

# Sniffing out predators

## Using olfaction to protect native species



Grant Norbury



Manaaki Whenua  
Landcare Research



**PREDATOR  
FREE NZ**

Key management objective  
is to attract mammals to our  
cunning devices

	Olfactory		Auditory		Visual	
ATTRACTION	Food	Social	Food	Social	Food	Social

124

*Noburns*, 2017, Vol. 64: 124-135  
0029-4470 © The Ornithological Society of New Zealand Inc.

### Behaviour of stoats (*Mustela erminea*) raiding the nests of rock wrens (*Xenicus gilviventris*) in alpine New Zealand

L. LITTLE  
C. M. KING\*

Environmental Research Institute, School of Science, University of Waikato, Hamilton, New Zealand

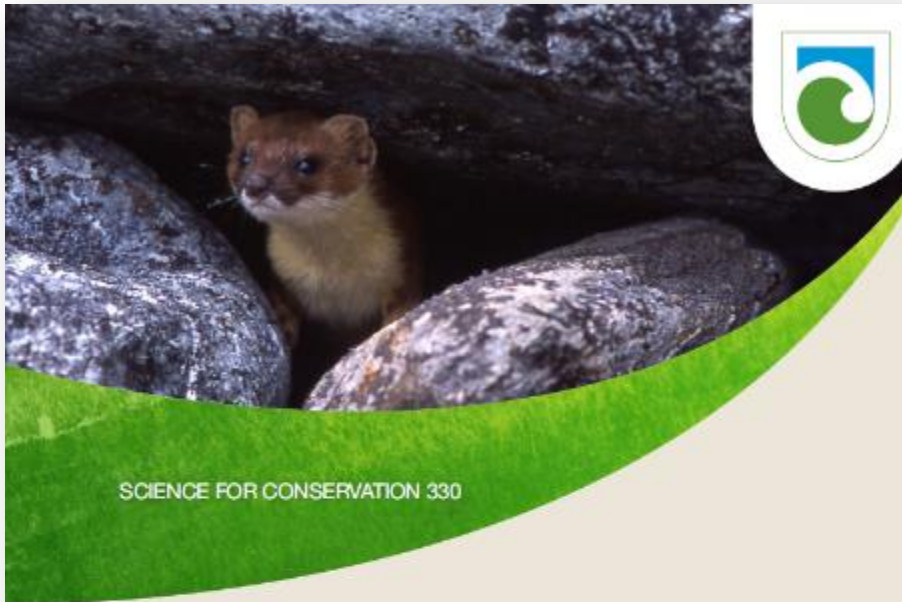
COLIN F. J. O'DONNELL

Biodiversity Group, Department of Conservation, Private Bag 4715, Christchurch 8140, New Zealand

**Abstract.** Understanding the behaviour of invasive predators is an important step in developing effective predator control techniques. Stoats (*Mustela erminea*), introduced to New Zealand in the 1880s, are major predators of indigenous birds in forest, wetland, and coastal habitats, and are an emerging threat to alpine biodiversity. Stoats have recently been found to prey upon rock wrens (*Xenicus gilviventris*), New Zealand's only truly alpine bird species. We monitored 32 rock wren nests using motion-activated infrared (IR) cameras from 2 locations in the Southern Alps over 3 breeding seasons, 2012-2015. The behaviour of stoats that preyed upon 13 rock wren nests was quantified to describe how they behaved around rock wren nests, and to determine whether understanding these behaviours could lead to improved predator control to help to protect this vulnerable bird species. Stoats usually hunted alone. They could reach nests on cliffs and on the ground equally easily by climbing or jumping to them. Rock wren nests were attacked most frequently during the day (85% of nests) and at the chick stage in their life cycle, making this their most vulnerable stage. We suggest that this is because stoats are attracted to nests by the auditory cues of chicks calling out for food. Nests were rarely visited by stoats before or after the observed predation events. Stoats left little evidence of nest predation events beyond enlarging nest entrances. There was no indication that IR cameras or the actions of field workers affected predation behaviour, although some stoats clearly knew the cameras were there. There is an urgent need to deploy effective stoat control to remove rock wren populations. Control should focus on cliff habitats as well as on more accessible ground nests, and, if resources are limited, should primarily focus on the nestling stage. Future research could trial auditory lures to attract stoats in traps, and determine the vulnerability of rock wrens to predation outside the breeding season.

Little, L., King, C.M., O'Donnell, C.F.J. 2017. Behaviour of stoats (*Mustela erminea*) raiding the nests of rock wrens (*Xenicus*





SCIENCE FOR CONSERVATION 330

## Mammalian pheromones – new opportunities for improved predator control in New Zealand

B. Kay Clapperton, Elaine C. Murphy and Hussam A. A. Razzag



New Zealand Government

Department of  
Conservation  
*Te Papa Atawhai*

	Olfactory		Auditory		Visual	
<b>ATTRACTION</b>	Food	<b>Social</b>	Food	<b>Social</b>	Food	<b>Social</b>
<b>DETERRANCE</b>		Social		Social		Social

ANTI-PREDATOR TRAINING:  
AN EXPERIMENTAL APPROACH IN  
REINTRODUCTION BIOLOGY

A thesis submitted in  
partial fulfilment of  
the requirements for the  
Degree of  
Master of Science in Zoology  
by

DEBORAH K. HUME

Research Notes

Responses to a Model Predator of New Zealand's  
Endangered Takahe and Its Closest Relative,  
the Pukeko

JUDITH S. BUNIN AND IAN G. JAMESON

Zoology Department, University of Otago, P.O. Box 56, Dunedin, New Zealand

Introduction

New Zealand's avifauna, characterised by several species of endemic flightless birds, has evolved in isolation from recent mammalian predators. Consequently, there has been no selection pressure to develop defensive mechanisms against terrestrial predators. When *Possuminus GD* (1900–1200) and Europeans (AD 1850) arrived, much of New Zealand's native avifauna became easy prey to predators introduced by these settlers (Diamond & Veitch 1981; Holdaway 1987). Vulnerability may have been calculated by unusual anatomy (lack of defensive behaviour) or by nesting, roosting and pecking in areas exposed to introduced predators (Dell 1991).

and dramatic declines in Takahe numbers (Lavers & Mills 1978; Eason & Bosch 1993), and there is evidence of minor predation on Takahe eggs, chicks, and adults (Dell 1987; Lavers & Mills 1978; Maxwell, in press). Given the current status of Takahe and their low fecundity, even marginal levels of adult predation could have serious implications for the survival of the species in the wild (Crombie 1994).

In contrast, the Pukeko or Purple Swamphen (*Porphyrio porphyrio*), the Takahe's closest extant relative, introduced from Australia within the past 1000 years (Miller 1981) and has responded to disturbance and numbers since European colonisation in extreme ways. New Zealand's most successful avian species, Pukekos evolved in the presence of a variety of natural mammalian

Received: 24 April 2017 | Accepted: 21 May 2017  
DOI: 10.1111/1365-2654.12947

RESEARCH ARTICLE\*

Journal of Applied Ecology

Predator exposure improves anti-predator responses in a  
threatened mammal

Rebecca West<sup>1</sup> | Mike Letnic<sup>1</sup> | Daniel T. Blumstein<sup>2</sup> | Katherine E. Moserby<sup>1,3</sup>

<sup>1</sup>Centre for Ecosystem Science, School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, NSW, Australia

<sup>2</sup>Department of Ecology and Evolutionary Biology, University of California, Los Angeles, CA, USA

<sup>3</sup>Wild Recovery Ltd., Bodry Down, SA, Australia

Correspondence:  
Rebecca West,  
Email: rebecca.west@unsw.edu.au

Funding information:  
Australian Research Council Linkage Grant  
between Wild Recovery, University of New  
South Wales, Linkage Grant

Abstract

1. Incorporating an understanding of animal behaviour into conservation programmes can influence conservation outcomes. Exotic predators can have devastating impacts on native prey species and thwart reintroduction efforts, in part due to prey naivety caused by an absence of co-evolution between predators and prey. Attempts have been made to improve the anti-predator behaviours of reintroduced native prey by conducting laboratory-based predator recognition training, but results have been varied and have rarely led to improved survival in reintroduction programmes.

2. We investigated whether *in situ* predator exposure could improve anti-predator responses of a predator native mammal by exposing prey populations to low densities of introduced predators under controlled conditions. We reintroduced 352

Animal Conservation (2018) 2, 155–163. © 2018 The Authors. Journal compilation © 2018 British Ecological Society

Helping reintroduced houbara bustards avoid predation:  
effective anti-predator training and the predictive value of  
pre-release behaviour

Yehuda van Heezik<sup>1</sup>, Phillie J. Seldon<sup>2</sup> and Richard P. Malmoney<sup>2</sup>

National Wildlife Research Centre, National Conservation and Development, P.O. Box 1094, 7411 Sandvick, Sandvick, Victoria, Department of Conservation, Dunedin, New Zealand; Royal Field Station, Pukaki Bay, Waipara Road, Timaru, New Zealand

Received 21 July 2017; accepted 20 January 2018

Abstract

The success of captive-bred and release programmes is often compromised by predation of released individuals, which are naive about predators. Post-release behavioural preparation of release candidates in the form of anti-predator training has been attempted infrequently, usually using models of predators, but success was most often measured in terms of increased behavioural responses rather than survival in breeding *pre-release* release. Here we report that post-release survival of captive-bred houbara bustards (*Chamaeleo leucurus*) was improved through exposure to a live predator before release, a result with possible applications for a wide range of species currently the focus of reintroduction projects. We also show that rearing houbara with minimal human contact and training with a model of a predator had no effect on post-release survival. Moreover, individual post-release behavioural responses to a model predator are the cause of their mortality, were



# Patrick Garvey

Developing a 'super lure' for stoats and weasels

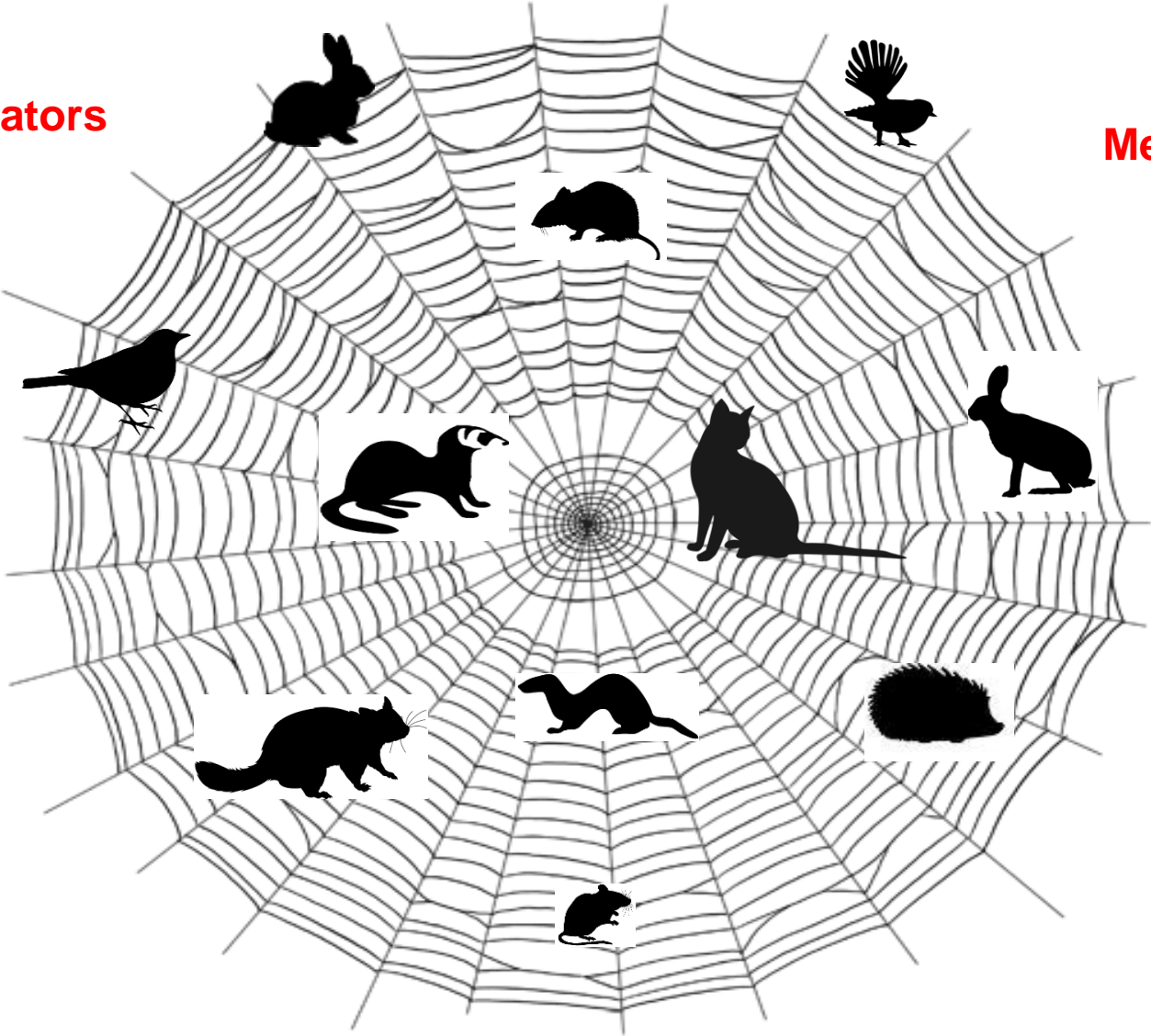




# Olfactory web of information

Apex predators

Mesopredators



Prey

# Experiments - Predator interactions

Stoats **fear and avoid** ferrets and cats

Garvey, Glen & Pech (2015) Biological Invasions

Stoats are **attracted** to the odour of ferrets and cats

Garvey, Glen & Pech (2016) Behaviour Ecology & Sociobiology



# Information is power.....

- Risk assessment
- Niche partitioning
- Mustelid family



# Mustelid lure - trial



*Kokako  
project  
Hunua  
ranges*



**WHANGAWEHI  
CATCHMENT**  
MANAGEMENT GROUP

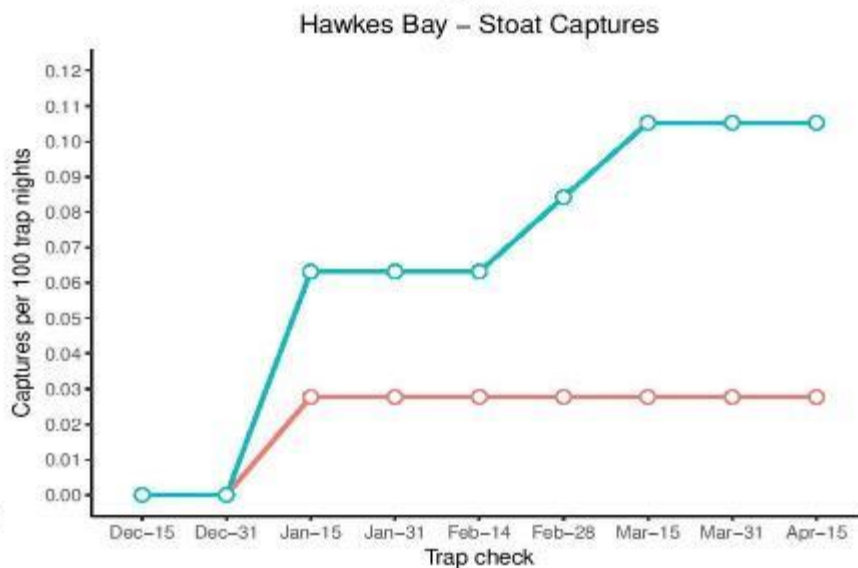
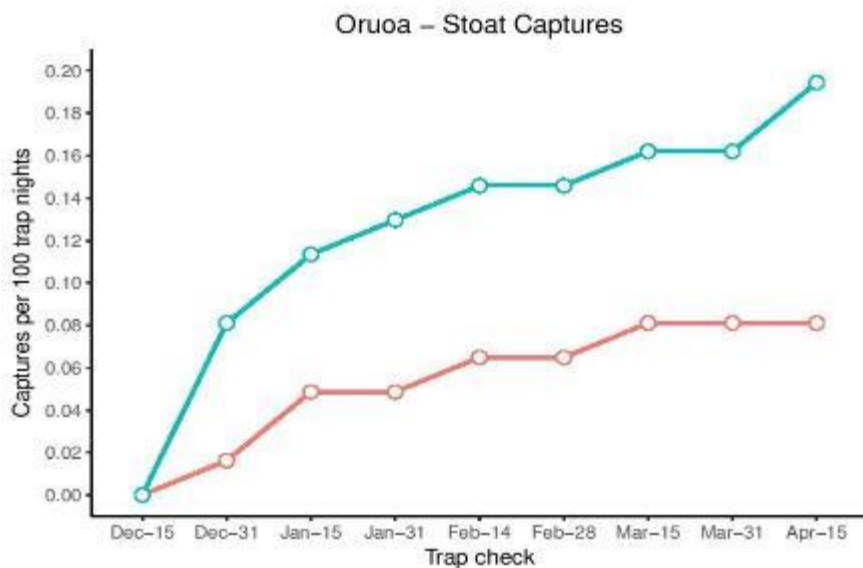
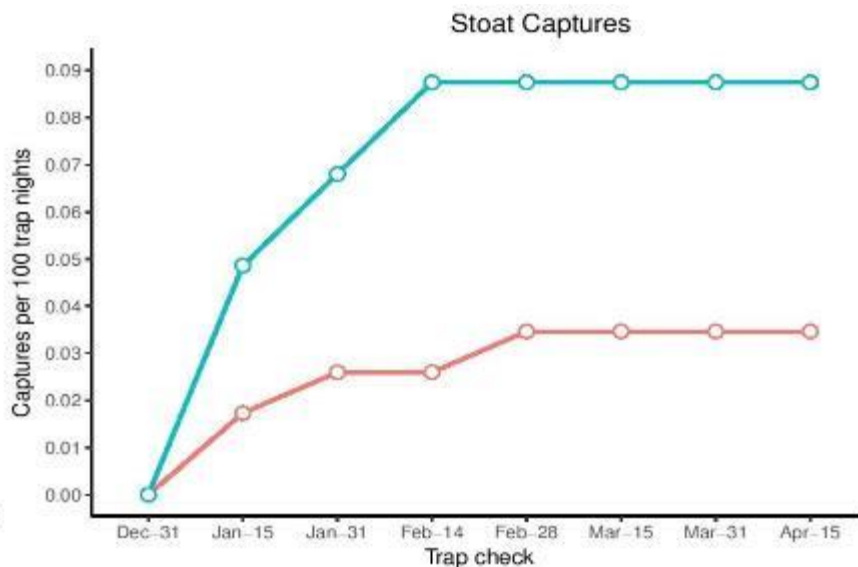
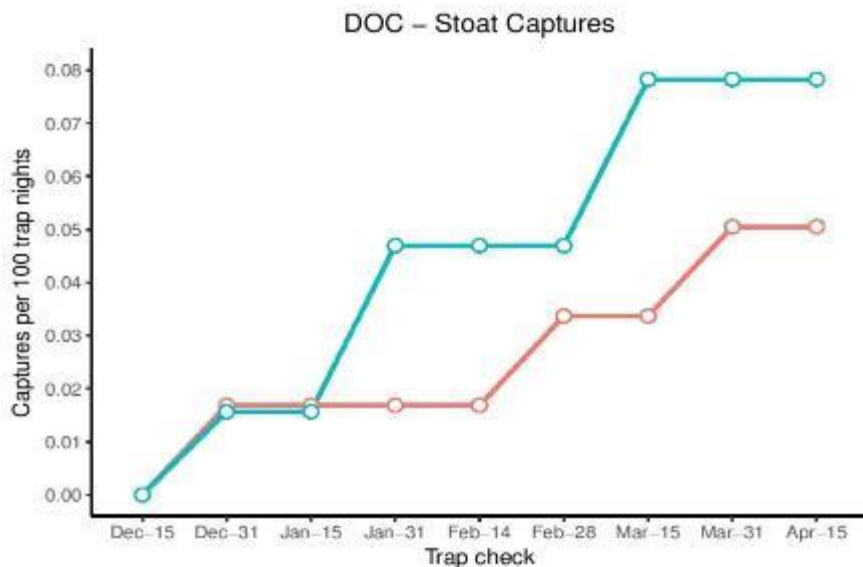


Department of  
Conservation  
*Te Papa Atawhai*

*Kaweka Forest  
Park*



# Lure trial – Stoat captures

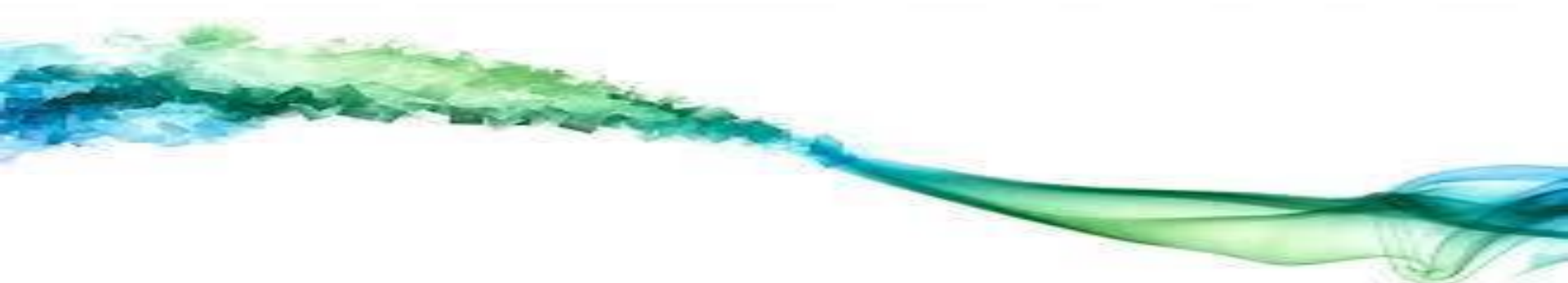


# Natural lure has limitations!

- Difficult to collect
- Landscape scale
- Longevity could be extended



**\* Need to synthesise ferret odour**



# Behaviour trial

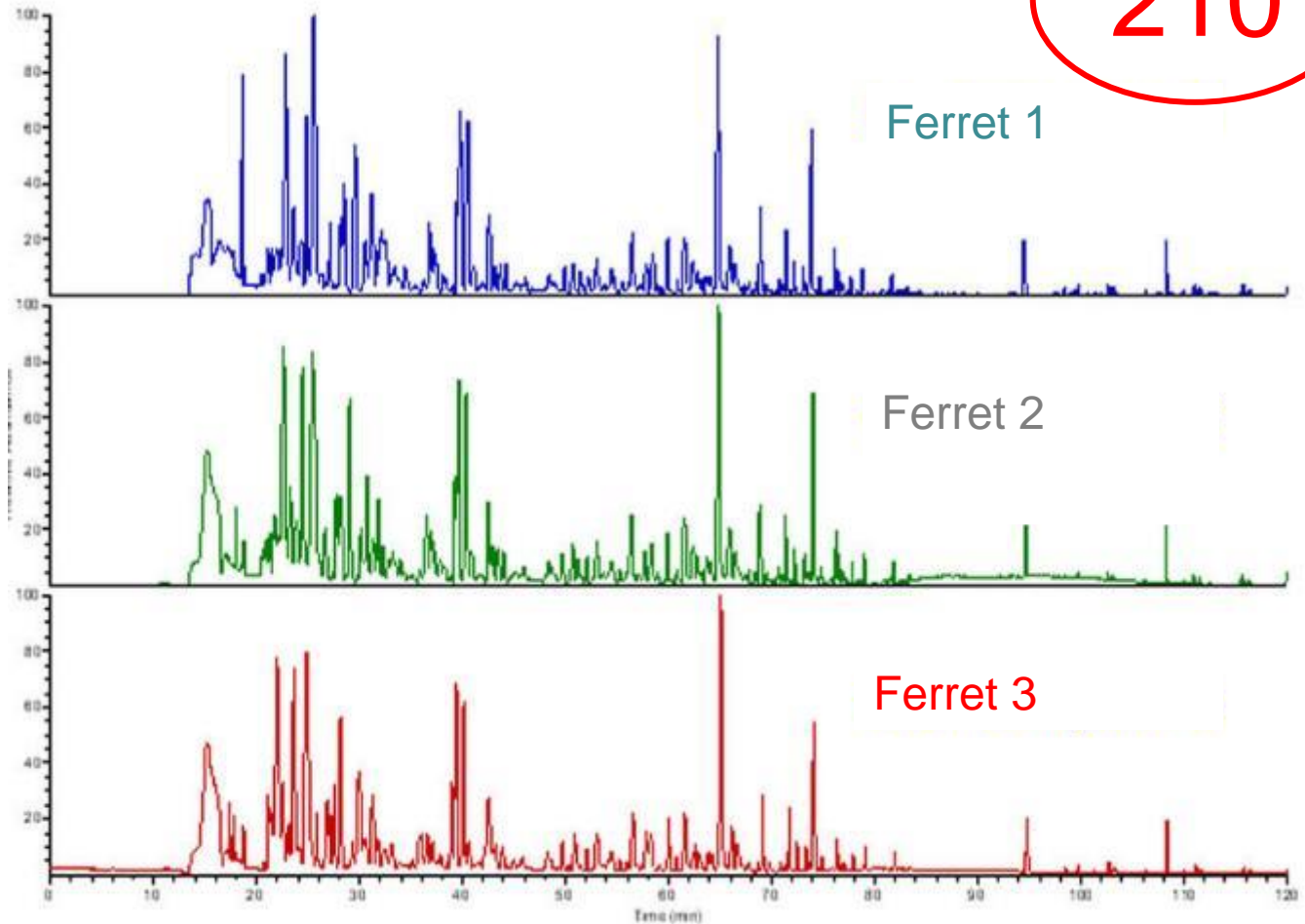








# Chemical analysis



# Synthesising mustelid lure

Behavioural trials combined with chemical analysis

- 8 key compounds identified
- Testing the most attractive combination







NEW ZEALAND'S BIOLOGICAL HERITAGE

Ngā Koiora  
Tuku Iho

National **Science** Challenges



Landcare Research  
Manaaki Whenua

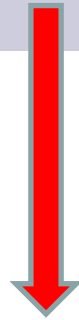


THE UNIVERSITY OF AUCKLAND  
FACULTY OF SCIENCE



Department of Conservation  
*Te Papa Atawhai*

	Olfactory		Auditory		Visual	
ATTRACTION	Food	Social	Food	Social	Food	Social



Remove social reward and habituate to cue

Remove food reward and habituate to cue



# Exploiting olfactory learning in alien rats to protect birds' eggs

Catherine J. Price<sup>a,b,1</sup> and Peter B. Banks<sup>a,b</sup>

<sup>a</sup>Evolution and Ecology Research Centre, School of Biological, Earth, and Environmental Sciences, University of New South Wales, Randwick, NSW, 2052 Australia; and <sup>b</sup>Behavioural Ecology and Conservation Research Group, School of Biological Sciences, University of Sydney, Sydney, NSW, 2006 Australia

Edited by Stan Boutin, University of Alberta, Edmonton, AB, Canada, and accepted by the Editorial Board September 14, 2012 (received for review July 5, 2012)

**Predators must ignore unhelpful background “noise” within information-rich environments and focus on useful cues of prey activity to forage efficiently. Learning to disregard unrewarding cues should happen quickly, weakening future interest in the cue. Prey odor, which is rapidly investigated by predators, may be particularly appropriate for testing whether consistently unrewarded cues are ignored, and whether such behavior can be exploited to benefit prey.**

we predict that repeated failed foraging attempts “push” the cues into the background of a predator’s sensory realm so misleading or irrelevant information can be ignored in the future, a process that efficient predators must use constantly. Although actual sensory perception of the cue may not be affected, decreasing cue salience and responsiveness in this context is a short-term behavioral adaptation likely to arise out of a combination of associative



# Messing with the mind

Using unrewarding prey stimuli to reduce predator impacts

# Background

- NZ's endemic fauna evolved with avian predators that hunt using sight
- Fauna visually cryptic with few defences against mammals that hunt mostly using smell





# Background

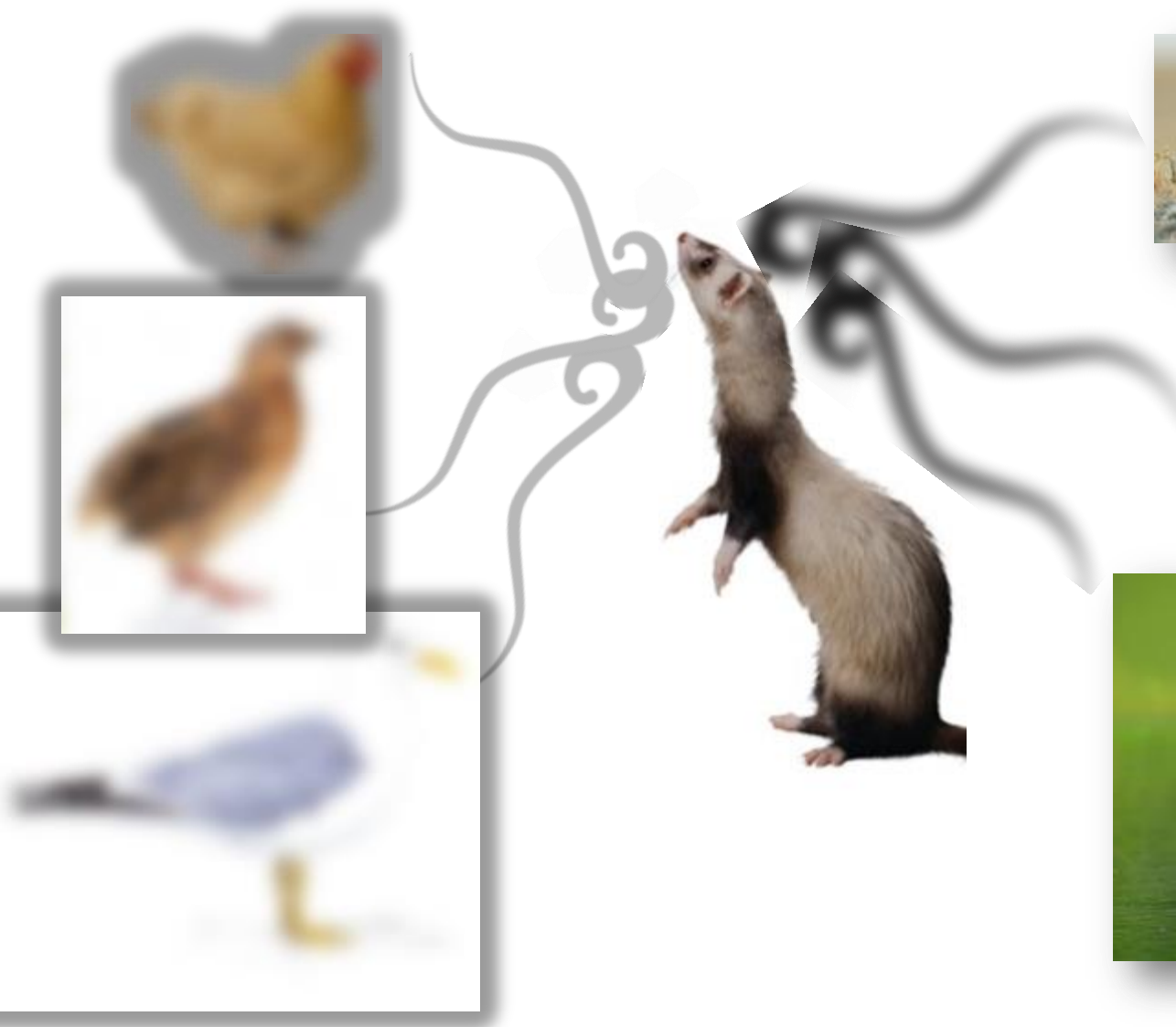
- NZ's endemic fauna evolved with avian predators that hunt using sight
- Fauna visually cryptic with few defences against mammals that hunt mostly using smell
- Mismatch between visual defences and olfactory hunting

## What can be done to address this mismatch?

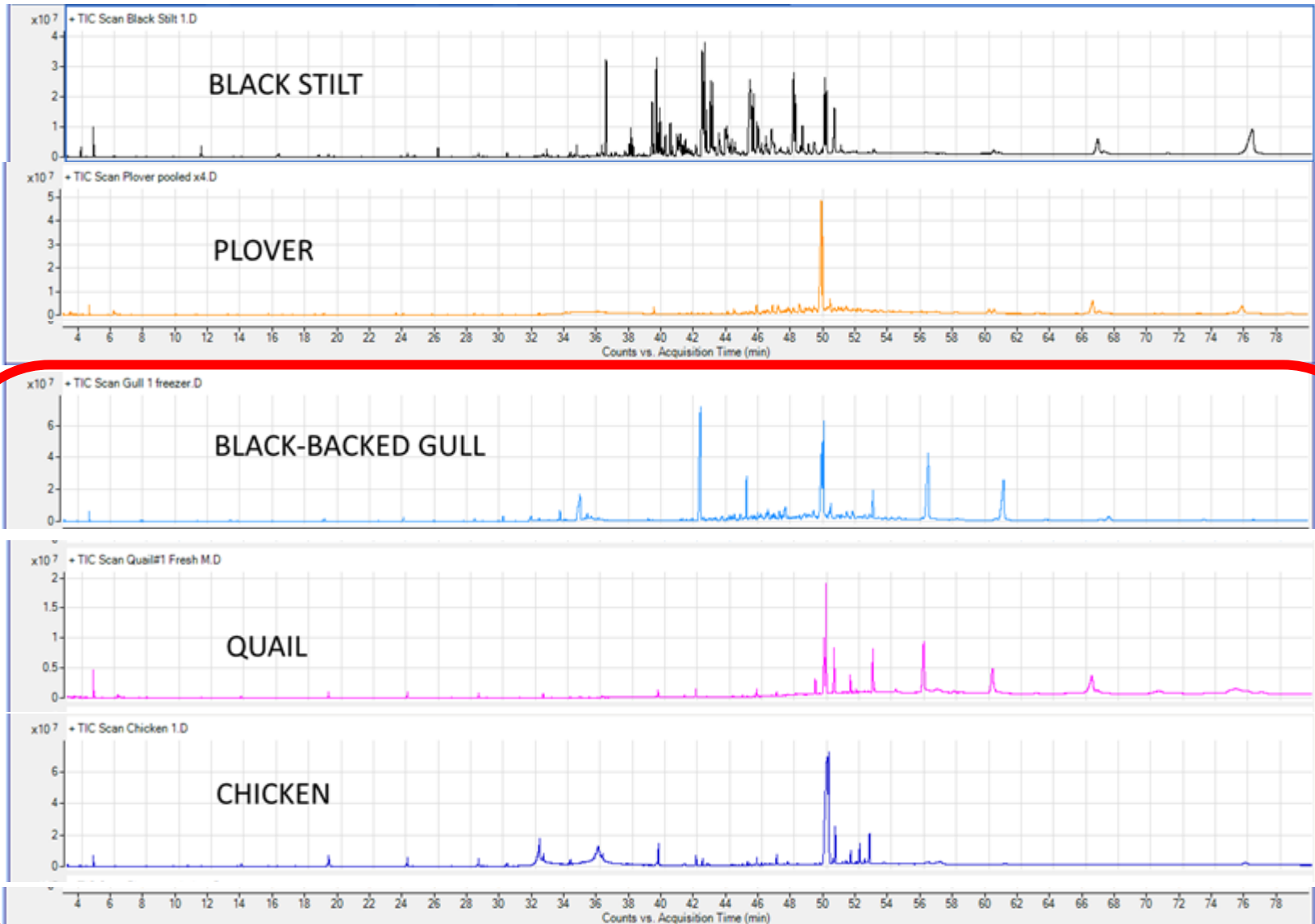
- Robert MacArthur, Eric Pianka, Merritt Emlen – predators constantly make foraging decisions to maximise energy intake
- Hunger forces focus on rewarding cues – ignore unprofitable cues that waste energy
- Cryptic prey ignored if more easily detectable prey available

# Habituation

# Generalisation



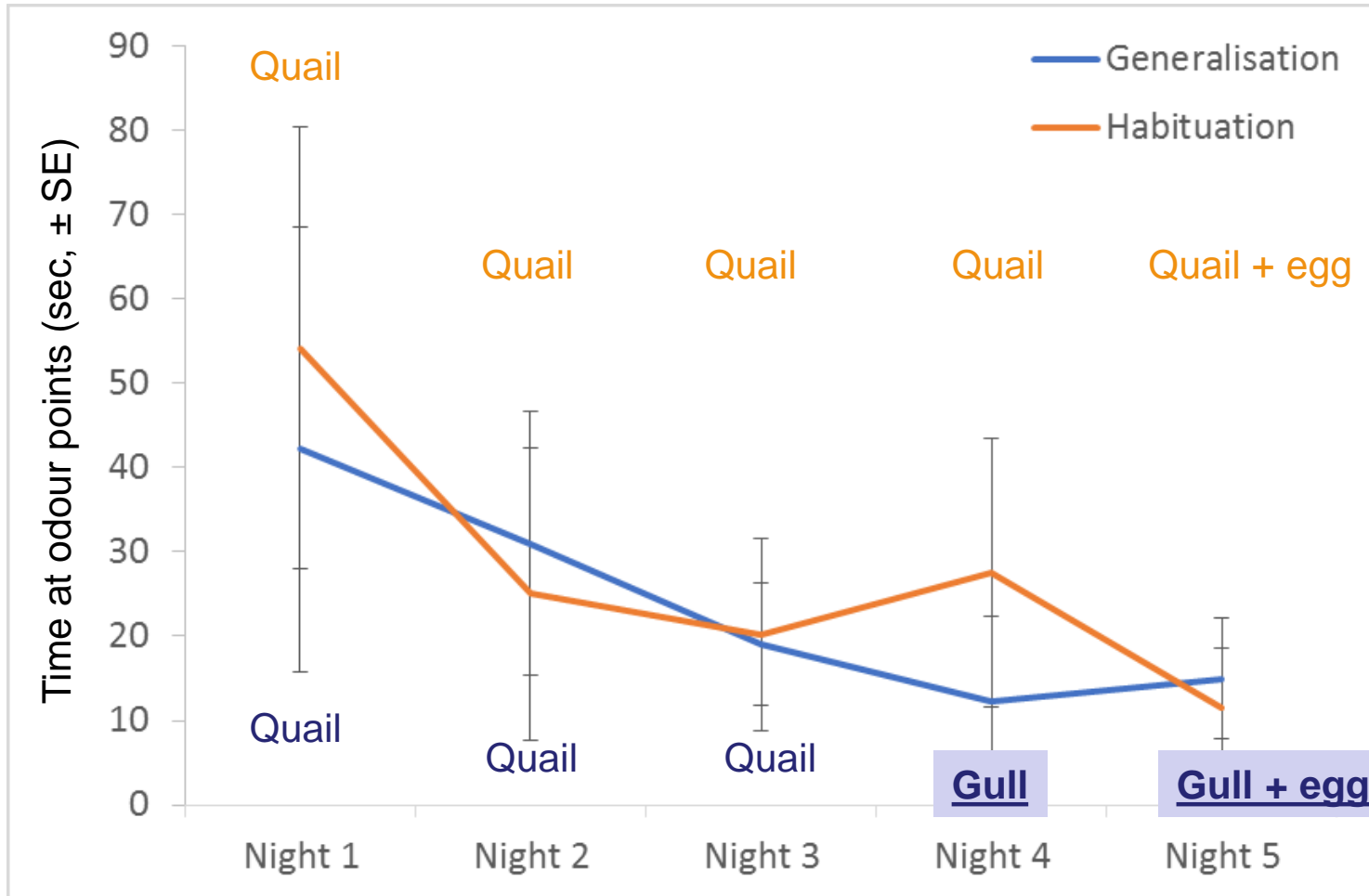
# Chemical profiles of bird odours



# Ferret and hedgehog pen trials



# Ferret pen trials

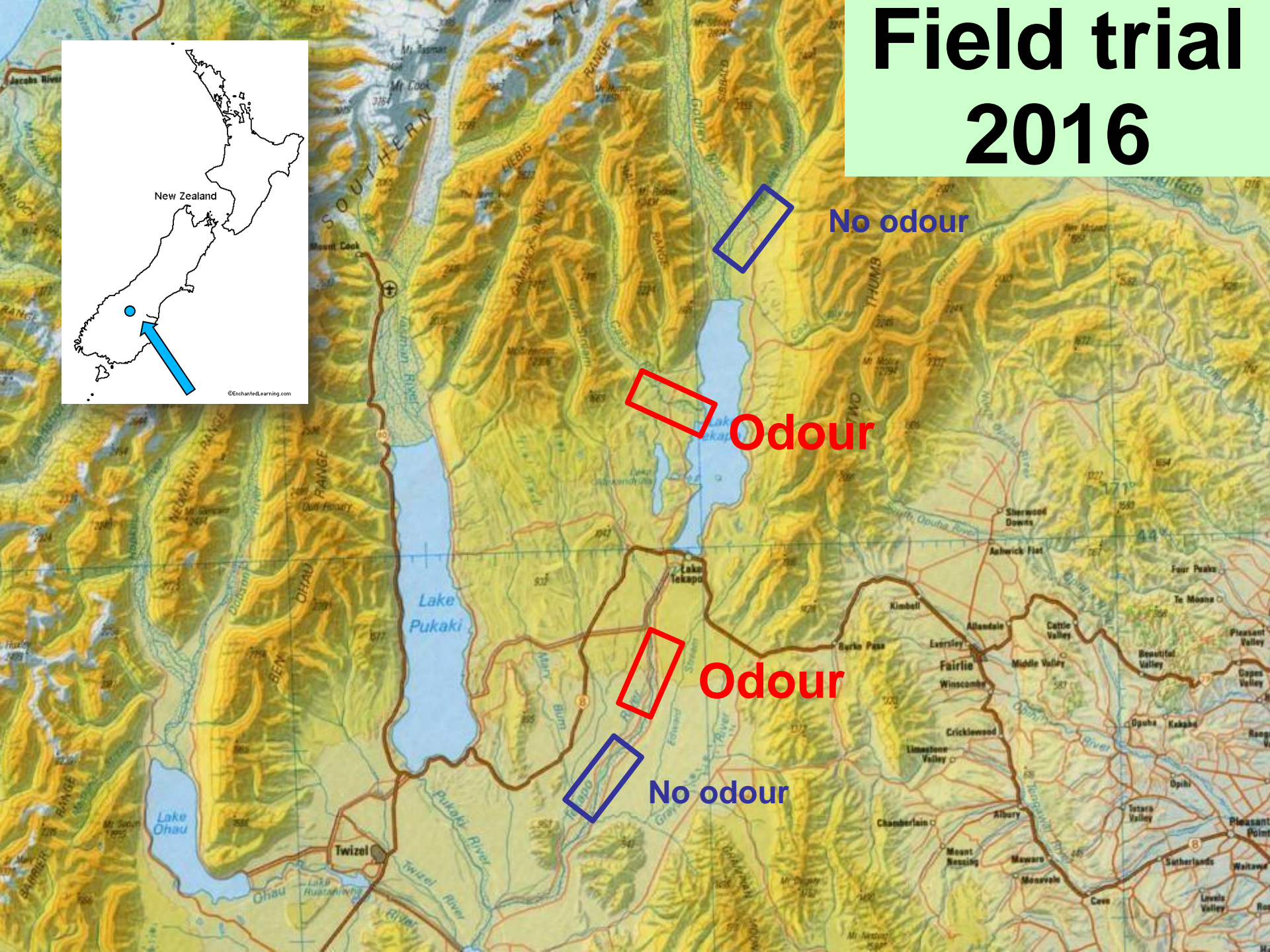






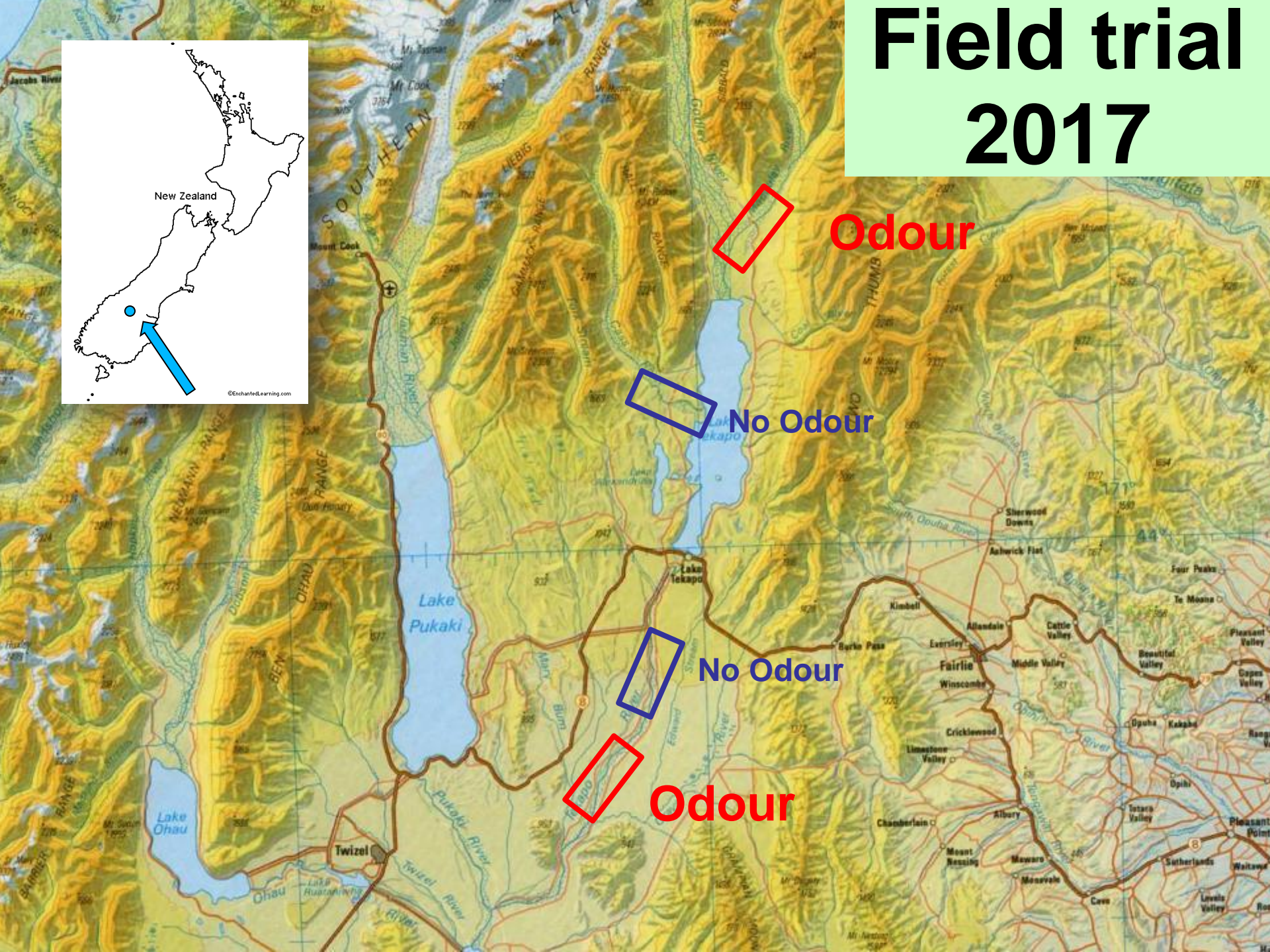


# Field trial 2016





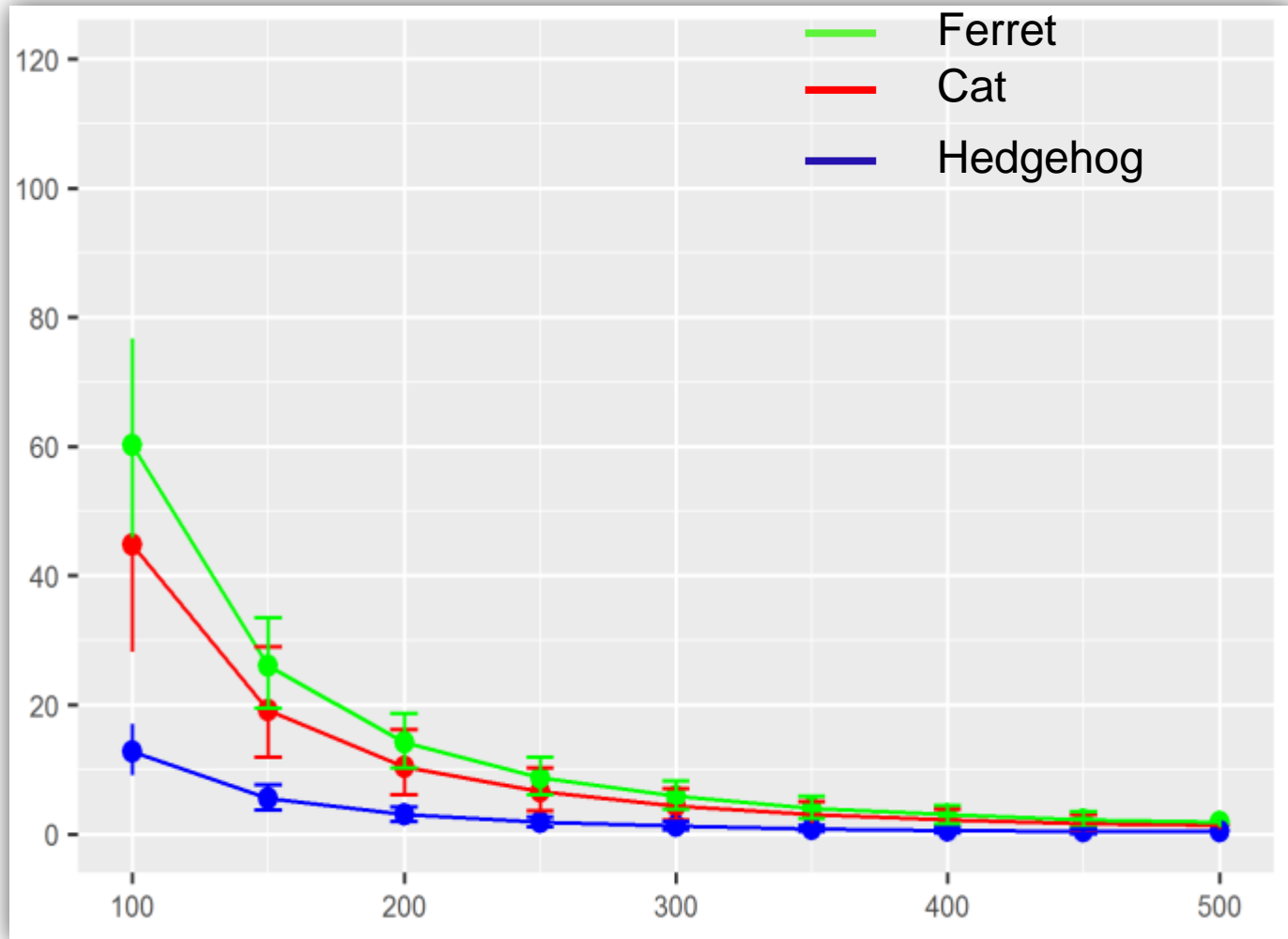
# Field trial 2017





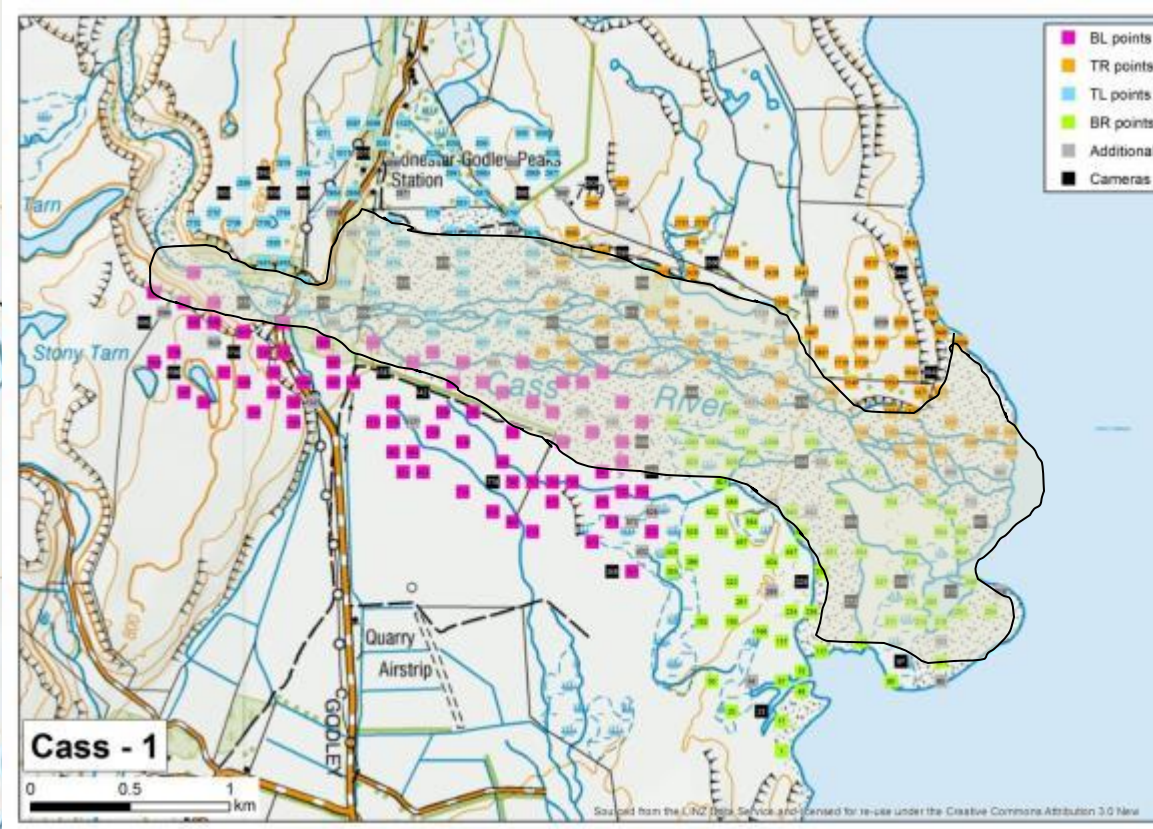
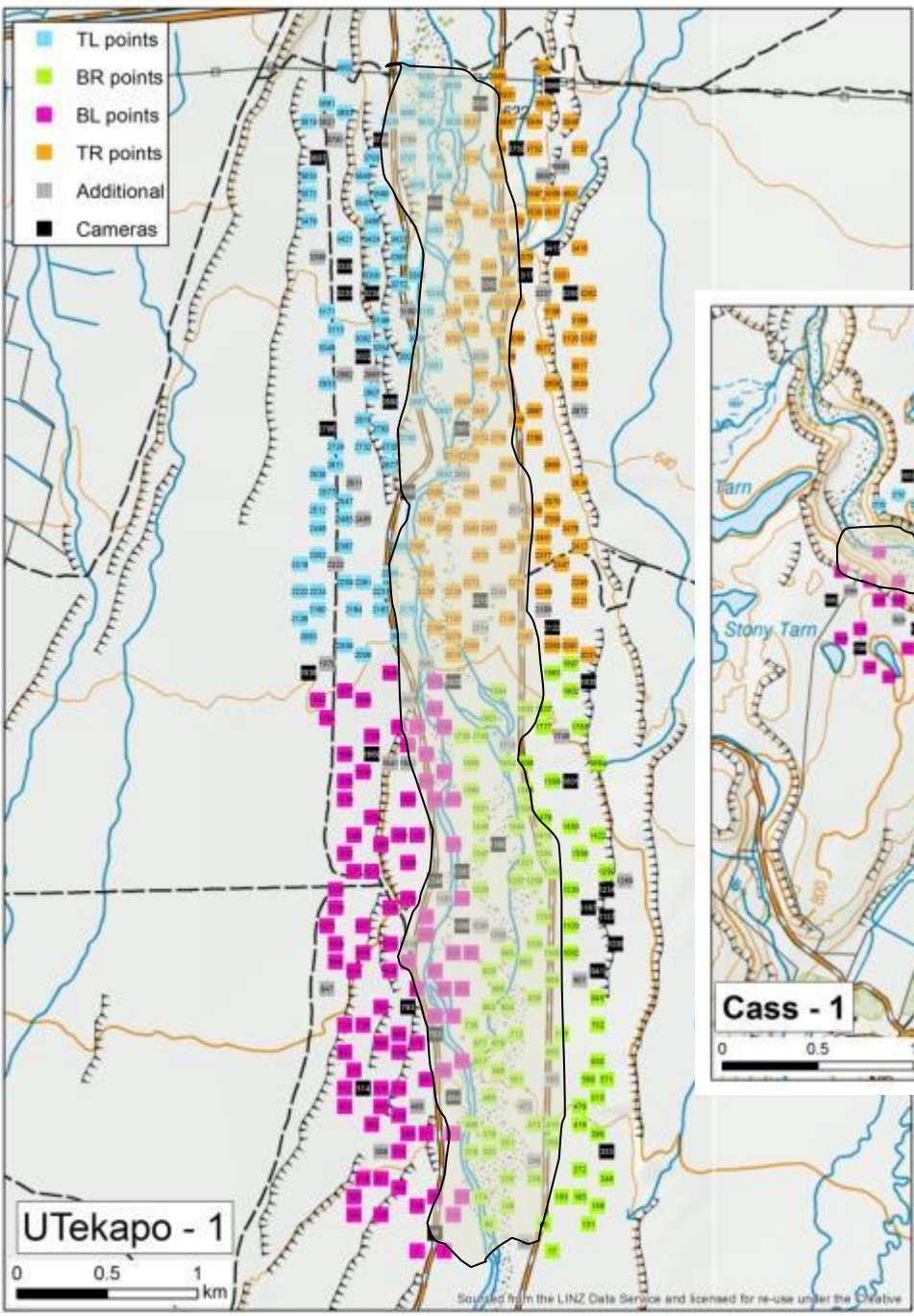
# Modelling encounters with odours

No.  
encounters  
with odour  
points  
(per mth)



Distance between odour points (m)

# Odour points





# Predator abundance





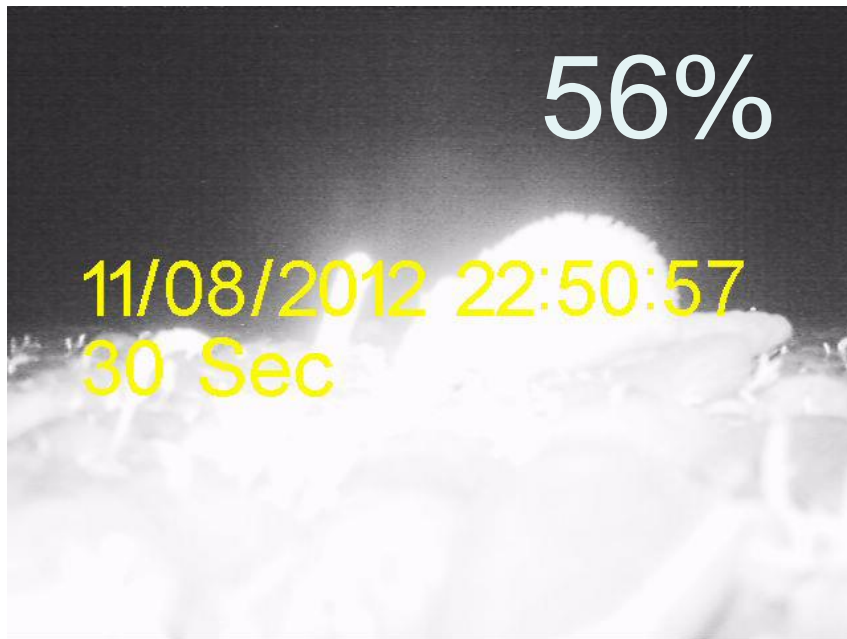
# Interactions with odour points

**Camera**

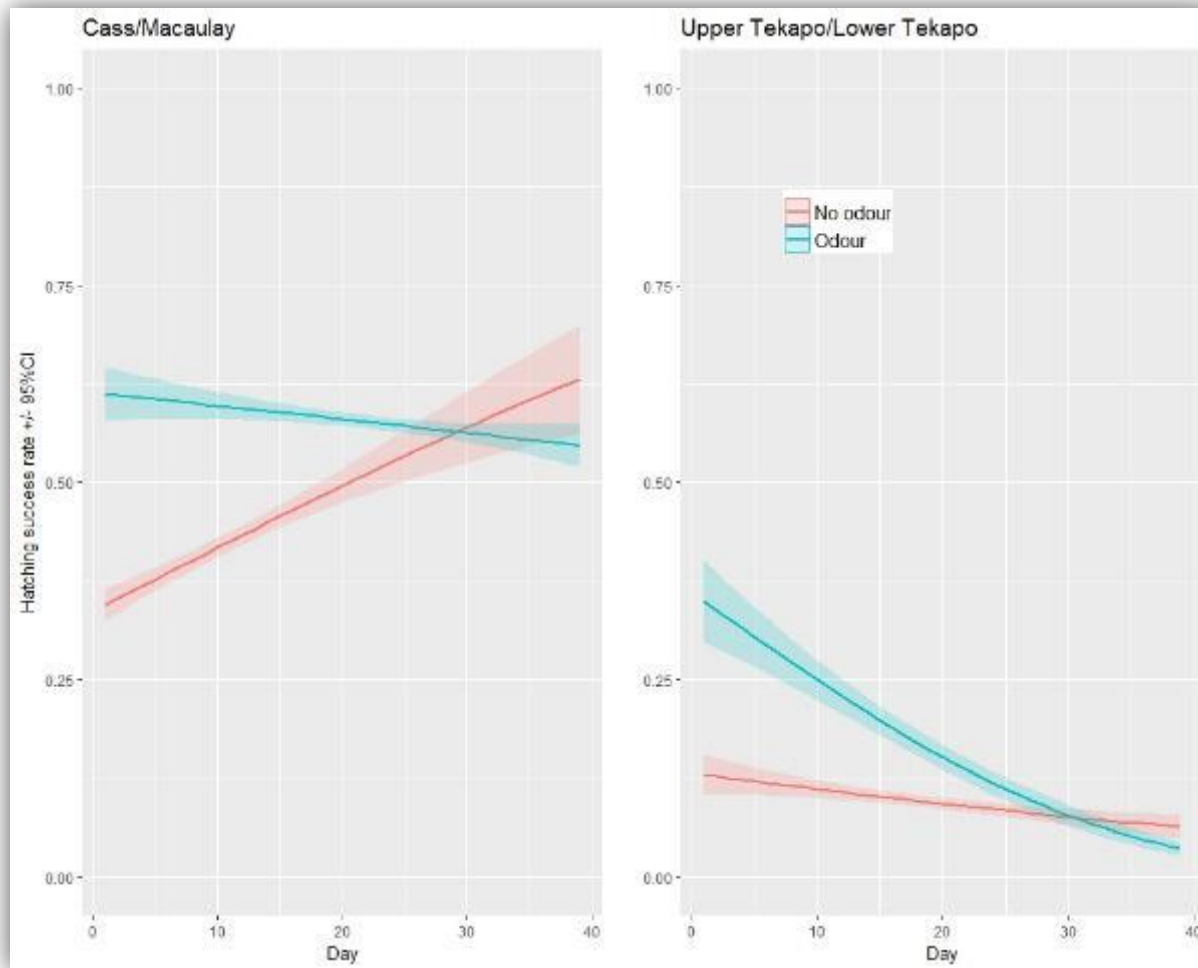


**Odour smear  
on rock**

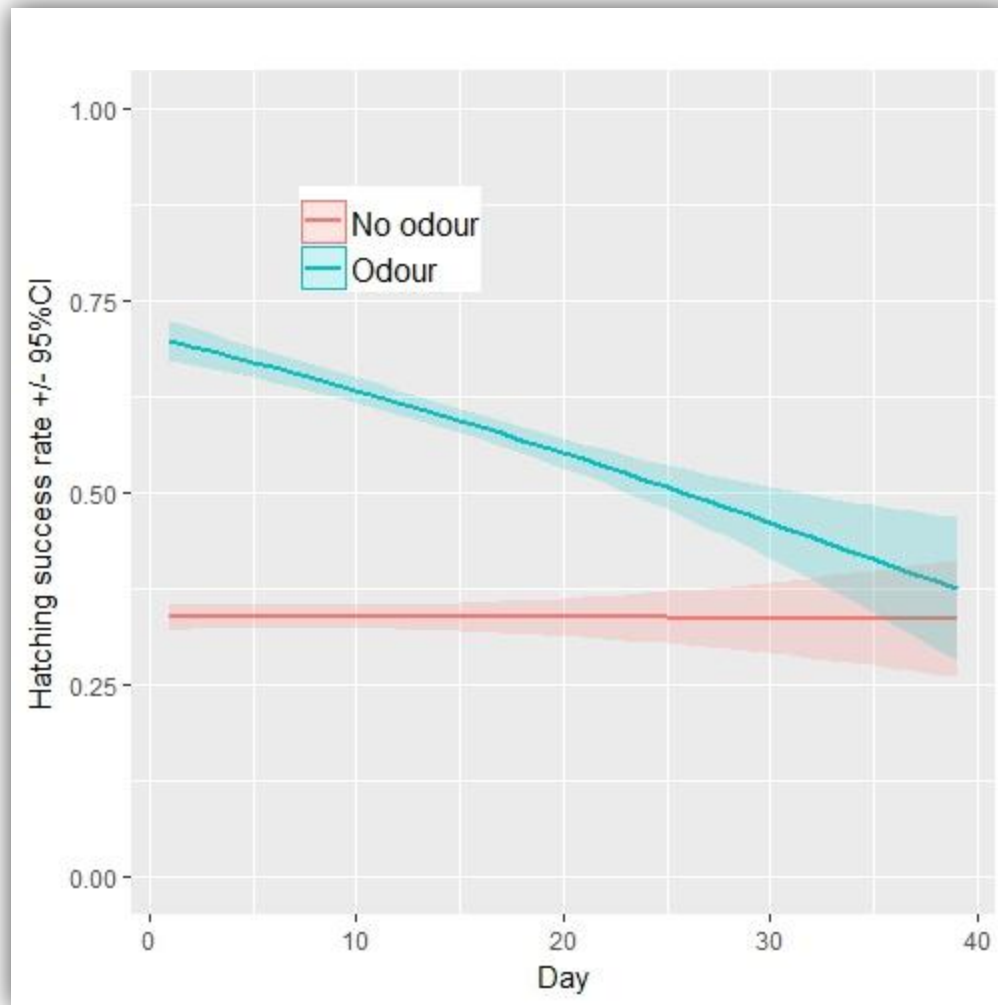




# Banded dotterel & wrybill



# Pied oystercatchers (sites combined)



# Summary

- Boosted chick production by c. 40–100% during a 25–32 day period
- Survival of chicks born early typically higher than chicks born later (Aalbert Rebergen, unpubl. data).
- Probably targets predators that inflict most damage, and evade control programs



# How is it any better than existing lethal methods?

- Lethal methods cannot be applied everywhere, especially where problem predators are native and protected
- Common sense to develop array of methods:
  - predators learn to avoid single methods that are repeated
  - different methods suit different circumstances
- Best applied during vulnerable periods e.g. breeding season or during translocation
- Areas prone to rapid re-invasion
- **Predators that rely on alternative prey**
- **Prey that are visually cryptic**

Funded by a Ministry of Business, Innovation and  
Employment's Smart Ideas grant, and the  
Strategic Science Investment Fund.



**Manaaki Whenua**  
Landcare Research