

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

# **Response of kiwi to a range of baits and lures used for pest control in New Zealand.**

**Tamsin Elizabeth Ward-Smith**

**1998**



A thesis presented in partial fulfilment of the requirements for the Degree of Master of  
Science in Ecology at Massey University



“Seagull”

## Acknowledgements

I have travelled just about over the whole of North Island during this thesis and have met so many people along the way who have helped me!

Firstly though, funding was provided by the **Department of Conservation**, and the **Massey University** Graduate Research Fund. All the work in this study was made possible by the use of time-lapse infra-red video equipment, kindly lent by **Chris Eckroyd** and the New Zealand Lottery Board. Also, without **Barry Springrice** the stuff would never have gone in the first place, or after the numerous times it broke down. I am very thankful that he knew so much!. **Hugh Robertson** also assisted with setting this project up, and with **Rogan Colbourne** introduced me to Northland kiwi.

At Massey I am very grateful to **Murray Potter** for putting up with me and this thesis for so long, especially for getting me hooked on kiwi in the first place, for never sending me away to come back later, and for always being positive! **Robin Fordham** has also been very supportive, and has given lots of helpful editing hints. **Alastair Robertson** was patient with all my stats questions, but more importantly lent his house so we could write in peace, you can't imagine what a luxury that was. **Bruce** and **Fiona** also lent their house for a month and thanks also to them. **Erica Reid** is just one really helpful secretary and has made my life a lot easier!

For my time at Waikaremoana I thank **John McLennan** for his kiwi inspiration, for helping to get things going, and always happy times at the lake (I just want to get back there), **Jonathan Miles** for ferrying me around and help with setting up cameras, and **Grant, Sid, Ray** and **Frank** for leaping (most of the time) to carry batteries up and down the hills (Ray especially for organising to charge them, and for always going out of his way to help, it made a real difference!). In Northland I am especially grateful to **Pat Millar** for jacking up the accommodation, making me welcome up there and for skillfully identifying suitable nests, **Ray Pierce** for providing a caravan, and the **Lovells** for awesome meals, desperately needed showers, their help, and somewhere to relax (other than the caravan!). I am also grateful to **Ray** and **Barbara Walter** on Tiritiri Matangi Island, for welcoming me to work there and providing support, **Karori Reserve**

for letting me work with the weka, and **Dick Veitch** for his help with permit applications.

During the work with captive kiwi I have also met, and want to thank numerous people who made the work fun and run as smoothly as possible: **Eric Fox** and the **Otorohanga Kiwi House**, and **Tony Billing** for allowing me to work with kiwi in their establishments (Tony Billing and Bronwyn in particular for their kindness, good food and wine), **June** and **John Holt** for somewhere to stay in luxury, and do field work, and **Pat** and **Arthur Cowan** for time with them at their amazing home, yummy food and good vibes.

I also want to thank **Dave Morgan** who has helped me so much with getting to grips with baits, answering many questions and with planning work for Chapter five. **Carter Observatory**, Wellington also kindly provided sunset and sunrise times used in the behaviour chapter.

Heaps of thanks to all my friends and flat-mates; in particular **Penny Aspin** for being such a cool person and never failing to find us a distraction, **Brent Stephenson** for his wizzey skills at map drawing and computer stuff (ugg!!), and endless cups of coffee, **Don Ravine** who's just Don, always helpful, patient, full of positive boosts to my confidence (when I needed it) and a great proof reader, **Karen** who is just a great friend to me and who has suffered this thesis almost as much (and has still hung in to read drafts), **Janine** for her positivity and motivation for life, and **Zane** for putting up with lots of stress and lending his car to jet up and down the country. Lastly, thanks heaps to my **mum**, my **dad** and **John** for always being there (to lug batteries when all the other muscles had run out), and if not, then for sending me positive stuff in letters. You guys are just great!

## Abstract

The primary aim of this thesis was to assess the palatability to North Island brown kiwi (*Apteryx australis mantelli*) of a range of non-toxic baits and flavours used to lure baits. During the wild bait trials incubation patterns of nesting male kiwi, chick behaviour and the presence of predators at the nesting burrow were recorded. A new 'improved' ground laid 1080 paste was also tested on a range of non-target bird species. All ten captive kiwi fed at least once on at least one bait type (i.e. carrot, No.7, RS5, apple pulp, and paste) but did not prefer any to their usual artificial diet. Wild kiwi did not feed on any bait type placed outside the nest entrance, but may have ingested apple pulp, or paste when they probed these baits. Results indicate that cereal-based baits are the safest bait type to sow aerially in kiwi habitat, while apple pulp baits are highly acceptable to kiwi. Cinnamon, aniseed, orange and clove flavours did not significantly attract or deter captive kiwi from feeding on portions of their usual diet. Insufficient flavoured cereal No.7 baits were eaten to determine whether any bait and flavour combination affected kiwi response to these baits. No wild kiwi fed on any cinnamon or orange flavoured No.7 cereal baits placed outside the nesting burrow, but kiwi did probe these baits. Incubating male kiwi left the nest once each night, except for two kiwi which sometimes left the nest twice in a night. One of these sometimes made three trips from the nest in a night. The active period of kiwi did not appear to be influenced by the number of times they emerged in a night. Male kiwi tended to spend less time away from the nest when chicks were due to hatch, following which they increased the time spent away. Possums, rats and mice regularly visited kiwi nests, but did not deter males from incubating, or harm kiwi eggs or chicks. Five species - robin, saddleback, blackbird, pukeko and weka, fed on a non-toxic cinnamon-lured form of 1080 paste. Species other than those mentioned rarely landed on the ground and therefore encountered paste infrequently. Captive weka found the paste highly palatable, while 24% of robins and possibly half of a pukeko family fed on the paste. All bird visits to the paste baits declined after the first day of exposure. Recommendations are made on the safe laying of paste baits in areas where robin, saddleback, weka or pukeko are present.

## Table of contents

Acknowledgements.....	iii
Abstract.....	v
Table of contents.....	vi
List of figures.....	x
List of tables.....	xi
 Chapter one: A review of 1080: its use, and effects on non-target species, with specific reference to kiwi.....	 1
 INTRODUCTION .....	 1
PART ONE.....	1
Background to pests in New Zealand and methods for their control.....	1
Compound 1080 - use and effects on vertebrate animals.....	3
Impacts of 1080-poison operations on non-target species .....	4
Background to New Zealand 1080 operations .....	5
Subsequent bait modifications .....	5
Monitoring of common and rare bird species .....	6
Types of 1080 baits used in New Zealand .....	7
PART TWO.....	8
Study animal - Kiwi .....	8
The Kiwi Recovery Plan .....	10
Risk of poisoning to kiwi .....	11
Difficulties with monitoring kiwi during poisoning operations.....	12
Outputs from the Kiwi Recovery Plan .....	13
Thesis aims and layout.....	16
REFERENCES .....	17
 Chapter two: The response of captive and wild kiwi to a range of non-toxic baits used for pest control in New Zealand. ....	 32
 ABSTRACT .....	 32
INTRODUCTION .....	32



## Chapter two

MATERIALS AND METHODS.....	35
Kiwi used .....	35
Baits used.....	37
Captive kiwi trials .....	42
Wild kiwi trials .....	44
RESULTS .....	45
Captive kiwi trials .....	45
Wild Kiwi Trials .....	54
DISCUSSION.....	61
Captive kiwi trials .....	61
Wild kiwi trials .....	64
Captive verses wild kiwi .....	66
Conclusions.....	67
Main points arising from the study .....	68
RECOMMENDATIONS.....	69
REFERENCES .....	69
APPENDIX 1.....	76
APPENDIX 2.....	77
APPENDIX 3.....	78

Chapter three: Response of captive and wild kiwi to a range of flavours added to baits used for pest control in New Zealand. ....	79
--	----

ABSTRACT .....	79
INTRODUCTION .....	79
Flavours added to baits in New Zealand .....	80
Testing flavours on non-target bird species .....	80
MATERIALS AND METHODS.....	82
Materials .....	82
Captive kiwi trials .....	82
Wild kiwi trials .....	85
RESULTS .....	86
Captive kiwi trials .....	86
Wild kiwi trials .....	94



Chapter three

DISCUSSION..... 97

    Captive kiwi flavour trials.....97

    Wild kiwi flavoured bait trials .....99

    Conclusions..... 101

    Main points arising from the study: ..... 101

RECOMMENDATIONS..... 102

REFERENCES ..... 102

Chapter four: Behaviour of incubating kiwi and predators at nesting burrows..... 106

ABSTRACT ..... 106

INTRODUCTION ..... 106

    Kiwi breeding behaviour..... 106

    Kiwi and predators..... 107

    Study areas..... 108

    Introduced mammals..... 108

METHODS ..... 109

    Data collection and analysis..... 109

RESULTS ..... 110

    Video monitoring of kiwi..... 110

    Video monitoring of predators at the nest..... 121

DISCUSSION ..... 122

    Video monitoring of kiwi..... 122

    Predator visits to the nest..... 124

REFERENCES ..... 126

Chapter five: Testing the response of native birds to a new formulation of  
1080 apple paste..... 129

ABSTRACT ..... 129

INTRODUCTION ..... 129

    Background..... 129

    Non-target species testing ..... 130

    Objective..... 131

METHODS ..... 131

    Bait used ..... 132

    General forest birds..... 132

    Robins..... 134

    Kereru ..... 134

    Weka..... 135

    Pukeko ..... 135

RESULTS ..... 136

    General forest birds..... 136

    Robins..... 138

    Kereru ..... 139

    Weka..... 139

    Pukeko ..... 141

DISCUSSION ..... 143

    Forest birds ..... 143

    Robins..... 144

    Kereru ..... 145

    Weka..... 146

    Pukeko ..... 146

    General comments..... 146

RECOMMENDATIONS..... 147

    Management..... 147

    Research..... 147

REFERENCES ..... 148

APPENDIX 1..... 151

## List of figures

Figure	Page
1.1 A North Island brown kiwi.	9
2.1 Location of wild kiwi study sites.	38
2.2 View across Lake Waikaremoana, Te Urewera National Park.	39
2.3 Looking towards a video recorded kiwi nest.	39
2.4 View of bush patches containing kiwi in Northland.	40
2.5 Position of the five bait types outside a kiwi nest in Northland.	40
2.6 The proportion of captive kiwi which fed on baits at least once, and more than once.	47
2.7 Mean duration spent feeding by captive kiwi on their usual food and each bait type.	50
2.8 Total duration spent feeding each night by captive kiwi on all bait types.	52
2.9 Mean number of probes per minute by wild kiwi on baits and presented invertebrates.	60
3.1 Mean duration spent feeding by captive kiwi on flavoured food portions in the first two hours of the night.	89
3.2 Total duration spent feeding by captive kiwi on flavoured food portions throughout the whole night.	90
3.3 Mean duration spent feeding by each captive kiwi on flavoured food portions in the first two hours of the night, and throughout the whole night.	91/92
4.1 Mean time of emergence after sunset for incubating wild kiwi.	112
4.2 Mean duration spent away from the nest for incubating wild kiwi.	113
4.3 Mean duration that wild kiwi spent away from the nest with increasing stage of incubation.	114
4.4 Wild kiwi emerging from its nest.	116
4.5 Possum at the entrance of a wild kiwi nest, and with its head inside the nest.	117
5.1 Location of video recorded sites on Tiritiri Matangi Island in the Hauraki Gulf.	133

## List of tables

Table	Page
2.1 Number of captive kiwi which fed on each bait type on nights one to five.	48
2.2 Total number of each bait type eaten by captive male and female kiwi.	48
2.3 Repeated Measures ANOVA investigating the duration that captive kiwi fed on each bait type and their usual food.	51
2.4 Repeated Measures ANOVA investigating the duration that captive kiwi fed on each bait type on nights one to five.	51
2.5 Kruskal-Wallis values for one-way ANOVA between sex and the rank assigned to each bait type for individual captive kiwi.	53
2.6 Kruskal-Wallis values for one-way ANOVA between sex and the ranks assigned within bait types according to the numbers of baits eaten by individual captive kiwi.	54
2.7 Number of small and large pellet baits eaten by captive kiwi.	54
2.8 Number of observations of wild kiwi feeding on presented food and other invertebrates outside the nest.	55
2.9 Number and duration of wild kiwi encounters with each bait type, and worms and cicada nymphs.	57
2.10 Total number of times wild kiwi probed each bait type, or worms or cicada nymphs.	59
3.1 Repeated Measures ANOVA investigating the duration captive kiwi fed on flavoured food portions in the first two hours of the night.	87
3.2 Repeated Measures ANOVA investigating the total duration captive kiwi fed on flavoured food portions.	88
3.3 Total number of flavoured baits eaten by captive kiwi.	94
3.4 Total number and duration of wild kiwi encounters with cinnamon-flavoured cereal baits.	96
3.5 Total number and duration of wild kiwi encounters with orange-flavoured cereal baits.	96
4.1 Percentage of times wild kiwi emerged and covered their nest.	118
5.1 Number and mean duration of bird visits to paste bait.	136
5.2 Number and mean duration of visits to paste bait made by all species.	137

<b>Table</b>	<b>Page</b>
5.3 Number and mean duration of feeding visits to paste bait by all species.	138
5.4 Number and duration of feeding visits made to the paste by male and female robins.	140
5.5 Number and duration of visits to paste by species other than robin.	141
5.6 Number and duration of visits and feeding visits to paste by pukeko.	142