



Misinformation tactics protect rare birds from problem predators

Optimal Foraging

- Predators learn to focus on prey cues that reliably predict available prey
- Ignore those that do not

Photo: Auckland Zoo

Exploiting olfactory learning in alien rats to protect birds' eggs

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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. Using wild free-ranging populations of black rats, *Rattus rattus*, an alien predator of global concern, we tested whether the application of bird-nesting odors before the introduction of artificial nests (odor preexposure), enhanced the survival of birds eggs (prey) compared with areas where prey and nesting odors were introduced concurrently. In areas where predators had encountered prey odor before prey being available, the subsequently introduced eggs showed 62% greater survival than in areas where prey and odor were introduced together. We suggest that black rats preexposed to 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 and nonassociative learning processes (9); for example, a predator may initially form an adverse or neutral association with a misleading cue, which fades over time as habituation occurs.

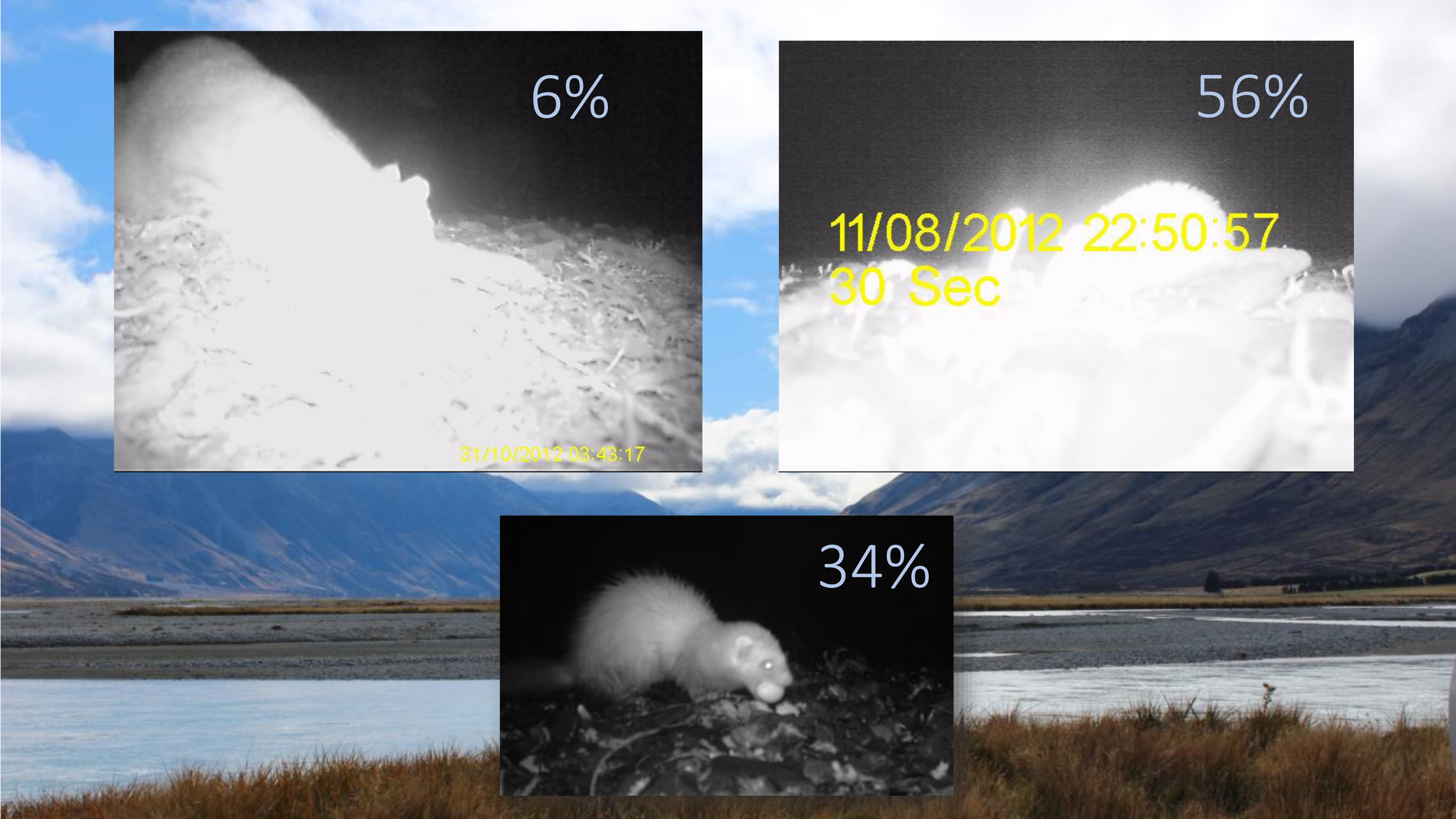
Being able to ignore incoming information is likely to be particularly relevant for olfactory-driven behaviors (10). Olfactory cues are detectable over large temporal and spatial scales (11) and initiate search behavior in a wide variety of predators (12). Mammalian predators live in a rich olfactory world, able to detect and recognize immense numbers of odors and distinguish


Could we use unrewarded prey odour cues to habituate predators, and make them ignore real prey cues?
And increase their foraging costs, and make them miss real prey?


Doubled banded plover


Pied oystercatcher


Wrybill
Photos: Trish Brown


6%
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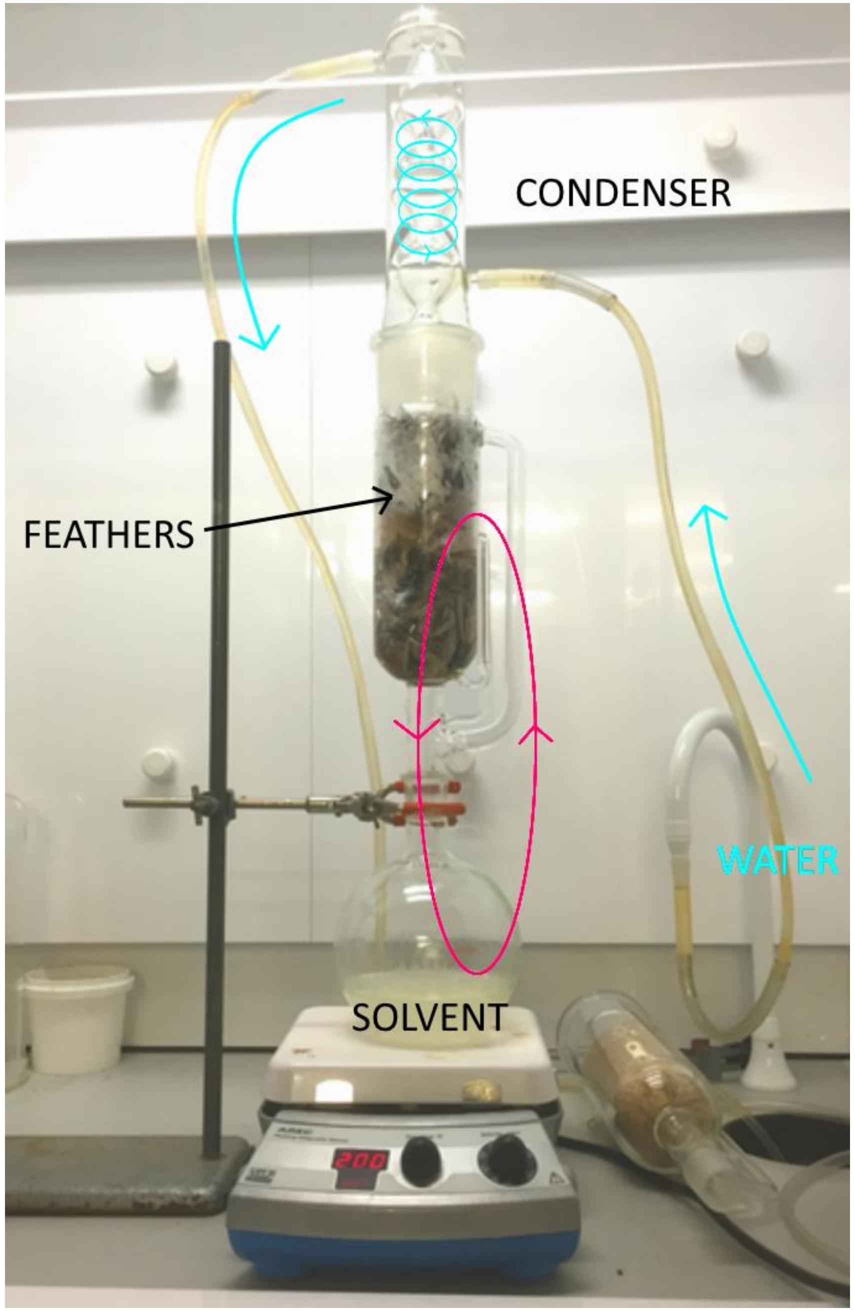
Odour extraction

Chicken feathers

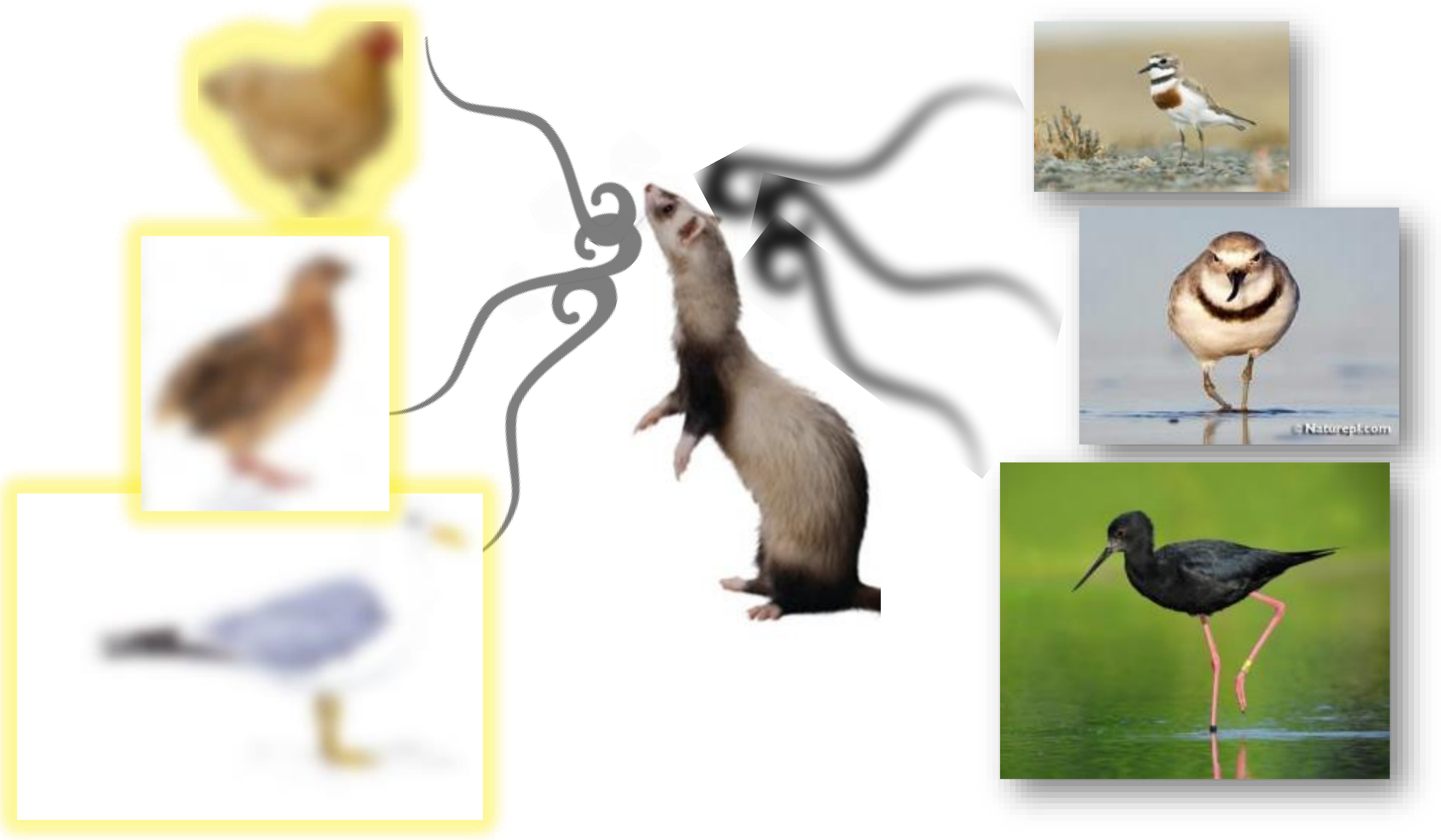
Quail

Black-backed gull



Habituation

Generalisation



Ecological Applications, 0(0), 2020, e02200

Invasive mammalian predators habituate to and generalize avian prey cues: a mechanism for conserving native prey

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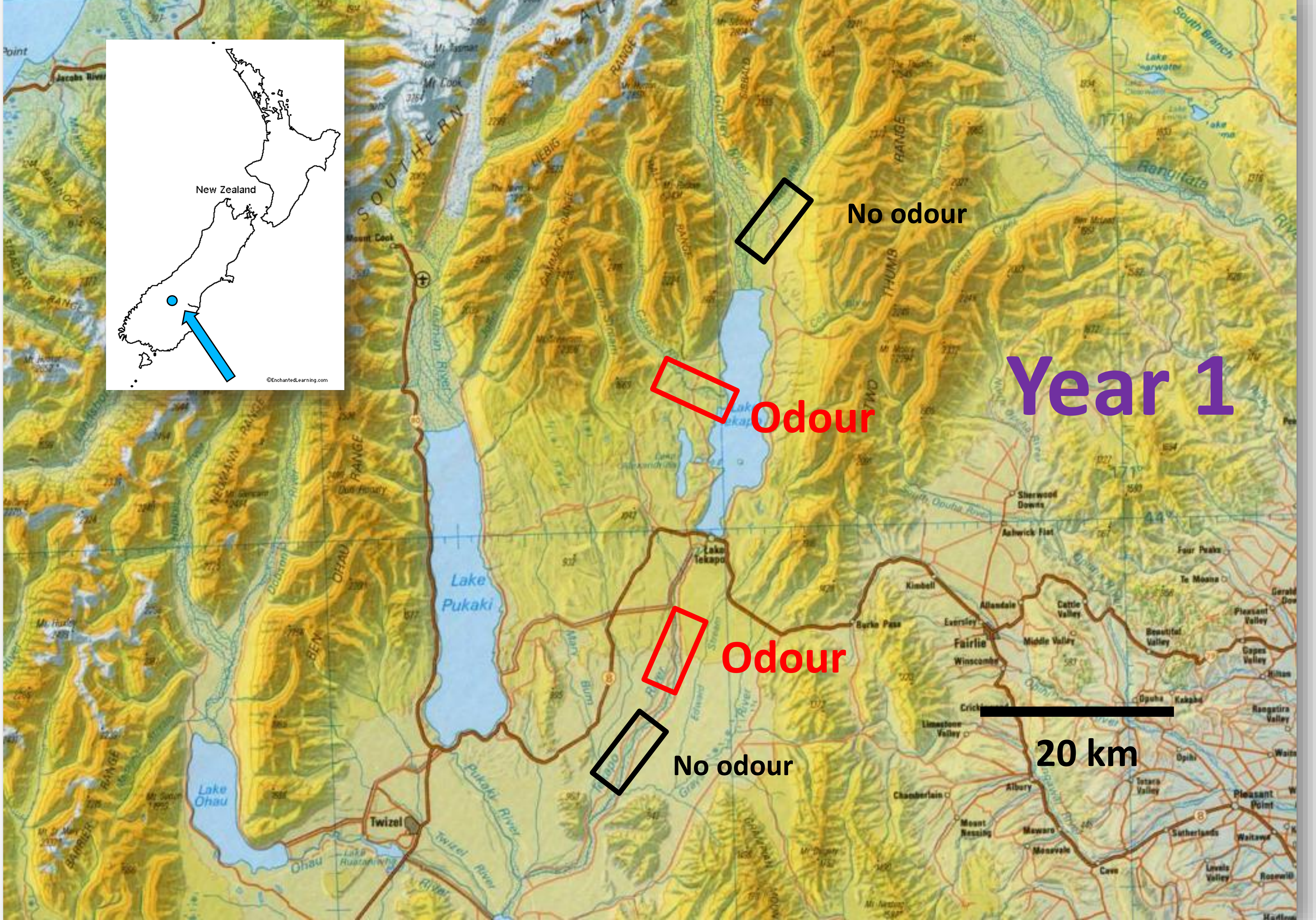
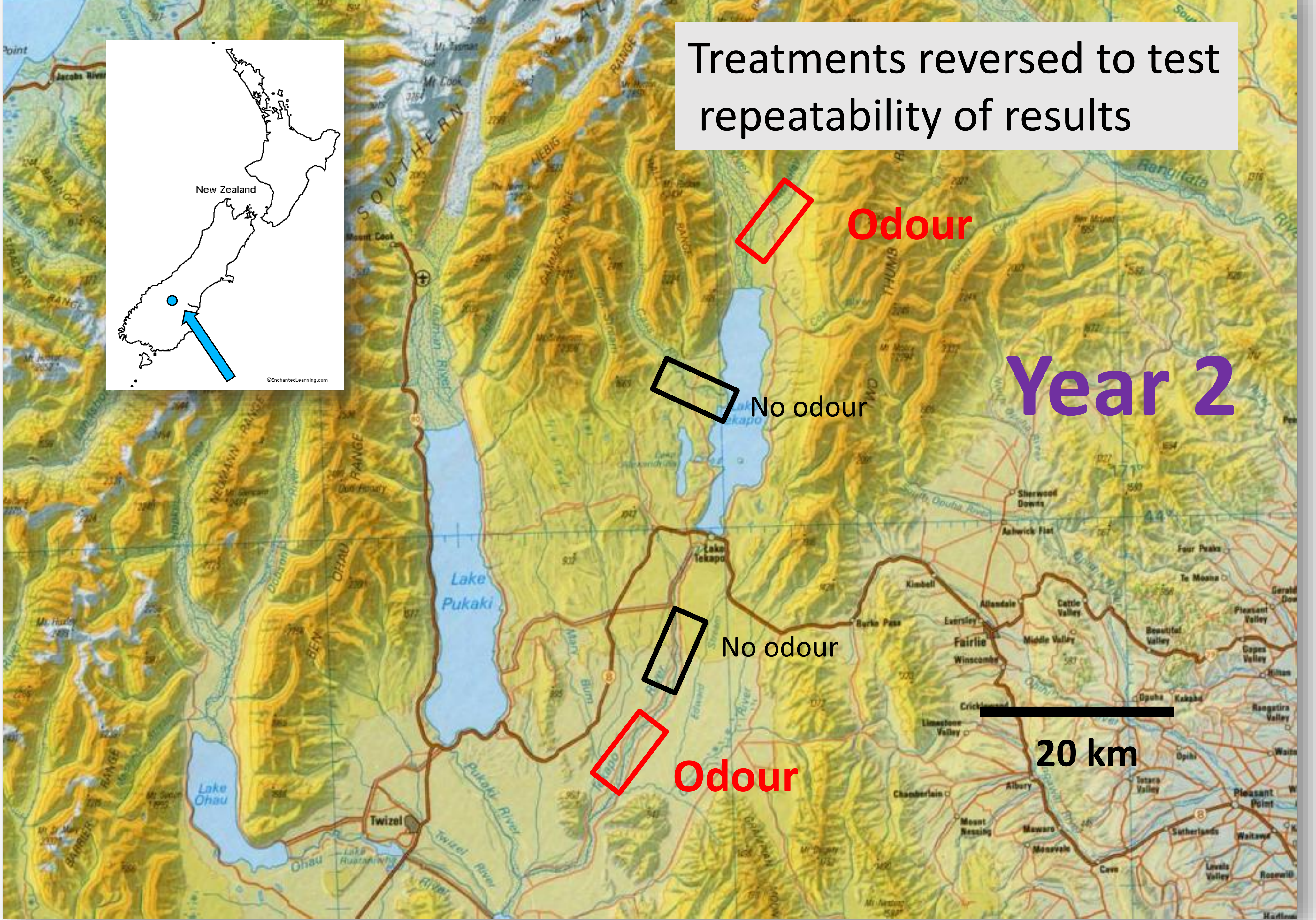
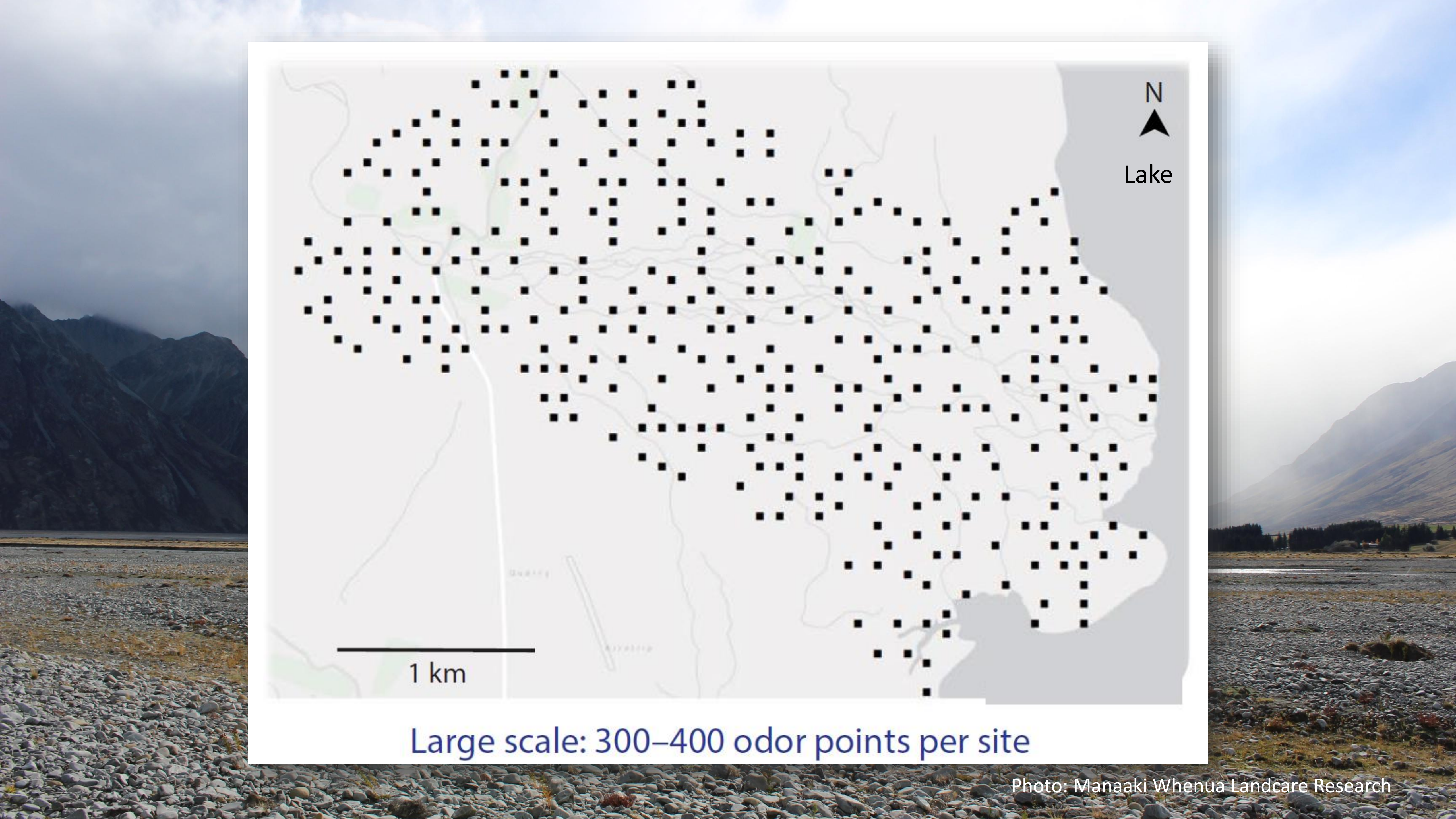
Abstract. Invasive mammalian predators can cause the decline and extinction of vulnerable native species. Many invasive mammalian predators are dietary generalists that hunt a variety of prey. These predators often rely upon olfaction when foraging, particularly at night. Little is understood about how prey odor cues are used to inform foraging decisions. Prey cues can vary spatially and temporally in their association with prey and can either reveal the location of prey or lead to unsuccessful foraging. Here we examine how two wild-caught invasive mammalian bird predator species (European hedgehogs *Erinaceus europaeus* and ferrets *Mustela putorius furo*) respond to unrewarded bird odors over successive exposures, first demonstrating that the odors are perceptually different using house mice (*Mus musculus*) as a biological olfactometer. We aim to test if introduced predators categorize odor cues of similar prey together, a tactic that could increase foraging efficiency. We exposed house mice to the odors using a standard habituation/dishabituation test in a laboratory setting, and wild-caught European hedgehogs and ferrets in an outdoor enclosure using a similar procedure. Mice discriminated among all bird odors presented, showing more interest in chicken odor than quail or gull odor. Both predator species showed a decline in interest toward unrewarded prey odor (i.e., habituation), but only ferrets generalized their response from one unrewarded bird odor



Year 1
No odour
Odour
Odour
No odour
20 km
New Zealand
©EnchantedLearning.com
Lake Pukaki
Lake Ohau
Lake Tekapo
Twizel
Fairlie
Mount Cook


Treatments reversed to test repeatability of results
Odour
No odour
Year 2
No odour
Odour
20 km
New Zealand
Lake Pukaki
Lake Tekapo
Lake Ohau
Twizel
Fairlie


N
Lake
1 km
Large scale: 300–400 odor points per site
Photo: Manaaki Whenua Landcare Research

Ecological Applications, 29(1), 2019, e01814

Modeling habituation of introduced predators to unrewarding bird odors for conservation of ground-nesting shorebirds

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Abstract. Foraging mammalian predators face a myriad of odors from potential prey. To be efficient, they must focus on rewarding odors while ignoring consistently unrewarding ones. This may be exploited as a nonlethal conservation tool if predators can be deceived into ignoring odors of vulnerable secondary prey. To explore critical design components and assess the potential gains to prey survival of this technique, we created an individual-based model that simulated the hunting behavior of three introduced mammalian predators on one of their sec-

Deploying bird odours

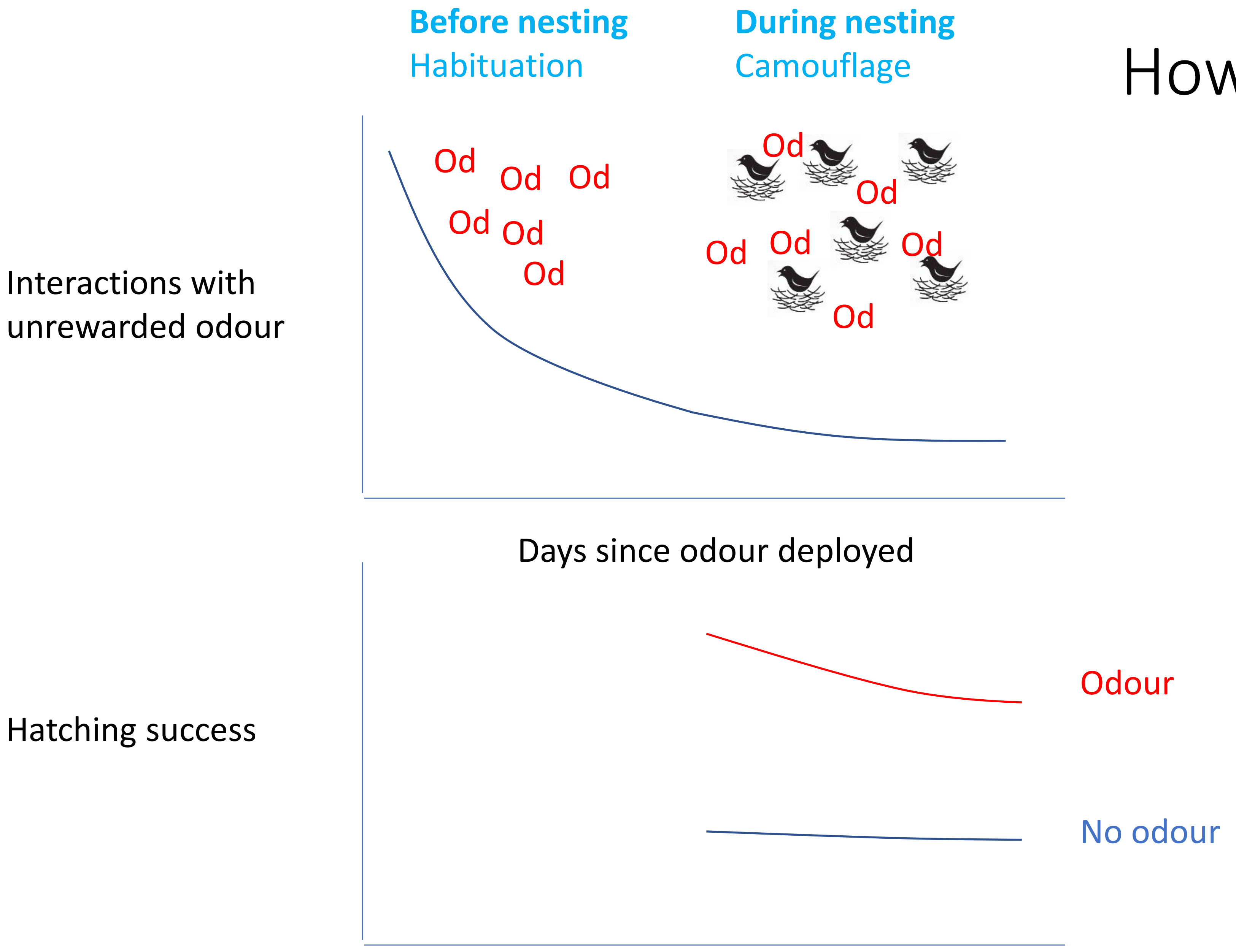
Photos: Manaaki Whenua Landcare Research

Interactions with odour

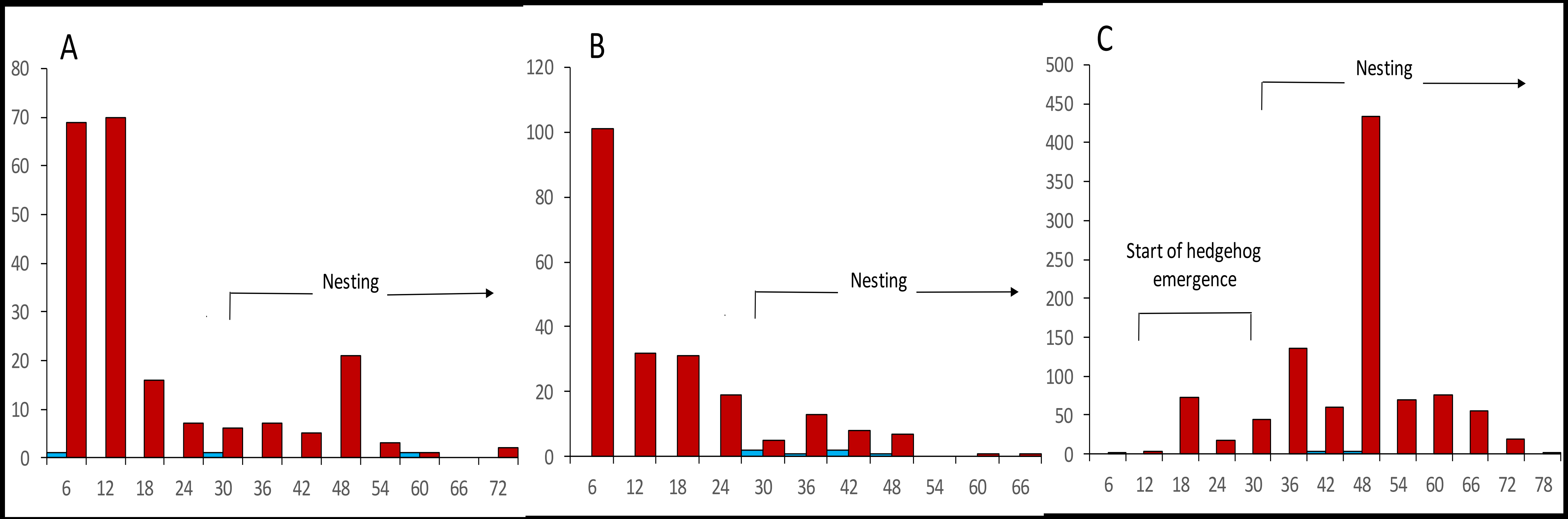
Camera

Odour smear on rock

How misinformation should work



Predators lost interest in bird odour



Photos: Manaaki Whenua Landcare Research & Jan Kelly

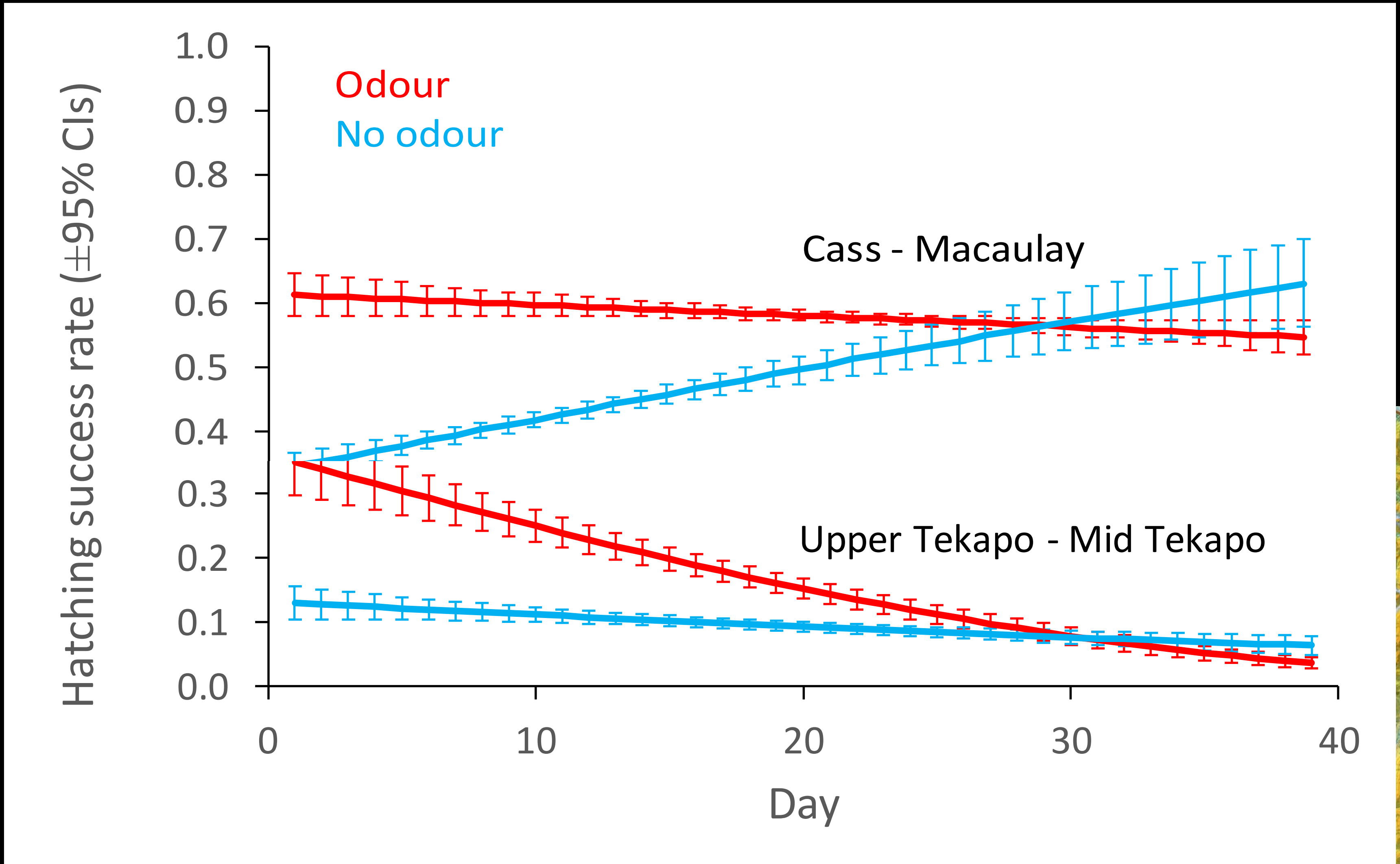
Nest survival

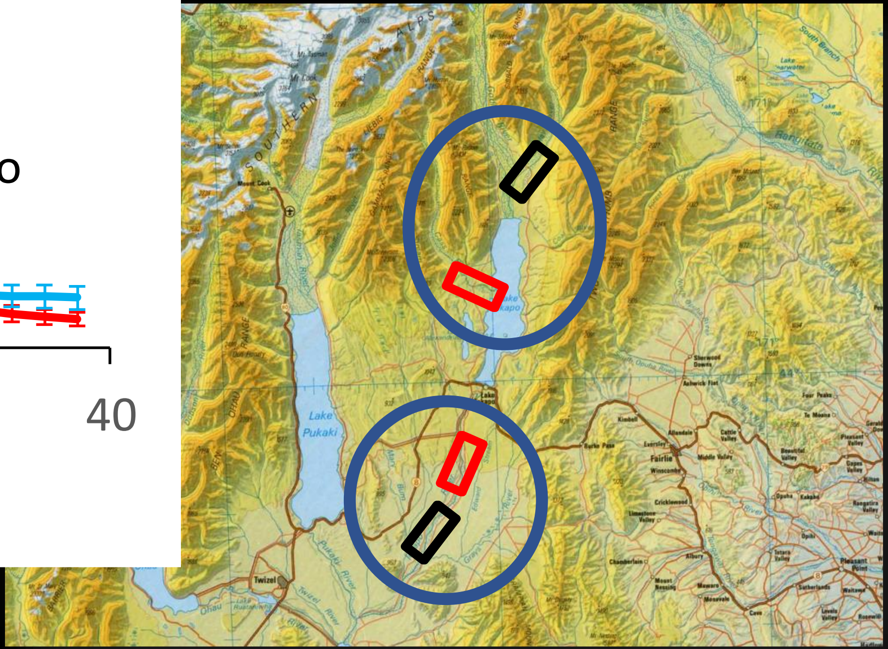
Monitored fate of 470 nests

51-64 nests per site-year

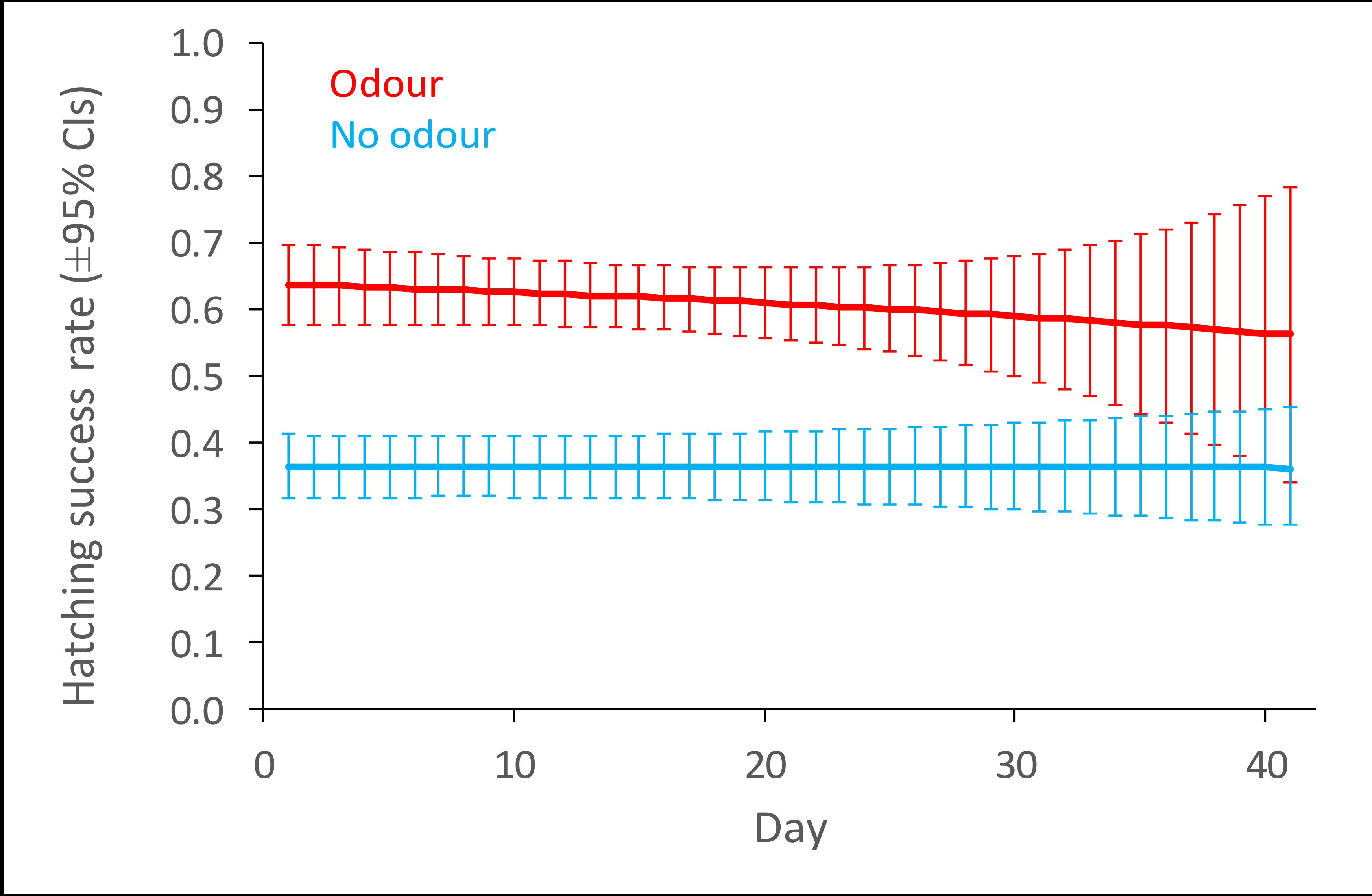
Photos: Manaaki Whenua Landcare Research & Trish Brown

Odour treatment improved hatching success for 25 days

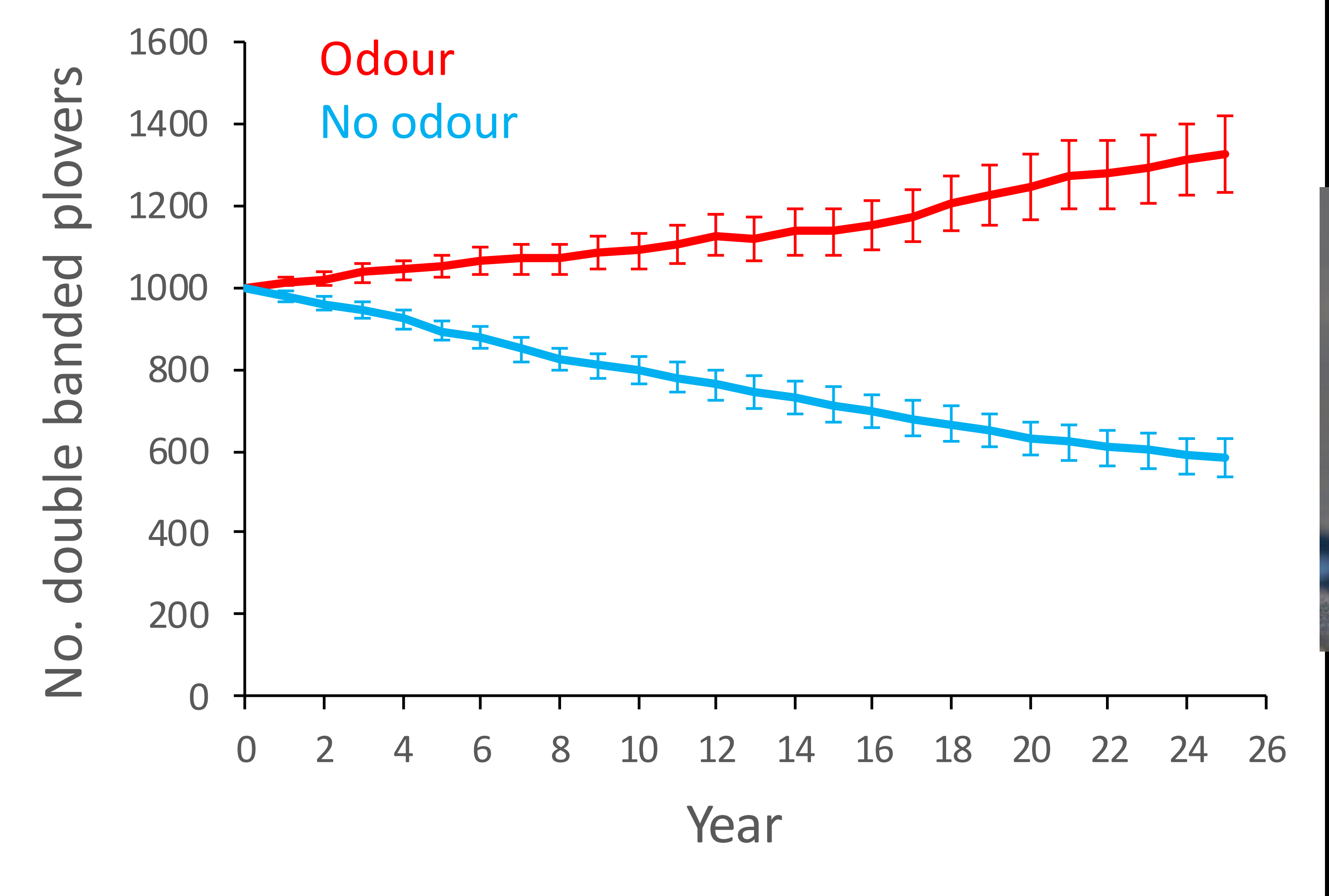




Odour treatment improved hatching success for 35 days



Population projections



Where lethal methods are ineffective

Social limitations prevent lethal methods

Native predators

Is it any better than trapping or poisoning?

No ecological release of herbivores or mesopredators, or compensatory reinvasion

Small or elongated areas prone to high rates of reinvasion

When/where is it most likely to work?

- Generalist predators with access to alternative high value food
- Secondary prey that are visually and auditorily cryptic
- Over relatively short periods when prey are most vulnerable, e.g. early phase of breeding or translocation

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SCIENCE ADVANCES | RESEARCH ARTICLE

ECOLOGY

Misinformation tactics protect rare birds from problem predators

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Efficient decision-making integrates previous experience with new information. Tactical use of misinformation can alter choice in humans. Whether misinformation affects decision-making in other free-living species, including problem species, is unknown. Here, we show that sensory misinformation tactics can reduce the impacts of predators on vulnerable bird populations as effectively as lethal control. We repeatedly exposed invasive mammalian predators to unprofitable bird odors for 5 weeks before native shorebirds arrived for nesting and for 8 weeks thereafter. Chick production increased 1.7-fold at odor-treated sites over 25 to 35 days, with doubled or tripled odds of successful hatching, resulting in a 127% increase in modeled population size in 25 years. We demonstrate that decision-making processes that respond to changes in information reliability are vulnerable to tactical manipulation by misinformation. Altering perceptions of prey availability offers an innovative, nonlethal approach to managing problem predators and improving conservation outcomes for threatened species.

INTRODUCTION

Decision-making is vulnerable to misinformation because deciphering uncertain information is cognitively taxing (*1*, *2*). Although heuristic approaches (or rules of thumb) can reduce cognitive costs (*3*), they can result in misguided and costly decisions. Instead, when negotiating information-rich environments, many decision makers are thought to become "Bayesian updaters" (*4*), using both previous experience and new information to guide optimal choices. Information that proves useful or reliable motivates positive future responses, while useless or unrewarding information is filtered into the perceptual background and ignored thereafter (*1*). Tactical misinformation, or "fake news," can succeed if it diverts the selective attention of decision makers by changing the perceived value of information.

Experiments in highly simplified environments with both humans (*5*) and animals (*6*) show the ease with which different forms of misinformation can exploit selective attention processes to alter choice. However, whether such processes occur in real world, com-

many predators provide vital ecosystem services but can sometimes affect other vulnerable species, leading to their persecution (*9*). To prevent extinctions, reducing predation by both native and non-native predators is an urgent priority, but current methods can cause ecological harm when predators are removed (*10*), are often ineffective (*11*), and increasingly lack social license (*12*). New techniques to solve this dilemma are urgently needed.

Decision-making theory offers an innovative, nonlethal solution that draws on principles of information search, nonassociative learning (habituation), and camouflage (*13*–*16*). It underpins the decision-making behavior of predators, predicting that individuals will give up and move from areas that provide little or no reward (*17*) and will stop searching for prey that are too costly to find when other food is available (*18*). Sensory cues, such as odor, that reveal the identity and location of prey help predators make these foraging decisions (*19*, *20*). Decoupling cues from rewards have been demonstrated on a small scale in wild rats searching for artificial nests baited