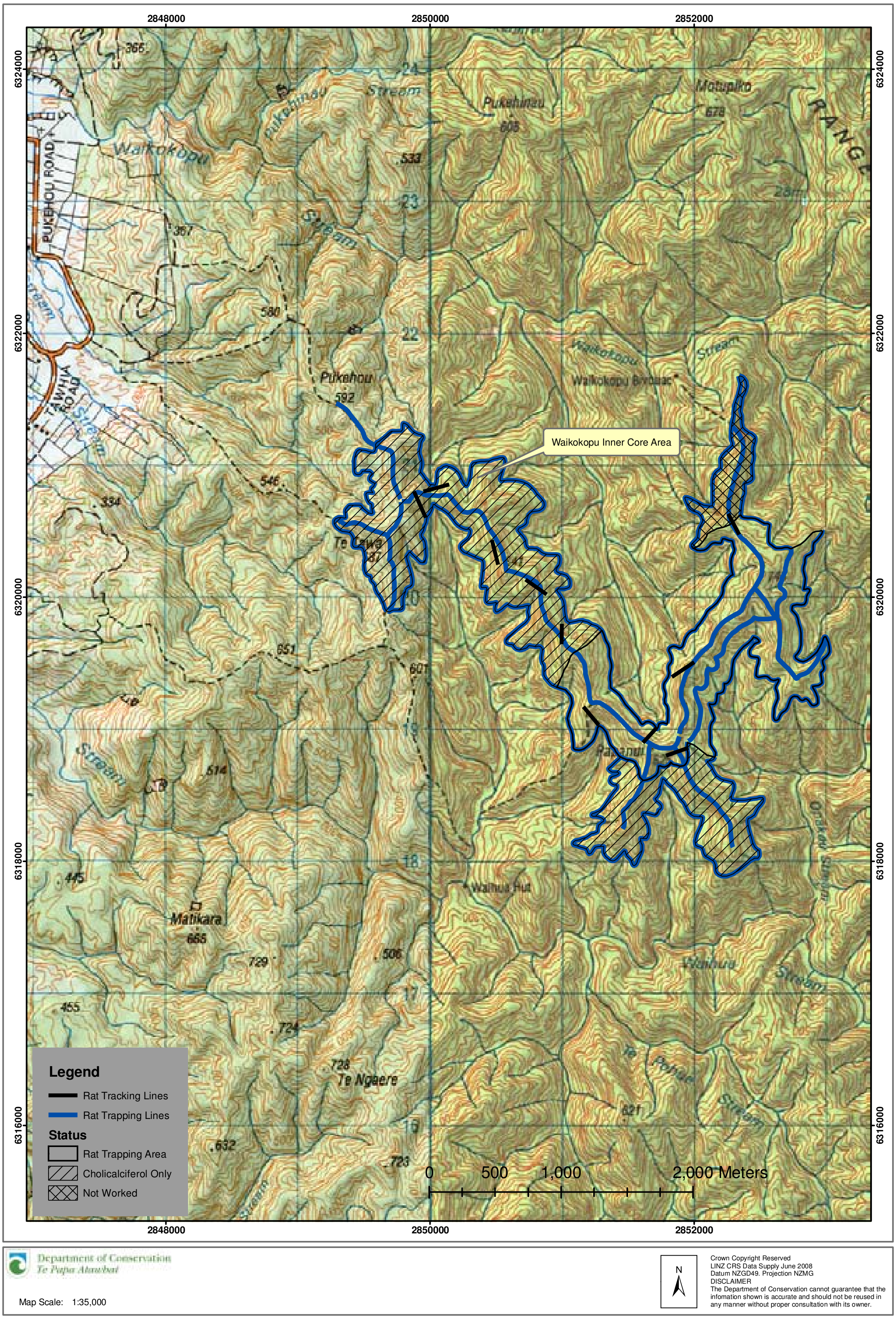


Figure 4.3.2 Location of rat control lines and rat monitoring lines in the Waikokopu Core Area, Te Urewera Mainland Island, 2008/09

In total 6298 rats were trapped within TUMI during the 2008/09 season. This represented an increase of 40% from the previous year (Table 4.3.2)

Rat tracking indices for Otamatuna and Oruamananui are shown in Figure 4.3.3, and those for Mangaone, Onepu, Pakoakoa and Waikokopu in Figure 4.3.4.

Figure 4.3.3

Rat tracking indices at Otamatuna Core Area and Oruamananui non-treatment area, Te Urewera Mainland Island, 2008/09

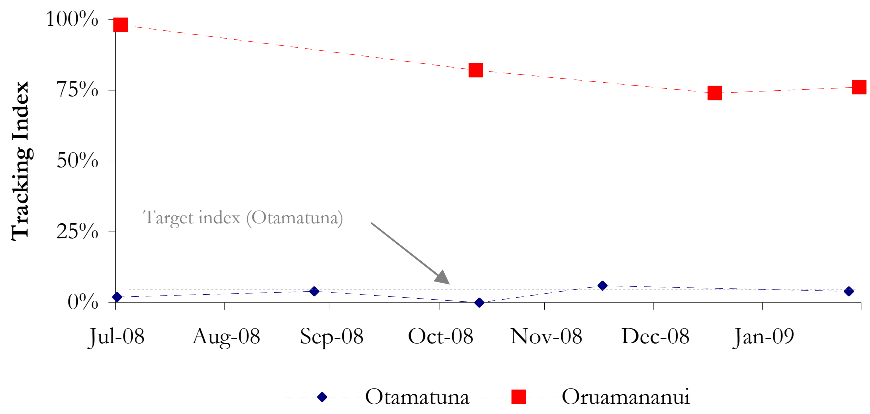


Figure 4.3.4

Rat tracking indices at Mangaone, Onepu, Waikokopu and Pakoakoa Core Areas, Te Urewera Mainland Island, 2008/09. The dashed line indicates the index target for the control period which itself is indicated by the shaded area

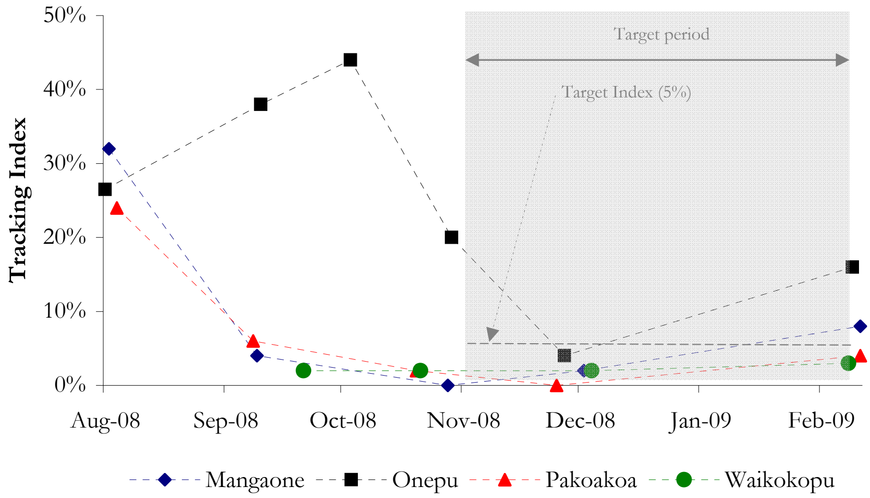


Table 4.3.2 Rat captures at Otamatuna, Mangaone, Onepu, Waikokopu and Pakoakoa Core Areas, Te Urewera Mainland Island, 2008/09

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Mangaone			103	208	209	233	98	61					**912**
Onepu		250	456	445	106	70		75					**1402**
Otamatuna	238	402	412	430	178	244	226	98	254	272	108	61	**2923**
Pakoakoa			297	101	95	112	96	37					**738**
Waikokopu				147	36	16	36	1	26	61			**323**
Total	**238**	**652**	**1268**	**1331**	**624**	**675**	**456**	**272**	**280**	**333**	**108**	**61**	**6298**

4.3.5 Trials

No trials relating to rat control were conducted within TUMI during the 2008/09 season. A follow-up to the "DOC200 v Victor in wooden tunnel" trial undertaken 2004/05 – 2005/06 within the Mangaone Core Area was planned but postponed during this season and will recommence in 2009/10.

Some initial investigations were undertaken:

- Reduction of bird by-kill in traps
- Reduction of pig interference by modifying tunnels

4.3.6 Discussion

This has been the most successful season for rat control in the history of the project. Indices were consistently low (during target periods) at four of the five control sites, particularly at Otamatuna where year-round control of rats to low levels for ecosystem benefits is being attempted.

Cholecalciferol (in the form of Feracol®) continued to be an effective tool in the reduction of rat abundance, particularly in the capacity of a knockdown agent. Once rats are at low densities, regular trapping (using particular regimes) is capable of maintaining rat numbers at these low levels; the combination of the use of Feracol® and a trapping regime appears to be a reliable prescription for reducing rat abundance to low levels. At the four sites where Feracol® was used to manage rats (in conjunction with trapping), control targets were consistently reached, whereas at Onepu where Feracol was not used, indices control targets were not reached.

As discussed in a previous report (Moorcroft et al. 2007) rat abundance (as measured by tracking indices and inferred from trapping rates) appear to be consistently lower than at Waikokopu than at other Core Areas. The use of Feracol® for reducing abundance (and density) appears to be more effective at Waikokopu, as might be expected.

There was significant interference (tunnels had doors pulled out and the trap treadle was often chewed) of rat traps by pigs at Otamatuna and Mangaone this season, as there had been in the preceding two seasons. The number of set traps available to catch rats was significantly reduced although this varied from round-to-round; at times approximately 60% of tunnels at Otamatuna had been sprung after baiting. Pigs were clearly targeting the bait particularly within the following 24 hours after being set, with the double impact of reducing the number of trap nights and incurring a monetary cost as trap treadles often had to be replaced. Reducing the incidence of pig interference is an important goal in the short-term.

The coreflute tunnels at Otamatuna were replaced with full wooden tunnels in 2007/08., Onepu and Mangaone One of the drivers for the change was to reduce the ability of pigs to interfere with the tunnels, principally through having a robust tunnel design and ensuring tunnels were well staked. Even though the addition of wooden tunnels temporarily (and significantly) reduced the impact of pigs, it became apparent that further modifications were needed as pigs had learnt to push up the rear door and access the trap. The addition of spring-loaded latches over the rear door was initially successful at eliminating pig interference (for 1-2 months), eventually however, this latch mechanism was ultimately circumvented by pigs. At the time of writing, the TUMI team had enlisted CMI springs (Auckland) (DOC200 trap maker) to assist in this process, with a view to further modifications being made early in the 2009/10 season.

At Pakoakoa and Waikokopu, Feracol® was distributed outside of the Inner Core Areas in an attempt to reduce the rat abundance in kokako nesting areas not protected from rats otherwise. At Pakoakoa and Waikokopu in particular, the small populations are still vulnerable to local extinction, therefore every nesting event is important in recovering the populations.

In Waikokopu, indications are (from tracking indices and trapping rates) that are sufficiently low that control could be achieved by using only Feracol® distributed along existing control lines. At this stage, this result would seem unlikely within any other Core Area (if using current control lines). With this in mind, Waikokopu may be a prime location to further investigate the relative ecological differences between the Ikawhenua and Waimana areas as pertaining to rat abundances.

At Onepu, the trapping regime for this season was similar to that in 2007/08, however the tracking indices were markedly different (mean tracking indices 1 November to 28 February: 2007/08, 0%; 2008/09, 13%), however, rat abundance indices at the non-treatment site (Oruamananui) indicated that rat abundance may have been higher in non-treated areas this season compared to 2007/08. Where the trapping of 962 rats within Onepu in 2007/08 was sufficient to achieve control targets, the trapping of 1087 rats 2008/09 was not. It is possible that the Oruamananui control site indices could be used in direct relation to predicting trapping intensities required for meeting targets within trapping only areas.

Good levels of kokako nesting success as well as low rat abundance indices over the previous seasons indicated a correlation between the two results. Control of rats to low levels is essential in ensuring that kokako breed successfully. However, as kokako are vulnerable to stoat and possum as well as rat predation, clearly kokako recovery cannot be reliant on adequate rat control alone.

Results from previous seasons (result and outcome monitoring) indicate that the current operational efforts for rat control can be successful for restoring remnant populations of endangered native species using the Core Area approach. While control targets in some areas were not met during the 2008/09 season, results from past seasons have shown the current methodologies to be sound.

4.3.7 Conclusions and Recommendations

- Maintain year-round control at Otamatuna and seasonal control at Mangaone, Onepu, Pakoakoa and Waikokopu Core Areas.
- Continue the 'kokako territory' control approach at priority sites (Pakoakoa, Waikokopu), using cholecalciferol as the principal control tool.
- Continue to investigate methods for reducing pig interference on rat traps.
- Continue investigations into reducing the by-kill of native birds trapping in traps.

4.3.8 Acknowledgements

Thanks to this season's rat trappers (Keith Beale, Arthur Sandom, Gaye Payze, Joe Rurehe, Leonard Sparks, and James Conway), and also all the volunteers who put time and effort into the project; especially BOP polytechnic volunteers and volunteers from the Rimutaka Forest Park Trust for their assistance with tunnel deployments. Thanks also to all DOC Opotiki staff for continued efforts with the Core Areas in contractor and data management and field work; ECHB Conservancy staff for their continued contributions; Darren Peters and Craig Gillies for their efforts and support with trials in the area.

4.4 STOATS (DAN BAIGENT AND GREG MOORCROFT)

4.4.1 Introduction

Trapping results within TUMI indicate that stoats are by far the most common of the three mustelid species present in the area and management of mustelids within TUMI is therefore focused on this species.

Trap set design within the project has evolved in regard to both trap and cover types, with current research being undertaken on the efficacy of the recently-introduced DOC200. Data from trials testing the DOC200, suggests this trap has joined the Fenn as a viable option for wide-scale stoat control, although its performance in comparison to the Fenn is yet to be fully determined. Within this project, Fenn traps are usually placed in double sets under a wire mesh cover (see Moorcroft et al. 2007), while DOC200s have most commonly been set as a single trap in a wooden box.

Trap lines within TUMI 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.

The aim for annual stoat control is to protect native species from depredation and we monitor the survival of young kiwi as a measure of the success of the stoat trapping programme. This section of the report focuses on issues (Section 5.3).

4.4.2 Objectives

The annual objectives for stoat control within TUMI were:

- To reduce predation events on kiwi less than 1000g so that no more than 50% of non-natural deaths are caused by stoats.
- To assess the effectiveness of stoat control techniques used in investigations.
- To develop and/or maintain stoat trapping networks and trapping regimes in Otamatuna, Mangaone, Onepu, Pakoakoa and Waikokopu Core Areas.

4.4.3 Methods

Stoat control was undertaken by setting kill traps on tracks (or control lines). These control lines were generally set on prominent topographical features such as ridges, spurs, rivers and streams. Pink triangles with the trap number inscribed were used to mark trap sites.

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 set at 150m (Table 4.4.1).

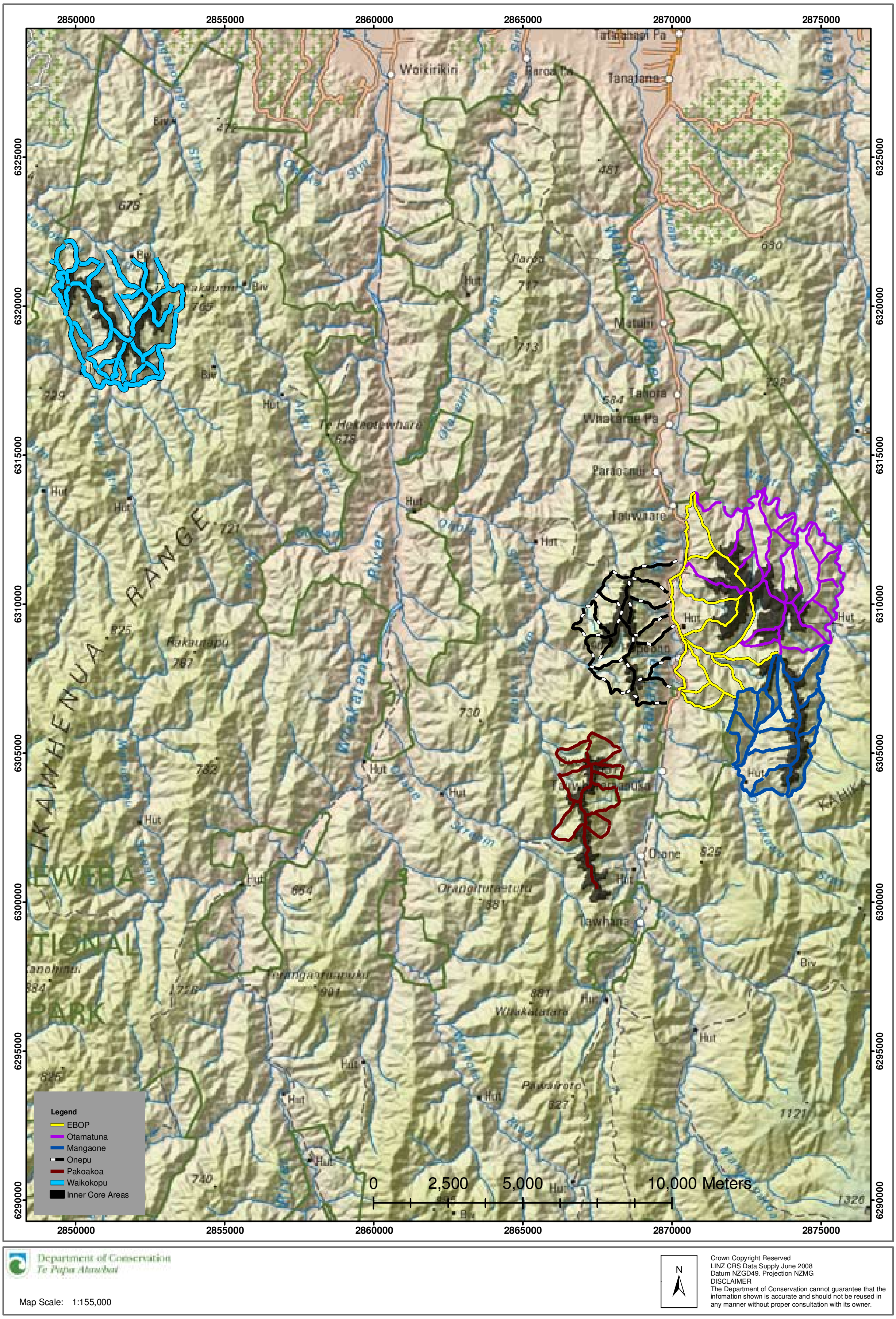


Figure 4.4.1 Stoat trapping lines in Core Areas, Te Urewera Mainland Island, 2008/2009

As of 30 June 2009, a total of 7851 ha was encompassed by stoat control lines, with management taking place in six areas: Otamatuna (1497 ha), Mangaone (1130 ha), EBOP (1410 ha), Pakoakoa (800 ha), Onepu (1232 ha) and Waikokopu (1782 ha) (Figure 4.4.1).

The six control areas managed under different contracts (where stoat control may be in conjunction with the control of other pests).

The average density of traps over the entire stoat trapping area is 4.7 traps per hectare (Table 4.4.1).

Table 4.4.1 Characteristics of stoat trapping areas within Te Urewera Mainland Island, 2008/09

Control area	Size of area (ha)	Number of trap sites	Trap sites per hectare	Trap spacing (m)
Otamatuna	1497	304	4.9	150
EBOP	1410	256	5.5	150
Mangaone	1130	257	4.4	150
Onepu	1232	346	3.6	100
Pakoakoa	800	232	3.4	150
Waikokopu	1782	282	6.3	200 & 100
Total	**7851**	**1677**	**4.7**	**-**

In total, traps for stoats were placed at 1677 sites within TUMI in 2008/09.

Fenn traps were used at 963 sites: 790 were double-set Fenns under wire cages and 173 were single Fenns set in wooden boxes (Table 4.4.2).

Single DOC200 traps in wooden boxes (Curtis Springs and DOC) were used at 923 sites, however 209 of these were placed side-by-side with a double-set Fenn trap set to compare catch rates.

Seventy seven double-set Fenn sets were replaced with new DOC200 traps within the EBOP management area (Table 4.4.2).

Altogether there were 1886 trap sets present in the project and a total 2676 traps available (Table 4.4.2.)

Table 4.4.2 Number and type of trap sets for stoat control in Core Areas, Te Urewera Mainland Island, 2008/09

Control area	Number of trap sites	Trap types				Total number of trap sets	Total number of traps
		Double-set Fenn	Single-set Fenn	Single-set DOC 200	Extra single-set DOC200[a]		
Otamatuna	304	304				304	608
EBOP	256	179		77	69	325	504
Mangaone	257	257			90	347	604
Onepu	346		173	173		346	346
Pakoakoa	232	50		182	50	282	332
Waikokopu	282			282		282	282
Total	**1677**	**790[b]**	**173**	**714**	**209**	**1886**	**2676**

[a] DOC200 traps installed as part of a paired (side-by-side) trial in comparison with double-set Fenn traps under a wire-mesh cover

[b] All double-set Fenn traps were placed on the ground under a wire-mesh cover

Traps were baited with either a hen's egg or with 'Erayze' (Connovation Ltd, New Zealand), a bait based on dehydrated rabbit meat. Eggs were replaced every six weeks during warmer months and every eight weeks during cooler months. Where Erayze was used, the bait was replaced at every trap check.

Contractors were contractually obliged to maintain the condition of the Fenn trap sets so that nine out of 10 traps tested must have a spring-off weight below 150g with five of these springing off below 100g.

Stoat management regimes in Core Areas are essentially year-round operations although trap check frequencies vary according to the season.

Trap checks were undertaken by contractors on a pre-set schedule with the frequency of checks varying slightly between sites.

Trap checks began July or August at most sites, with 10-14 checks undertaken at the majority of sites. Two-weekly trap checks were done during December, January and February when stoats are normally trapped in larger numbers.

- EBOP: 11 rounds, starting 10 August ending early June
- Mangaone: 14 rounds, starting 24 July ending 17 June
- Otamatuna: 13 rounds, starting 14 July ending 18 June
- Onepu: 9 rounds, starting 3 August ending 30 May
- Waikokopu: 9 rounds, starting August ending 2 June
- Pakoakoa: 6 rounds, starting 30 November ending 25 February

This season, the total trapping area within TUMI was expanded with the addition of 122 DOC200 traps placed at 150m intervals within the Pakoakoa Outer Core Area increasing the stoat control area here from 212 hectares to 800 hectares.

4.4.5 Results

In total, 305 stoats were trapped in the five Core Areas within TUMI (Table 4.4.3). This total included 22 stoats trapped in Victor Professional traps set for rats (Section 4.3).

Captures within dedicated stoat traps have decreased 31% from the 2007/08 season with a comparable number of trap checks having been undertaken.

A spike in capture numbers (as observed in previous years) occurred during the summer months (specifically late December and January) in all control areas.

Where there was a sizeable winter layoff (>2 months) between trap checks and following on from the end of the previous season, a one-off spike of stoat captures in the first subsequent clearance occurred.

Table 4.4.3 Number of stoats trapped within Core Areas, Te Urewera Mainland Island, 2008/2009

Control Area	Stoats trapped in 'stoat' traps	Stoats trapped in 'rat' traps	Total
Otamatuna	92	9	**101**
EBOP	62	-	**62**
Mangaone	41	4	**45**
Onepu	35	2	**37**
Pakoakoa	18	4	**22**
Waikokopu	35	3	**38**
Total	**283**	**22**	**305**

4.4.6 Field Trial: Single DOC200 vs. Double-set Fenn in Wire Tunnel

In this section the results of a field trial comparing catch-rates of stoats between 'paired' single DOC200 traps and two Mark 6 Fenn Traps are presented.

The trial set out to answer whether single set DOC 200 traps set in wooden tunnels as effective at catching stoats as double set Mk 6 Fenn traps in mesh tunnels.

Methods

During May 2006 217 sets each consisting of a new single DOC200 trap housed in a wooden box were placed within 5m of an existing trap set consisting of two Mark 6 Fenn traps under a wire mesh cover (see Moorcroft et al. 2007 for layout) in the EBOP, Mangaone and Pakoakoa stoat management areas (see above).

21 trap check rounds were completed within the trial period commencing 13 August 2006 and ending 10 September 2007.

All trap sets were baited with one hen's egg which was replaced every 4 – 8 weeks depending on the time of year.

Results

Trapping outcomes for the trial period are presented in Table 4.4.4.

Table 4.4.4 Trapping results for trial comparing double set Fenn traps in mesh tunnels and single set DOC 200s in wooden tunnels in the Mangaone / Otamatuna / Pakoakoa Core Areas, Te Urewera Mainland Island, 13 August 2006 to 10 September 2007

Trap type	Stoats trapped	Rats trapped	Other animals trapped	Trap set at check	Trap sprung, no catch
Fenn	70	324	8	4033	161
DOC 200	47	217	8	4137	57
Total	**117**	**541**	**16**	**8170**	**218**

Statistical analyses were done by Craig Gillies (Research and Development Division, Department of Conservation) who concluded that the most appropriate test to use to compare the data was the *Z*-Test comparing two sample means.

The Fenn traps caught significantly more stoats than the single DOC200 sets ($Z = -1.96$, $p = 0.05$).

The mean number of stoats caught was 0.22 ± 0.035 SE in the DOC200 traps and 0.32 ± 0.041 SE stoats in the double Fenn sets over the course of the trial.

Further analysis of the data revealed that if a Fenn trap set had caught a rat it was 4.57 times more likely (Confidence Interval: 2.76 lower limit, 7.58 upper limit) to catch a stoat than those Fenn sets that didn't catch a rat.

If the Fenn trap set hadn't caught a rat it was 0.93 times more likely to catch a stoat than a DOC200.

Conclusions

The double Fenns sets under a wire mesh cover caught significantly more stoats than the single DOC200 sets in a wooden best practice tunnel. The reason for this was that once a Fenn set caught a single rat it was much more likely to catch a stoat in the second trap (if a DOC200 caught a rat it was then unavailable to catch a stoat in that session).

If double-set Fenn trap sets had not caught a rat they had similar catch rates to single DOC200 traps

4.4.7 Discussion

In contrast to the stoat control in all other Core Areas, the extension of stoat control at Pakoakoa focused on spurs and ridges closer to the Inner Core Area in an attempt to investigate potential trapping gains as compared to the previous 'main ridge' stoat trapping regime. These new control lines also followed (wherever possible), already established possum control lines. The expansion of stoat control within the Pakoakoa Core Area is yet to realise a significant increase in stoats captures although this is not unexpected. It is likely that stoat catch rates and kokako monitoring results during the 2009/10 season will start to indicate whether the expansion area was sizeable enough to adequately reduce local stoat numbers.

Although stoat control within TUMI continued on similar lines to the previous season markedly fewer stoats were trapped this year (n=283) than in the previous one (n=390). This reduction has not been attributed to lack of quality contractors or attention to detail within the stoat trapping regime. Established contractors maintained stoat contracts during both the 2007/08 and 2008/09 seasons, including specific areas under contract where it was demonstrated that the quality of stoat control was of the highest level. While it is not assumed (as shown by audits) that every trap was checked and maintained to an "excellent" standard all of the time, it appears likely that if anything, there was an overall *improvement* in standards during this season. With the exclusion of contractor quality, it is possible that the base 'local' populations have been reduced to below levels required to maintain a stable rate of "stoat capture by trap" within individual Core Areas. It may also be possible that the increase in focus on multi pest control within the Core Areas has led to a reduction in preferred food sources and therefore a generalised dispersal of stoats into more highly favoured areas. Improved rat control (and rats are the main prey of stoats in forests) may be limiting food supply to some degree (however, the area controlled for rats is quite a lot smaller than the area controlled for stoats). In addition to this, it is also possible that stoats are receiving secondary poisoning from the use of Feracol® to control both possums and rats within most Core Areas, though this seems unlikely due to stoat feeding habits. Seasonal variation in stoat populations may be another explanation; with population levels strongly affected by prey abundances.

Since 2007/08, 'Erayze' stoat bait has been used within the Waikokopu Core Area. All indications are that this bait is a suitable replacement for the best practice bait of a hen's egg. While Erayze does appear to go mouldy between trap checks, especially in winter, it does not appear to decrease overall stoat capture results.

Currently Fenn traps are the most commonly used trap within the TUMI project. The DOC200 is the current Departmental best practice trap and has the advantages over the Fenn of having been passed as a “humane” trap, is more straightforward to set and can be set more consistently. Ultimately, it is likely that the Fenn trap sets will be phased out of this project however there is some uncertainty about what the best replacement will be. The results presented in this report from the field trial comparing single DOC200s and double-set Fenns illustrate a dilemma for managers where a less reliable set up (Fenn traps) actually catches more stoats than the best practice trap (DOC200). More information is needed and a further trial examining the performance of double-set DOC200s against a single-set DOC200 will be started in the 2009/10 season in this project; the outcome of this trial should better illuminate choices for managers. Also on the horizon is the multi-kill trap being developed by the Goodnature ™ Company in association with the Department. The continuing development of this type of trap will provide yet more options for managers. However, the desire to achieve annual pest control targets and taking into account the normal budget restrictions means that when managing stoats over a large area, changes to programmes usually need to occur incrementally and be based on good information. Maintaining the condition of any trap in the field is important both for the functioning of the trap (so it can catch pests) and to reduce operational costs, so emphasis will continue to be placed on this area.

Part of the current management focus has included the up-skilling of Ngai Tuhoe (local tangata whenua) workers particularly in relation to operational matters. This will continue to happen within the upcoming years, with the aim of enabling Tuhoe workers to be able to competitively tender for Departmental contracts.

During this year, emphasis was put on replacing the mild steel trigger plates in the DOC200 traps with stainless steel ones. The mild steel plates were prone to rust, particularly once an animal had been caught and had decayed in the trap. Replacing the plates is a relatively simple task that can be completed in the field (approximately 5 minutes per trap) and should extend the life of the plates beyond the three to four years achieved with the mild steel plates.

4.4.8 Recommendations

- Maintain a regular maintenance programme of Fenn and DOC200 traps.
- Continue monitoring kiwi as a measure of the effectiveness of the stoat trapping regime.

4.4.9 Acknowledgements

A big thank-you to Keith Beale, Joe Rurehe, Ian Te Pou, James Conway, Asher Morley (sole contractors), Arthur Sandom and Gaye Payze (Waimana Pest Control) Kevin Marsden (KLM Holdings Ltd) who undertook stoat contracts or assisted in some way with the stoat project within TUMI and for their dedication to trapping stoats this season. Also to Ian Crossan and Annie Assen for their involvement to date.

Thanks also to DOC staff at the Opotiki Office who have worked hard on making this project a success.

Thanks also to Darren Peters (RD&I, Wellington) and Craig Gillies (RD&I, Hamilton) and the East Coast Hawke's Bay Conservancy staff for their assistance in the project in general.

4.5 DEER (GREG MOORCROFT AND SHANE GEBERT)

4.5.1 Introduction

Red deer (deer) (*Cervus elaphus scoticus*) were first controlled within TUMI (at Otamatuna) in 1997/98 and management 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. The Otamatuna Core Area (2494 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 by measuring the number of palatable seedlings (in various height classes) within plots. Also, deer abundance is measured using a relative index of the number of deer faecal pellets in plots. The methods and the outcomes of the monitoring are examined in another section within this report (Section 5.6), while this section discusses the outcomes and issues associated with controlling deer.

4.5.2 Objectives

The management objective for deer control this season was:

- To kill a minimum of 70 deer within the Otamatuna Deer Control Area.

4.5.3 Methods

Deer were primarily controlled by ground hunting undertaken by contractors using indicator dogs. There was also some incidental shooting by DOC staff encountering animals (but not using dogs). All dogs used by contractors had passed DOC training qualifications and were also trained for ground-bird (kiwi (*Apteryx mantelli*)) aversion. Animals were stalked and shot using high-powered rifles. Pigs were also hunted if incidentally encountered. The Otamatuna Deer Control Area is closed to all other hunting, and all kills by DOC staff or other contractors are recorded and included in the results presented here.

Contractors were required to carry a Global Positioning Satellite receiver (GPS) (Garmin *60CSx*) which was usually supplied by the Department. The GPS was kept face-up in a place that allowed the best possible contact with satellites and kept on continuously during hunting to record tracking data: kill locations were recorded as waypoints. An accurate record was kept of the number of hours spent hunting and the number of animal kills and the number of encounters was also recorded.

The right-side jawbone of any animal killed was removed and brought in to the Opotiki DOC office enabling kills to be verified and data on population structure to be collected.

In 2008/09, two hunters (Wayne Looney (400.5 hours) and Jason Healy (481 hours)) were each contracted to kill 39 deer, or alternatively hunt for a maximum of 480 hours in the block. Hunting in the Te Waiiti River, adjacent to the block was limited to no more than 70 hours (or 9 deer shot) to ensure that coverage of the entire block was achieved, and that the river remained a source of deer for local hunters who have traditionally moved through this area.

4.5.5 Results

A total of 79 deer and 14 pigs were killed in the Otamatuna Deer Control Area this season. DOC staff accounted for 9% (n=7) of the deer kills; all of these were shot in the Te Waiiti Stream while two staff were conducting surveys for whio (*Hymenolaimus malacorhynchos*) (Table 4.5.1).

Of the 79 deer killed, 41 were male and 38 were sexed as females.

Table 4.5.1 Hunting effort and the number of deer and pigs killed in the Otamatuna Deer Control Area, Te Urewera Mainland Island, 1996/97 – 2008/09

	Contractor hunting hours	Animals killed by contract hunters		Animals killed by DOC staff		Total number of animals killed		Contractor deer kills per 100 hours
		Deer	Pigs	Deer	Pigs	Deer	Pigs	
1996/97	Not applicable	-	-	28	0	28	0	-
1997/98	Not available	29	0	12	1	41	1	-
1998/99	665	66	8	2	0	68	8	9.9
1999/00	1241.5	87	29	6	6	93	35	7.0
2000/01	1072	74	6	0	0	74	6	6.9
2001/02	847	44	10	0	0	44	10	5.2
2002/03	693	24	21	3	3	27	24	3.5
2003/04	740	43	4	0	0	43	4	5.8
2004/05	482	37	6	12	0	49	6	7.7
2005/06	914	58	11	5	1	64	12	6.3
2006/07	781	64	24	9	1	73	25	8.2
2007/08	801.5	66	8	5	0	71	8	8.2
2008/09	881.5	72	14	7	0	79	14	8.2
Total	**9118.5**	**664**	**141**	**89**	**12**	**754**	**153**	**7.0**

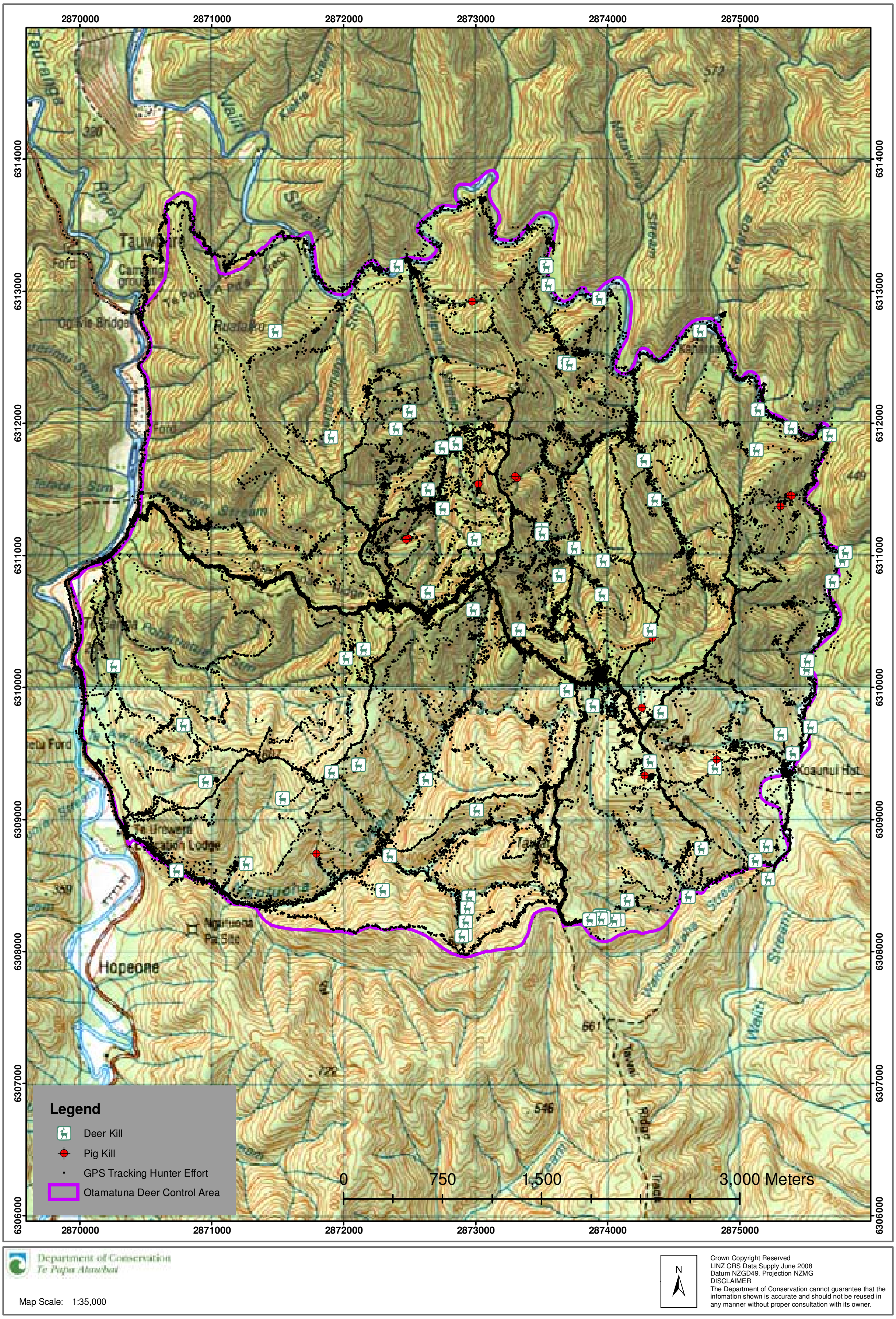


Figure 4.5.1 Locations of deer and pig kills, and GPS tracking locations from contract hunters, in the Otamatuna Deer Control Area, Te Urewera Mainland Island, 2008/09

4.5.6 Discussion

This season, as in the previous two, has seen a continued focus on the removal of deer from the Otamatuna Deer Control Area and the associated monitoring of palatable seedlings as well as the presence of deer pellets. This work continues to be an important part in the understanding of the effort needed to restore the forests of Northern Te Urewera.

It is clear from past results that the ongoing invasion of deer from outside the control area means deer numbers will build up quickly if control is not maintained. This will have obvious negative effect on palatable seedling abundances in particular. However, more research is required to understand the nature of the relationships between the number of deer controlled and the abundance of palatable seedlings.

Employing the same contractors over the past five seasons has resulted in increased familiarity with the hunting area and the movements of deer.

4.5.7 Recommendations

- See Section 5.6 for recommendations regarding deer management.

4.6 CATS (GREG MOORCROFT AND PETE LIVINGSTONE)

4.6.1 Introduction

Feral cats are present in northern Te Urewera but at low densities (as gauged from trapping results and field sign).

Resident feral cats may still impact significantly on local fauna as illustrated by the predation of two monitored kiwi (*Apteryx mantelli*) chicks (one in each year of 2001/02 and 2002/03).

4.6.2 Objectives

- To maintain a network of kill traps targeting feral cats in the Otamatuna and Mangaone Core Areas.

4.6.3 Methods

A network of 85 125mm Connibear-type (Steve Allan) kill traps was set at 500 m apart on main ridge and spur lines in the Otamatuna and Mangaone Core Areas. Trap locations are shown in Figure 4.6.1. Traps are placed on trees within a wooden box which is open on one side and enclosed by mesh on the back. Bait is placed on nails within the box and the trap is set on the front face. Traps are set off the ground (c.400mm to 1000mm) and the majority of traps have a runner (angled board or branch to allow improved access to target species).

Traps were baited with Erayze© (Connovation Ltd), a dried salted rabbit block, or animal (beef or mutton) fat. Traps were checked four times over the year: November, January, February and March.

4.6.4 Results

No cats were trapped this season in the Conibear-type traps although possums were occasionally caught.

Two juvenile cats were caught in Fenn traps in the Te Waiiti Stream.

4.6.5 Discussion

There is a very low level of cat abundance in northern Te Urewera, however, previous captures and predations have shown that cats are present and can have impacts. In terms of managing cats it is probably worthwhile to maintain a network of traps and as current traps are along stoat trap lines there is an obvious opportunity for synergy between the two regimes. Servicing the cat traps specifically is likely required once or perhaps twice a year, while the rebaiting of traps could occur in conjunction with stoat trap checks another two or three times per season.

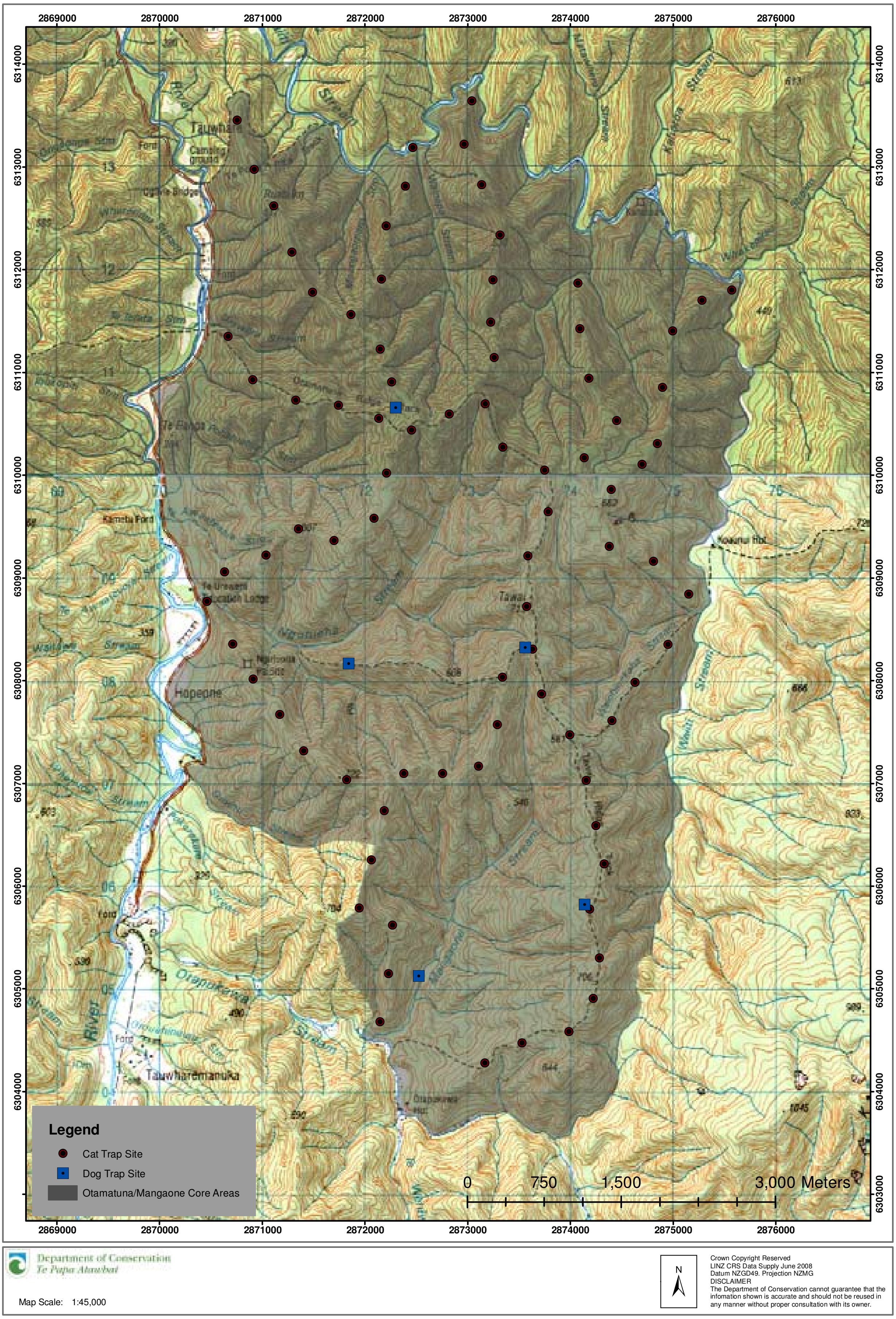


Figure 4.6.1 Location of kill traps for cat control and live-capture traps for dog control, Otamatuna and Mangaone Core Areas Te Urewera Mainland Island, 2008/09

4.7 DOGS (GREG MOORCROFT)

4.7.1 Introduction

Feral dogs, in particular, can and have had major impacts on kiwi populations (e.g. Taborsky 1988). Within this project, from December 2002 to October 2003, 13 out of a sample of 17 radio-tagged kiwi were either killed (n=9), or went missing. Over the previous six years, only one adult kiwi had suffered the same fate. Six (46%) of the deaths were positively identified as dog predations, but dogs likely accounted for most if not all of the losses. In 2007/08, a female transmitterised whio incubating a clutch of eggs was killed on the nest by a wild dog (as strongly indicated by marks on the carcase).

In northern Te Urewera, feral dogs are known to occur widely throughout the area. Pig and deer hunting are common activities and dogs are used for both. The use of dogs in Te Urewera National Park is strictly regulated; however, the situation in northern Te Urewera is complicated by the land tenure where blocks of private land accessed on legal roads are surrounded by National Park. Hunting practices on private land adjacent to Conservation estate cannot be controlled and compliance of practices on Conservation land in remote areas is problematic.

Reducing the threat of feral dogs to kiwi within TUMI has been managed with a two-pronged approach: the behaviour of dog owners has been targeted through education, and increased regulation and compliance; and feral dogs in key areas have been targeted using traps, and opportunistically, through hunting.

4.7.2 Objectives

- To reduce the threat of feral dogs to kiwi in the Otamatuna and Mangaone Core Areas.

4.7.3 Methods

During 2007/08, a system of remote alert traps, intended to target feral dogs, was developed within the Opotiki Area Office for use in the Mainland Island. The system consisted of a robust aluminium live-capture swing-door trap that had a sensor attached. The sensor was connected to a VHF radio which linked into the DOC system. Trap status email alerts were received daily, indicating whether the trap was shut or open. Five traps had been deployed by February 2009 (see Figure 4.6.1). Shut-trap alerts were also transmitted to cell phones. The trialing and testing of the system (e.g. bait types, set-off weights) is ongoing.

The five remote-alert traps replaced the four standard (i.e. non-remote-alert) live-capture traps that had been sporadically operated.

If feral dogs were encountered within northern Te Urewera they were either removed or destroyed on site.

4.7.4 Results

No dogs were caught in traps this season.

Three dogs were shot by staff or contractors. All three had been seen in Te Waiiti Stream; two were shot on the Waipapa Ridge and one shot in Te Waiiti Stream.

A dog kiwi-aversion training day was held in the Waimana Valley on 26 April 2009.

4.7.5 Discussion

The colouring and body shape of dogs seen in Te Waiiti Stream closely resembled feral dogs that were shot in the neighbouring Waiata catchment. It is quite likely that the young dogs seen in Te Waiiti were progeny of dogs shot in Waiata. If this is this case then distance travelled indicates the potential of feral dogs to disperse significant distances.

Dogs remain a significant threat to the long-term survival of kiwi in northern Te Urewera. Managing the threats from dogs requires a multi-pronged approach, including legislative (including compliance), owner awareness, aversion training, as well as control techniques (including trapping). The development of improved control techniques such as the remote-alert traps is only part of the solution to reduce the threats from dogs. Sustained interaction with the community and, where necessary, enforcement of legal prescriptions, must be continued to meet our objectives.

4.8 PIGS (GREG MOORCROFT, ANDREW GLASER AND DAN BAIGENT)

4.8.1 Introduction

Pigs (*Sus scrofa*) are present throughout northern Te Urewera and as an introduced mammal are a threat to the integrity of the native ecosystem.

Pigs are seen as an important food source by local people, particularly tangata whenua, and pig hunting, especially using dogs, is a common practice throughout Te Urewera. However, feral dogs and/or lost hunting dogs pose a significant threat to ground dwelling birds (e.g. kiwi, weka). Within this project there are definitive cases where feral dogs have killed kiwi as well as a nesting whio. Predation of kiwi by feral dogs is a major cause of local population extinction.

In recent years, there has been escalating interference by pigs with rat trap sets in Mangaone, Onepu and (in particular) Otamatuna Core Areas. Pigs take the trap bait, and possibly trapped animals from one trap after another along a trap line, thereby significantly reducing the number of traps available to catch rats and therefore the effectiveness of the control regime. At times, at Otamatuna, over 50% out of a total of approximately 2300 traps checked in one round were sprung with trap covers disturbed. Pigs would also frequently destroy (by chewing) the plastic treadles present on the Victor Professional® rat trap, the most common trap type used in the project (Section 4.3).

Rats are controlled year-round at Otamatuna with trapping being the main method used to keep rats at low levels (although Feracol® is used to 'knockdown' rat numbers at certain times of the year). Rats are controlled seasonally (start November to end February) in the other four Core Areas using similar regimes (Section 4.3).

As well as rat trap interference there has been low-level interference by pigs on the stoat traps set under wire-mesh covers (Section 4.4) often leaving the unset traps exposed as a risk to kiwi and other birds.

Pigs have previously been shot in Otamatuna Core Area by hunters employed to control deer, however, the kills were largely incidental as pigs were not primarily targeted (Section 4.5).

4.8.2 Objective

- To reduce the interference of pigs on rat trapping regimes

4.8.3 Methods

Pig-proofing Rat Tunnels

In order to reduce the interference of pigs on rat traps, effort was placed into developing and trialing a trap tunnel (or cover) that would exclude pigs.

A significant amount of background work had been completed prior to this season, including the design of a robust wooden tunnel based on the Departmental best practice for rat control. This tunnel is essentially consists of a roof and base connected by two sides made from 150 x 25mm rough-sawn treated timber. At the front is a galvanised mesh screen with a hole cut in to allow the rat to access the trap. At the rear, a door (made of various materials – see below) was slotted into two grooves cut into the sides. The door allowed for operator access to the trap for servicing. Tunnels were fixed to the ground with a c.800mm steel rod firmly stapled to the trap.

Initially traps were field tested (against pig interference) with standard wire-mesh doors cut to fit. However, pigs learned to push the doors up with their snouts, allowing them to pull the traps out and access the bait. As above, the trap would be set off and often the treadles chewed beyond usefulness.

Several other door types were tested including polycarbonate and pressed steel.

The tunnels in Otamatuna were installed during in several sessions over the latter half of the 2007/08 year by a team of staff and contractors.

During July 2008 the coreflute tunnels over the rat traps at Onepu and Mangaone were replaced with wooden tunnels.

Pig Traps

Three pig traps were installed in January and February 2009 as a pilot study or trial to determine the potential of the designs for controlling pigs in Core Areas. Two traps were placed near Te Mapou Hut and the third on a sidle track in the Tawai Peak vicinity.

All three traps were constructed from fence posts, warratahs and heavy-gauge mesh and were of the push-in type. Here, an animal could push through an entrance way made from touching and curving mesh, but were restricted from escaping by the shape of the mesh which would close when an animal pushed against it. Two were constructed in circular shapes with one entrance, and a third trap was constructed as an oval with a push-in entrance at each end (see Appendix 9.6).

Initially, the trap doors were tied back and the traps were pre-baited with dried maize scattered on the ground both inside and outside the trap.

When staff or contractors were working for several days in the area (and therefore able to conduct daily checks), traps were baited and set. When staff or contractors were not present to check these traps they were wired shut to prevent animals being caught.

Hunting

Pigs were occasionally shot by hunters contracted to control deer in the Otamatuna Deer Control Area (Section 4.5).

From 17 – 22 May 2009, two Department of Conservation staff who are experienced pig hunters (Andrew Glaser, 4 days and Scott Theobald, 3 days) used a total of three dogs to target pigs in the eastern half of Otamatuna Core Area, particularly around Te Mapou Hut region. The hunters worked together for the three days they were both hunting.

The dogs used were trained and certified for avian aversion and had been proven to meet the highs standards of behaviour needed to operate in a kiwi management area. The dogs were fitted with tracking equipment to enable them to be located after both successful and unsuccessful hunts.

Liver samples were taken to test for levels of cholecalciferol to ascertain if any there was risk to hunters who may harvest pigs in the wider area.

Because of the testing of cholecalciferol no meat was taken for consumption.

4.8.4 Results

Pig-Proofing rat tunnels

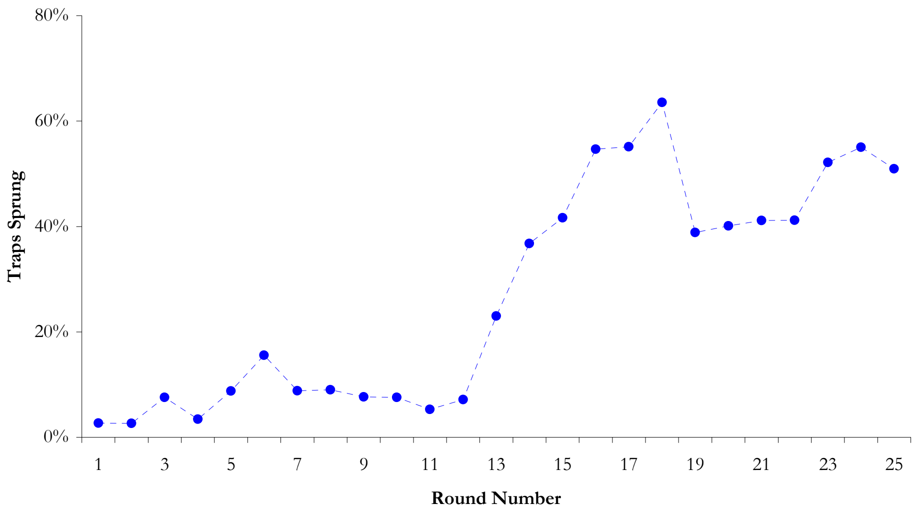
There was an initial reduction in number of sprung traps, however interference increased over time as the pigs learned how to access the traps usually by pushing the access door up. The incidence of interference at Otamatuna is indicated in Figure 4.8.2.

Generally, the level of interference at the three sites where tunnels were changed varied over the year but interference did continue at localised areas (within the three sites).

All types of door were able to be removed by pigs.

Figure 4.8.2

Proportion of rat traps sprung per servicing round, Otamatuna Core Area, Te Urewera Mainland Island, 2008/09



Pig Traps

The pig traps were operated sporadically through February to late-April when the traps were wired shut.

4 pigs were caught in the pig trap situated near the Kaharoa Ridge.

Hunting

14 pigs were shot by contract hunters undertaking deer control.

24 pigs (13 males, 10 females, 1 unconfirmed) were shot by Departmental investigation team ranging in size from suckers to 130 pounds. All pigs were killed and disposed of.

Liver samples were taken from 12 of these pigs.

The results of the testing for cholecalciferol are presented in Appendix 9.7. The range was 9 – 66 nmol/L or 0.243 – 0.582 gm Wet Weight Tissue.

4.8.5 Discussion

By the end of the 2008/09 year, we did not have a complete solution to the problem of pigs interfering with rat traps, especially within the Otamatuna Core Area. The two main approaches to resolve the problem were to either construct pig-proof rat traps or to reduce the number of pigs in the rat trapping areas. If rat traps are pig-proof, then a rat trapping regime can function more-or-less regardless of the number of pigs in the vicinity. Although managers may want to remove pigs for other (e.g. ecological) reasons there are ongoing costs and issues for doing this, whatever methods are used.

At Otamatuna where the year-round rat trapping regime was most affected by pig interference, there was a clear reduction in interference after the tunnels were changed over. However, as the year progressed the incidence of interference increased, and field evidence showed that pigs had learned to access the new tunnels. It was thought by managers that the best solution was to continue developing the tunnel so pigs would be excluded, although this would not be a short term answer. By the year-end, as discussed in Section 4.3, the envisaged solution of constructing a pig-proof rat trap had not yet been realised although good steps had been made towards the end point.

The construction of the pig traps was essentially a pilot study to test the feasibility of the method within TUMI. It is clear that the traps do work but as usual with live capture traps, running them requires a significant investment of resources. Two of the traps were set up relatively close to a management hut and the third on a track that was readily accessible for staff but not used by the public. However, to be effective these traps probably need to be kept open for reasonable periods of time (5-7 days) and checked every day. As there was no one person dedicated to this task, the traps were opened and checks were made as staff were available to do this. Further options for operating a live trapping system could be considered if appropriate and the traps could be incorporated into a management regime for pigs.

The dedicated hunting of pigs at Otamatuna using specialised dogs and experienced operators was conducted too late in the financial year (May) to be able to gauge whether this approach was successful in reducing pig interference. It is important to note that this hunting was done in an attempt to solve the pig interference issue in the short term, especially around Te Mapou Hut area. Also of concern was the rising incidence of interference of pigs on the traps set for stoats under wire covers which were baited with hen's eggs (Section 4.4). The eggs are easily accessed by the pigs lifting up the wire-mesh covers; the traps would often be left exposed and if they weren't set off would be a risk to native fauna, in particular kiwi. The hunting also presented an opportunity to test the pigs for levels of cholecalciferol (used a control agent for rats; Section 4.3) as an indication as to whether any retrieved meat would present a risk to humans if consumed.

Further discussion will be had to try and develop a means of controlling pigs using local hunters so that the meat can be retrieved for consumption. This is an important issue for local people and the Department needs to be mindful of the potentially negative perceptions created from culling pigs which are then left to rot. However, there are complexities in managing this issue and finding a solution will require a lot of thought and discussion with local iwi. Issues include sourcing local hunters with dogs that have been trained to the high standards needed to operate in a kiwi management area.

The results presented in Appendix 9.7 indicated that the pigs probably had elevated levels of cholecalciferol but there is limited information on baseline levels, especially in feral animals, including pigs (Alastair Fairweather, Department of Conservation, pers. comm.). However, the amounts found were not of a level that would be of harm to humans; the cholecalciferol levels in the livers of the pigs were well below what a human would get if they ate fish (Alastair Fairweather, Department of Conservation, pers. comm.). Further sampling would provide both more baseline data and also more information on the risk to humans of consuming meat harvested from areas where cholecalciferol has been used.

4.8.6 Recommendations

- Continue to investigate rat tunnel design modifications as a means to exclude pigs.
- Investigate options for removing pigs within Otamatuna Core Area.
- Take more liver samples of pigs shot in the management areas.

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. The monitoring methods used are usually well established and follow best practices, but in some cases have been adapted to fit local circumstances.

Table 5.1.1 identifies what components of the ecosystem were monitored during 2008/09, methodology and monitoring rationale (assessment of management action).

Table 5.1.1 Conservation monitoring overview for Te Urewera Mainland Island, 2008/09

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, dog 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 Pakoakoa and Waikokopu Core Areas; whio monitoring was done in a site with pest management (Te Waiiti Stream) and a non-treatment site (upper Tauranga River); kiwi monitoring was done in the Otamatuna and Mangaone Core Areas; mistletoe monitoring was undertaken in the Otamatuna Core Area (including Ogilvies Ridge), Pakoakoa Core Area, the Oruamananui comparison Area and the Okopeka non-treatment area; palatable seedlings were counted in both the deer control area (Otamatuna) and a comparison area (Onepu); and forest canopy condition was done in Otamatuna, in the eastern side of the project's operational area and in the Okopeka non-treatment area.

Previous outcome monitoring components included measuring abundance of long-tailed bats, assessing northern rata condition, undertaking five-minute bird counts and measuring North Island robin survival and breeding success.

5.2 KOKAKO (CODY THYNE AND JANE HAXTON)

5.2.1 Introduction

Kokako are vulnerable to predation by introduced pests, especially at nest sites where eggs and chicks are taken by rats, possums and mustelids. Within Te Urewera Mainland Island (TUMI) kokako are used as an indicator species to measure the effectiveness of pest control programs.

From data gathered at Otamatuna Core Area in 1996/97, it was found that 75% of successful kokako nests were located above the A-Line (Section 2.2). From this information a potentially more cost-effective management approach (compared to Otamatuna) for kokako protection population was initiated.

5.2.2 Objectives

The annual objectives for kokako management during 2008/09 were:

- To undertake nest monitoring in the Pakoakoa and Waikokopu Core Areas to measure nesting success.
- Complete a biennial census of Waikokopu and Pakoakoa to measure population status.

5.2.3 Methods

Nest monitoring was undertaken in two Core Areas: Pakoakoa and Waikokopu. Monitoring methods followed Flux and Innes (2001) where all known pairs were frequently followed and observed for nesting behaviour. No banding or DNA sexing was undertaken this season.

A population census was undertaken at Pakoakoa in October 2008 and post breeding in June 2009 at Waikokopu. Census methods were used as described by Hudson and King (1993).

5.2.4 Results

Five pairs were monitored within the Waikokopu Core Area: four pairs attempted to nest with eight nests confirmed. A fledgling from a further nest that was not located, indicated a total of nine nests for the season. In total eight chicks were located (Table 5.2.1). Three pairs successfully produced chicks with two pairs re-nesting after having successfully fledging chicks. The results indicate a nesting success rate of 56 percent.

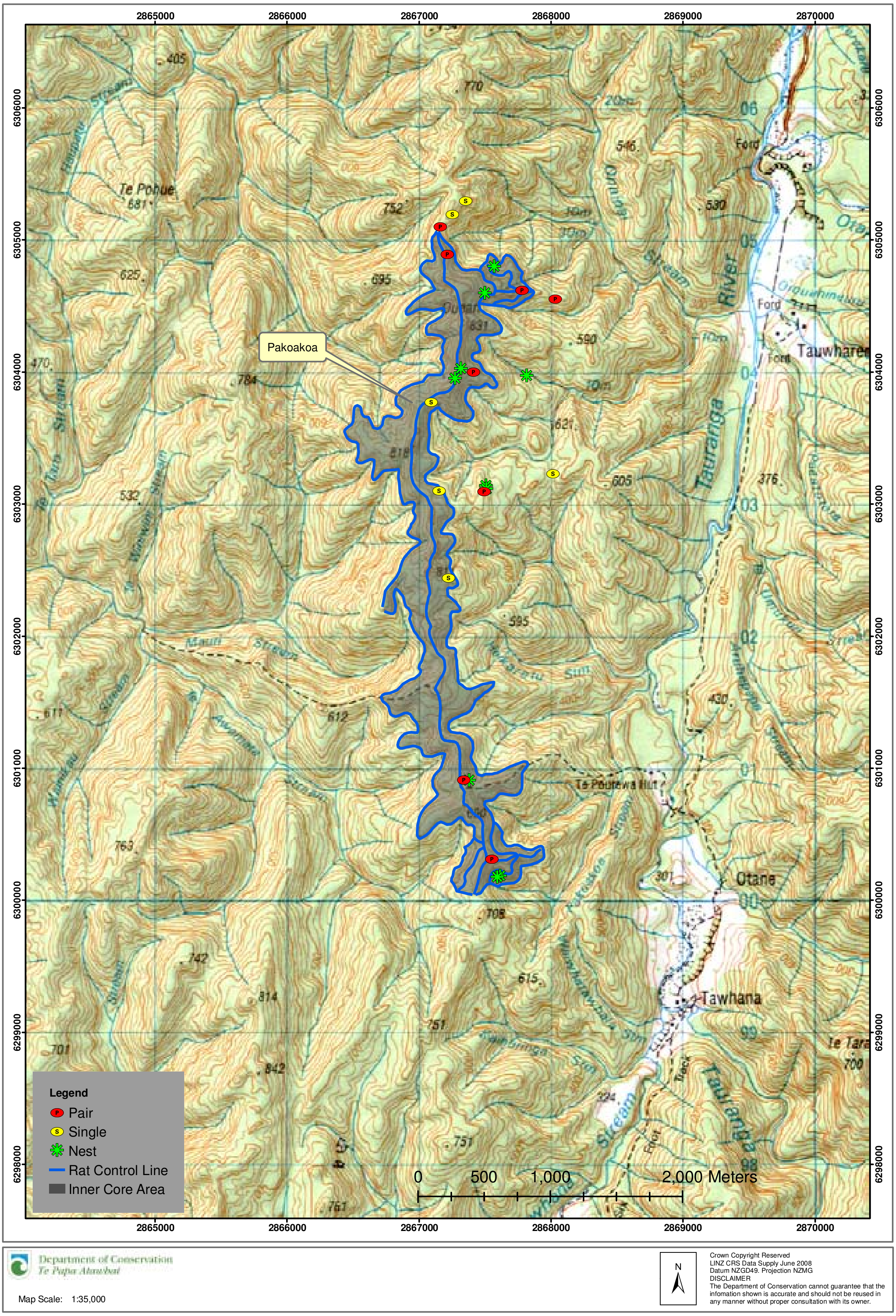


Figure 5.2.1 Locations of territorial kokako and kokako nests in the Pakoakoa Core Area, Te Urewera Mainland Island, 2008/09

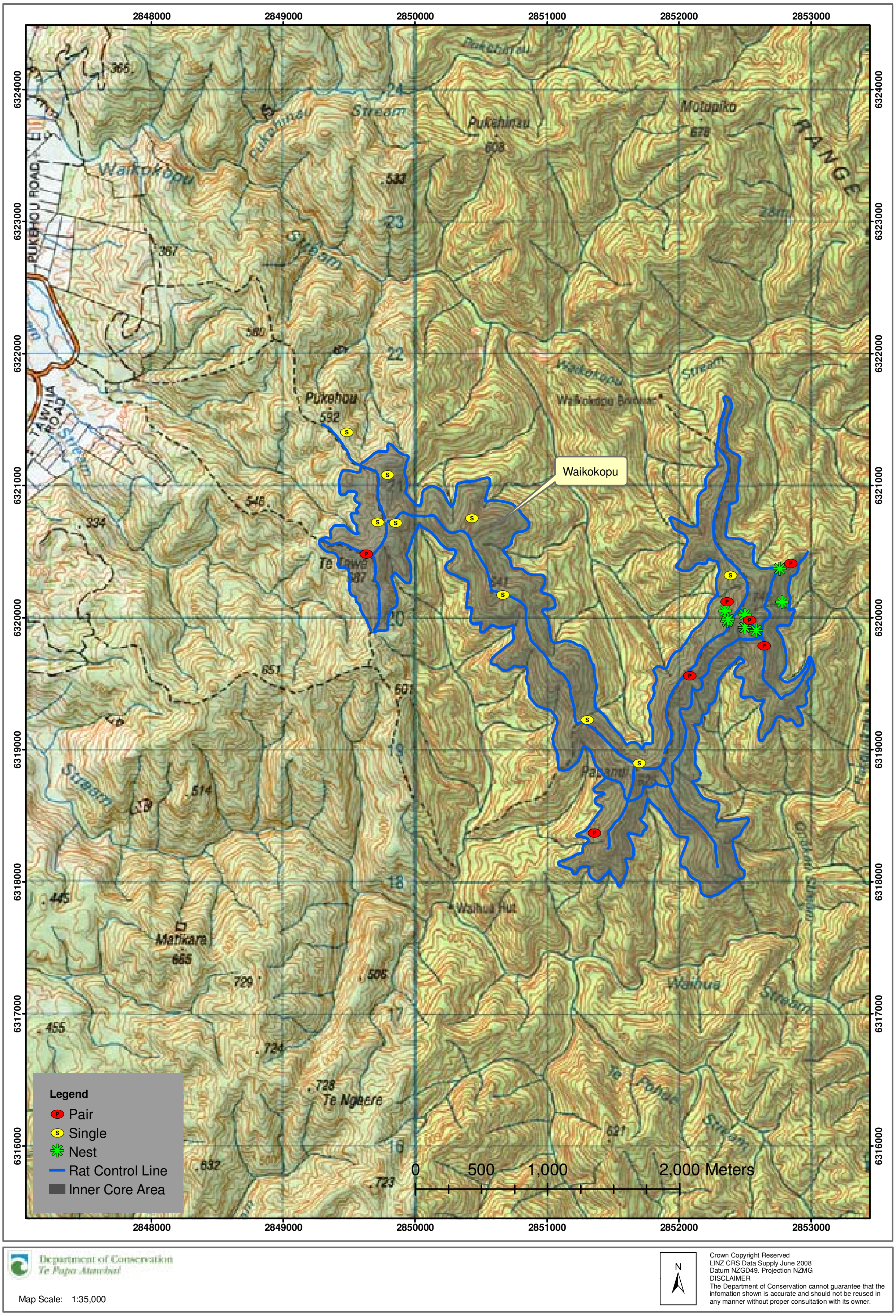


Figure 5.2.2 Locations of territorial kokako and kokako nests in the Waikokopu Core Area, Te Urewera Mainland Island, 2008/09

Six pairs were monitored within the Pakoakoa Core Area, Five pairs attempted to nest, giving a total of ten nesting attempts. The exact location of one nest was not recorded before it had failed but the pair had certainly been nesting. The sixth pair was probably nesting, evident by the presence of a brood patch after the female was killed by a falcon. Within eight weeks the remaining single bird had found a new partner and the territory once again was held by a pair. No breeding attempts were observed from the new pairing. Three pairs succeeded in fledging chicks. Two pairs successfully fledged two broods. The third pair was not successful until their third and final attempt. Aluminum sleeves were applied to trees around this nest and one other nest after stoats were identified as predators of previous nest attempts. Both these nests successfully fledged chicks. Results observed indicate a nesting success rate of 50 percent. The breeding season was concluded mid May 2009.

A census was conducted at Pakoakoa in October 2008. Six pairs and three singles were located in the Inner Core Area, the same number recorded during the previous census in 2006. A further two pairs, previously unknown, were recorded outside the Core Area during the nesting season. The Waikokopu census was completed post-breeding. Seven pairs and six singles were located compared to five pairs and nine singles located during the previous census in 2006.

Table 5.2.1 Monitoring effort and observed nesting success at Waikokopu and Pakoakoa Core Areas, northern Te Urewera, 2008/09

Core Area	Number pairs	Number known nesting attempts	Number known successful nests	Number chicks fledged from monitored nests	Nesting success rate	Number fledged per nesting attempt
Waikokopu	5	9	5	8	56%	0.9
Pakoakoa	6	10	5	9	50%	0.9

5.2.5 Discussion

The nesting success rates achieved this year at Waikokopu and Pakoakoa are encouraging. If nesting success rates greater than 50% can be achieved by providing additional protection, we can increase the number of birds that may establish territories within each Core Area leading toward Core Area security and our 10 year goal of 30 pairs at each of these sites.

Multiple nesting attempts (occurring after both failed and successful clutches) were observed this season at both Core Areas leading to an extended breeding season (the last monitored chicks fledged on 16 May).

As in previous seasons, there was a high rate of nest failure at Pakoakoa early in the season with several nest predations occurring. The success rate improved however, with three late re-nests successfully fledging chicks. Two of these nests had aluminium sleeves placed around the nest tree and surrounding trees in an attempt to provide additional protection. This additional measure appears to have been effective. Pakoakoa is the only Core Area that does not have comprehensive stoat control in place and observations last season suggested stoats were responsible for some nest failures. This year, two of the five nest failures were attributed to stoats, one to a possum, another to infertile eggs and one cause of failure remained unknown. The failure occurred two weeks before the approximate fledge date suggesting stoat or avian predation. Additional stoat control has been established this season (Section 4.4) but may require a few years of operation before the benefits to kokako become apparent.

In contrast, Waikokopu and the other Core Areas have comprehensive stoat control in place and nesting success results observed at Waikokopu this season indicates stoat control, in addition to rat and possum control is probably required to ensure nesting success rates above 50%.

The number of chicks produced at each site this year was the highest recorded during the last 4 years of nest monitoring. Since the 2005/06 season 18 chicks have been produced at Waikokopu and 17 chicks have been produced at Pakoakoa over the same period (from a total of 6 pairs) with over half produced this season.

Some new pairs have been identified at Pakoakoa but are located outside the Core Area boundary where census effort has not been concentrated. Efforts will be made prior to and during the next breeding season to more accurately record new pairs and singles that have established both inside and outside the Inner Core Area.

The female of a Pakoakoa pair, evident from the presence of a brood patch, was killed by a Falcon in front of the observer in late December. The remaining bird remained single for approximately eight weeks before finding a new partner. No nesting attempts were observed by the new pairing.

The pair known as the 745 High Point Pair attempted three times this season. Over the last three years this pair has attempted six times with only one success. All causes of nest failure were unconfirmed although their second nest showed signs of damage possibly caused by a possum. A stoat was seen in the area when the observer had noted the failed nest and was following the pair.

The status of the population is still critical in Pakoakoa; however, hopes of recovery have been raised with the observation of a number of non territorial throughout the breeding season. With ten chicks including the one mentioned above) adding to the population this season there is optimism that pair numbers will increase over the next few seasons as long as pest control targets are maintained.

5.2.6 Conclusion and Recommendations

Pakoakoa and Waikokopu Core Areas both remain in a highly vulnerable state and sustained pest control effort must continue to ensure that these populations are given the best opportunity to recover. It is important at sites with low pair numbers that every measure is taken to ensure kokako security. It appears that stoats continue to be the main cause of nest predation in Core Areas that do not have extensive stoat control. Sleeving nest trees at Pakoakoa where possible is a measure that should be undertaken over the next few years until more comprehensive and effective stoat control is in place. Additional stoat control is expected to be initiated at Pakoakoa this coming season. The benefits of this to kokako will probably take a number of seasons to become apparent as stoat numbers are gradually reduced.

Nest monitoring will be repeated at both Waikokopu and Pakoakoa this coming season to confirm the assumption that extensive stoat control, in addition to rat and possum control, is required to recover small remnant kokako populations in northern Te Urewera. Nest trees will not be sleeved with aluminium at Waikokopu as stoat control measures have been in place now for some time. It is expected that the population at Waikokopu will expand if nesting success rates in excess of 50% can be maintained.

The census figures for Waikokopu indicate that the population is starting to show signs of growth with the addition of a few pairs since the last census. Population growth at Pakoakoa is not occurring though some pairs have established outside the Inner Core Area boundary. Increasing nesting success is seen as the key to increasing the population in the next few years.

It is recommended to:

- Continue nest monitoring at Waikokopu and Pakoakoa to test pest control regimes and determine the effectiveness of additional stoat control at Waikokopu.
- Sleeve all nest trees at Pakoakoa where appropriate to increase nesting success rates.
- Complete a biennial census at both Onepu and Mangaone Core Areas in the Spring and/or post breeding.

5.2.7 Acknowledgements

Thanks to the following people: Nest monitoring volunteers Tjalle Boorsma, Miriam Brenner, Mark Rossiter and Robin Toy.

5.3 NORTH ISLAND BROWN KIWI (GREG MOORCROFT)

5.3.1 Introduction

The principal cause of decline of kiwi populations in northern Te Urewera is the intensive predation by stoats (*Mustela erminea*) in their first six months of life. After approximately six months of age, kiwi have generally reached sufficient size (c.1000g) to ward off attacks by stoats.

Therefore, the survival of young kiwi is monitored in the adjacent Otamatuna and Mangaone Core Areas (4000 ha) as an indicator of the effectiveness of the stoat control regime. The threshold for 'success' is when a young kiwi reaches 1000g in weight regardless of what happens to an individual after this stage.

Population monitoring and the tracking of sub-adult kiwi are also undertaken.

5.3.2 Objectives

The objectives of kiwi management within TUMI for the 2008/09 season were:

- To monitor the fate of young kiwi.
- To monitor the survivorship of territorial kiwi.
- To track the fate of non-territorial sub-adult kiwi.
- To monitor the population of kiwi in the Otamatuna and Mangaone Core Areas.

5.3.3 Methods

Adult kiwi were monitored using transmitters (Sirtrack Ltd or Kiwitrack Ltd). Adult kiwi were generally handled once per year when transmitters were changed during non-breeding periods. Signals from adult kiwi were obtained at least once-monthly but often more frequently during the breeding season (August to March).

Adult male kiwi were fitted with *Egg Timer* transmitters which indicate when males have begun incubating eggs and the number of days since incubation began. Any nests located were monitored regularly and at approximately day 95 (as indicated by the Egg Timer transmitter) the nest was visited at night after the male had left. Any chicks located were fitted with a double-stage (i.e. includes a mortality mode) 'Chick' transmitter (c. 12g, KiwiTrack Ltd). Chicks were monitored weekly with regular checks undertaken to ensure transmitter and harness condition were adequate.

Any kiwi found dead were examined for signs of predation, including a thorough site search and post mortem if necessary (conducted by trained DOC staff or Massey University).

The positions of any sub-adult kiwi were regularly checked including using aerial surveys if necessary.

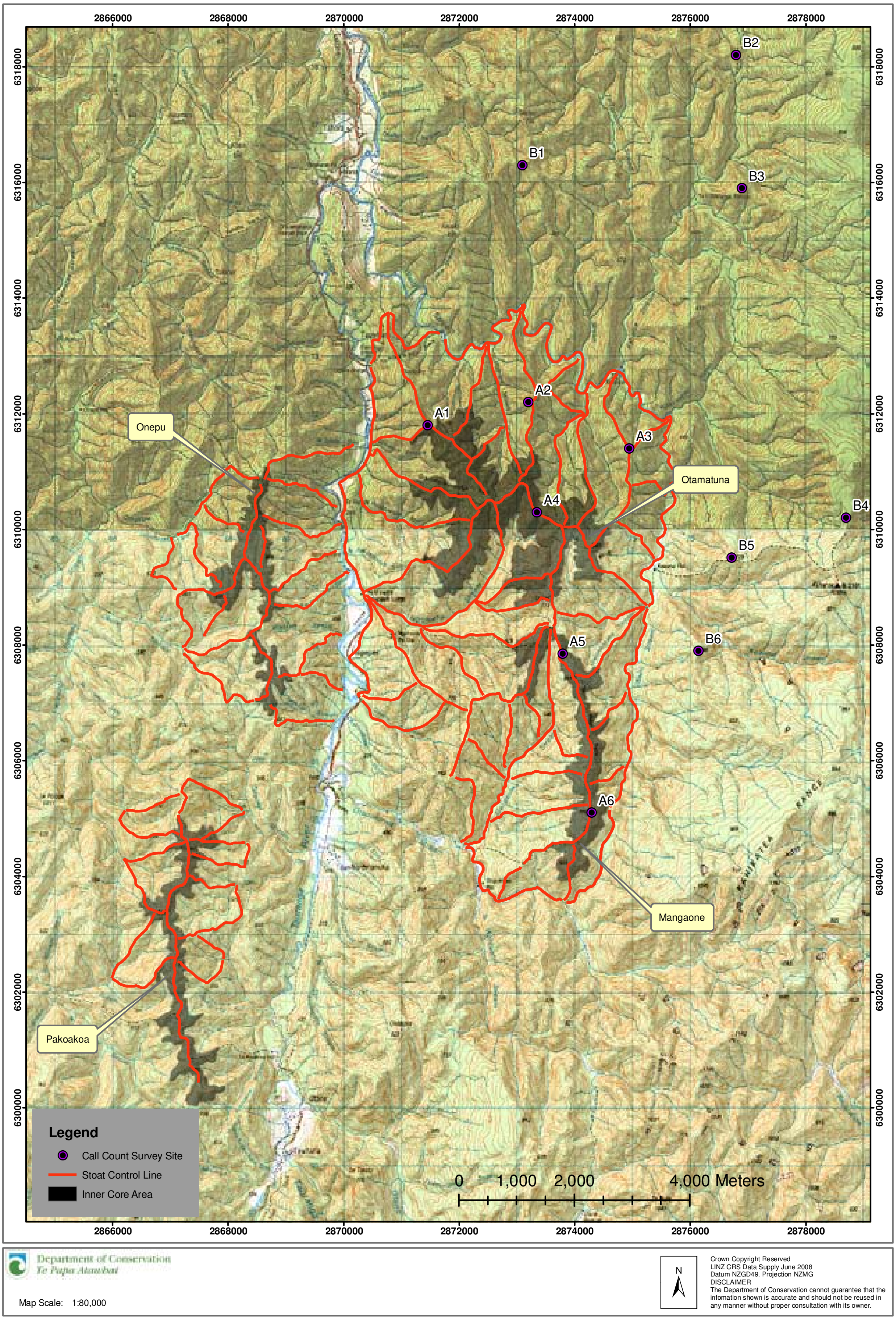


Figure 5.3.1 Location of kiwi listening sites and kiwi monitoring area including stoat control, Te Urewera Mainland Island, 2008/09

Population monitoring through call count surveys (two hours of listening over four nights at six sites) was conducted in Otamatuna and Mangaone Core Areas during May and June 2009.

5.3.5 Results

Survival

Nine kiwi (NTU-109, 112, 113, 121, 124, 125, 130, 131, 132) with transmitters were alive at 1 July. Six kiwi were caught (NTU-123 was re-caught, plus 5 chicks, NTU-133 to 137) meaning 15 birds were monitored this season. Over the course of the year, two birds dropped transmitters (NTU-124, 130) and two birds died (NTU-133, 135) leaving 11 kiwi with transmitters alive at 30 June (Table 5.3.1).

Details of individual kiwi monitored this season can be found in Appendix 9.4.

The fates of all birds caught within the Mainland Island are presented in Table 5.3.1.

Table 5.3.1 Fate of kiwi caught in Te Urewera Mainland Island, 1996/97 to 2008/09

	Present Start of Year	Caught	Re-captured	Dead	Lost	Tx dropped	Tx removed	Present End of Year
1996/97	0	10			3			7
1997/98	7	12		3	1	1	2	12
1998/99	12	22		1	8	5		20
1999/00	20	14		1	11	4	7	11
2000/01	11	15		3	7	4	2	10
2001/02	10	11		3	4			14
2002/03	14	14		8	4	2	1	13
2003/04	13	7		6	7	2		5
2004/05	5	1						6
2005/06	6	9		2	1	2		10
2006/07	10	8		2	7	4		5
2007/08	5	9		3	1	1		9
2008/09	9	5	1	2		2		11
Total		**137**	**1**	**34**	**54**	**27**	**12**	

Chick survival

Four males attempted to breed this season (as indicated by Chick Timer transmitters or actual results) (Table 5.3.2). Transmitter signals indicated that one male (NTU-131) attempted to nest twice but subsequently abandoned both nests. Neither of these sites was located before they were abandoned. Two other males (NTU-109 and -132) nested once, and one male (NTU-121) nested twice, giving a total of six nesting attempts.

Four nesting attempts were successful with each producing a solitary chick; single non-viable eggs were found in two nests (NTU-109, 132) while evidence of only one egg being laid was found in the two nests of NTU-121 (each of these eggs were viable and successfully hatched).

Five chicks had transmitters attached this season: four chicks (NTU-133, 134, 135, 136) were captured at nest sites and one bird (NTU-137) was located by a dog during the day. As NTU-137 was not caught at a nest site, it has not been included in the chick survival statistics.

By 30 June, two chicks (NTU-133, 134) had reached 1000g and one chick (NTU-135) had been killed, probably by a stoat (insufficient evidence was found to conclusively determine the cause of death, however circumstantial evidence indicated stoat predation). Two chicks (NTU-136, -137) were alive but weighed less than 1000g (Table 5.3.3).

Of the chicks that reached 1000g in weight, NTU-134 remains alive but NTU-133 was killed on 15 May. Circumstantial evidence and post mortem results indicate the cause of death was by trauma to the body probably by a falling branch under which the kiwi was found.

Since 2000/01 when only traps have been used to control stoats, the fates of 24 kiwi chicks are known. Of these 24, 29% survived to 1000g, 46% were probably killed by stoats, 17% were killed by other predators and 8% died in natural circumstances. Of the chicks that survived to reach 1000g (n=7), two are known dead, one is still alive and four have been lost from the monitoring sample (Table 5.3.4).

Table 5.3.2 Nesting outcomes of monitored kiwi, Te Urewera Mainland Island, 2008/09

Adult male kiwi	No. nests	1st clutch		2nd clutch		Season Total	
		Eggs	Chicks	Eggs	Chicks	Eggs	Chicks
NTU-109	1	2	1	0	0	2	1
NTU-121	2	1	1	1	1	2	2
NTU-131	1	?	0	?	0	?	0
NTU-132	1	2	1	0	0	2	1
Total	**6**	**5+**	**3**	**1**	**1**	**6+**	**4**

Table 5.3.3 Details of kiwi chicks captured in Otamatuna and Mangaone Core Areas, Te Urewera Mainland Island, 2008/09

Kiwi chick	Sire	Dam	Date caught	Weight at capture (g)	Bill length at capture (mm)	Stoat predation	Survived to >1000g	Fate at 30 June (cause of death or last known weight)
NTU-133	NTU-109	Unknown	5/11/2008	365	43.0		Yes	Dead (natural death)
NTU-134	NTU-121	NTU-123	6/11/2008	230	43.3		Yes	Alive (1020g)
NTU-135	NTU-132	NTU-113	4/12/2008	285	43.4	Yes		Dead (stoat predation)
NTU-136	NTU-121	NTU-123	31/03/2009	225	47.0			Alive (850g)
NTU-137	Unknown	Unknown	22/05/2009	515[a]	53.0			Alive (750g)

a NTU-137 was not caught at a nest and as such its parentage and age are not known. It is not included in analyses for chick survival.

Table 5.3.4 Fate of kiwi chicks fitted with transmitters during trapping-only stoat control operations, Otamatuna and Mangaone Core Areas, Te Urewera Mainland Island, 2000/01 to 2008/09

Season	Season total	Survived >1000g	Probable stoat kills	Other predations (<1000g)	Natural mortality (<1000g)	Unknown fate or alive and <1000
2000/01	4	0	2	1	0	1
2001/02	4	1	1	2	0	0
2002/03	8	4	3	1	0	0
2003/04	0	0	0	0	0	0
2004/05	0	0	0	0	0	0
2005/06	0	0	0	0	0	0
2006/07	4	0	2	0	0	2
2007/08	3	0	2	0	1	0
2008/09	5	2	1	0	1	1
	28	**7**	**11**	**4**	**2**	**4**

Sub-adult monitoring

One sub-adult kiwi was monitored this season (NTU-130), a female that was caught as a sub-adult near the Otamatuna helicopter pad in March 2008. In 28 October 2008 the bird was located in the upper Mangaone catchment, but on 16 April 2009 the transmitter was found dropped in the right fork of the Ngutuoha Stream. As this bird was caught as a sub-adult and dropped its transmitter before it was known to be territorial, no information on dispersal could be derived.

Population monitoring

Call counts were conducted in the Otamatuna and Mangaone Core Areas for the first time since 2004/05. Results are presented in Table 5.3.5 below and show that the mean call rate this season was very similar to those for 2002/03 to 2004/05.

Table 5.3.5 Number of calls heard and call rates of North Island brown kiwi in Otamatuna and Mangaone Core Areas, Te Urewera Mainland Island, 2001/02 – 2008/09

Year	Female calls	Male calls	Total calls	Call rate (calls /hour)
2001/02	25	204	229	4.8
2002/03	19	110	129	2.7
2003/04	10	111	121	2.5
2004/05	24	102	126	2.6
2008/09	13	105	118	2.5

5.3.6 Discussion

The capture of just four chicks at nests was somewhat disappointing in terms of management outcomes. The average of one chick per nesting male was lower than expected, although an historical figure of 1.5 chicks per nesting male per season has been previously calculated (unpublished data). The results indicate the variability of nesting outcomes from year-to-year, and once again highlight the need to have an adequate sample of known nesting males to monitor.

The proportion of chicks surviving to the threshold weight this season is encouraging. Although the sample size from this season is small, having two chicks survive to the threshold weight and another be close to it is an encouraging sign for the effectiveness of the pest control. The fact that one chick was predated in the time of most intensive trapping (mid-summer) shows how vulnerable kiwi are to predation even with low stoat abundances.

The call count rate at Otamatuna was lower than expected as anecdotal evidence had indicated an increasing population in the Otamatuna and Mangaone Core Areas following a decrease associated with dog kills in 2003. Kiwi had more recently been heard at three hut sites where birds were once heard but then had been (presumably) killed by dogs. It is uncertain whether the call count rate this season is an accurate reflection of current kiwi abundance as it is comparable to rates recorded 2003/04 and 2004/05 after the dog kill events. Future monitoring, perhaps including the use of other methods, should indicate whether the population is being sustained.

From the data collated to present it appears that the stoat trapping regime protects sufficient young kiwi to enable the population to be sustained, although the sample size is still small. More study needs to be done on fates of kiwi after reaching the threshold weight, including monitoring the survival and dispersal of juvenile kiwi from their natal territories.

5.3.7 Recommendations

- Continue to monitor kiwi within TUMI as a measure of the effectiveness of stoat control.
- Increase the sample size of kiwi with transmitters to include at least 5 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.
- Review the kiwi monitoring programme.

5.3.8 Acknowledgements

Rhys Burns continued to provide valuable advice, and expertise in the field. Andrew Glaser, Cody Thyne, Tim Allerby, Rhys Burns, Jane Haxton and Greg Moorcroft listened for kiwi this season.

5.4 WHIO (ANDREW GLASER AND TIM ALLERBY)

5.4.1 Introduction

Whio populations were once widespread throughout New Zealand; these populations have undergone dramatic declines over the past century and whio are classified as nationally endangered.

Whio populations are vulnerable to predation throughout various life stages; nesting female, nests, juveniles, fledged juveniles and adult birds in moult. Stoats have been identified as the key manageable threat to whio and are attributed as the main factor influencing whio decline nationally.

Whio live at low densities in linear river habitat with territories extending over an extensive area from main stems to small tributaries. Their habitat use is not solely restricted to waterways and whio have been found to use the forest at certain times of the year. Whio populations are reliant on in-situ management across catchments to provide for their security and recovery; unlike many other threatened species where their security can be assured on offshore islands, whio require protection on the main islands due to their habitat requirements.

Te Urewera Mainland Island (TUMI) has been identified as one of eight Security Sites for securing whio from extinction. TUMI has also been identified as the highest priority site through the Threatened Species Optimisation ranking for whio protection, and is also recognised by the Whio Recovery Group as the priority site for future resource allocations.

Whio nesting success, adult female survival and habitat use has been monitored on both the upper Tauranga River and Te Waiiti Stream over the 2007/08 and 2008/09 breeding seasons through the use of radio telemetry and video surveillance. These two rivers were chosen because of their historical datasets, accessibility, whio population, and variation in predator control.

Te Waiiti Stream is the treated site that benefits from predator trapping. Predator trapping exists in the form of possum control on both sides of the river and stoat control in the form of a single trap line following the river with stoat trapping only on the true left side of the valley.

The upper Tauranga River has no predator control in the near vicinity and so acts as the non-treatment.

Note: Information contained in this report also refers to some activities and results from the 2007/08 season.

5.4.2 Objectives

- Determine the nesting productivity.
- Determine the primary threat to whio nesting success.
- Determine adult female survival rates and their seasonal movements.

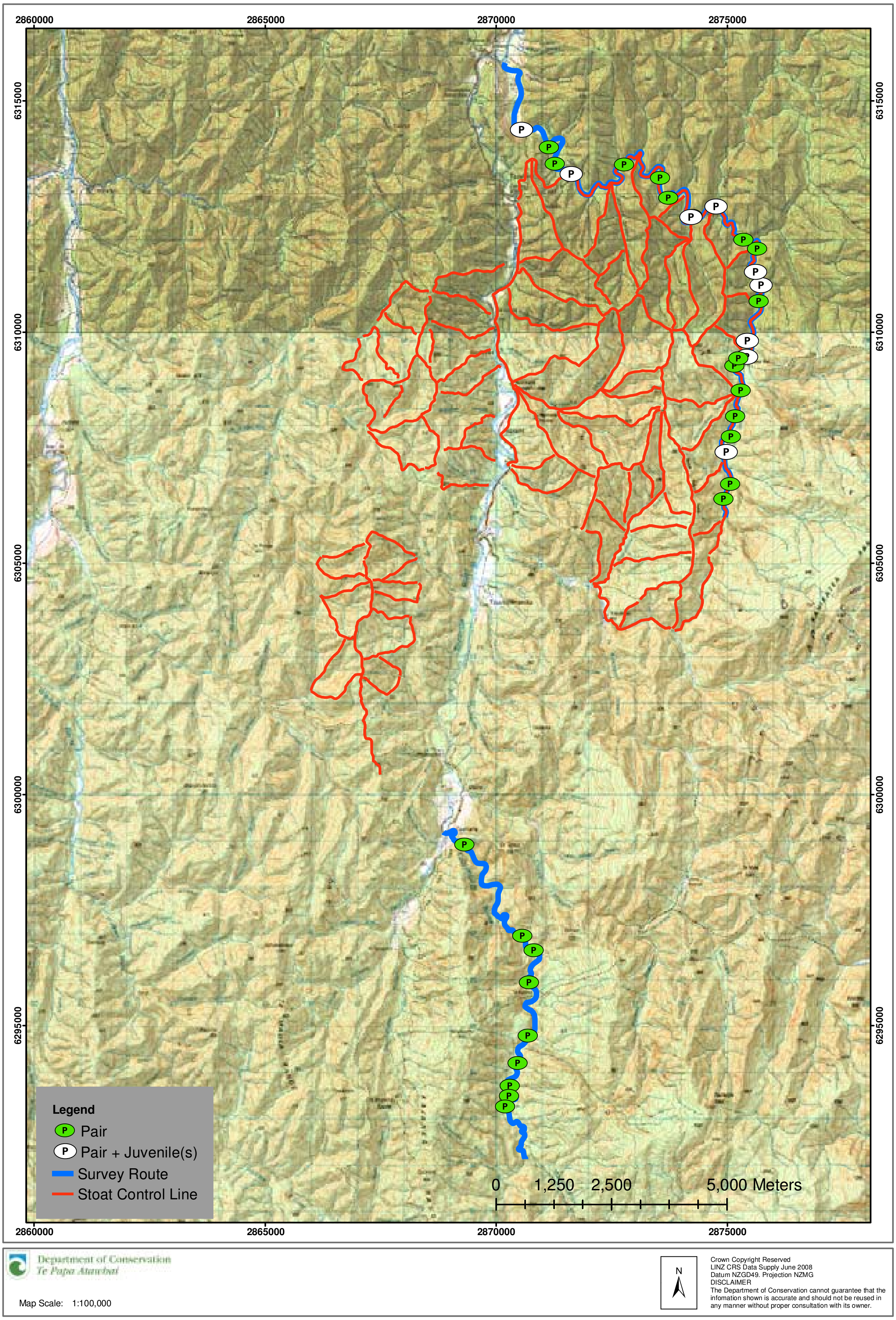


Figure 5.4.1 Whio survey routes, whio territories and stoat control lines, Te Urewera Mainland Island, 2008/09

5.4.3 Methods

This season, whio were monitored in Te Waiiti Stream (where some stoat control is in place; see Section 4.4) and the upper Tauranga River (which serves as a non-treatment / comparison site) (Figure 5.4.1).

Monitoring efforts were divided amongst several techniques: walk-through survey, nest monitoring using video cameras and close-order monitoring of female whio using radio transmitters; each of these is explained below.

Monitoring techniques were often employed concurrently at each site; for example staff would locate some whio through observation or using a trained dog; on the same survey trip, other whio were located using radio telemetry, and (in the upper Tauranga) cameras used to monitor nests were serviced.

Catching of whio was also undertaken to attach and remove transmitters, attach and/or replenish colour bands and to insert transponders (PIT tags) where applicable.

Walk-through survey

Walk through surveys and transmitter checks were conducted at both the treatment and non-treatment sites through key stages of the breeding cycle to determine the number of pairs, singles or juveniles present and the stage of the breeding cycle. Surveys started in late August 2008 and were carried out at regular intervals until late June 2009.

A certified dog ("Neo") trained to detect whio, was used during several walk-through surveys to verify previous observations and where appropriate to locate nests. Using a trained dog is the most accurate method of surveying.

Following fitting of transmitters (see below), surveys were carried out fortnightly until females showed signs of being gravid. Once nesting behaviours were observed surveys were carried out more frequently: on the upper Tauranga River, survey frequency became weekly then daily as peak nesting occurred. On Te Waiiti Stream, surveys were carried out weekly during peak nesting. Survey frequency on Te Waiiti Stream did not become as frequent, as carried out on the upper Tauranga River, as cameras were not installed.

At times, checks were carried out on both rivers simultaneously requiring multiple staff members to carry out these checks. Three staff members and one experienced volunteer were involved in the surveying aspect of this study.

When the nesting period was over, survey frequency of females returned to fortnightly checks on both rivers until all juveniles had fledged.

Female birds were monitored fortnightly right through the moult to assess their level of vulnerability during this flightless period.

Video-camera nest monitoring

Video surveillance was carried out on the upper Tauranga River, to replicate a similar study conducted in Fiordland (Willans 2002), in order to ascertain the primary cause of whio nest failure.

Cameras sourced from the Department of Conservation Electronics Team (National Office) were used in this study to provide constant surveillance of nests. Camera units were powered by 12 Volt batteries, requiring battery changes every 48 hours, and used an infra-red light source. Data was recorded on memory cards then transferred to computers for viewing and analysis.

Due to the lack of video camera units and time required to keep cameras operational, cameras were only installed on nests on the upper Tauranga River.

Once nests were located on the upper Tauranga River they were assessed to determine if the site was suitable for the installation of a video camera. Not all nest sites were suitable for camera installation due the logistics of transporting equipment to the nest site.

During the 2007/08 season cameras were installed on two nests on the upper Tauranga River while during the 2008/09 season cameras were installed on three nests.

Close-order monitoring

Radio telemetry was utilised to locate nests, determine females' habitat use and mortality during the vulnerable periods of nesting and during moult.

Radio transmitters weighing 24 grams (Advanced Telemetry Systems, USA) with weak-link backpack harnesses were fitted to adult females prior to the breeding season. Fitting of transmitters was carried out using best practice procedures as outlined in the Blue Duck Best Practice Manual (Blue Duck (Whio) Recovery Group 2004).

Eighteen transmitters were deployed on adult females during the 2007/08 breeding season; nine on the upper Tauranga River and nine on Te Waiiti Stream. On the upper Tauranga River transmitters were deployed in mid-August 2007 and were removed in mid June 2008. On Te Waiiti Stream transmitters were deployed in late-August 2007 and were removed in late-February 2008.

During the 2008/09 breeding season, 19 transmitters were fitted to adult females; nine on the upper Tauranga River and 10 on Te Waiiti Stream. Transmitters were deployed in late-August 2008 and removed in late-June 2009 on the upper Tauranga River and were deployed in late-August 2008 and removed in late-May 2009 on Te Waiiti Stream.

Not all females on were fitted with transmitters so only data collected from those pairs fitted with transmitters has been analysed.

Catching

The catching, banding and the attaching of transmitters of adults was carried out for the second year on the Tauranga River to aid a study relating to nesting success and adult female mortality. Catching was carried out on two occasions during this year: late August 2008 and late June 2009.

Over 30 feather samples were taken from both the Te Waiiti and the Upper Tauranga monitored populations during the catching surveys. These feather samples will provide DNA samples to establish the genetic links of management sites across New Zealand.

Iwi Partnership and Community Relations

Partnerships with local Tuhoe are being developed through their involvement in surveying and monitoring, advocacy, talks and specialised training.

5.4.4 Results

Walk-through surveys

Te Waiiti (Treatment)

25 territorial pairs were observed on Te Waiiti Stream during the 2008/09 season (Table 5.4.1).

Of the territorial pairs, 15 attempted nesting with two failures being observed. The cause of one failure was unknown while the other failure was attributed to a stoat predation. The 13 nests that successfully hatched resulted in 52 known hatchlings. Twenty seven juveniles survived to fledging age this season.

A chance encounter through the use of a predator dog resulted in the detection of a whio mortality site. The autopsy proved inconclusive; however, the predator dog indicated the presence of a stoat at the site.

Upper Tauranga (Non-Treatment)

Ten territorial pairs were observed on the upper Tauranga River during the 2008/09 season.

Of the 10 territorial pairs, five attempted to breed although no nests successfully hatched. All five nests succumbed to stoat predations.

Two mortalities occurred on the upper Tauranga River this season. One death was recognised as a stoat predation. The other female died early in the breeding season and was quickly replaced by another female. This death was thought to have resulted from a harrier or falcon.

Video-camera nest monitoring

A total of five nests were monitored by video surveillance on the upper Tauranga River over the study period.

During the 2007/08 breeding season only two nests were suitable for the installation of video cameras. One of these nests was on an island in the river bed and hatched successfully. The second nest failed; however, a memory card fault resulted in no footage being obtained.

During the 2008/09 breeding season three nests were suitable for the installation of video cameras. All three nests failed. Footage of stoats raiding the nests was captured at all three sites.

Close-order monitoring

Te Waiiti (Treatment)

Nesting

As no nests were monitored with cameras on Te Waiiti Stream all nests were monitored closely with physical checks.

In total 17 nesting attempts were observed on Te Waiiti Stream over both the 2007/08 and 2008/09 breeding seasons. Of the 17 attempts, six nests failed and 11 nests hatched successfully.

During the 2007/08 breeding season 11 nesting attempts from the nine females fitted with transmitters were monitored through physical checks. Six of the 11 nests hatched successfully while the other five nests failed. The cause of failure of two of these nests was not identified. One nest failed due to lost hunting dogs killing the incubating female. Scene examinations suggested that stoats caused the final two nest failures.

During the 2008/09 breeding season six attempts from the ten females fitted with transmitters were monitored through physical checks. Five of the six nests hatched successfully with only one failure being observed. A scene examination of the failed nests suggested that a stoat caused the failure.

Female Habitat Use and Mortality

Adult female movements and mortalities were observed through the use of radio transmitters on Te Waiiti Stream. Over the course of the study, eight of the 19 females fitted with transmitters on Te Waiiti Stream died.

Extensive use of side streams by specific individual females was observed on Te Waiiti Stream with many mortalities occurring up these side streams.

Three adult female mortalities were observed at the end of the 2007/08 season. Two of these mortalities were positively attributed to stoat predations while scene evidence found both harrier and stoat sign at the third mortality. All mortalities were observed in side streams outside of their territories on the main river.

Scene examinations of three adult female mortalities attributed their deaths to stoat predations on Te Waiiti Stream during the 2008/09 season. These mortalities occurred late in the breeding season as females neared moulting. Two of these mortalities were located up side streams away from the main river.

An adult female mortality due to a dog predation was observed on Te Waiiti Stream during the 2007/08 breeding season. This female was killed while on her nest incubating.

One adult female died during the 2008/09 breeding season after getting a stick lodged in her transmitter harness.

During the 2007/08 season one adult female disappeared from Te Waiiti Stream before her transmitter was removed. This female has not been located again.

Multiple observations were made of adult females using side streams throughout the duration of the study. Some individuals used side streams on a regular basis for roosting and foraging throughout the breeding season; however, most observations up side streams occurred late in the season or during the moult period.

Adult females were found in small streams as far as 3.5 kilometres from their territory on the main river. They were also found in small seeps at altitudes of 500m a.s.l.

One female fitted with a transmitter died after a stick became stuck in its transmitter harness.

Upper Tauranga (Non-Treatment)

Nesting

In total 11 nesting attempts were observed on the upper Tauranga River over the duration of the study. Of the 11 attempts, 10 nest failures occurred with only one nest hatching successfully.

Physical Nest Observations

Aside from those monitored with cameras six nests were monitored with regular physical checks over the study period.

During the 2007/08 breeding season one nest was monitored through physical checks. A scene examination suggested that the possible cause of this failure was due to disturbance by a cat.

Nesting was attempted on three other occasions during the 2007/08 season by various pairs. None of these three actual nest sites were precisely located resulting in no physical checks being carried out. One nest site was not visible due to its location deep inside a bank and failed without the cause being identified. The two other nests failed early, before nest sites were located. The cause of one failure was unknown while the other failure was assumed to be due to a stoat. This assumption was made by strong evidence found in the vicinity of the nest site.

During the 2008/09 breeding season two nests were monitored through physical checks. The first nest failed during the laying stage with a scene examination suggesting that a stoat caused the failure. The second nest failed during incubation with scene examinations again suggesting that a stoat caused the failure.

Female Habitat Use and Mortality

Adult female movements and mortalities were observed through the use of radio transmitters.

All adult females moved very little outside of their established territories on the main river during the study. The only observed use of side streams from adult females was late in the moult period when one bird was found about 400m up a side stream, away the main river.

One female died during the 2007/08 season. The scene examination and autopsy attributed this mortality to a stoat predation.

Two females died during the 2008/09 season. Scene examinations and autopsies of both mortalities suggested that one death was likely to be caused by a harrier or falcon while the other was caused by a stoat.

During the period between seasons when transmitters were not on females, two individuals disappeared from the monitored area of river. These individuals have not been observed again.

Catching

Te Waiiti (Treatment)

12 new adults were banded and transponded and 23 juveniles were transponded during the 2008/09 season. Eight territorial birds remained unbanded / transponded on Te Waiiti Stream at the end of the season.

Upper Tauranga (Non-Treatment)

Eight new adults were banded and transponded during the 2008/09 season. Three territorial adults remained unbanded and transponded at the end of the season.

Iwi Partnership and Community Relations

Ngai Tuhoe were involved on a number of occasions throughout the year including participating in surveys, and being involved with television programmes produced by TV3 (TV3 News) and TVNZ (Meet the Locals programme). The focus has been on the Rangitahi (youth) to develop an awareness and appreciation of this taonga. A Tuhoe trainee has been involved over the past three years in assistance with monitoring whio and has now reached a point of competency to be the team leader for the TUMI whio programme.

Table 5.4.1 Monitoring data for whio in the Te Waiiti Stream, Te Urewera Mainland Island, 1999/00 - 2008/09

	Survey distance	Pairs present	Singles	Pairs producing juveniles	Juveniles produced	Juveniles fledged
1999/00	20km	6	4	-	-	18
2000/01	20km	11	0	-	-	20
2001/02	20km	13	1	12	51	47
2002/03	20km	15	1	12	48	46
2003/04	20km	20	7	1	6	1
2004/05	20km	21	0	13	52	12
2005/06	20km	19	1	10	30	10
2006/07	20km	20		9	41	10
2007/08	20km	21		14	66	32
2008/09	20km	25	0	13	52	27
Total	-	-	-	-	385	236

* Survey distance was listed as 18 km in previous reports, however a re-calculation done recently has found the distance to be 20km

** Previously incorrectly reported as '31'

Table 5.4.2 Monitoring data for whio in the upper Tauranga River, Te Urewera Mainland Island, 1995/96 - 2008/09

Date	Survey Distance	Pairs	Singles	Pairs producing juveniles	Juveniles Produced	Juveniles Fledged
Mar-96	9km	4	0	-	-	1
Mar-00	9km	4	2	-	-	2
May-01	9km	3	0	-	-	0
Apr-02	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
2005/06	10km	8	?	2	9	7
2006/07	10km	10		4	12	7
2007/08	10km	11		1	6	3
2008/09	10km	10		0	0	0
Total	**-**	**-**	**-**	**-**	**70**	**49**

Table 5.4.3 Productivity of whio in the Te Waiiti (treatment) and upper Tauranga (non-treatment) sites, Te Urewera Mainland Island, 2008/2009

Study site	Survey distance (km)	Territorial pairs	Pair density (per km)	Pairs producing ducklings (%)	Pairs fledging young (%)	Number of known ducklings produced	Number known fledged young	Proportion young fledged (%)	Fledglings per total number pairs
Te Waiiti	20	25	1.3	52	36	52	27	52	1.1
Upper Tauranga	10	10	1	0	0	0	0	0	0

Table 5.4.4 **Comparative analysis of selected population parameters for whio in Te Waiiti (treatment) (2000/01 - 2008/09)* and the upper Tauranga River (non-treatment) (2002/03 – 2008/09), Te Urewera Mainland Island**

Study site	Survey distance (km)	Mean territorial pairs	Mean pair density (per km)	Mean pairs producing young	Mean juveniles produced per pair	Mean fledglings per pair	Mean chicks produced	Mean fledged young	Mean fledged young
Te Waiiti	20	17.1	0.9	63%	2.3	1.6	48.6	24.7	53%
Upper Tauranga	10	8.3	0.83	31%	1.3	0.9	10.0	6.6	53%

* In 2003/04 river levels were too high gather breeding data therefore the data has been excluded from this analysis.

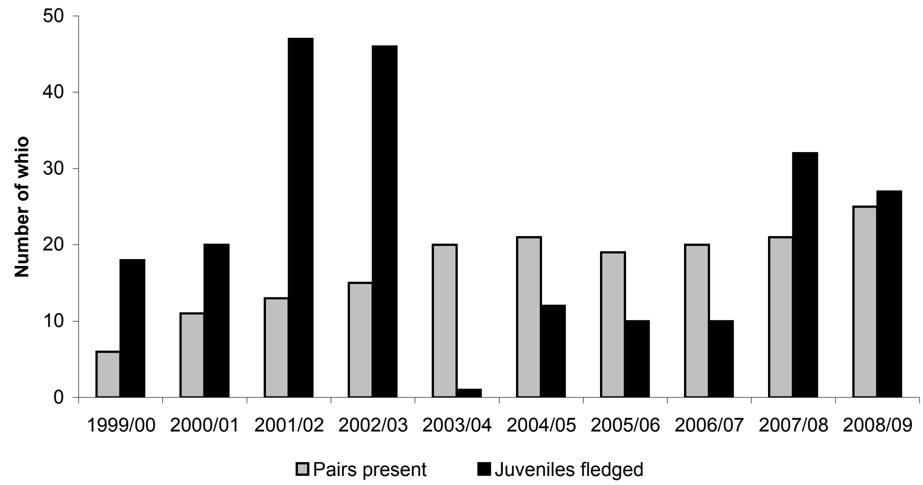
Table 5.4.5 **Comparative nesting success and female survival of whio in Te Waiiti (treatment) (2000/01 - 2008/09) and the upper Tauranga River (non-treatment) (2002/03 – 2008/09), Te Urewera Mainland Island**

River	Season	Females with transmitters	Nesting Attempts	Nest failures: Cause of nest failure				Nest failures: Total	Female mortalities: Causes of female mortality					Female mortalities: Total	Use of side streams
				Stoat	Cat	Dog	Unknown		Stoat	Harrier	Dog	Management	Unknown		
Tauranga	2007/08	9	6	2	1		2	5	1					1	minimal
Tauranga	2008/09	9	5	5				5	1	1				2	minimal
Tauranga	Total	18	11	7	1		2	10	2	1				3	
Te Waiiti	2007/08	9	11	2		1	2	5	2		1		1*	4	extensive
Te Waiiti	2008/09	10	6	3		1	2	6	3			1		4	extensive
Te Waiiti	Total	19	17	5		2	4	11	5		1	1	1	8	
All birds	**Both**	**37**	**28**	**12**	**1**	**2**	**6**	**21**	**7**	**2**	**2**	**2**	**1**	**11**	

* Harrier and stoat sign found with carcass; however cause of death could not be clearly attributed to either predator

Figure 5.4.2

Whio pair and fledgling numbers, Te Waiiti Stream, Te Urewera Mainland Island, 1999/00 – 2008/09



5.4.5 Discussion

From previous monitoring and the recent close order study it has been established that the population dynamics, survival and demographics of whio is unique and complex. Not only does this research change the definition of whio habitat use it has also provided insight into their vulnerability to stoat predation during key stages of their life cycle.

The video surveillance shows the vulnerability of whio to stoat attacks whilst sitting on the nests and that stoats are the main cause of nest failure. However, they were at their most vulnerable during the moult period and the observations through this monitoring period provided insights into the behavioural characteristics of moulting females. They appear to become more cryptic by retreating into small streams and headwaters where they can moult and grow new feathers, but by doing so they lose two of their natural defence mechanisms, flight and the use of the water, making them more vulnerable to stoat predations. Losing these breeding females is especially devastating to the viability of this population.

Tracking of adult females again highlighted the use of side streams, especially after the breeding season when adults are in moult. The high use of side streams coincided with a high mortality rate of adult females. Two carcasses were recovered well away from the main river, up side streams. These behaviours supported those observed in the 2007/08 season. Two females were killed within the stoat control boundaries while the other was killed outside. One female was killed by a stoat within the Otamatuna Core Area while another female was killed just within the boundary of the Mangaone Core Area. A small number of the territorial pairs without transmitters were only encountered on a few occasions. It is thought that they too are using side streams on a regular basis.

The dog predation event documented and substantiated the threat that uncontrolled and wild dogs pose to nesting females. Females are typically reluctant to leave nests even when a predator is close making them extremely vulnerable to dogs.

Whio management requirements are complex by the scale of the area that needs to be treated to secure and recover their populations. However, the management solution is quite simple to ensure their recovery: stoat control matching their demographics and habitat use will ensure their long-term security from extinction.

5.4.6 Acknowledgements

Brenda Bailey, Stu Cockburn, Sonny Biddle, Bella Biddle, Harangi Biddle, Hallis Hiroki, Nicola Etheridge, Mike Bodie, Hemi Barsdell, Teopara Hutchings and Spady Kutia.

5.5 MISTLETOE (HEMI (JAMES) BARSDELL)

5.5.1 Introduction

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).

Red mistletoe, or pirirangi (*Peraxilla tetrapetala*), *Alepis flavida* (alepis, yellow-flowering mistletoe) and scarlet mistletoe (*Peraxilla colensoi*) are the mistletoe species known to exist in the northern Te Urewera. Pirirangi is hosted primarily upon *Quintinia serrata* (tawherowhero) but is also present on red beech (*Nothofagus fusca*) and hard beech (*Nothofagus truncata*). Alepis is also hosted on red and hard beech, and is found rarely on black beech (*Nothofagus solandri*). Scarlet mistletoe is present in very low numbers on silver beech (*Nothofagus menziesii*).

5.5.2 Objectives

The objective for this season was:

- To monitor host tree and mistletoe health at Pakoakoa, Otamatuna, Ogilvies, Oruamananui and Okopeka.

5.5.3 Methods

Monitoring this season focused on host tree and *Peraxilla tetrapetala* health at Pakoakoa, Otamatuna, Oruamananui, Okopeka; and host tree and *Alepis flavida* health at Ogilvies.

Pakoakoa, Otamatuna and Ogilvies (Otamatuna) are Core Area sites where annual possum control to low levels is undertaken; Oruamananui is a Background Area site where possum control is undertaken every few years; Okopeka is the non-treatment comparison site for mistletoe monitoring (Figure 5.5.1).

The health of mistletoe plants and host trees was assessed using a Foliar Browse Index (FBI) method adapted from Knightbridge (2002). Attributes scored for host trees included: foliar density, dieback and borer. Attributes measured for mistletoe plants included: foliar density, possum browse, insect browse, width, height and dieback.

Only plants that were clearly visible from the ground were scored.

At all sites except Ogilvies, a recruitment rate was derived by surveying tagged potential or actual host trees for the presence of mistletoe. Data presented in this report was collected in previous years. At Ogilvies, an approximate level of recruitment was obtained by thorough searching of the area by an experienced field observer.

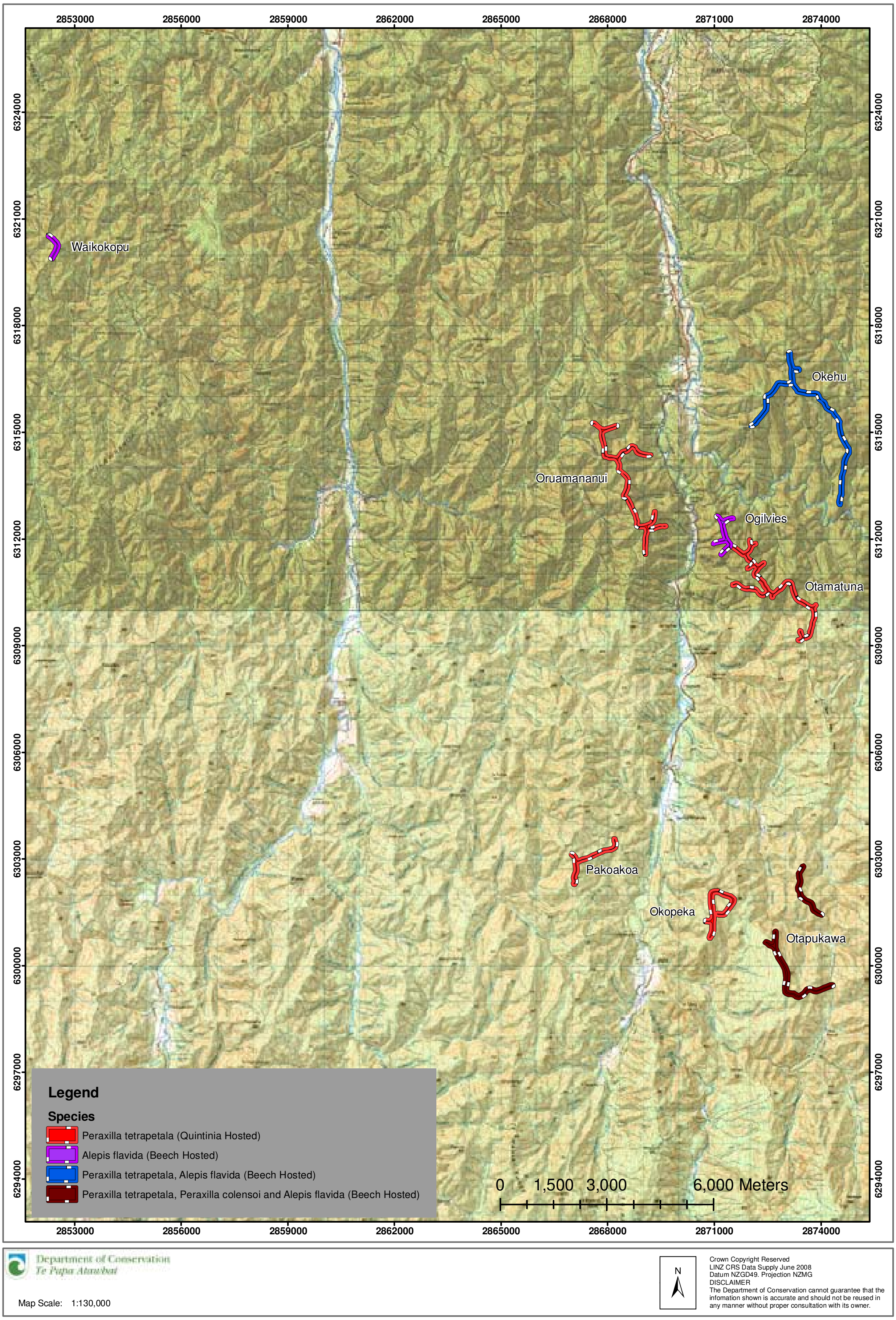


Figure 5.5.1 Mistletoe monitoring sites, Te Urewera Mainland Island, 2008/09

The data for mistletoe mortalities attributable to possums is derived from the decline in foliar cover and increase in dieback for individual plants. This contrasts to mortalities attributable to 'natural causes' (e.g. host tree death, wind throw). Here an assumption is made that natural dieback would be at a very low rate and that significant dieback would be caused by possums. Interpreting the data should be done with caution as mortality rates could be significantly over-estimated when samples sizes are small.

5.5.4 Results

Possum monitoring results for the areas in which mistletoe were monitored are presented in Appendix 9.5.

Comparative results of mistletoe foliar density and dieback for this season against previous season's results are presented in Figures 5.5.2 to 5.5.6.

At both Otamatuna and Pakoakoa, scores for both foliar density and dieback have remained constant and at low levels respectively.

Results from the Background Area site of Oruamananui show an increasing level of dieback and a decreasing level of foliar density. There has been no possum control at this site for the past three seasons.

Results show decreasing dieback scores and increasing foliar density score of alepis plants at Ogilvies. Possum control in this area has improved in recent years, particularly with the establishment of a kill-trapping regime in the entire Otamatuna Core Area (of which Ogilvies is part).

(Probable) possum-induced mortality of mistletoe plants at Okopeka has seen the sample size reduce from 13 in 2004/05 to three in 2008/09. Dieback and foliar density scores from this season are low and high respectively but they are based on a small sample (n=3): the few remaining mistletoes are currently in good condition on average.

Figure 5.5.2

Mean foliar density and dieback scores for *Peraxilla tetrapetala*, Otamatuna Core Area, Te Urewera Mainland Island, 2004/05 – 2008/09

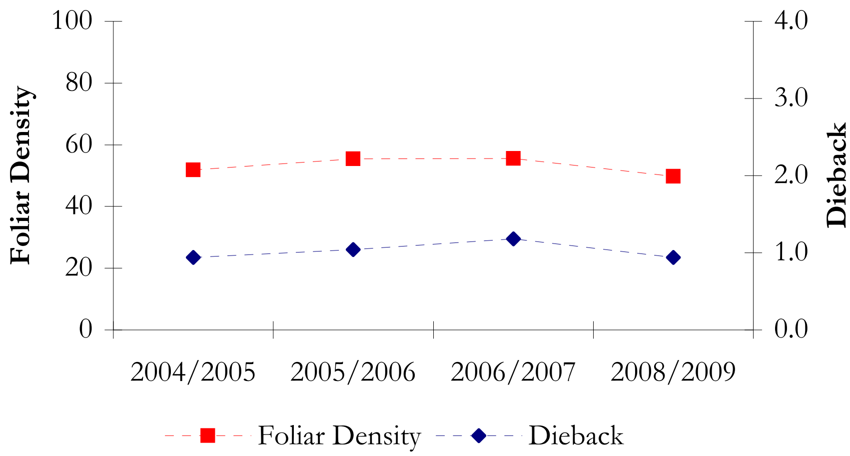


Figure 5.5.3

Mean foliar density and dieback scores for *Peraxilla tetrapetala*, Pakoakoa Core Area, Te Urewera Mainland Island, 2006/07 – 2008/09

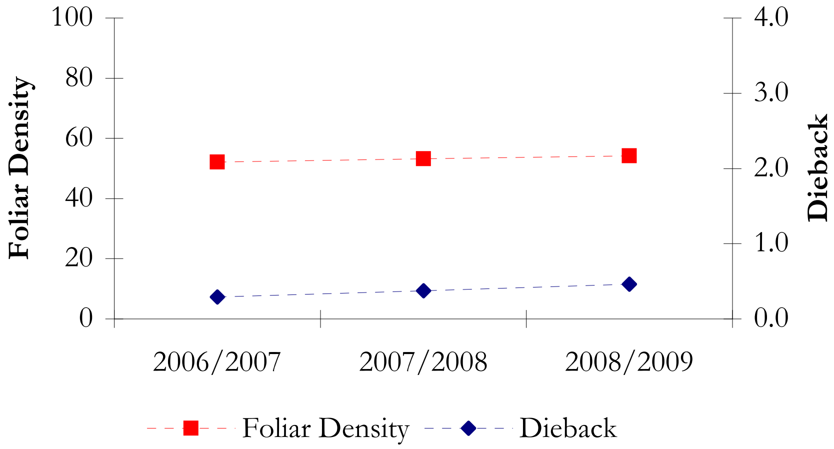


Figure 5.5.4

Mean foliar density and dieback scores for *Peraxilla tetrapetala* at Oruamananui (Background Area), Te Urewera Mainland Island, 2006/07 – 2008/09

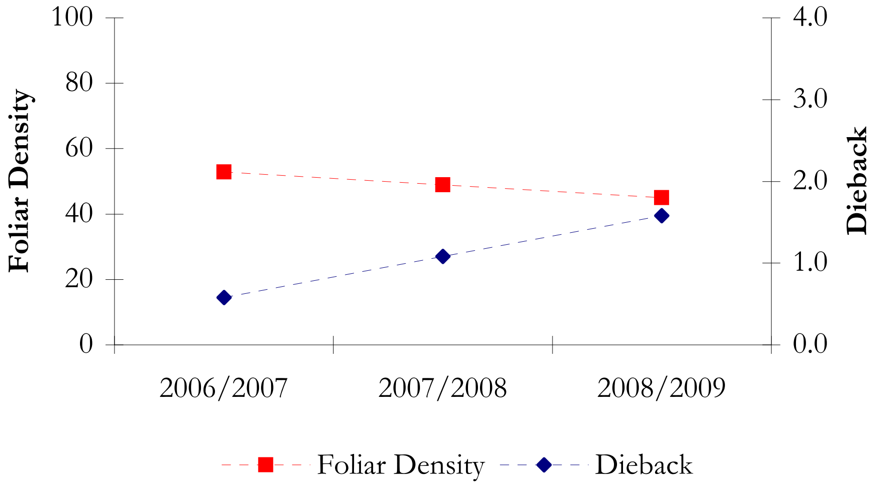


Figure 5.5.5

Mean foliar density and dieback scores for *Alepis flavida* at Ogilvies, Otamatuna Core Area, Te Urewera Mainland Island, 2005/06 – 2008/09

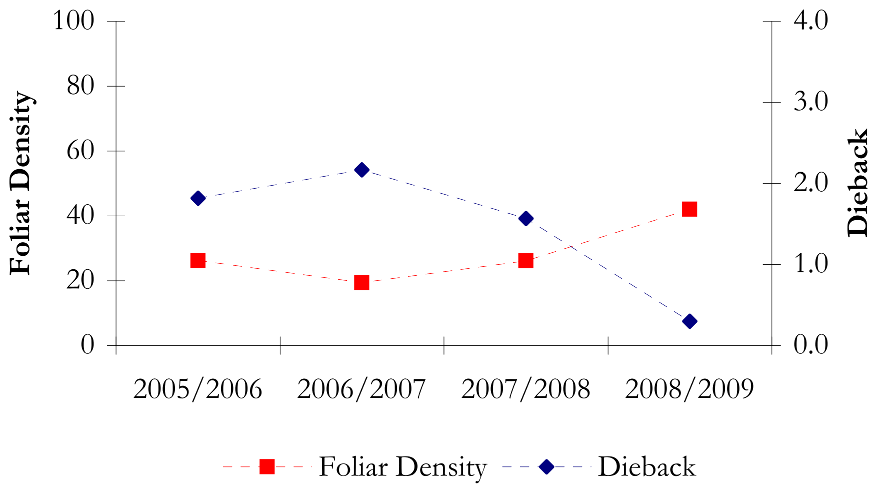
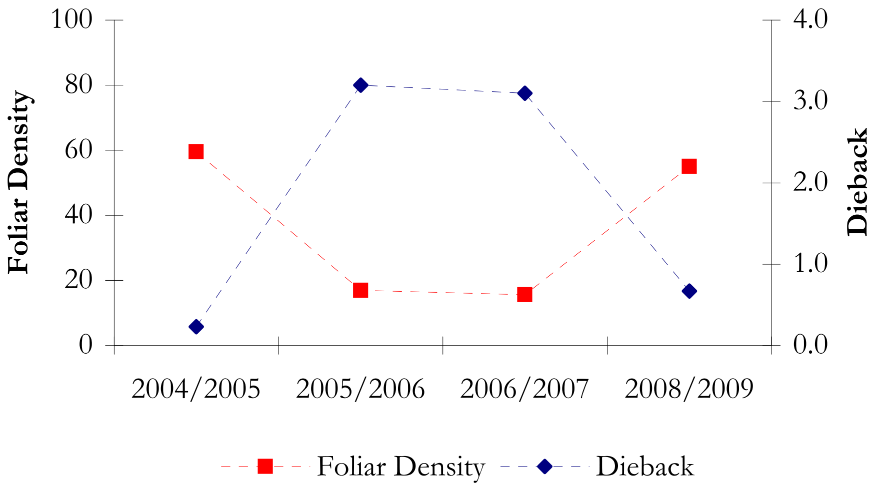


Figure 5.5.6

Mean foliar density and dieback scores for *Peraxilla tetrapetala* at Okopeka (comparison site), Te Urewera Mainland Island, 2004/05 – 2008/09



Data in Table 5.5.1 reflect the impact of possums on mistletoe abundance under different management regimes.

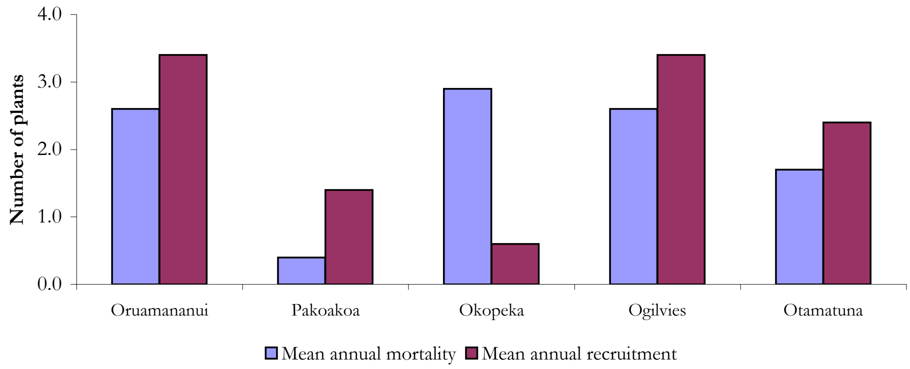
A positive relationship between mortalities and recruitments is shown at all but one of the sites (Figure 5.5.7). At Okopeka a negative relationship is shown; here, there has been considerably more mortalities than new plants recruited. Over the past 8 years, the population has decreased from 19 plants in 2000/01 to two plants in 2008/09.

Table 5.5.1 Proportion of mistletoe mortality attributable to possums at Otamatuna Core Area, Pakoakoa Core Area, Oruamananui (Background Area), Ogilvies (Otamatuna) and Okopeka (comparison site), Te Urewera Mainland Island, 2001/02 – 2008/09

Site	Monitoring period	Number of plants	Number dead	Population mortality due to possums (%)
Otamatuna	1999/00 - 2008/09	96	15	5
Pakoakoa	2003/04 - 2008/09	25	2	4
Oruamananui	2003/04 - 2008/09	49	7	12
Ogilvies	2001/02 - 2008/09	56	18	32
Okopeka	2000/01 - 2008/09	23	21	57

Figure 5.5.7

Mortality and recruitment rates of mistletoe at Otamatuna Core Area, Pakoakoa Core Area, Oruamananui (Background Area), Ogilvies (Otamatuna) and Okopeka (comparison site), Te Urewera Mainland Island, 2001/02 – 2008/09



5.5.5 Discussion

The effect of continued low possum densities on mistletoe population health has been shown to be highly beneficial. Mistletoe at the two sites (Otamatuna and Pakoakoa) where possum control has been most consistent (i.e. annual control to low levels) have good population characteristics including high foliar density, low dieback and high recruitment. In contrast, at Oruamananui where possum control is less frequent, the mortality rate due to possum browse is higher; and even more conclusively, at Okopeka where there is no possum control, there is an extremely high mortality rate due to possum browse.

The benefit of intensive control for beech-hosted mistletoe can be seen at Ogilvies. Prior to intensive possum control commencing in 2006/07, possum densities of 10% RTC resulted in moderate levels of dieback and mortality. Monitoring in 2008/09 however, showed an improvement in alepis population health due to the increase in possum control effort which started in 2006/07 and continued through to 2008/09.

The biannual possum control regime at the Oruamananui area was shown in 2006/07 to be maintaining mistletoe there in a healthy state. Possum densities had been reduced to 5% RTC biannually for the seven years prior to monitoring in 2006/07. Monitoring this year however, showed a reduction in mistletoe health there due to a lack of possum control since the 2005/06 financial year. This lack of control occurred due to a reprioritisation of possum control funding to others parts of the project. The decrease in mistletoe health at Oruamananui is indicative that a four year possum control rotation is not sufficient for maintaining quintinia-hosted *Peraxilla tetrapetala*. To some extent, it reflects a tolerance threshold of possum control (to low levels) at a frequency no less than once every three years. Further possum control at Oruamananui (which is proposed in upcoming years) should see a recovery in health for this population; it is proposed to continue monitoring at this site until 2010/11.

The population reduction at Okopeka highlights an unsustainable rate of population reduction. This rate of reduction will ultimately result in the local extinction of quintinia-hosted mistletoe at this site. This also reflects a trend of mistletoe population reduction in uncontrolled sites in the northern Te Urewera since the introduction of possums.

5.6 DEER IMPACTS (GREG MOORCROFT AND PETE LIVINGSTONE)

5.6.1 Introduction

Red deer (*Cervus elaphus scoticus*) have been shown to impact on the regeneration of favoured (or palatable) understorey plant species and to greatly reduce the density of these species within the forest types of the northern Te Urewera. The reversal of this pattern is the long-term aim of deer control within TUMI (Shaw et al. 1996). Extensive background information to the northern Te Urewera deer control program and the associated outcome monitoring is found in previous annual reports (Beaven et al. 1999, 2000).

This season was the eleventh year in which seedling/pellet transect lines have been used to measure changes in deer abundance and impacts within the Otamatuna Core Area. Deer control operations within Otamatuna began in 1998/99 and are undertaken over a 2494 hectare area called the Otamatuna Deer Control Area (OCDA) (Section 4.5). Seedling and pellet abundance are also measured in Onepu Core Area where no management of deer is done.

Pellet lines established by the former New Zealand Forest Service (NZFS) were measured in both Otamatuna as well as the greater Onepu/Ohora/Pohatu catchments where no deer control is undertaken.

The current target for deer control is the removal of a minimum of 70 deer (Section 4.5). This target was based on concerns that palatable seedling densities were falling in the OCDA and that a minimum number of deer needed to be set in order to better gauge the impacts of this deer control.

5.6.2 Objectives

- To measure the effect of deer control in the Otamatuna Core Area (Otamatuna Deer Control Area) on the abundance of palatable seedlings.
- To assess the abundance of deer in the Otamatuna and Onepu Core Areas and within the Ohora Stream catchment.

5.6.3 Methods

Seedling/pellet transects were established within the bait station grids (current Inner Core Areas) of both Otamatuna and Onepu Core Areas in November 1998 (1998/99). These lines, which were permanently marked, have been re-measured in every subsequent year up to and including 2008/09.

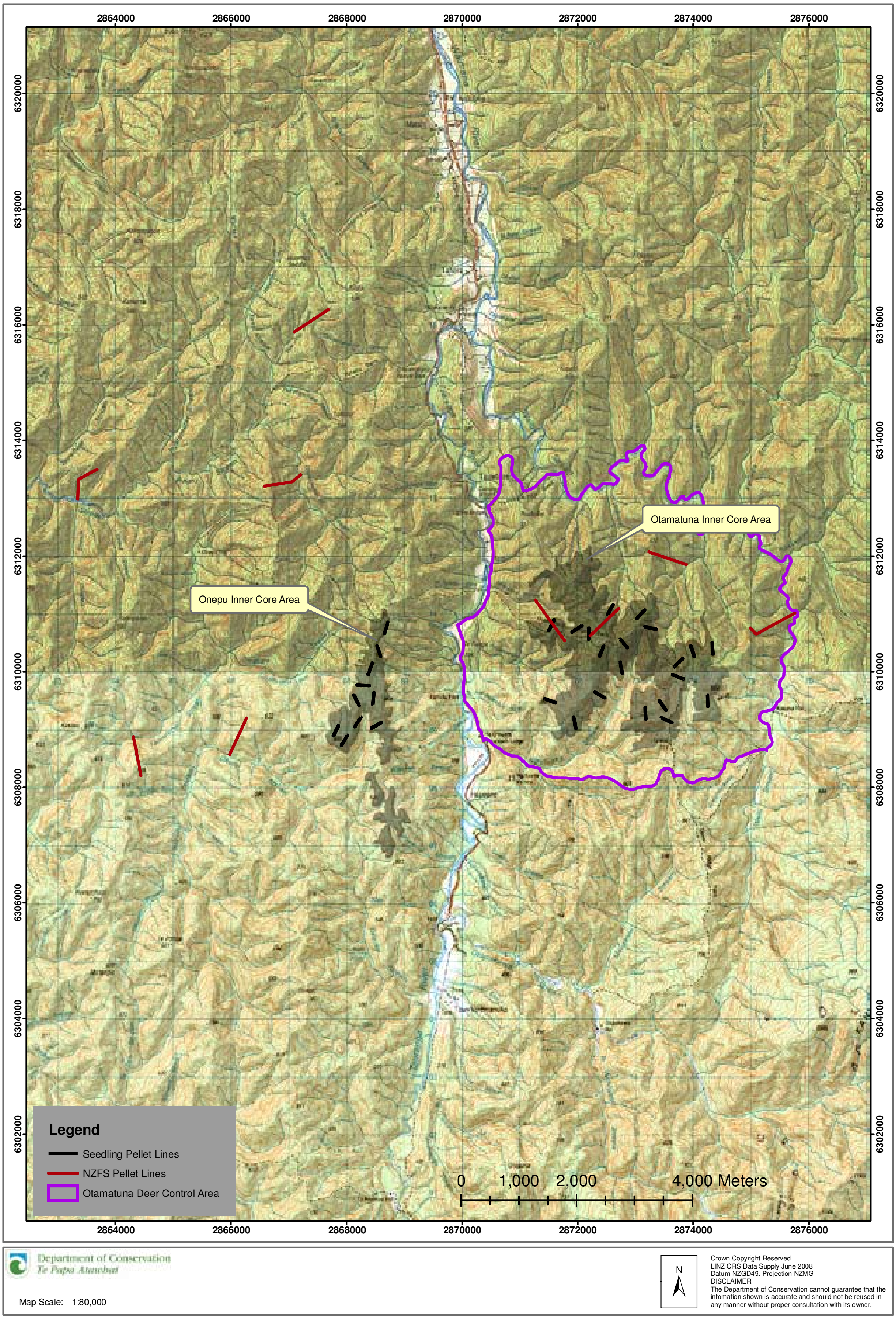


Figure 5.6.1 , Location of seedling/pellet lines, New Zealand Forest Service pellet lines and the Otamatuna Deer Control Area Te Urewera Mainland Island, 2008/09

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.

There are 20 lines (400 plots) located in Otamatuna and 10 lines (200 plots) located in Onepu (Figure 5.6.1).

To increase the sample size, the results for the most abundant palatable species have been added together for each year. The species used were *Coprosma grandifolia, C. lucida, C. tenufolium, Fuchsia excorticata* (fuchsia), *Geniostoma ligustrifolium* (hangehange), *Melicytus ramiflorus* (mahoe) and *Schefflera digitata* (pate).

The methodology for measuring the NZFS pellet lines is described in a previous TUMI 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 (Figure 5.6.1).

Seedling/pellet lines in Otamatuna were measured in November 2008 and January 2009 and in Onepu in January 2009. NZFS lines in the Ohora catchment were measured in February 2009 and in Otamatuna in January and February 2009.

5.6.4 Results

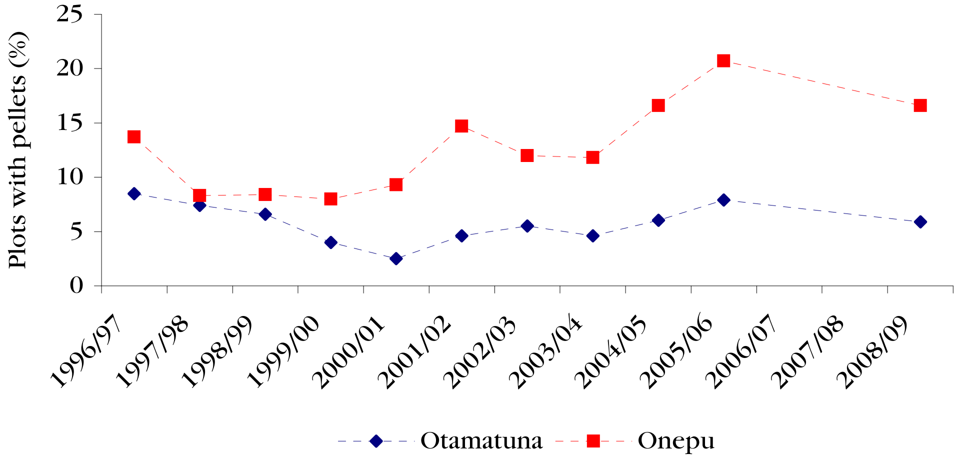
NZFS Pellet Lines

The clear difference in deer abundance between Otamatuna (deer control) and Onepu (non-treatment) as shown by the number of pellets in plots on New Zealand Forest Service pellet lines is demonstrated in Figure 5.6.2. Note that data from 2006/07 and 2007/08 has not yet been analysed and therefore is not included.

Year-to-year variations appear to be reflected in the data from both sites.

Figure 5.6.2

Mean percentage (per line) of plots with deer pellets for New Zealand Forest Service lines at Otamatuna (deer control) and Onepu Core Areas (non-treatment), Te Urewera Mainland Island, 1998/99 – 2008/09

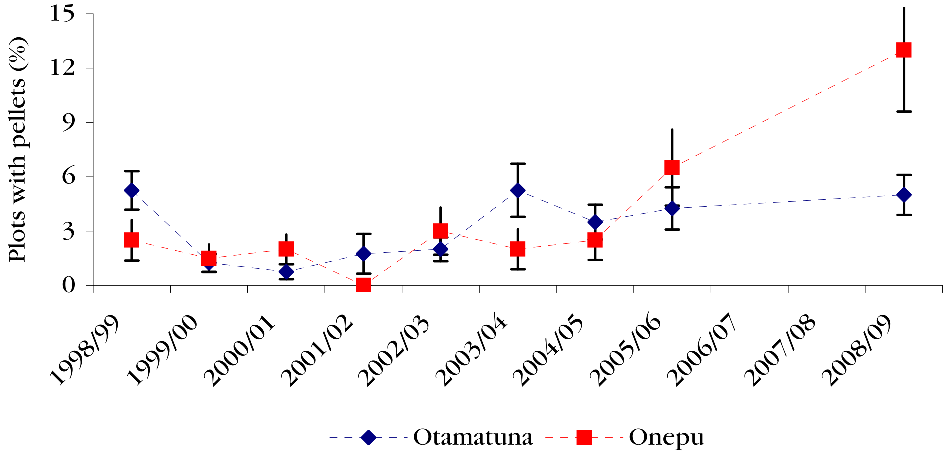


Deer Abundance (Seedling/Pellets Lines)

The differences in deer abundance between Otamatuna (deer control) and Onepu (non-treatment) as shown by the number of pellets in plots on seedling/pellet lines were significant for this season but this has not always been the case in the past. Note that data from 2006/07 and 2007/08 has not yet been analysed and therefore is not included.

Figure 5.6.3

Mean percentage (per line) of plots with deer pellets for seedling/pellet transects at Otamatuna (deer control) and Onepu (non-treatment) Core Areas, Te Urewera Mainland Island, 1998/99 – 2008/09

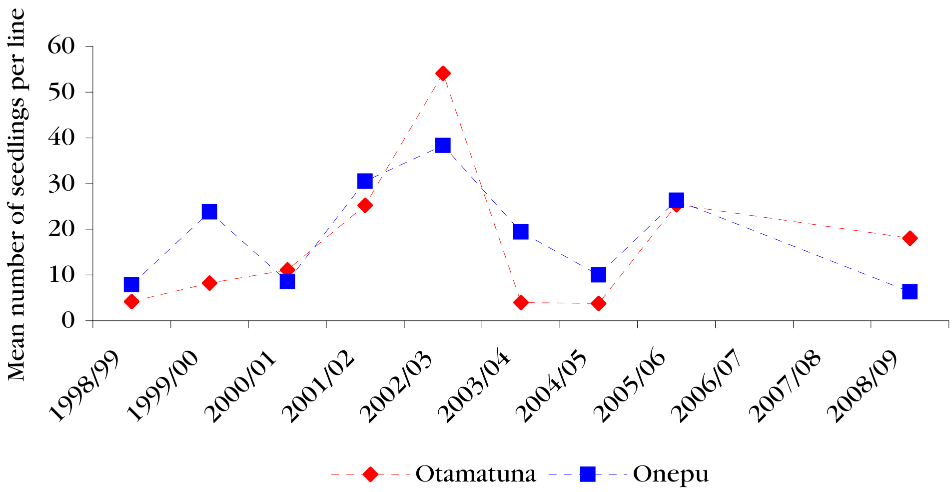


Palatable Seedling Abundance

This season, there was a significant difference in the mean number of palatable seedlings per line at Otamatuna (treatment) than at Onepu (non-treatment) (Figure 5.6.4).

Figure 5.6.4

Mean number of palatable seedlings per line at Otamatuna (deer control) and Onepu (non-treatment) Core Areas, Te Urewera Mainland Island, 1998/99 – 2008/09

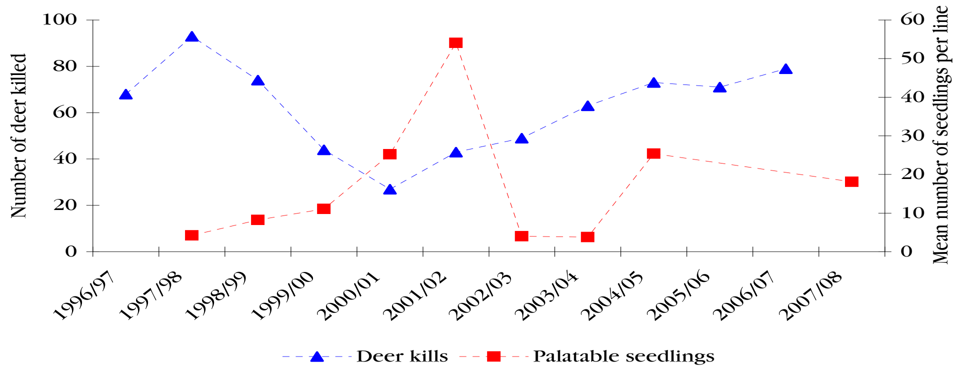


Relationships between management and outcomes

From the data presented in Figure 5.6.5, the relationship between the number of deer killed and the abundance of palatable seedlings does not appear to be a direct one. In recent years, when a consistent number of deer have been killed in the management area, palatable seedling abundance has not increased proportionally. Note that data from 2006/07 and 2007/08 has not yet been analysed and therefore is not included.

Figure 5.6.5

Mean number of palatable seedlings per line and the number of deer killed in the Otamatuna Core Area, Te Urewera Mainland Island, 1997/98 – 2008/09



There appears to be an inverse relationship between deer abundance (as shown by pellets in seedling/pellet lines) and the number of palatable seedlings at both Otamatuna (Figure 5.6.6) and Onepu (Figure 5.6.7). Note that data from 2006/07 and 2007/08 has not yet been analysed and therefore is not included.

Figure 5.6.6

Mean number of palatable seedlings per line and mean number of plots (per line) with deer pellets at Otamatuna Core Area, Te Urewera Mainland Island, 1998/99 – 2008/09

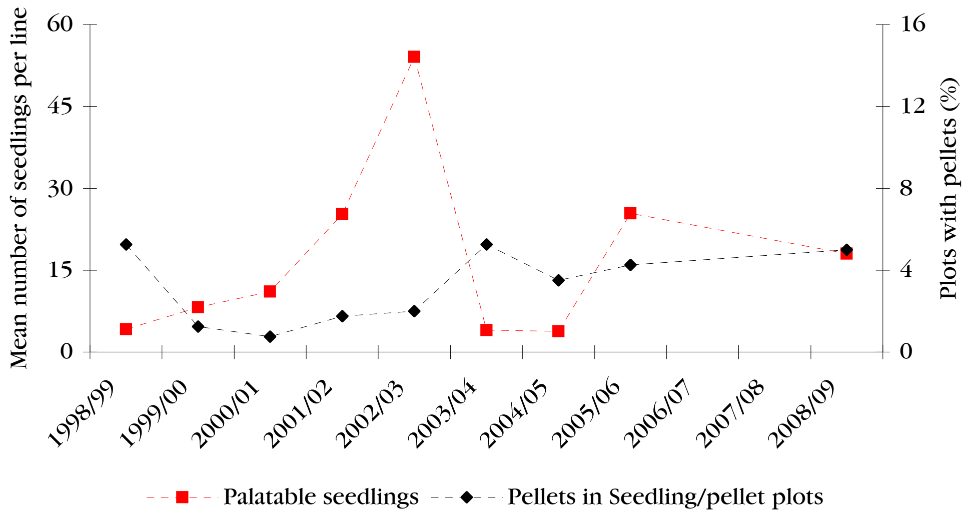
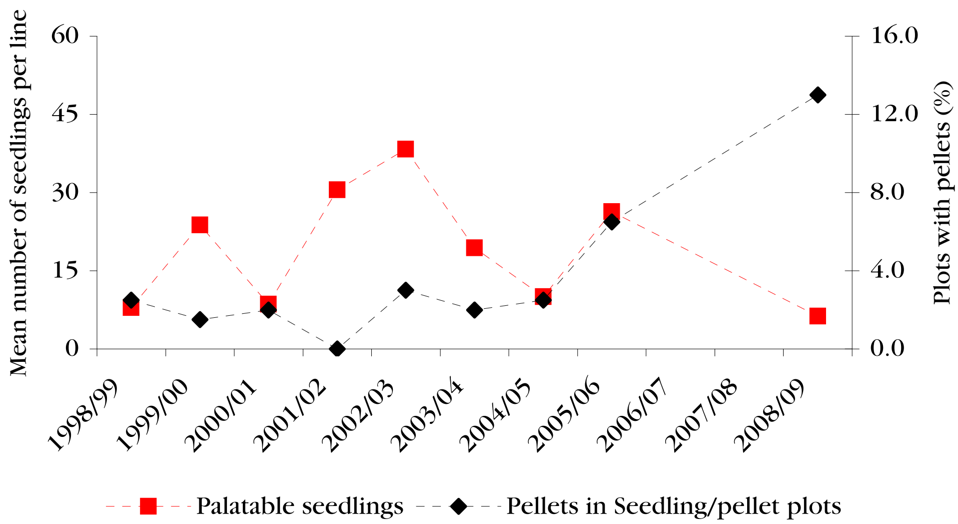


Figure 5.6.7

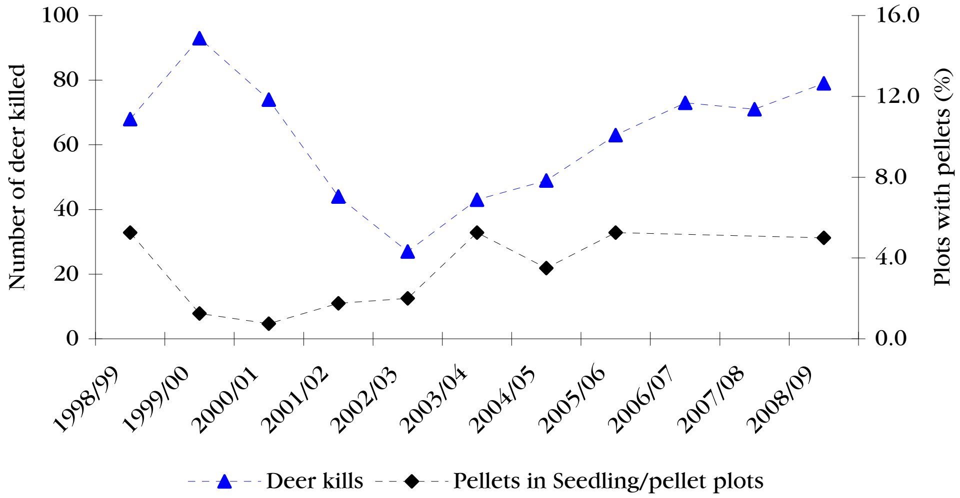
Mean number of palatable seedlings per line and mean number of plots (per line) with deer pellets at Onepu Core Area, Te Urewera Mainland Island, 1998/99 – 2008/09



The expected result of decreasing deer abundance with increasing deer kills is not wholly apparent in results from Otamatuna presented in Figure 5.6.8. Note that data from 2006/07 and 2007/08 has not yet been analysed and therefore is not included.

Figure 5.6.8

Number of deer killed and the proportion of plots (per line) with deer pellets for seedling/pellet transects, Otamatuna Core Area, Te Urewera Mainland Island, 1998/99 - 2008/09



5.6.5 Discussion

As discussed in previous annual reports (e.g. Moorcroft et al. 2007), the context for deer control in northern Te Urewera has changed markedly over the time that data presented here has been collected. There has been varying effort and success for deer control during that period although the outcome (palatable seedling abundance) and result (deer abundance) monitoring has been consistently done. However, the cessation of commercial deer recovery coupled with the reduction in recreational hunting (although this is based on anecdotal knowledge) has meant, in theory at least, the abundance of deer in the area where no management is undertaken should have increased. This hypothesis appears to be well supported by deer abundance monitoring at non-treatment sites within the project.

Ultimately managers of this project want to fully understand the relationships between a particular level of control, the abundance of deer and the abundance of palatable seedlings. It is apparent that understanding such relationships needs not only consistent monitoring and management effort (especially to ensure the target number of deer are killed) but also a suitable time frame to allow significant changes to be detected.

As above, previous pressures limiting deer recovery have eased over the past decade, and deer are more abundant in unmanaged areas. Although deer have been managed within Otamatuna Core Area, it is of relatively small size compared to the surrounding area. Therefore, it is reasonable to assume that as deer numbers have increased outside the managed area, there has been a corresponding increase in invasion pressure on Otamatuna thereby confounding the effects of management as measured in the result and outcome monitoring. Results show that even while hunting effort and the number of deer killed has increased, the number of deer has not continued to reduce, further supporting the hypothesis that deer invasion is compensating for the culling within the management area. This scenario would also explain why the palatable seedling abundance at Otamatuna has reduced even with increasing kill tallies.

The current management target of 70 deer killed was a best-guess figure set in 2007/08 based on results up to that time. Before any changes to management targets are made it will be useful to consider what trends are apparent in deer abundance in the wider northern Te Urewera, as well as the effects of management on deer and palatable seedling in Otamatuna. To determine these trends it would be appropriate to continue deer control within Otamatuna at the current level for a further two or three years to gain a more complete data set. Deer control would need to be adequately resourced and the current monitoring regime should continue on an annual basis to inform about the control outcomes.

5.6.6 Recommendations

- Maintain management target of 70 deer kills in the Otamatuna Deer Management Area for at least the 2009/10 and 2010/11 financial years.
- Continue with monitoring regimes on an annual basis including assessing palatable seedling abundance at Otamatuna and Onepu, and deer abundance on seedling/pellet and NZFS pellet lines in treatment and non-treatment sites.

5.7 CANOPY CONDITION (GREG MOORCROFT)

5.7.1 Introduction

The Foliar Browse Index (FBI) has been used in Te Urewera Mainland Island (TUMI) since 1998/99 to assess changes in canopy cover of trees species vulnerable to possum browse. In this period the foliage cover parameter has provided the most consistent and verifiable data and that is what this report concentrates on.

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 of 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.

5.7.2 Objectives

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

5.7.3 Methods

Within the six possum management areas (Section 4.2) there are 37 marked FBI lines grouped into 12 locations (Figure 5.7.1). Since 2007/08 the groups of lines have been divided into blocks of east and west with the trees in each block (except Otamatuna) being measured each alternate year (Table 5.7.1); Otamatuna is assessed each year.

This season, the trees in the east block were measured.

The methodology used in scoring trees followed Payton et al (1997). The foliage cover was scored using a cue card to estimate percentage of tree with canopy cover. All other FBI parameters were recorded but they are not reported on here.

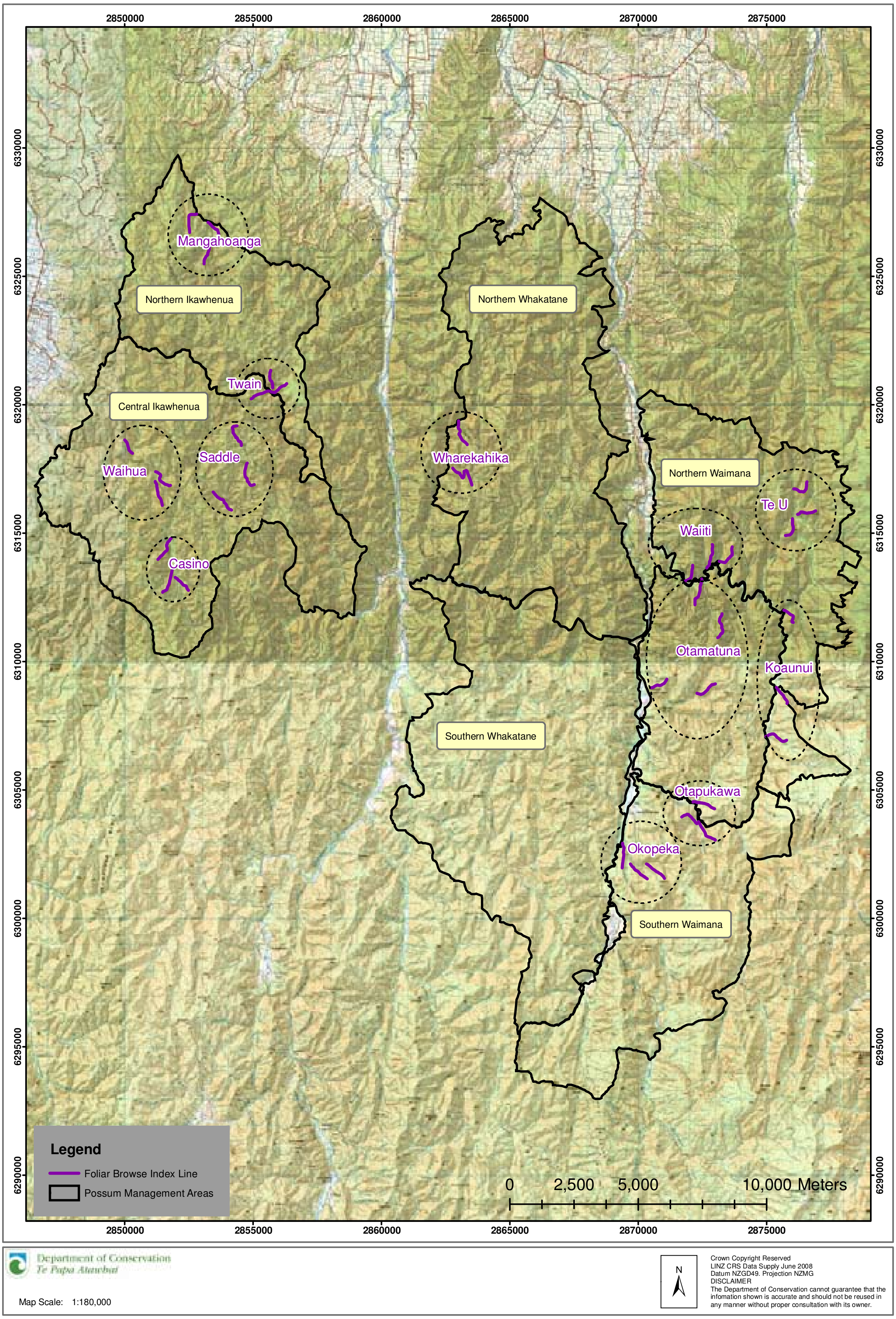


Figure 5.7.1 Location of groups of Foliar Browse Index monitoring lines within possum control areas and the non-treatment area (Okopeka), Te Urewera Mainland Island, 2008/09

Table 5.7.1 Location and year measured for Foliar Browse Index lines in Te Urewera Mainland Island, 1998/99 – 2008/09

Line Group	Block	Possum Management Area	Years Measured 1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2206/07	2007/08	2008/09
Saddle	West	Central Ikawhenua	✓		✓	✓	✓	✓	✓	✓	✓	✓	
Waihua	West	Central Ikawhenua	✓		✓	✓	✓	✓	✓	✓	✓	✓	
Casino	West	Central Ikawhenua	✓		✓		✓	✓	✓	✓	✓	✓	
Twain	West	Northern Ikawhenua	✓	✓	✓		✓	✓	✓	✓	✓	✓	
Mangahoanga	West	Northern Ikawhenua	✓	✓	✓		✓	✓	✓	✓	✓	✓	
Wharekahika	East	Northern Whakatane		✓	✓		✓	✓	✓	✓	✓		✓
Te U	East	Northern Waimana	✓	✓	✓		✓	✓	✓	✓	✓		✓
Te Waiiti	East	Northern Waimana	✓	✓	✓		✓	✓	✓	✓	✓		✓
Koaunui	East	Northern Waimana	✓	✓	✓		✓	✓	✓	✓	✓		✓
Otamatuna		Otamatuna Core Area	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Okopeka	East	Non-treatment	✓	✓	✓		✓	✓	✓	✓	✓		✓
Otapukawa	East	Southern Waimana	✓	✓	✓		✓	✓	✓	✓	✓		✓

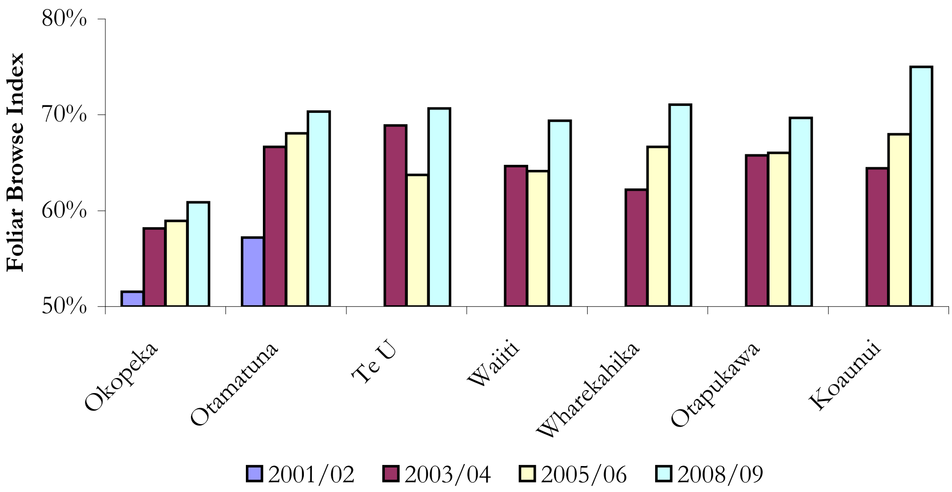
5.7.4 Results

The data presented in Figure 5.7.2 indicate that there are differences in canopy condition both between treatment and non-treatment sites, and over time at each site.

The mean score for canopy condition at Okopeka (comparison site) in 2008/09 was 61%, compared to 70% at Otamatuna Core Area and 71% for all Background Area sites measured.

Figure 5.7.2

Selected Foliar Browse Index results at Okopeka (comparison site), Otamatuna Core Area, and Background Area sites in Te Urewera Mainland Island, 2001/02 to 2008/09



5.7.5 Discussion

Data presented this year as well as analysis presented in previous reports (e.g. Moorcroft et al. 2007) indicate that the previous possum control regimes were adequate for protecting canopy condition. While it appears that canopy condition (especially tawhero (=kamahi)) as well as tawa is reasonably resistant to browse when possums are at low to mid-level abundance, it is clear that when possums are at relatively high abundances, canopy condition suffers to the extreme of tree mortality for some trees. As discussed in Section 4.2, the emphasis on possum control within TUMI has shifted to Core Areas in recent years, although there remains a commitment (in the draft Strategic Plan) to continue to control possums in the Background Area (this is further discussed in Sections 2.2 and 3.2). As part of this commitment there is a requirement to maintain a monitoring programme. However, considering that there will likely be changes in the way possums are controlled in the Background Area, it would be appropriate to review the monitoring programme in the near future.

Possum control in Core Areas will remain a priority and it would be useful at this stage to continue annual measurement of canopy condition at Otamatuna, although this recommendation is subject to any findings of a review. The possum control at Otamatuna has been improved since 2006/07 and it is expected that future results will be comparable to this year's or better again. Annual measurement of trees at Okopeka should likewise remain part of the programme (subject to the outcomes of any review).

5.7.6 Conclusions and Recommendations

Previous possum control regimes have been successful at maintaining canopy condition in the Background Area and in Core Areas.

Changes in possum control regimes as well as other reasons raise the need for a review of the monitoring regime.

It is recommended to:

- Review the monitoring programme for canopy condition.
- In lieu of a review being undertaken, continue the current monitoring regime of annual measurements at Otamatuna and Okopeka and biennial measurements in the two Background Area groups of lines.

6.0 Community Awareness and Participation

6.1 PUBLIC AWARENESS

The community relations ranger has played an important role in nurturing relationships with the local Waimana and Matahi Valley communities. Children from the Waimana School enjoyed an overnight trip to the Otamatuna Hut, and undertook activities such as GPS tracking, kiwi monitoring, and kokako spotting. The children displayed genuine interest and enthusiasm towards the project and environment.

Several local, national, and international volunteers have been actively involved in kokako nest monitoring, rat tunnel replacement, and stoat and rat trapping during 2008/09. Several volunteers have expressed a desire to return next year.

Interpretation panels along the Ngutuoha Nature Trail have been redesigned and replaced in both Te Reo and English versions. It is envisaged that the track will become the most accessible roadside entry point into the Mainland Island for day visitors.

6.2 TRANSFER OF KNOWLEDGE

TUMI hosted a group of tutors and students from the first national ranger trainee programme currently under development in New Caledonia. They unanimously paid tribute to the work being undertaken in the mainland island by such a dedicated, knowledgeable, and enthusiastic team.

2008 also saw a visit from two US Army personnel from the Oahu Military Base in Hawaii who spent several days in TUMI seeking advice, and acquainting themselves with a large scale pest control operation. As a result, several hundred DOC200 traps have been dispatched to Hawaii to assist in the control of mongoose and rats.

The dog trap, designed in-house by Greg Moorcroft, was presented to attendees of the North Island Kiwi Hui, and received much interest and positive feedback. One of the traps has recently been installed at Puketitiri.

Several staff members continue to provide advice to recovery groups and training programmes within the department:

- Andrew Glaser - Leader, Whio Recovery Group; Advisor- National Predator Dog Programme
- Cody Thyne and Jane Haxton - Advisors & Members, Kokako Recovery Group
- Daniel Baigent – Auditor, NPCA; Trainer – DOC pest management training course.

7.0 Acknowledgements

The Department of Conservation wishes to thank the Waimana Kaaku and the Western Tuhoe Executive for their ongoing support.

Environment Bay of Plenty has continued to provide strong support for the project.

This report was compiled and edited by Greg Moorcroft, Shane Gebert constructed the maps, and Jane Haxton did the formatting.

Current Department of Conservation staff involved in the project would like to thank and acknowledge all the staff (past and present) that have previously worked on the project.

DOC staff would also like to thank all the contractors, past and present, who have contributed so much to the project's success.

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9.0 Appendices

List of Appendices

Appendix 9.1 Information on Department of Conservation Best Practice for Rat and Stoat Control

Best practice information for rat and stoat control can be accessed through local DOC offices:

- Kill trapping for rats (DOCDM-29390)
- Trap layout and tunnel construction for Victor Professional rat traps housed in either a wooden or coreflute tunnel: (DOCDM-103712)
- Kill trapping for stoats (DOCDM-29448).

Rat and stoat control can be undertaken with the multi-pest 'DOC' series of traps:

- For 'DOC' series traps see: DOCDM-29856 (DOC150), DOCDM-29855 (DOC 200) and DOCDM-29851 (DOC250)
- Visit www.predatortraps.com for further information on the 'DOC' series of traps, including tunnel specifications and purchasing information.

Appendix 9.2 Possum Residual Trap Catch Indices per Management Area, Te Urewera Mainland Island, 2008/09

Area Type	Area		Block	Size (ha)	RTC	Comment
Background Area	Northern Waimana		0	211	0.0	
	Northern Whakatane		12	400	-	Not controlled
	Southern Whakatane		3	277	-	Not controlled
			4	295	-	Not controlled
			5	299	-	Not controlled
			6	321	4.2	
			7	298	4.8	
			8	469	3.4	
			15	306	6.0	
			17	174	3.3	
			18	247	1.3	
			19	313	4.1	
			21	254	4.7	
			22	398	3.5	
	Northern Ikawhenua		14	256	-	Not controlled
	Central Ikawhenua		12	304	-	Not controlled
Core Area	Mangaone	Outer Core	1	199	-	Not monitored
			2	396	7.2	
			3	319	3.5	
			4	397	-	Not monitored
		Inner Core		232	4.0	
	Onepu	Outer Core	1	349	2.1	
			2	361	3.4	
			3	377	0.0	
			4	400	2.1	
		Inner Core		179	2.7	
	Otamatuna	Outer Core	1	389	6.3	
			2	365	1.3	
			3	399	2.8	
			4	399	2.0	
			5	385	4.7	
		Inner Core	East	273	0.0	
			West	284	0.0	
	Pakoakoa	Outer Core	1	443	2.8	
			2	381	2.7	
			3	338	4.1	
			4	338	3.6	
			5	258	8.8	
			6	370	5.5	
		Inner Core		212	0.0	
	Waikokopu	Outer Core	1	449	0.7	
			2	299	0.0	
			3	424	2.7	
			4	315	5.5	
		Inner Core		375	4.7	

Appendix 9.3 Rat Tracking Indices for Core Areas and Oruamananui (non-treatment area), Te Urewera Mainland Island, 2008/09

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Mangaone		32%	4%		0%	2%		8%
Onepu		27%	38%	44%	20%	4%		16%
Otamatuna	2%		4%		0%	6%		4%
Pakoakoa		24%	6%		2%	0%		4%
Waikokopu				2%	2%	2%		3%
Oruamananui		98%			82%		74%	76%

Appendix 9.4 Fate and details of kiwi monitored, Te Urewera Mainland Island, 2008/09

NTU	Metal Band	Transponder	Sex	Age at capture	Date start	Date end (to 30 June 2007)	Fate at 30 June 2006	Cause of death	Breeding recorded	Number of nests	Number of chicks	Comments
109	R-57896		Male	Adult	21/02/2006	Ongoing	Alive		Yes	1	1	
112	R-63704		Male	Adult	25/03/2006	Ongoing	Alive		No			
113	RA-0814		Female	Sub-adult	25/03/2006	Ongoing	Alive					
121	R-57895	982009100733326	Male	Adult	20/03/2007	Ongoing	Alive		Yes	2	2	
123	RA-0812	982009100633079	Female	Adult	21/03/2007	Ongoing	Alive					Re-caught
124	R-63703		Male	Adult	3/10/2007	16/01/2009	Tx dropped		No			
125	RA-0815		Female	Adult	13/12/2007	Ongoing	Alive					
130			Unknown	Sub-adult	12/03/2008	30/04/2008	Tx dropped					
131			Male	Adult	12/03/2008	Ongoing	Alive		Yes	2	0	
132	R-63702		Male	Adult	3/04/2008	Ongoing	Alive		Yes	1	1	
133			Unknown	Chick	5/11/2008	15/05/2009	Dead	Natural				
134			Unknown	Chick	6/11/2008	Ongoing	Alive					
135			Unknown	Chick	4/12/2008	2/01/2009	Dead	Predator				
136			Unknown	Chick	31/03/2009	Ongoing	Alive					
137			Unknown	Chick	22/05/2009	Ongoing	Alive					

Appendix 9.5 Possum Residual Trap Catch Indices in Mistletoe Monitoring Areas, Te Urewera Mainland Island, 1996/97 – 2008/09

	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Oruamananui				3.7		2.6		2.4		1.9			
Pakoakoa Core Area				2.5				3.3	3.0	3.0	4.5	2.3	1.4
Okopeka	26.8				24.5					31.2			
Otamatuna Inner Core Area	25.0	0.7	2.4	1.7			5.7		4.5	2.7	2.7	0.7	0.0
Ogilves (Otamatuna Outer Core Area)	25.0	2.2	2.0			5.9	5.7		10.4	9.5		3.4	3.4

Appendix 9.6 Pig trap designs, Te Urewera Mainland Island, 2008/09

Figure 9.6.1

Plan view of a single-entry pig trap, Te Urewera Mainland Island, 2008/09

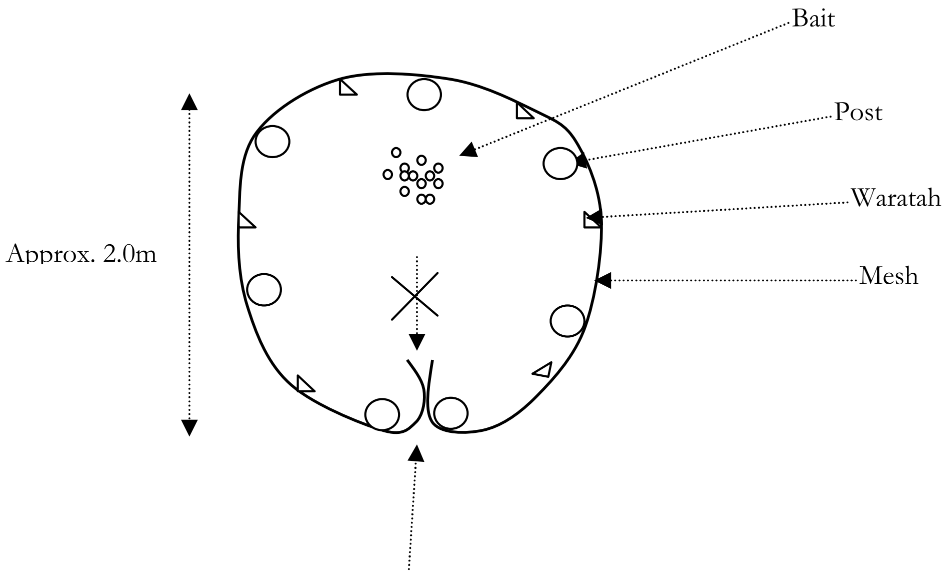
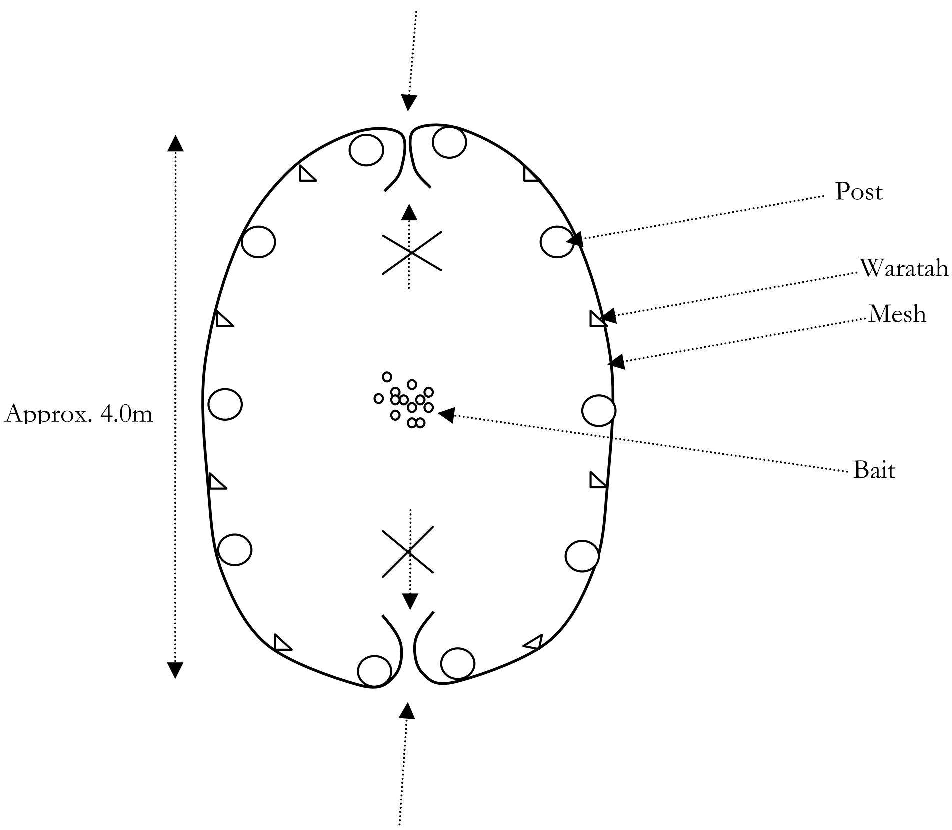


Figure 9.6.2

Plan view of a double-entry pig trap, Te Urewera Mainland Island, 2008/09



Appendix 9.7 Levels of cholecalciferol in pig livers, Otamatuna Core Area, Te Urewera Mainland Island, 2008/09

Sample number	Sample date	Result: nmol/L	Wet Weight tissue
Ota 1	(17-20/05/09)	21	0.473gm
Ota 2	(17-20/05/09)	29	0.243gm
Ota 3	(17-20/05/09)	66	0.462gm
Ota 4	(17-20/05/09)	61	0.342gm
Ota 5	(17-20/05/09)	32	0.426gm
Ota 6	(17-20/05/09)	9	0.582gm
Ota 7	(17-20/05/09)	52	0.312gm
Ota 8	(17-20/05/09)	48	0.430gm
Ota 9	(17-20/05/09)	51	0.393gm
Ota 10	(21/05/09)	50	0.560gm
Ota 11	(21/05/09)	53	0.578gm
Ota 12	(21/05/09)	40	0.549gm