Olfactory Misinformation:

using "fake news" to protect shorebirds from invasive species

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Hidden ….. but foxes, cats are finding them

How to avoid being eaten – Nature's strategy?

Nest predation on shorebirds increasing – climate change

Kubelka et al (2018) *Science*

Traditional solutions – kill or fence

Problem individuals – need additional tools

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Fox thought to have killed nearly 30 penguins at Manly's North Head shot overnight

Updated 27 Jun 2015, 3:21am

A fox that is thought to have mauled nearly 30 little penguins at Manly's North Head has been shot overnight.

An autopsy on the fox will be undertaken at Taronga Zoo to confirm it was the animal that killed 26 birds over the past 11 days, evading baits, traps and snipers.

NSW National Parks said the North Head little penguin colony is the last remaining on the New South Wales mainland.

How do mammals find food?

Search

Detect - ID

Approach

Subjugate

Consume

Olfactory information

Informative – chemistry provides information on food type, food quality

Long-lasting – can follow an odour to a point source over long distances

Spatially predictable – emission is tightly associated with the location of prey

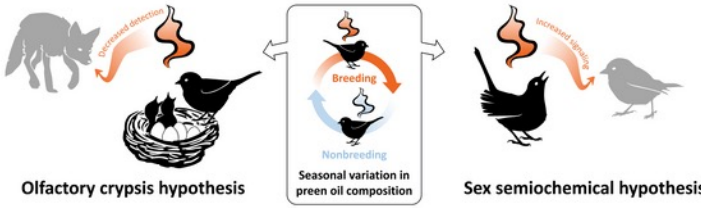
Foragers use odour to find food efficiently

Plots with odour visited by foxes faster than controls

Hughes, Price & Banks (2010) *PLoS One*

Reduced olfactory conspicuousness by switching preen wax chemistry?

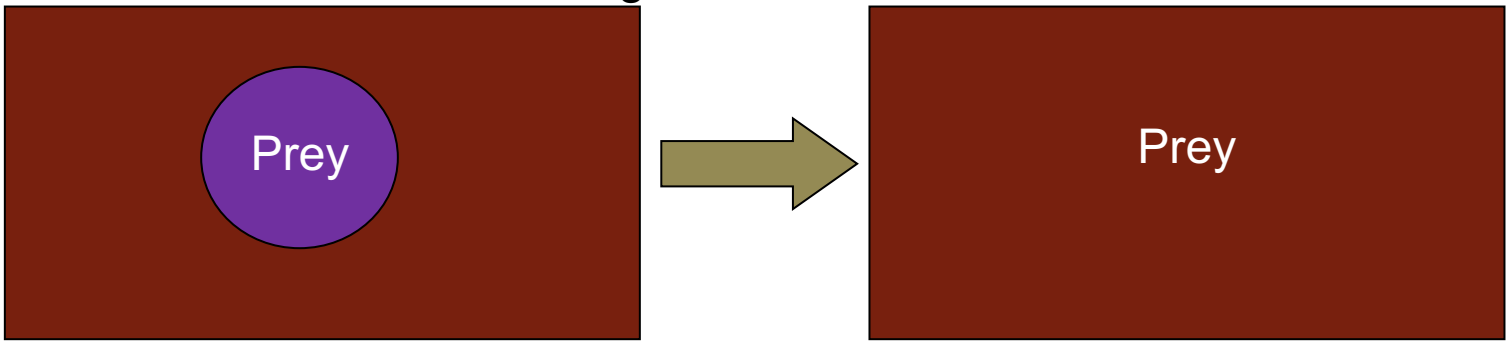
Reneerkens et al (2005) *J Exp Bio*



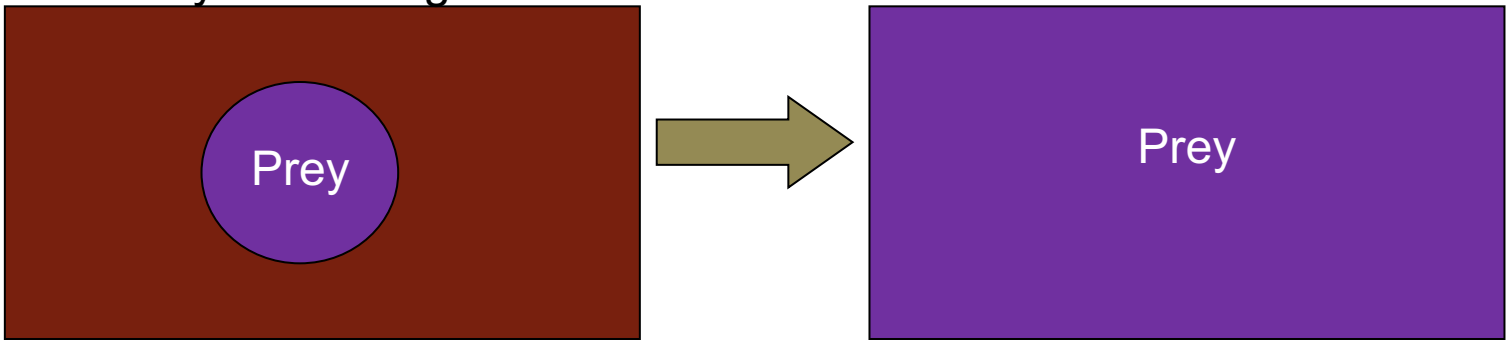
Grieves et al (2022) Biological Reviews

Avoiding olfactory detection? Camouflage?

Evolution of visual camouflage



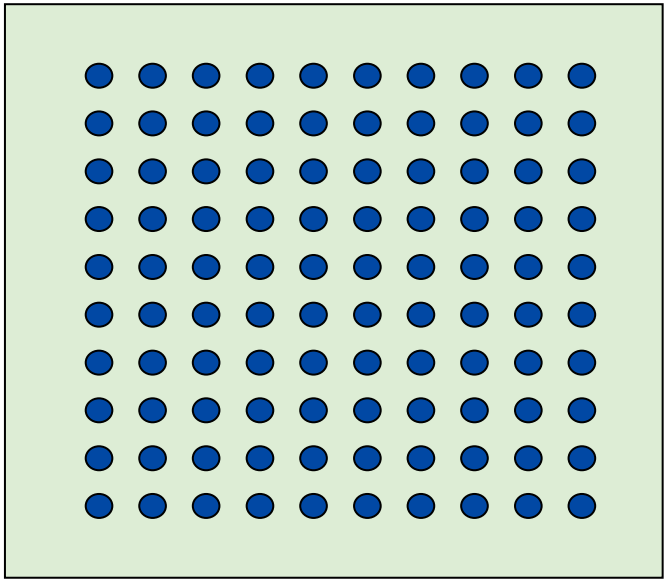
Olfactory camouflage?



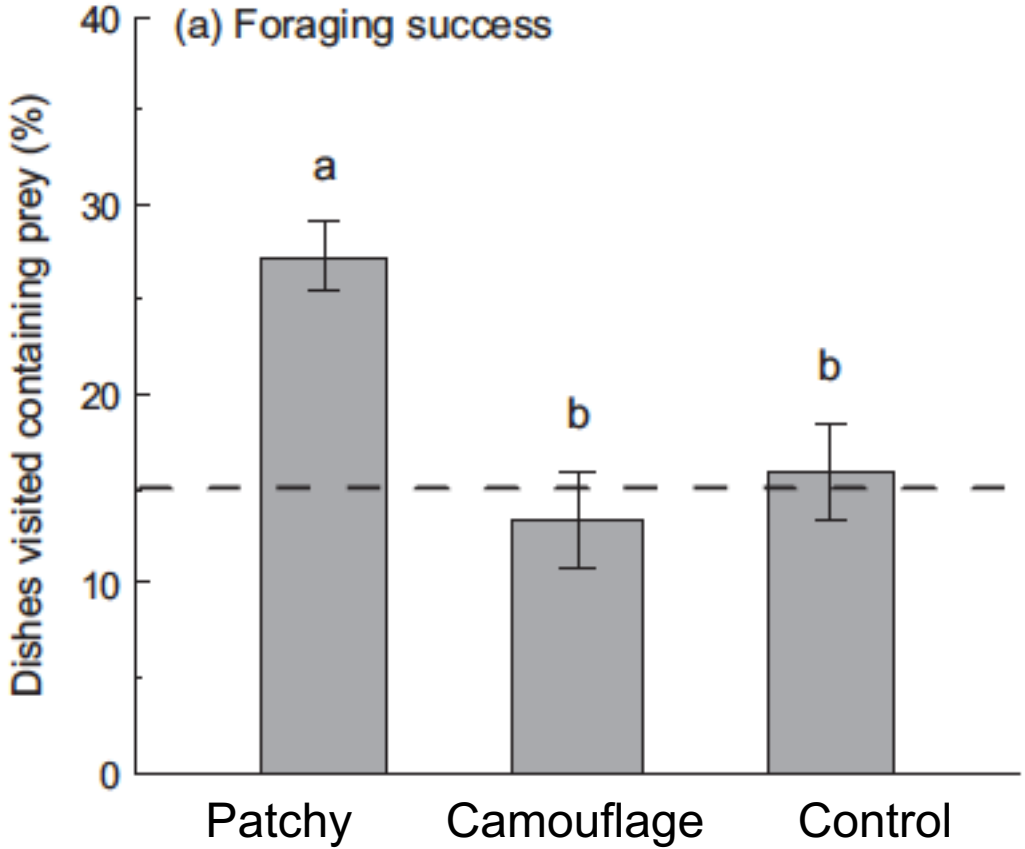
Odour everywhere – not useful as prey
not spatially predictable

Can we camouflage smelly food?

10m x 10m enclosure – 1 mouse
100 ‘patches’ = petri dish with sand
15 patches contain peanuts



Camouflaged peanuts hard to find – high foraging costs



Carthey et al (2011) *J Anim Ecol*

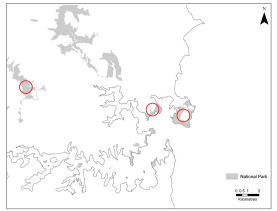
Experimental field test: wild predators, real eggs

Predator:
black rats
Rattus rattus

Prey:
quail eggs in artificial nest

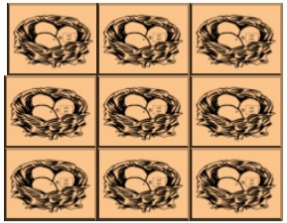
Odour:
Domestic quail feathers and faeces (10g/day)

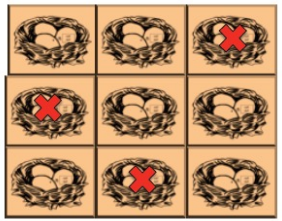
- 40 x 1 ha grids
  (Sydney Harbour & Lane Cove NP)
- 36 points/grid (16m apart)
- 9 nests with real eggs/grid



INTRODUCTION OF PREY

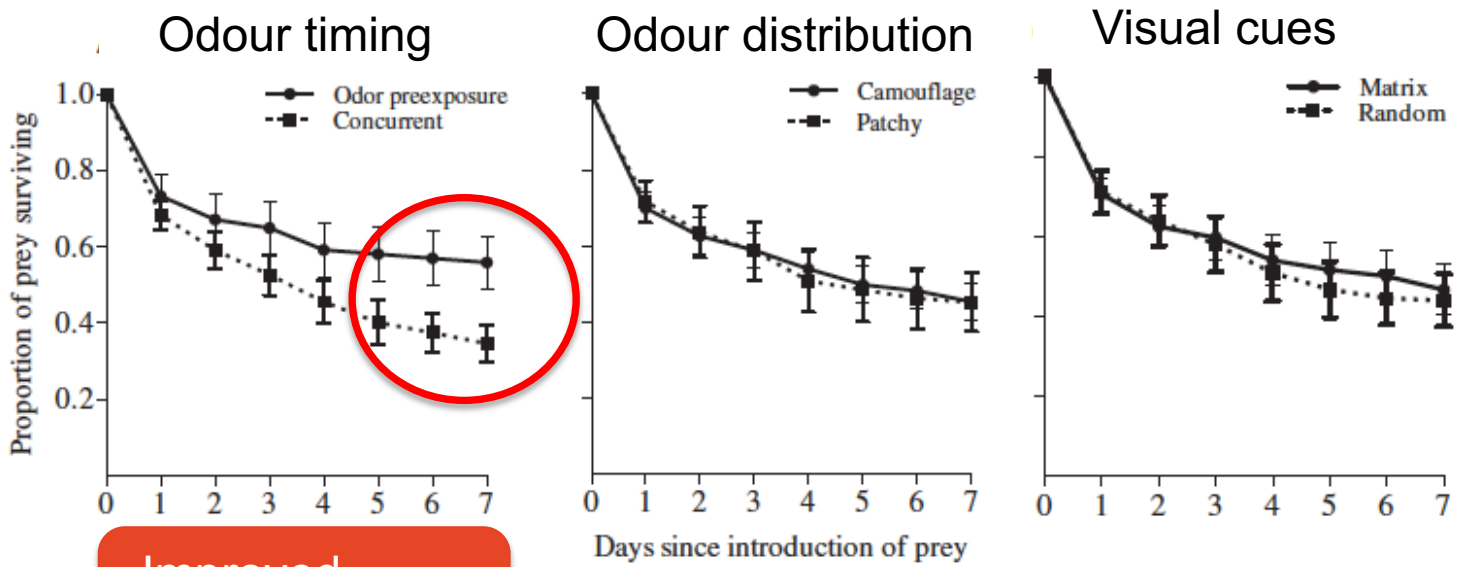
Pre-exposure: Day 1-7 odour Day 8 prey





Compared survival of quail eggs over 7 days

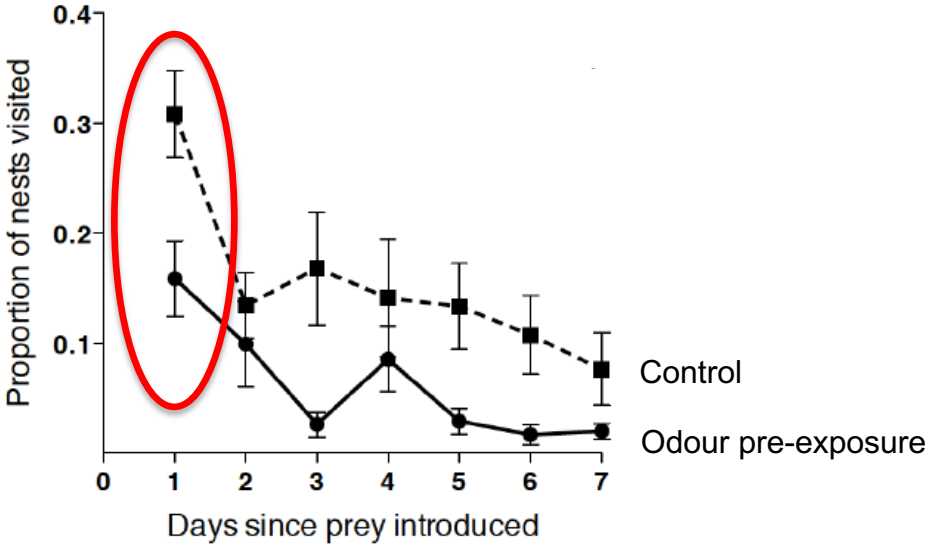
Odour pre-exposure improved artificial nest survival



Improved survival by 62%

Price & Banks (2012) *PNAS*

How? Rats interest in nests dropped over 3 days



1 week quail odour exposure

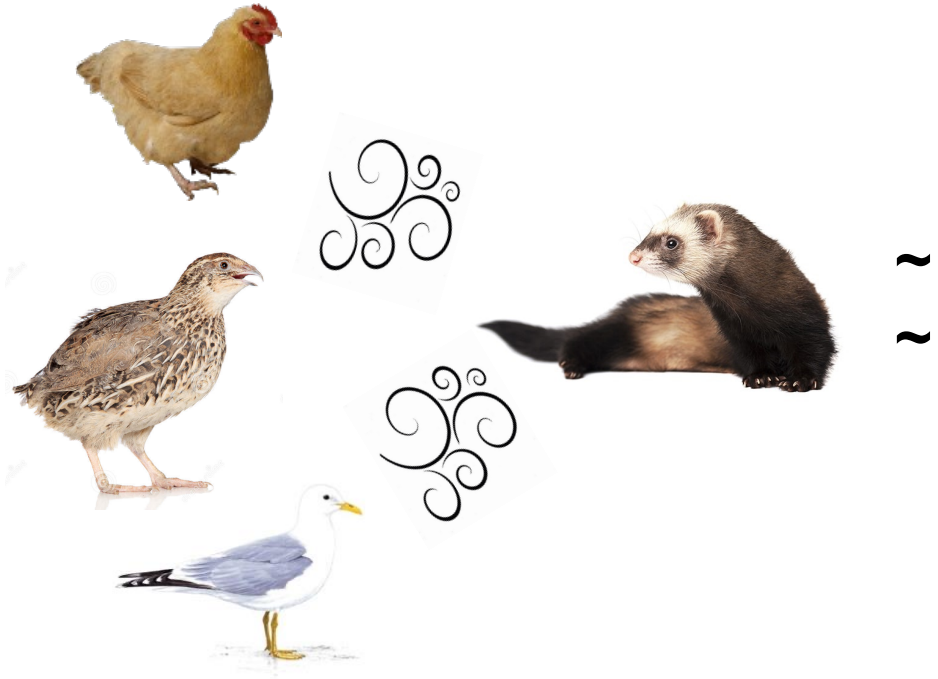
Rats lose interest in unrewarded odour

Sig lower predation on artificial nests

Price and Banks (2012) *PNAS*

Protecting threatened birds – how to use odour misinformation?

Do predators use general or specific foraging cues?



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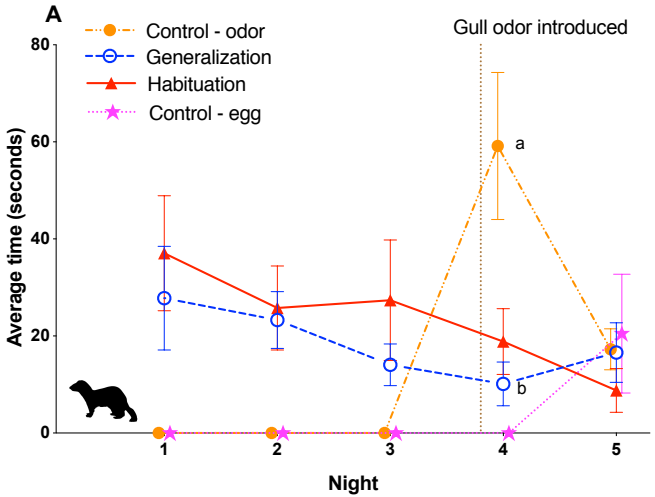
Banded dotterel (Double-banded Plover)
(NZ: Vulnerable)

Black Stilt
(NZ Critically Endangered)

Experimental test: Do predators categorise bird odours together?

Key: = quail odor = gull odor = quail egg odor

Treatment	Phase 1			Phase 2	Phase 3
Time	*Night 1*	*Night 2*	*Night 3*	*Night 4*	*Night 5*
Habituation					
Generalization					
Control for eggs					
Control for gull odor					



Ferrets: yes
Hedgehogs: Not as clear, lots of individual variability

Price et al (2020) *Ecological Applications*

Landscape scale test: multiple shorebird species

Double-banded Plover
(Banded Dotterel)
Charadrius bicinctus

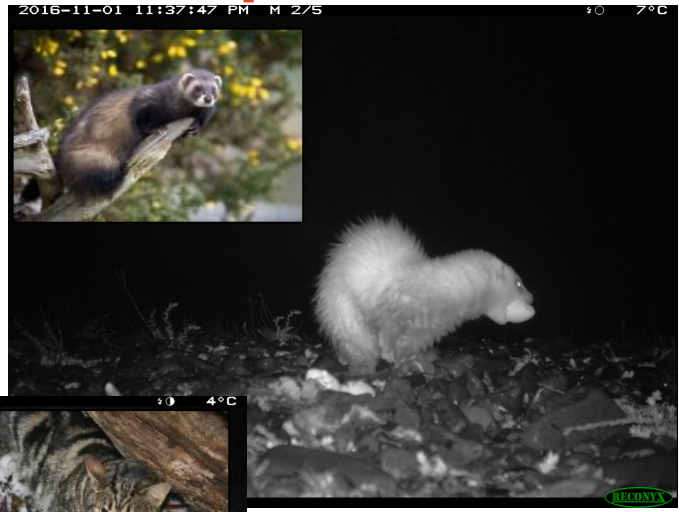
Wrybill *Anarhynchus frontalis*

South Island Pied Oystercatcher
Haematopus finschi

Black Stilt
Himantopus novaezelandiae

Landscape scale test: multiple predator species

40% nests predated by introduced mammalian predators before hatching (Sanders & Mahoney 2002 *Biol Cons)*

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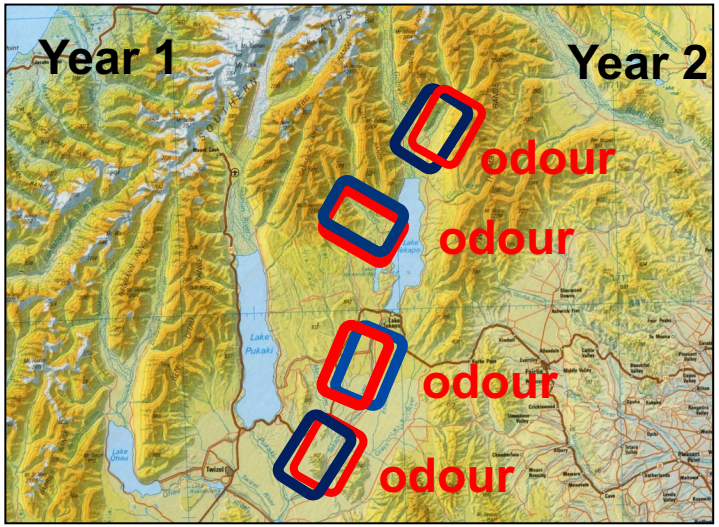
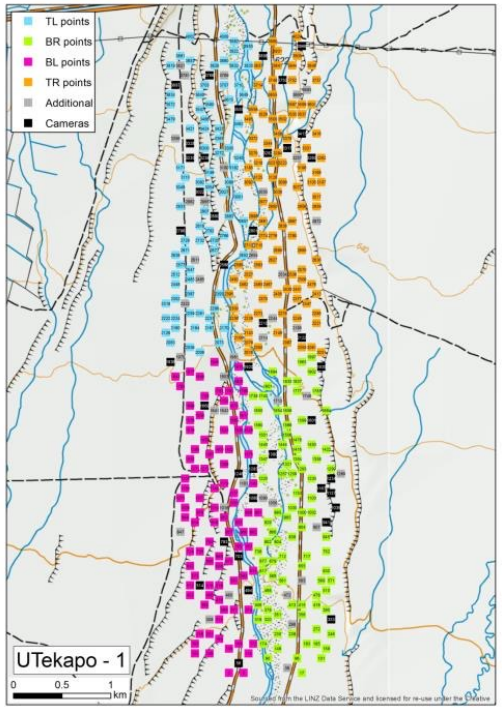
RECONYX
SEE WHAT YOU'VE BEEN MISSING...

Paired sites: odour pre-exposure vs no odour

Year 1, then reversed treatments in Year 2



4 sites average 960ha



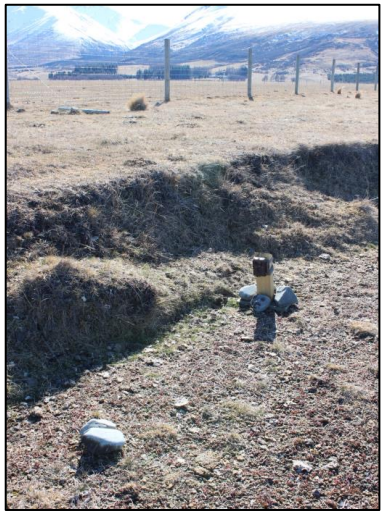
Odour sites: 300-400 odour points applied every 3 days, incl 40 cameras

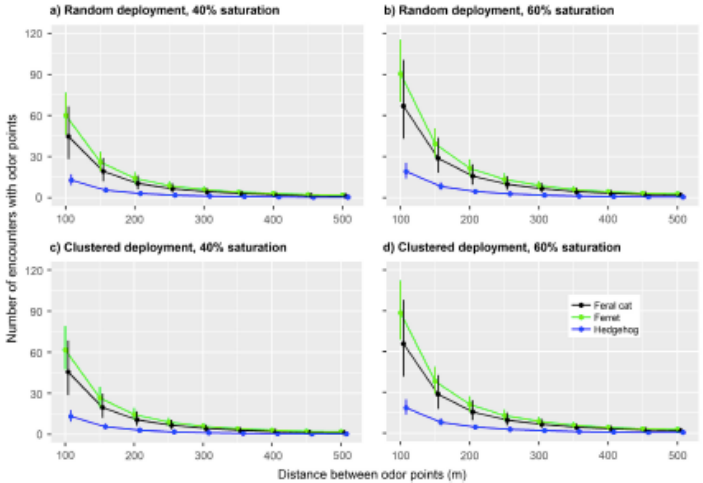
- Monitored predator abundance
- Monitored shorebird nests (n= 470)

Norbury et al (2021) *Science Advances*

Odour deployment

- Used 3 bird odours (chicken, quail, black-backed gull)
- Distributed randomly – 6 chicken: 3 quail: 1 gull

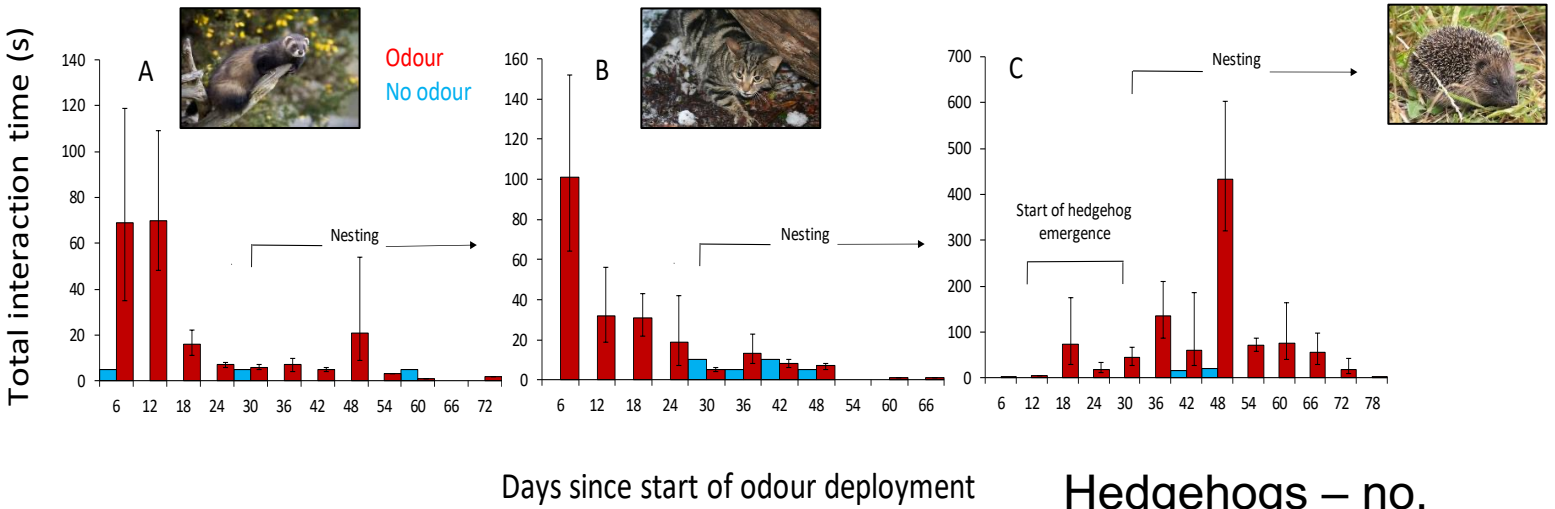




- Applied for 36 days before egg laying (pre-exposure), then for 52 days (camouflage)
- Odour point every 2.5ha (ave) based on modelling of predator encounters

(Latham et al 2019 *Ecological Applications*)

Did predators lose interest in bird odours?



Ferrets – yes (26% predation)

Cats – yes (4% predation)

Hedgehogs – no, responsible for **66%** of all nest predation (63% on treatment sites)

Norbury et al (2021) *Science Advances*

Results: Hatching significantly higher without any predator removal

Banded Dotterels and Wrybills: 37-104% higher hatching success over first 25 days

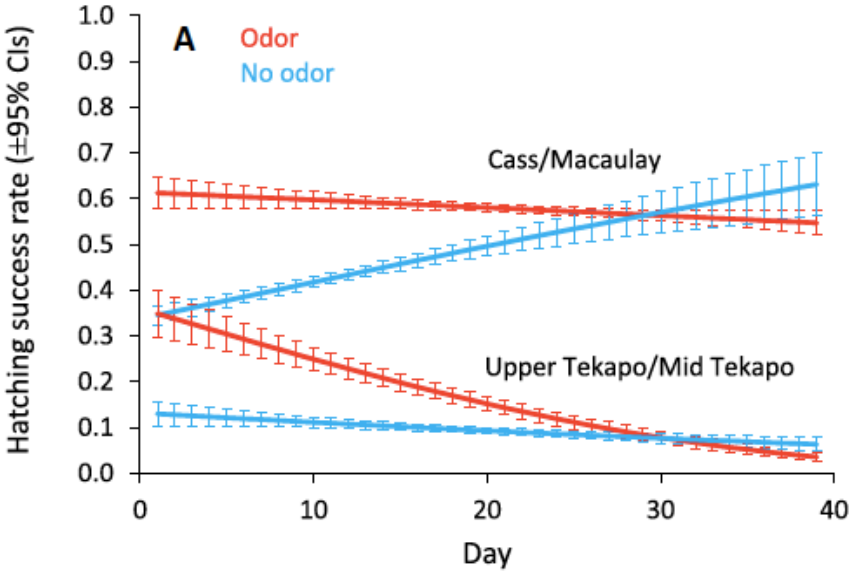
Pied Oystercatchers: 71% higher overall on the treatment sites over the first 32 days

Boost chick production by about 40–100% during a 25–32 day “window of opportunity”.

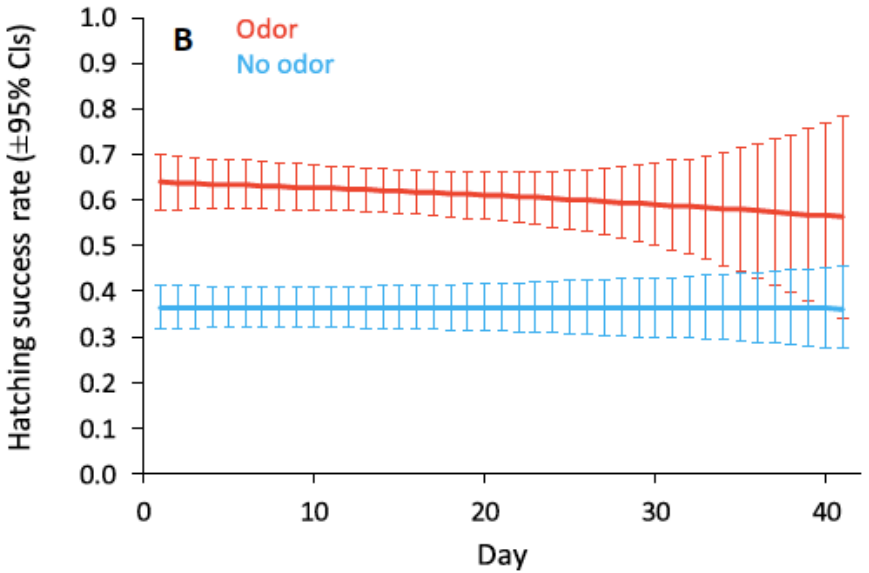
1.7 fold increase in hatching success across all sites (similar to lethal control)

Norbury et al (2021) *Science Advances*

Predicted hatching success per day based on daily survival rates for each nest monitored on each site

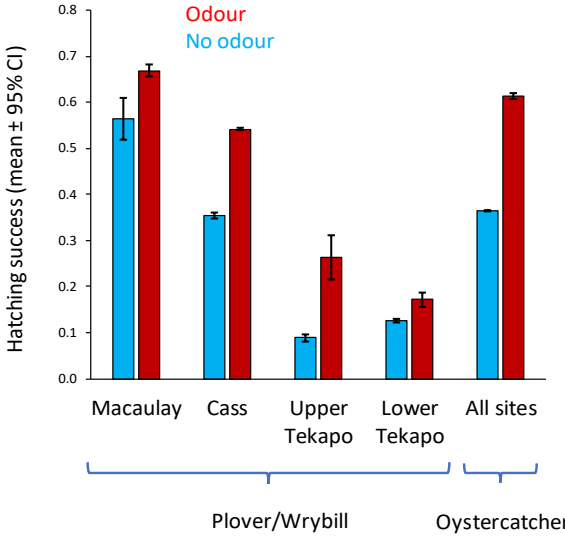


Double-banded Plover/Wrybill



Oystercatcher

Results: Hatching significantly higher without any predator removal



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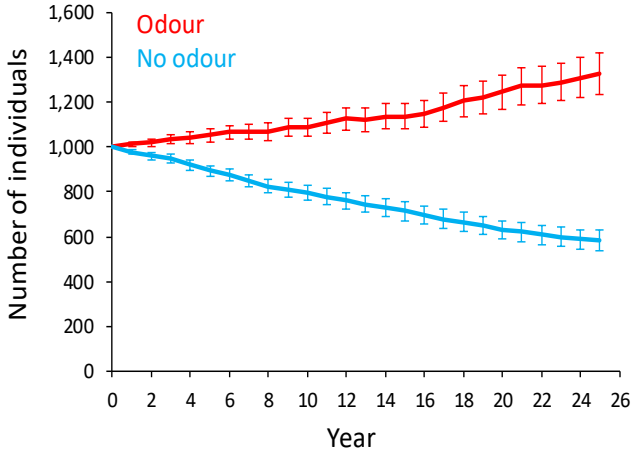
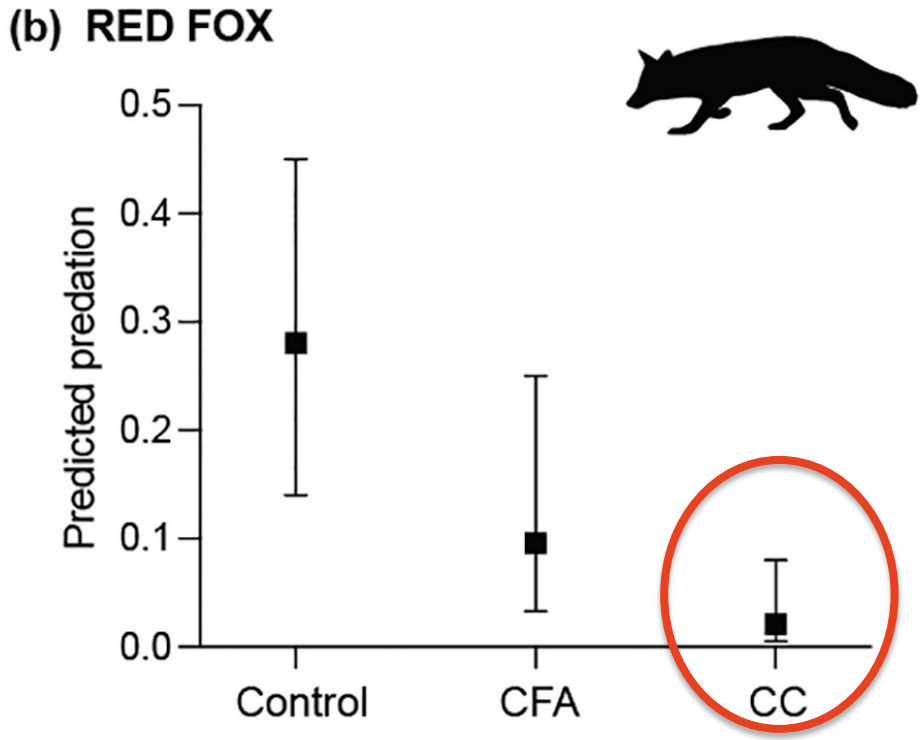


Population modelling projects 127% increase over 25 years

Test of chemical camouflage in Finland - foxes



Selonen et al 2022 *Biological Conservation*

Where to now?

- How to make this a practical tool? odour deployment, artificial odours

MIDCOAST council

- Collaborating with local Councils and agencies

- Non-lethal method for protecting birds from native predators eg Regent Honeyeater
- Sound cues – multimodal misinformation

Thank-you

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