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

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

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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 recover 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 to traps, and determine the vulnerability of rock wrens to predation outside the breeding season.

Little, J.; 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

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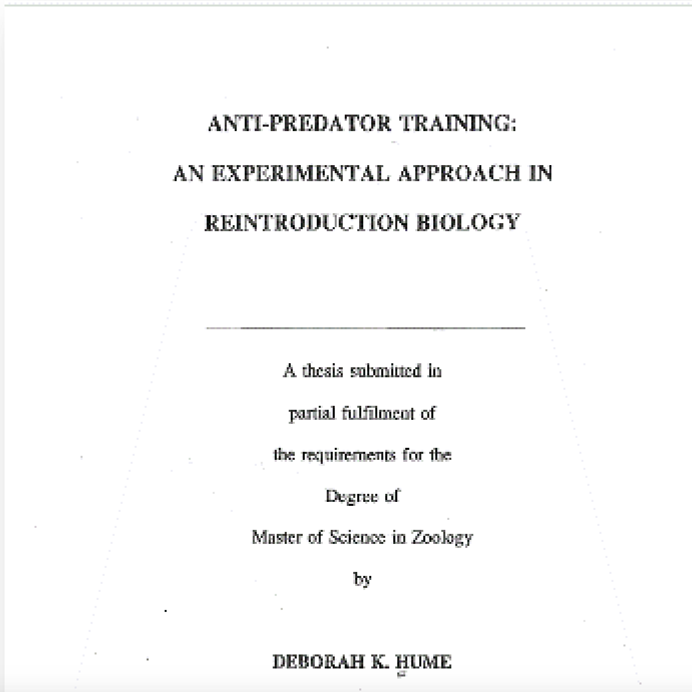
New Zealand Government

Department of Conservation
Te Papa Atawhai

	Olfactory		Auditory		Visual	
ATTRACTION	**Food**	**Social**	**Food**	**Social**	**Food**	**Social**
DETERRANCE		Social		Social		Social



ANTI-PREDATOR TRAINING:

AN EXPERIMENTAL APPROACH IN

REINTRODUCTION BIOLOGY

A thesis submitted in

partial fulfilment of

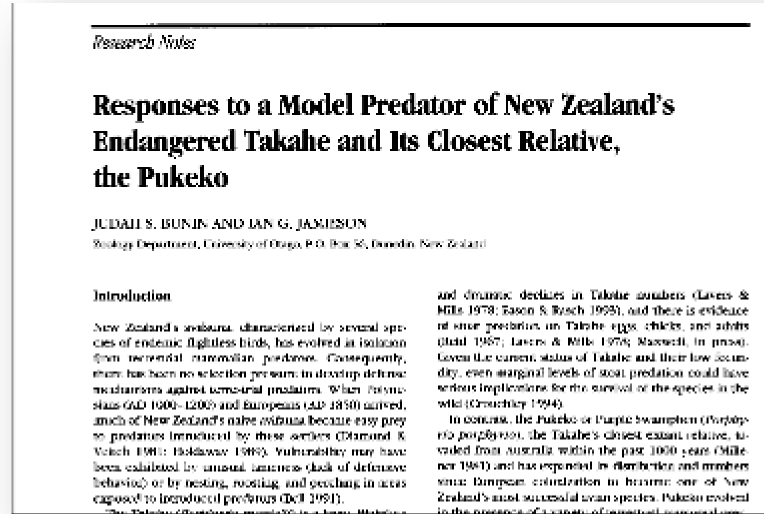
the requirements for the

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

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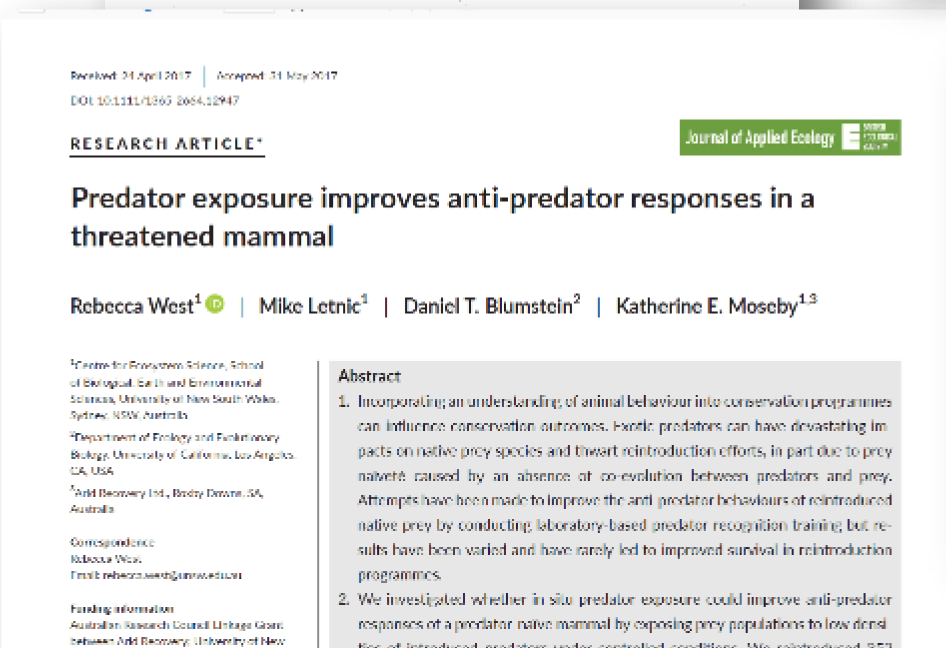
Introduction

New Zealand's avifauna, characterized by several species of endemic flightless birds, has evolved in isolation from terrestrial mammalian predators. Consequently, there has been no selection pressure to develop defense mechanisms against terrestrial predators. When Polynesians (AD 1000–1200) and Europeans (AD 1850) arrived, much of New Zealand's naive avifauna became easy prey to predators introduced by these settlers (Diamond & Veitch 1981; Holdaway 1989). Vulnerability may have been exhibited by unusual tameness (lack of defensive behavior) or by nesting, roosting, and perching in areas exposed to introduced predators (Bell 1991).

and dramatic declines in Takahe numbers (Lavers & Mills 1978; Eason & Rasch 1993), and there is evidence of stoat predation on Takahe eggs, chicks, and adults (Reid 1967; Lavers & Mills 1978; Maxwell, in press). Given the current status of Takahe and their low fecundity, even marginal levels of stoat predation could have serious implications for the survival of the species in the wild (Crouchley 1994).

In contrast, the Pukeko or Purple Swamphen (*Porphyrio porphyrio*), the Takahe's closest extant relative, invaded from Australia within the past 1000 years (Millener 1981) and has expanded in distribution and numbers since European colonization to become one of New Zealand's most successful avian species. Pukeko evolved



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RESEARCH ARTICLE

Journal of Applied Ecology

Predator exposure improves anti-predator responses in a threatened mammal

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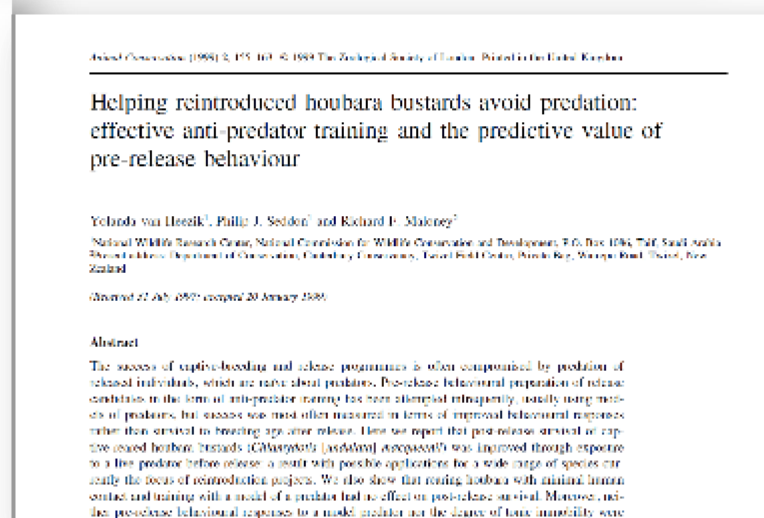
Abstract

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 naiveté 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-naive mammal by exposing prey populations to low densities of introduced predators under controlled conditions. We reintroduced 352



Animal Conservation (1998) 1, 155–163 © 1998 The Zoological Society of London. Printed in the United Kingdom

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

Yolanda van Heezik[1], Philip J. Seddon[1] and Richard F. Maloney[2]

(Received 21 July 1997; accepted 20 January 1998)

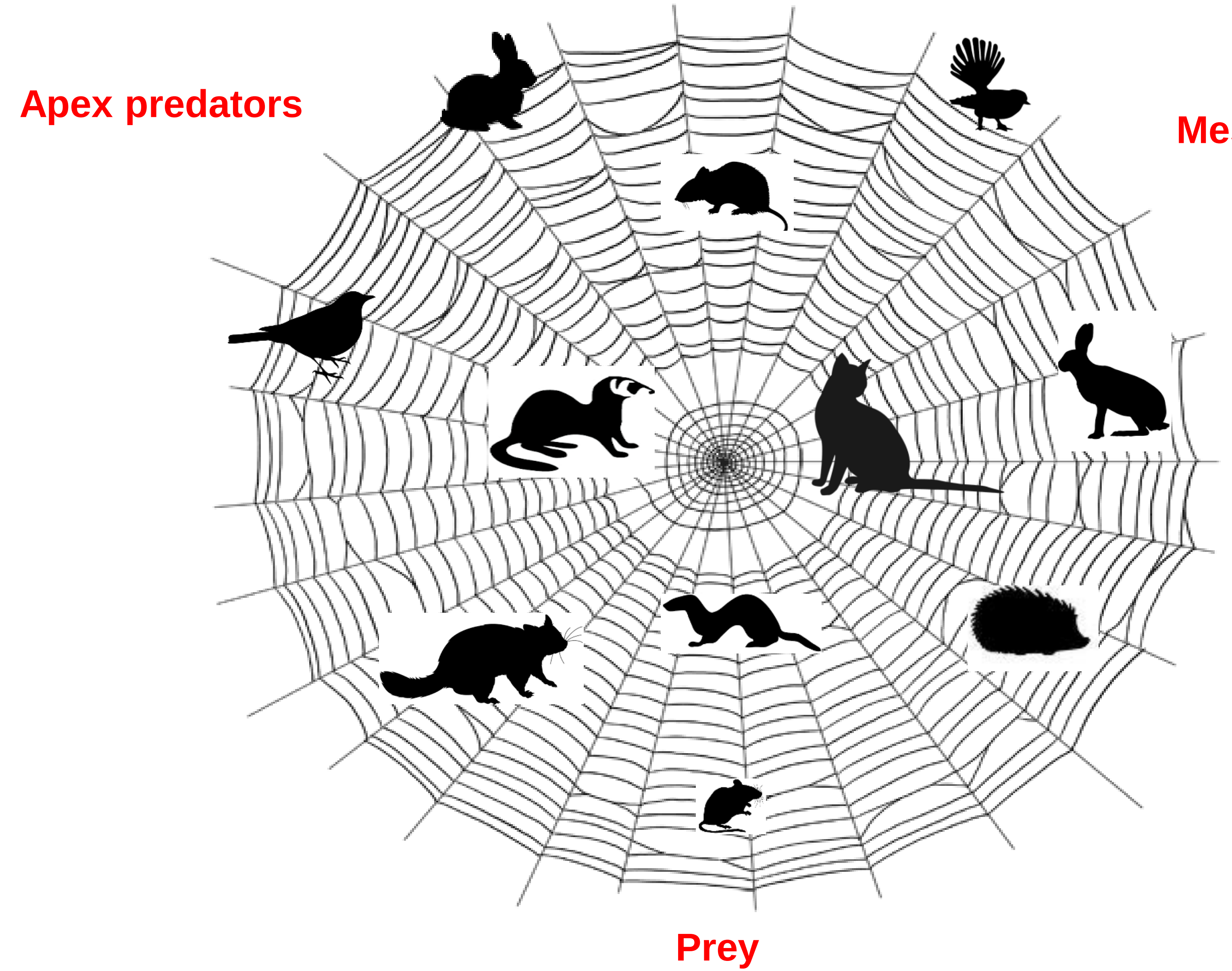
Abstract

The success of captive-breeding and release programmes is often compromised by predation of released individuals, which are naive about predators. Pre-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 improved behavioural responses rather than survival to breeding age after release. Here we report that post-release survival of captive-reared houbara bustards (*Chlamydotis* [*undulata*] *macqueenii*) 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, neither pre-release behavioural responses to a model predator nor the degree of tame immobility were

Patrick Garvey

Developing a ‘super lure’ for stoats and weasels

Olfactory web of information



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

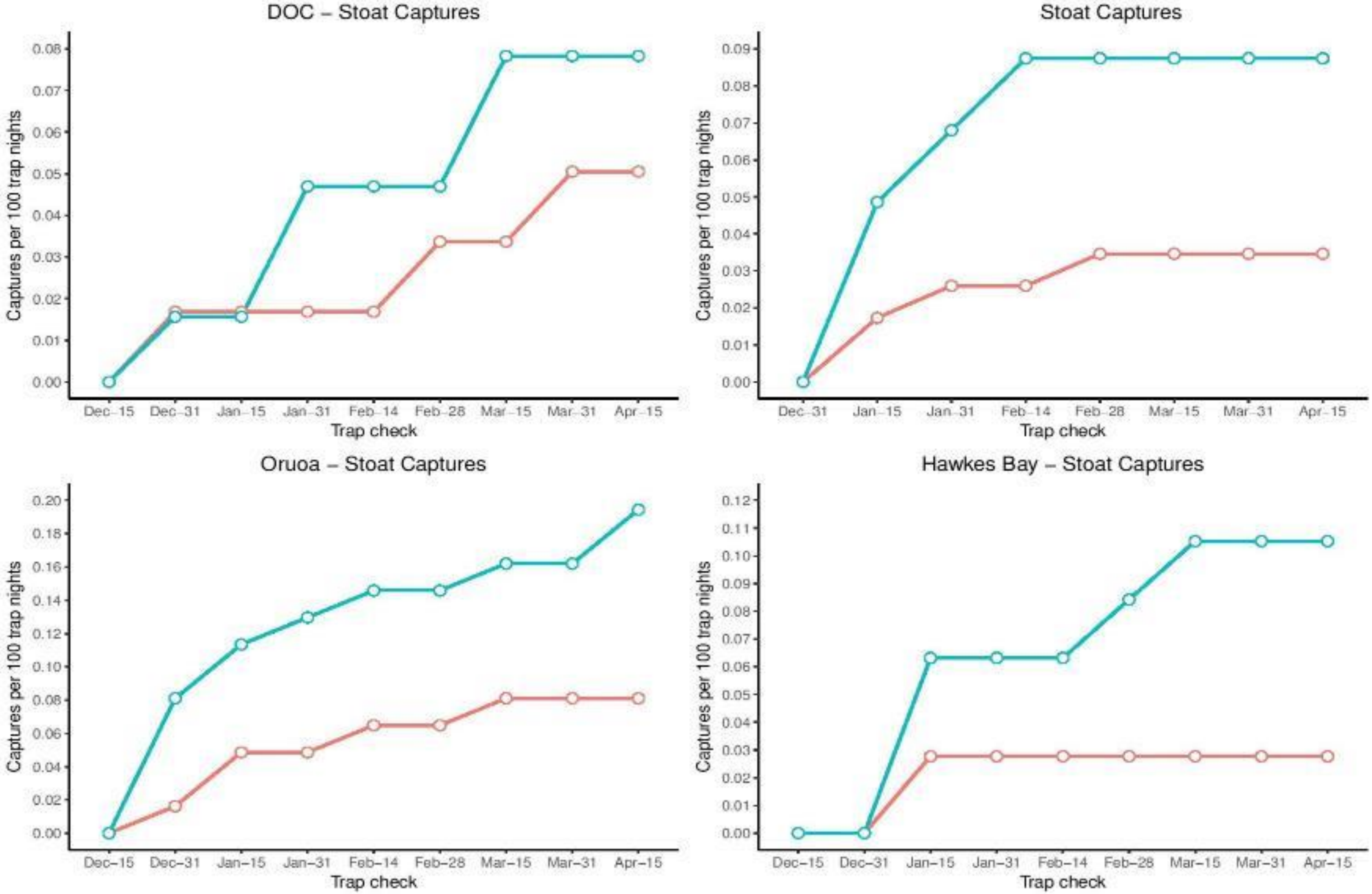
WHANGAWEHI CATCHMENT MANAGEMENT GROUP

WHAREROA GUARDIANS COMMUNITY TRUST

Department of Conservation *Te Papa Atawhai*

Kaweka Forest Park

Lure trial – Stoat captures

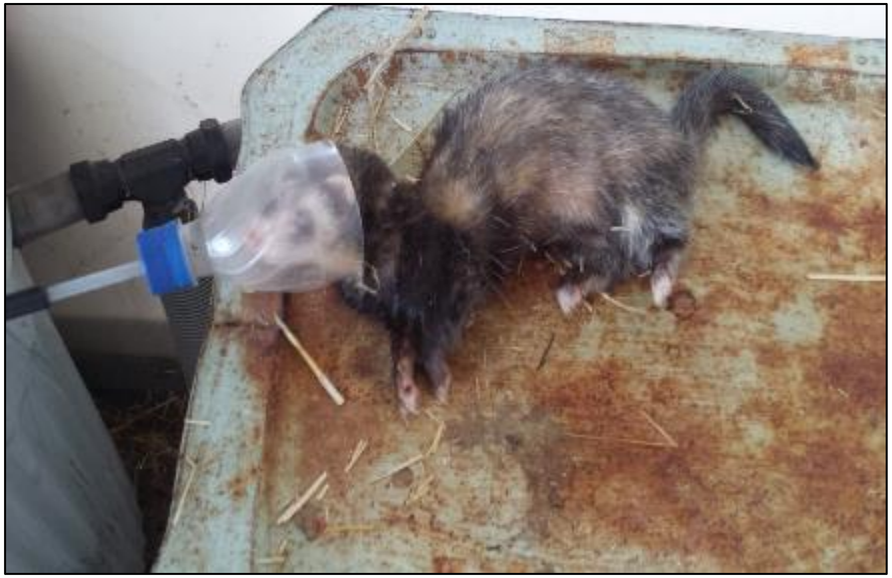


Natural lure has limitations!

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

*** Need to synthesise ferret odour**

Behaviour trial

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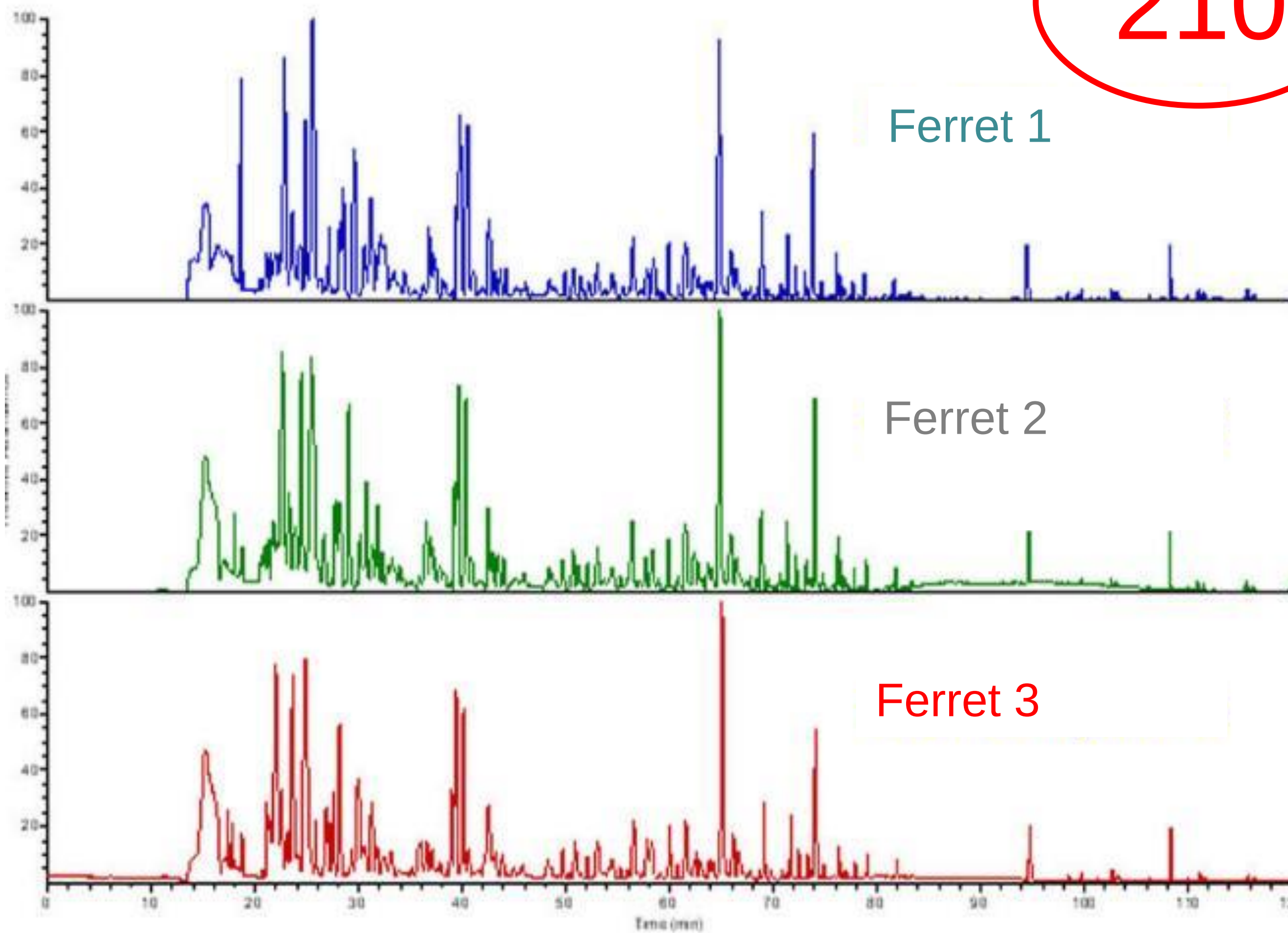
CAM106
RECONYX

Chemical analysis

210



Synthesising mustelid lure

Behavioural trials combined with chemical analysis

- 8 key compounds identified
- Testing the most attractive combination


HAWKE'S BAY
REGIONAL COUNCIL
NEW ZEALAND'S BIOLOGICAL HERITAGE
Ngā Koiora Tuku Iho
National SCIENCE Challenges
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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

PNAS

Exploiting olfactory learning in alien rats to protect birds' eggs

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[a]Evolution and Ecology Research Centre, School of Biological, Earth, and Environmental Sciences, University of New South Wales, Randwick, NSW, 2052 Australia; and [b]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



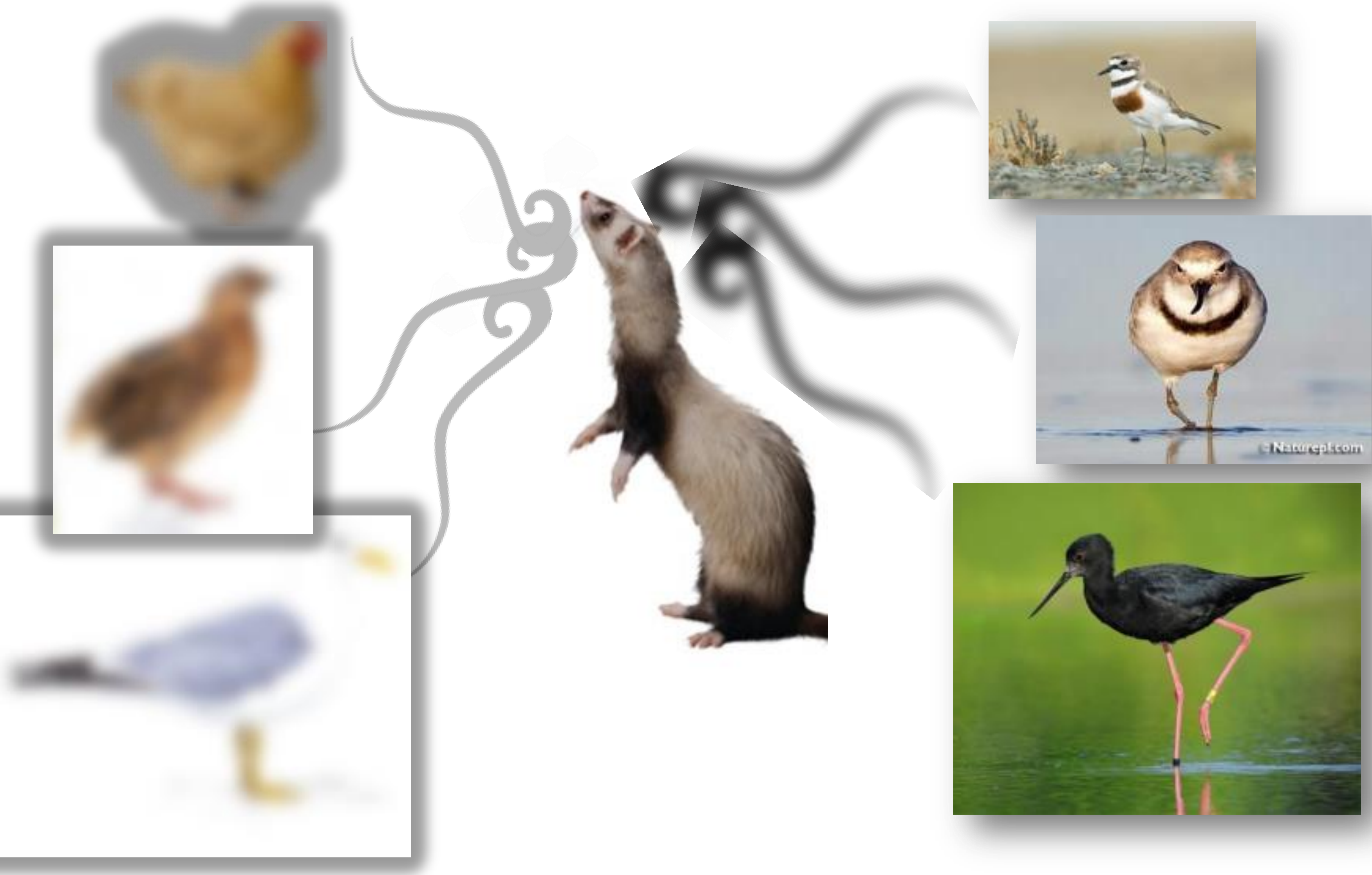
Background

- 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

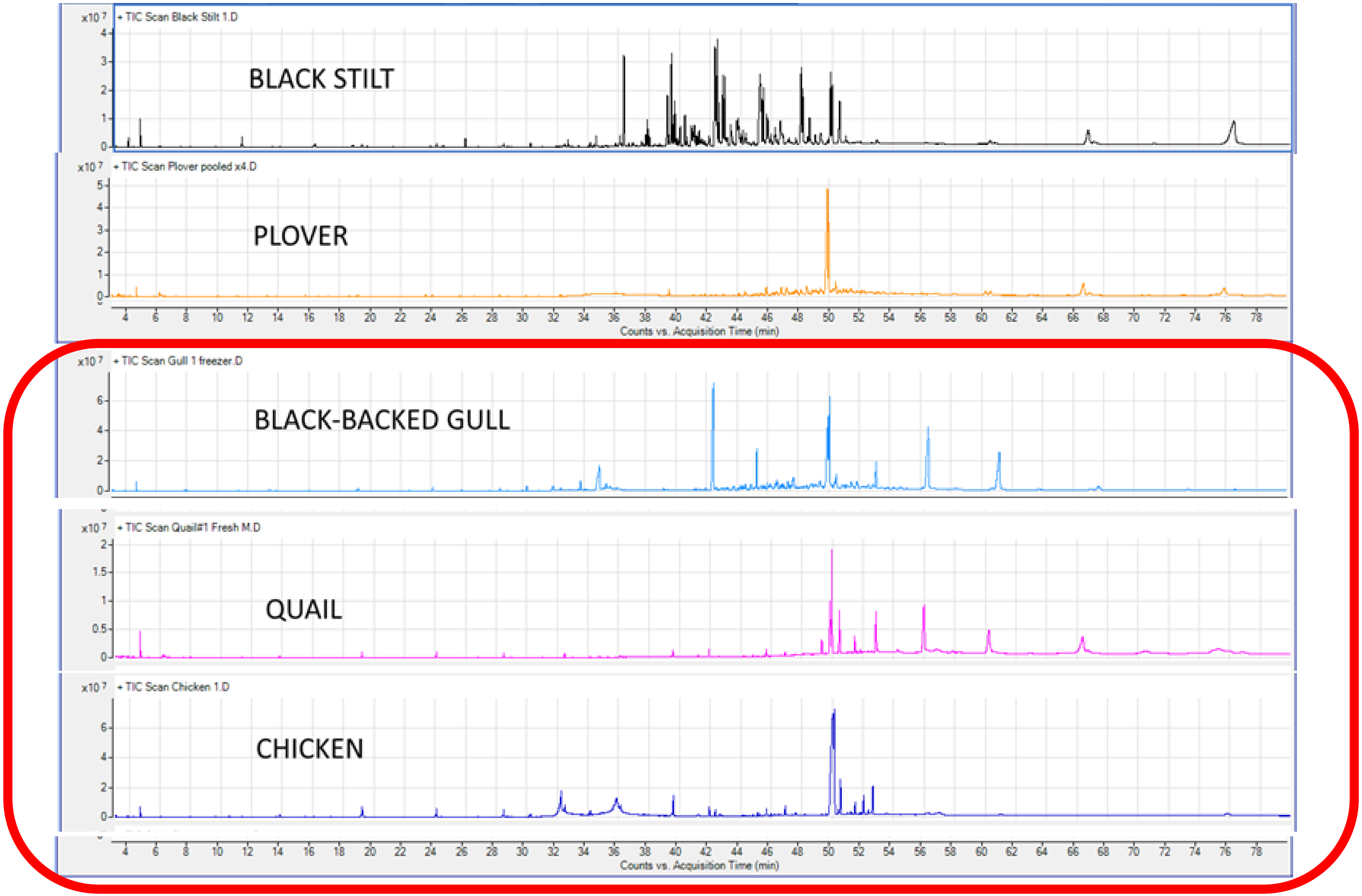
What can be done to address this mismatch?

- 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

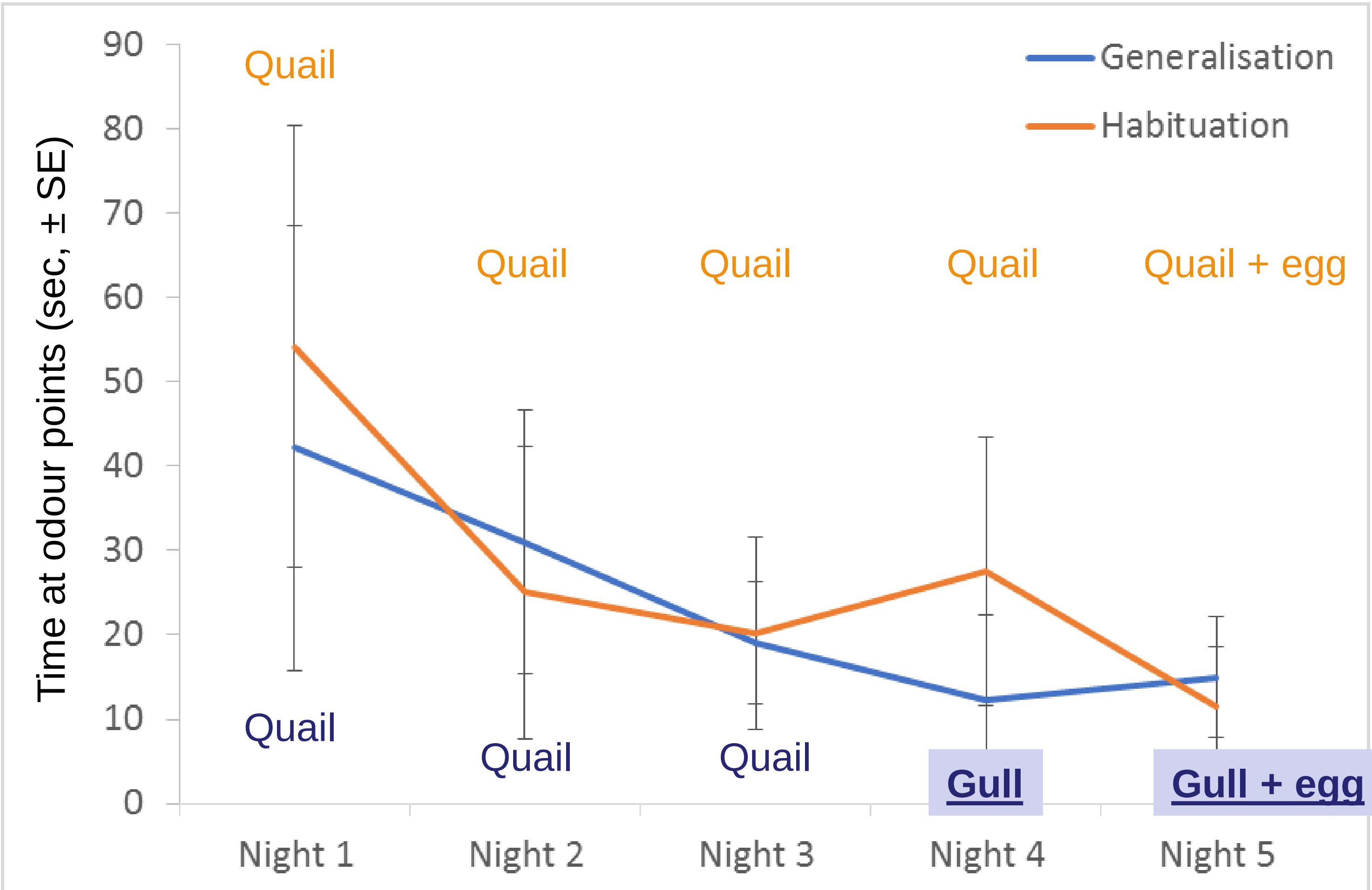


Chemical profiles of bird odours

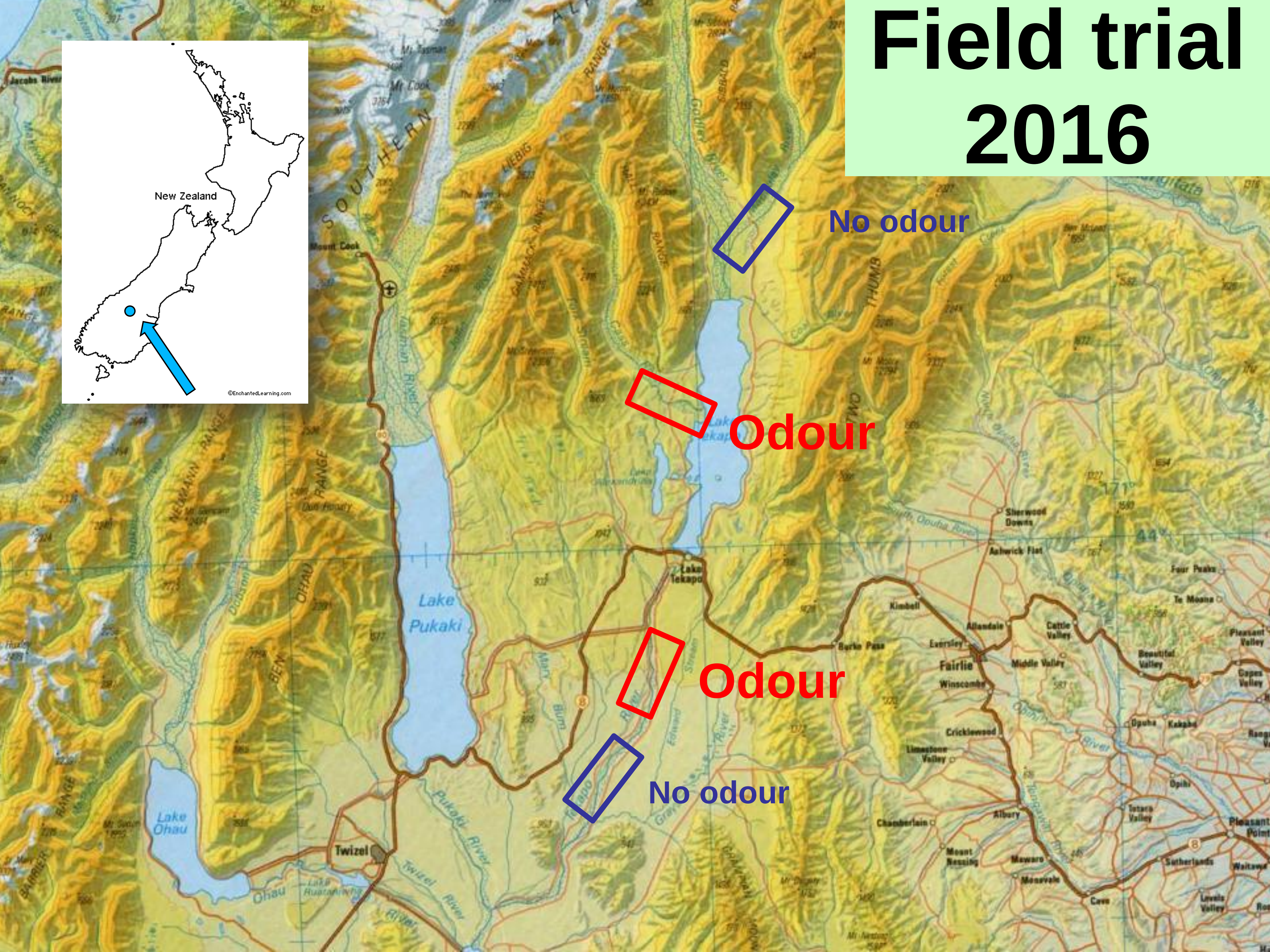


Ferret and hedgehog pen trials

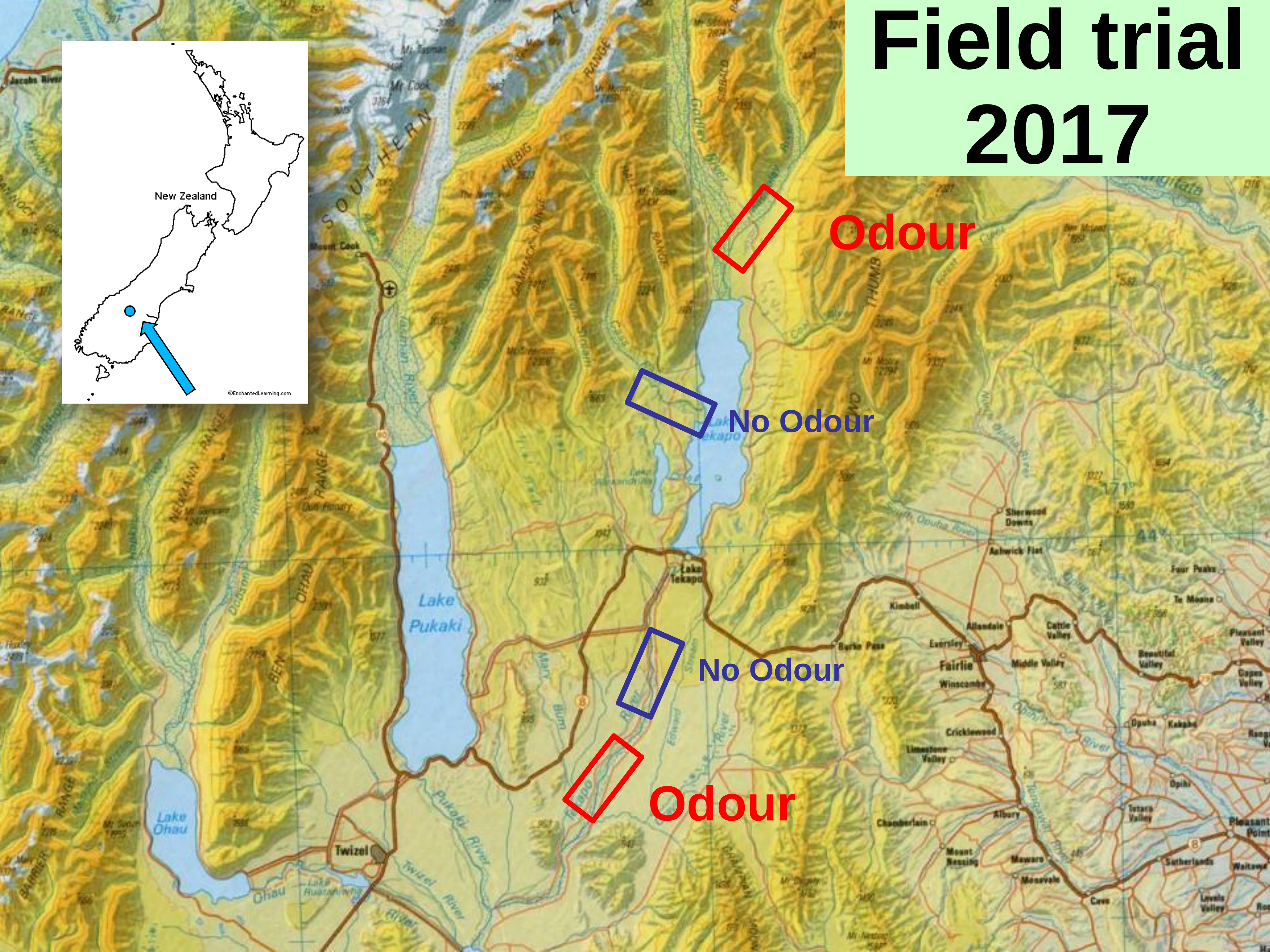
Ferret pen trials



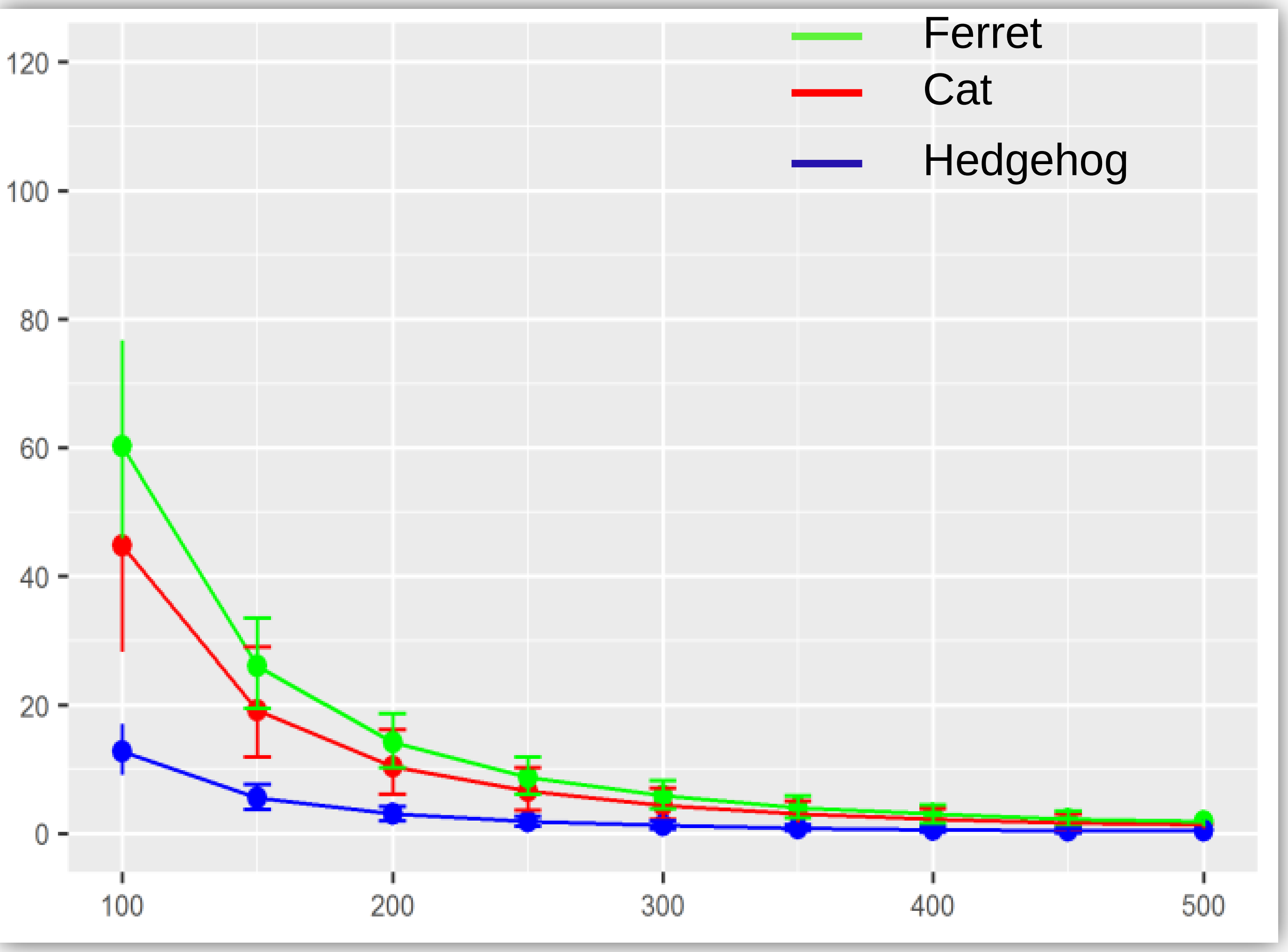
Field trial 2016



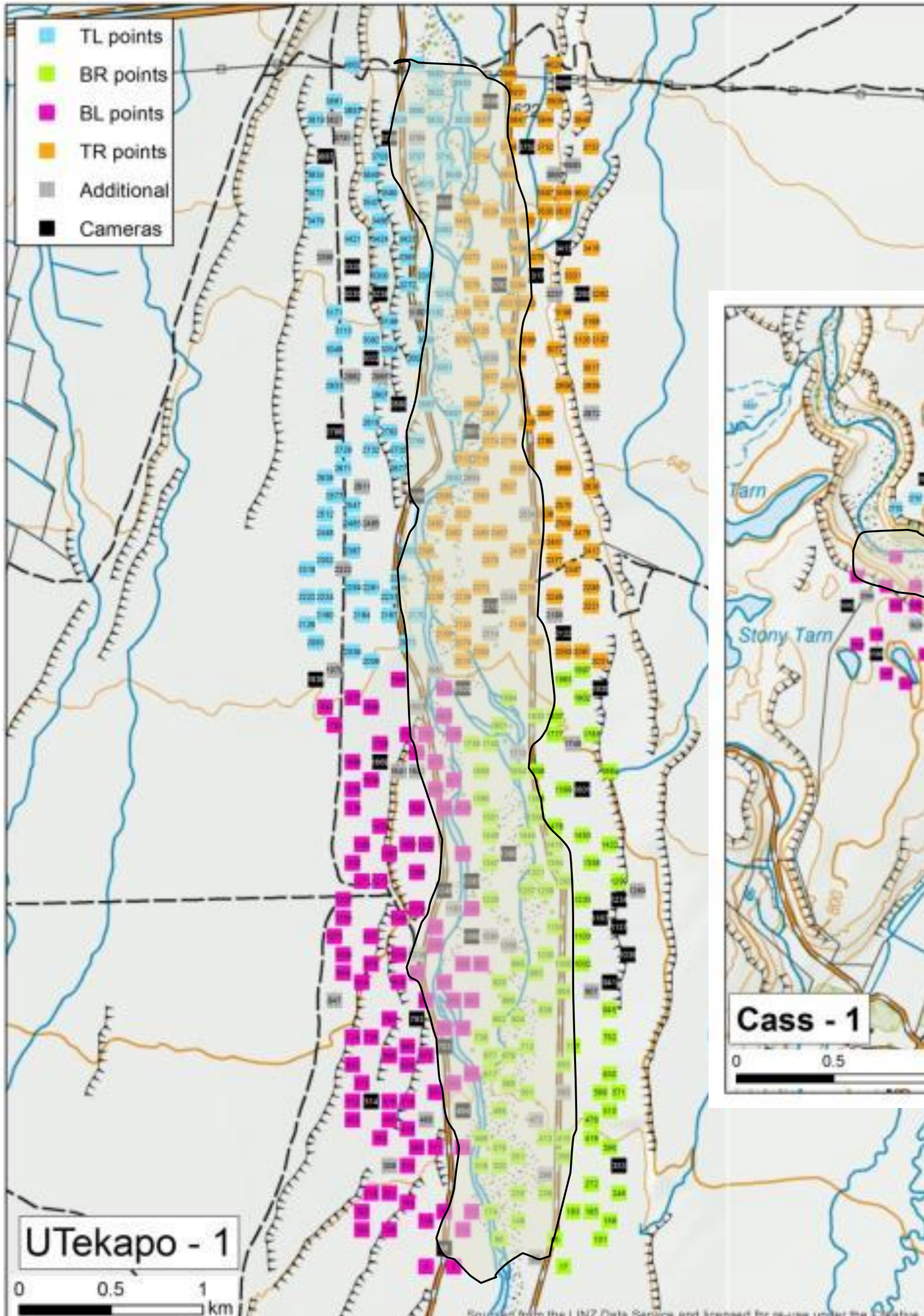
Field trial 2017

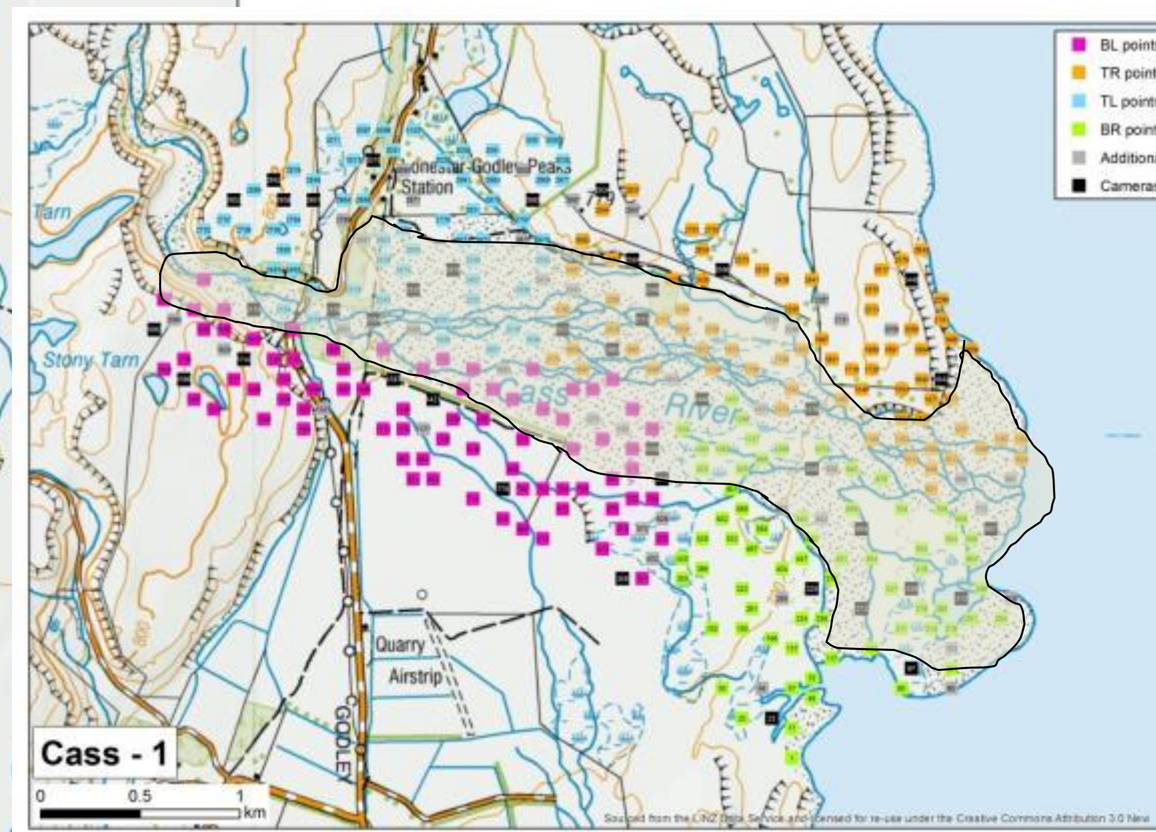


Modelling encounters with odours



Odour points





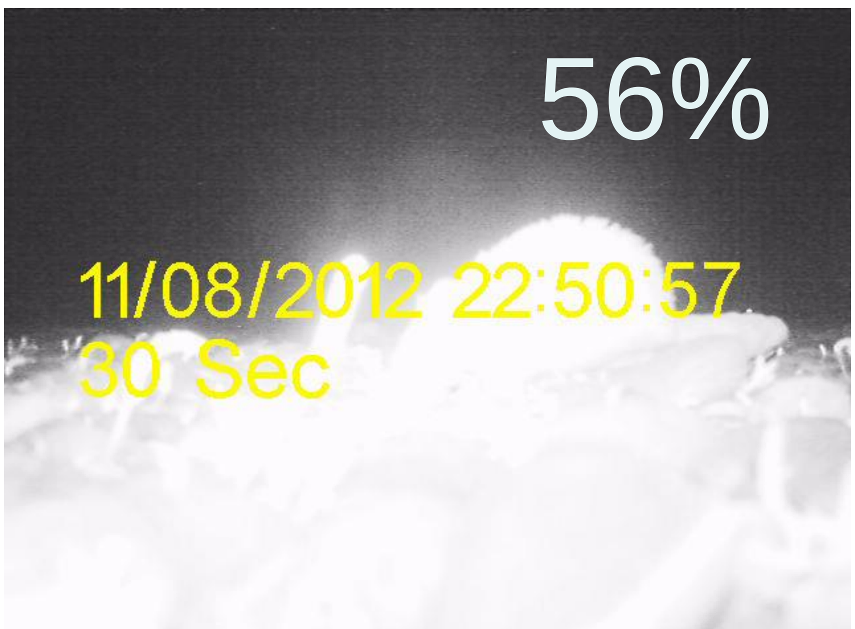
Predator abundance

Interactions with odour points

Camera

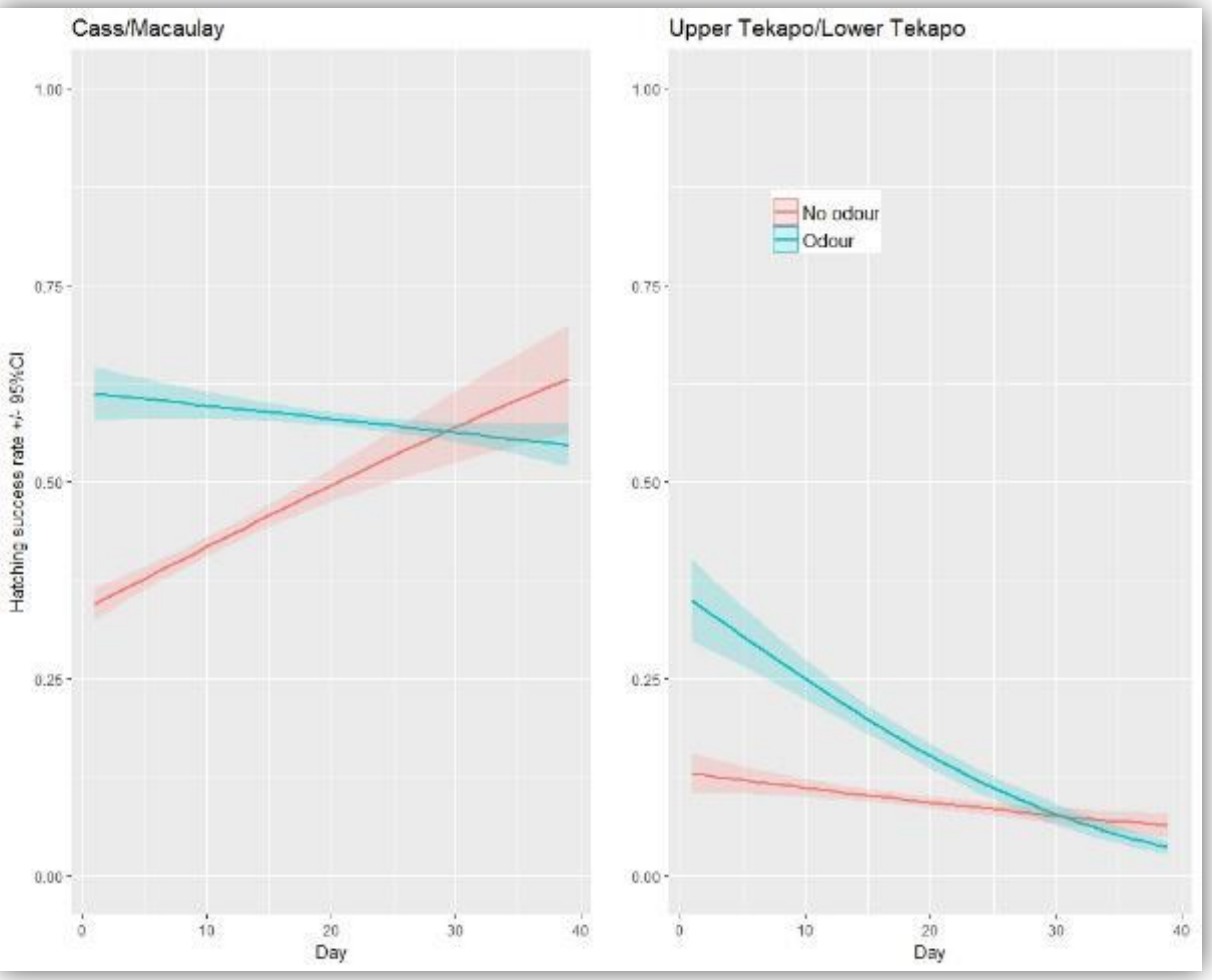
Odour smear on rock


6%
31/10/2012 03:43:17

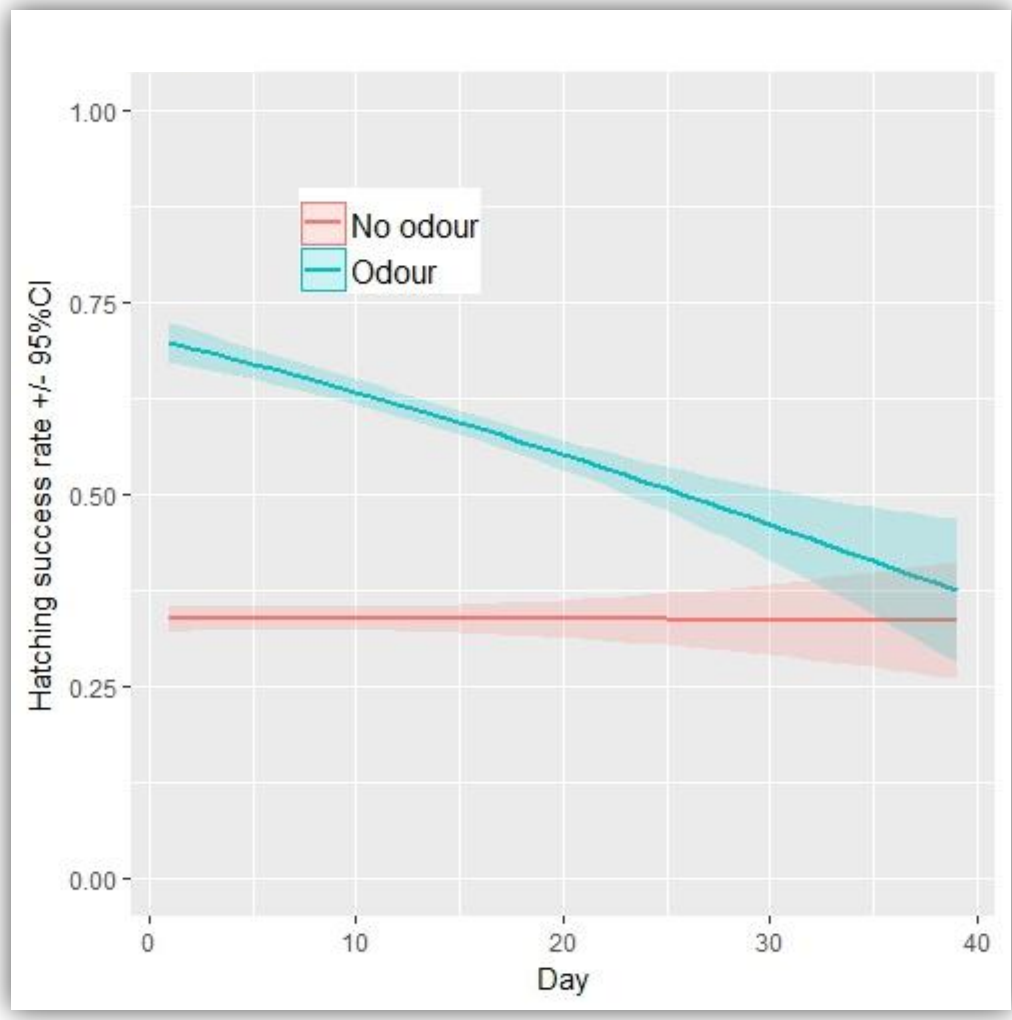

56%
11/08/2012 22:50:57
30 Sec


34%

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

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