

NZ ecosanctuaries:

what are they and what are their outcomes?



Manaaki Whenua
Landcare Research

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SONZI workshop
Whangarei
20 August 2019



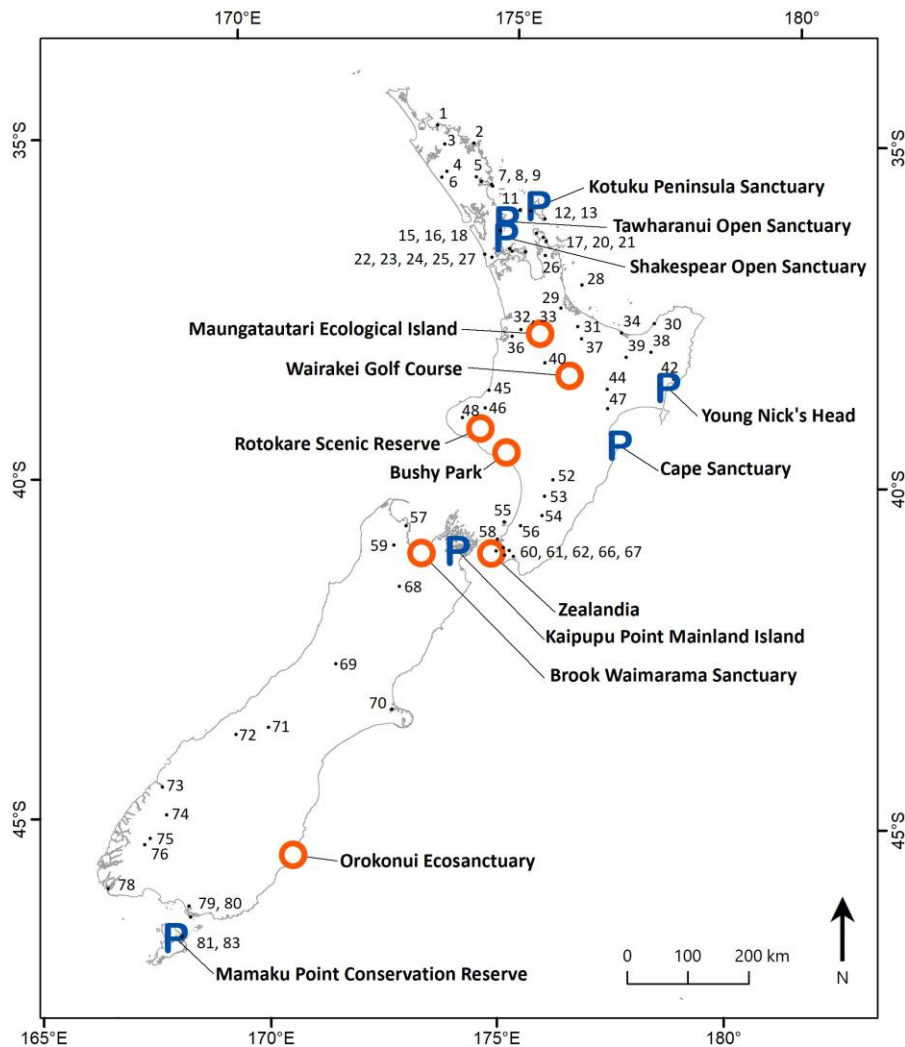


What are ecosanctuaries?

Projects >25 ha that:

- implement multi-species, pest-mammal control for ecosystem recovery objectives, and with substantial community involvement
-
- control or eradicate a broad suite of pests with best practice techniques
 - reintroduce missing species
 - manage a permanent and substantial risk of pest reinvasion
 - inspire and galvanise communities to local conservation

We identified 84 such projects on or near
the NZ mainland



Includes:

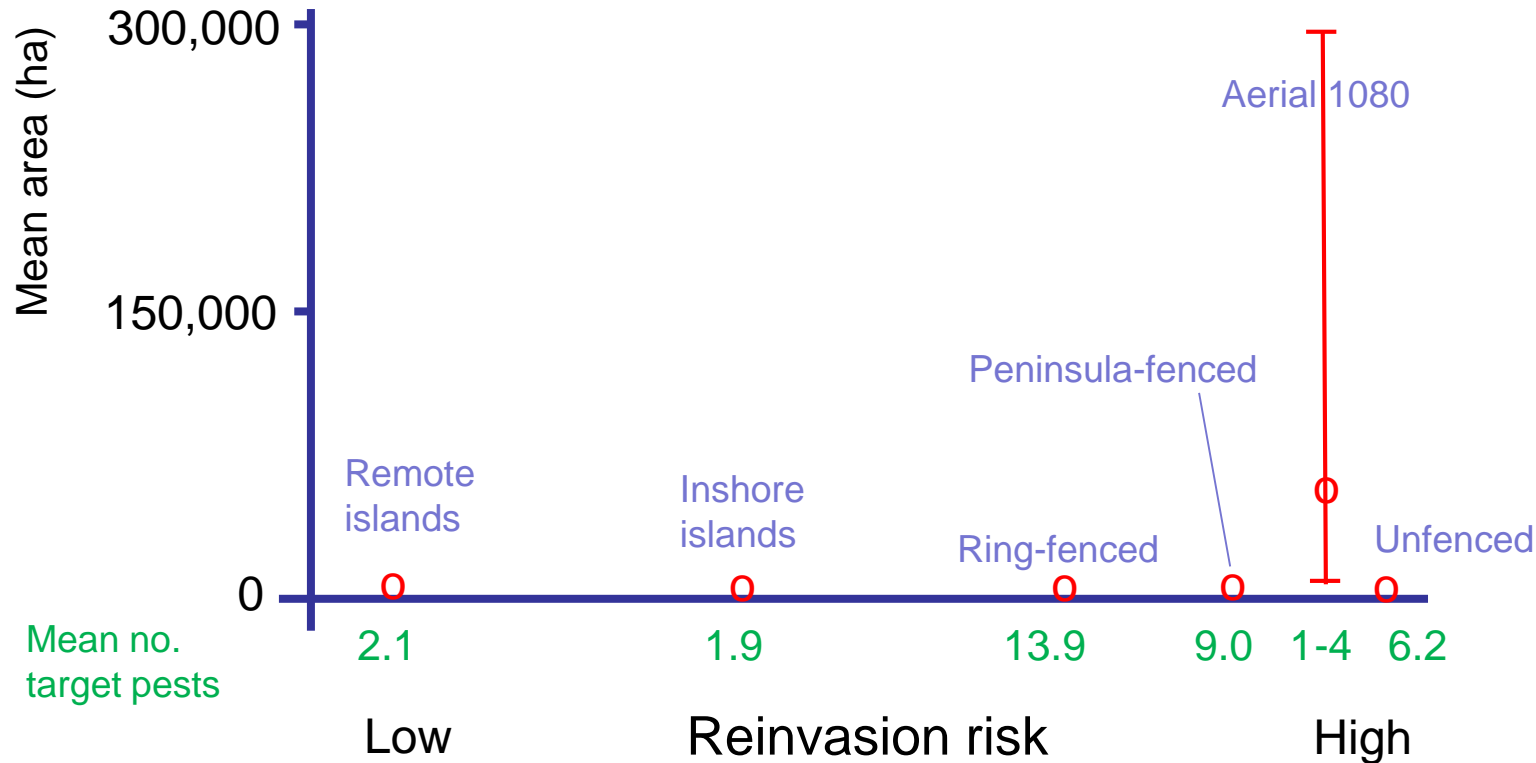
3 freshwater islands
16 marine islands
7 peninsula-fenced
7 ring-fenced
51 unfenced

84

cf 135 sanct. - Butler *et al.* 2014
600 groups - Peters *et al.* 2015



Ecosanctuary types / 'regimes'





Ecosanctuary area?

Excluding aerial 1080:

44,790 ha ship rat control

84,000 ha possum control

182,000 ha stoat control



Nga Manu



Nga Manu



Rod Morris

Therefore ecosanctuary area = $44,790 / 26,802,100 \text{ ha} \times 100 = 0.17\% \text{ NZ}$

Cf area pest-free islands = 46,000 ha

Towns et al. 2013

Cf pest mammal control/surveillance = 11.8 m ha = 45% NZ

Russell et al. 2015

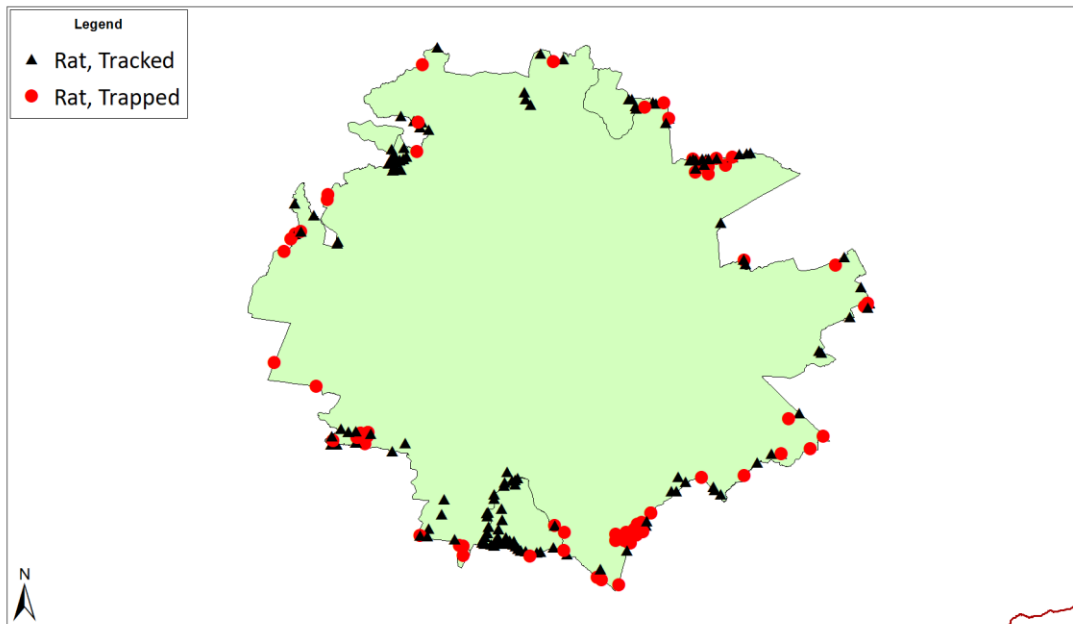


An end to trapping and poisoning of pests!

An *Xcluder Pest Proof Fence* is a scientifically proven fence design that will effectively exclude cats, possums, ferrets, stoats, hares, weasels, rats, mice and livestock.

Maungatautari – 3260 ha, 47 km fence

Rats trapped 2008 to 2019*: 80 = 6.7 p.a.



Rats tracked or trapped at
Maungatautari 2008-18

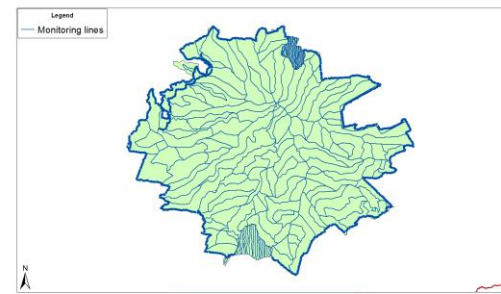
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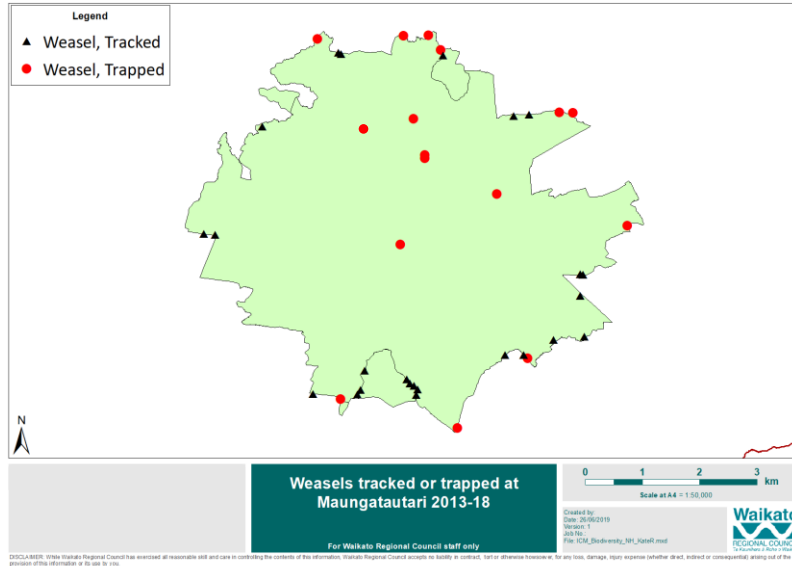
Monitoring lines 2008-15



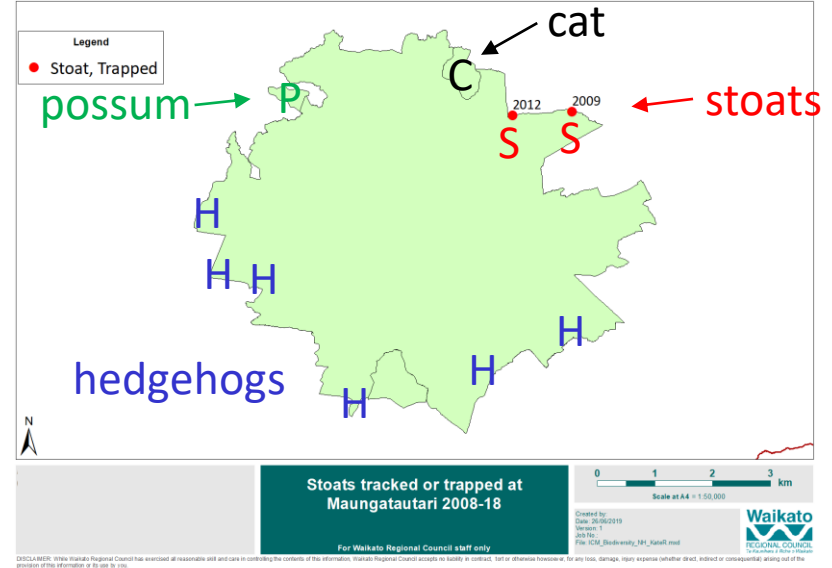
*Kate Richardson WRC
Geoff Churchill MEIT

Maungatautari*

Weasels trapped 2008 to 2019: 16

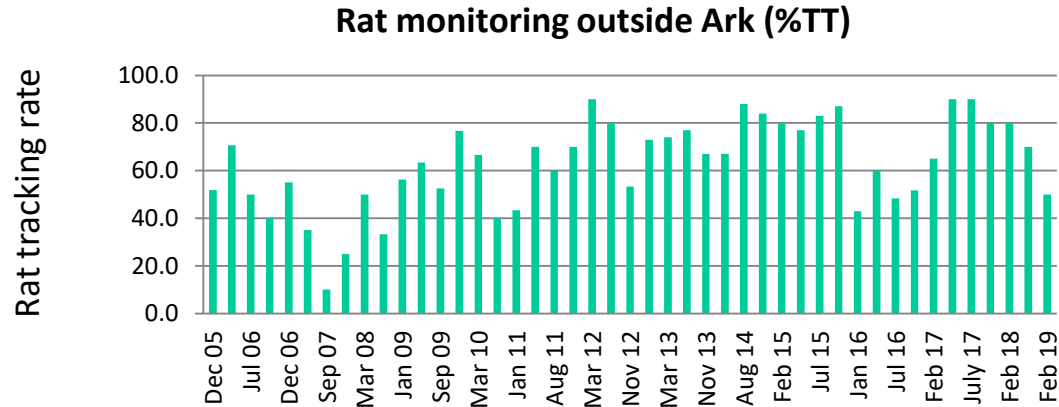
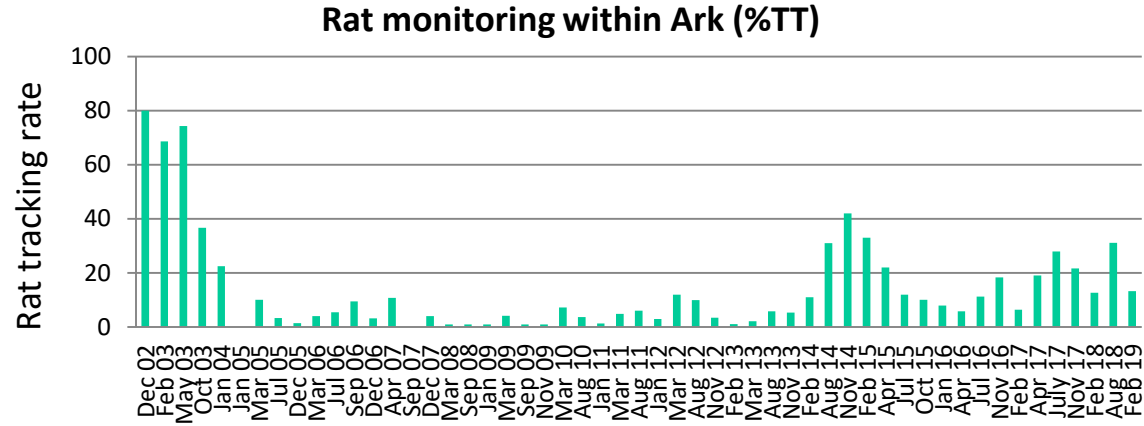


2 stoats, 1 cat, 6 hedgehogs, 1 possum



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Geoff Churchill MEIT

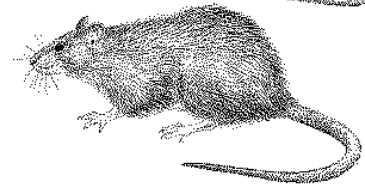
Unfenced sanctuary: Ark in the Park, Waitakeres, 2270 ha, 2002-19*



Ship rat



Norway rat



*Gillian Wadams, Forest and Bird

Objectives of ecosanctuaries



- Ecological restoration: '...the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed' (Int. Soc. Ecol. Rest. 2016)
- 'management that aims to restore biotic communities to a condition more like that of a selected time period in the past' (Atkinson 1994)
- Restore 'ecological integrity'
 - indigenous dominance (weed and pest control)
 - species occupancy (translocation incl. planting)
 - environmental representation
- Restore mauri, kai, rongoa (medicinal), whakairo (carving), raranga (weaving)
- 'Native species thrive where we live, work and play' (Cape to City)

Final comments



Ecosanctuaries:

- Just part of restoration
- Strongest practical enactments of eg Nat. Parks Act
- More social than biological network
- Are safe havens – needed before connectivity
- Challenge *pests* vs *habitat* as limiting factors
- Need meta-assessment of biodiversity outcomes

A photograph of a New Zealand parrot, possibly a kākā, perched on a large, grey, textured rock. The bird has green plumage with blue feathers on its wings and tail. It is looking towards the right. In the background, there is a vast, hazy landscape with rolling hills and a body of water under a cloudy sky. The overall tone is serene and naturalistic.

Biodiversity outcomes of New Zealand sanctuaries: a national analysis

...the story so far...



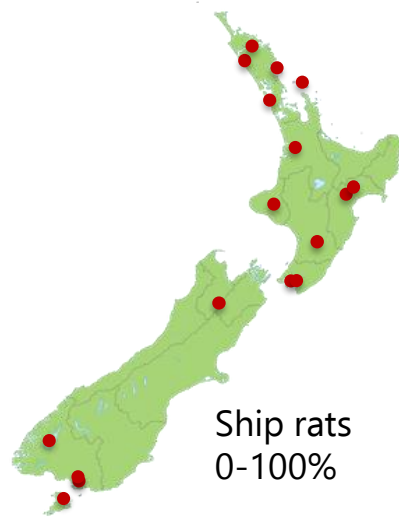
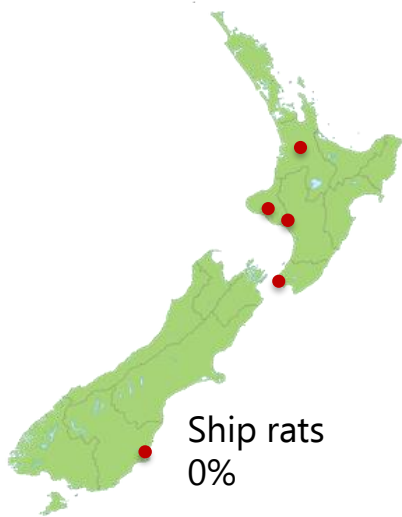
Ring-fenced



Fenced peninsulas



Unfenced



Sanctuaries biodiversity monitoring database

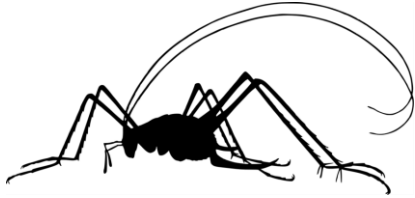


- 80 biodiversity datasets from 27 sites

17.5% (n=14)



10% (n=8)



10% (n=8)



62.5% (n=50)



(n=31)



Sanctuaries biodiversity monitoring database

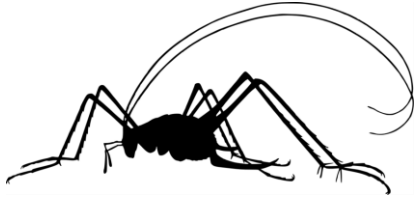


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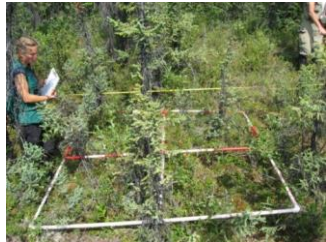
10% (n=8)



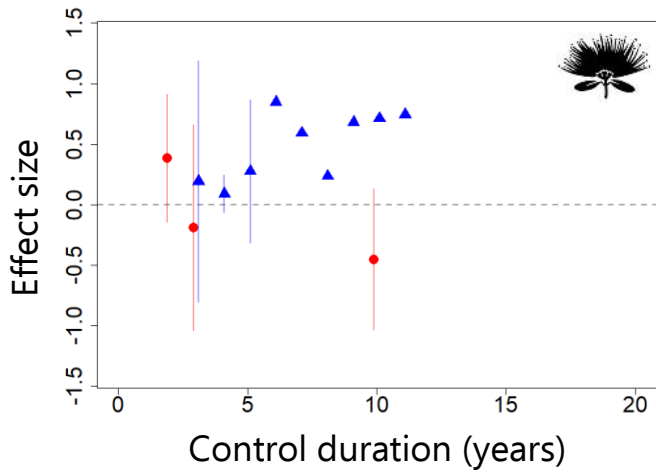
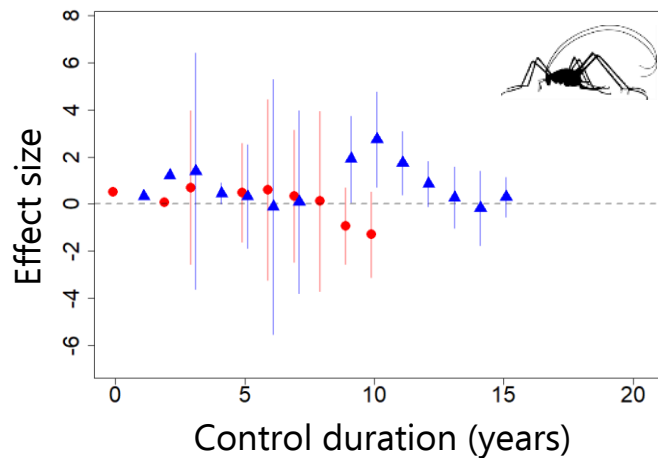
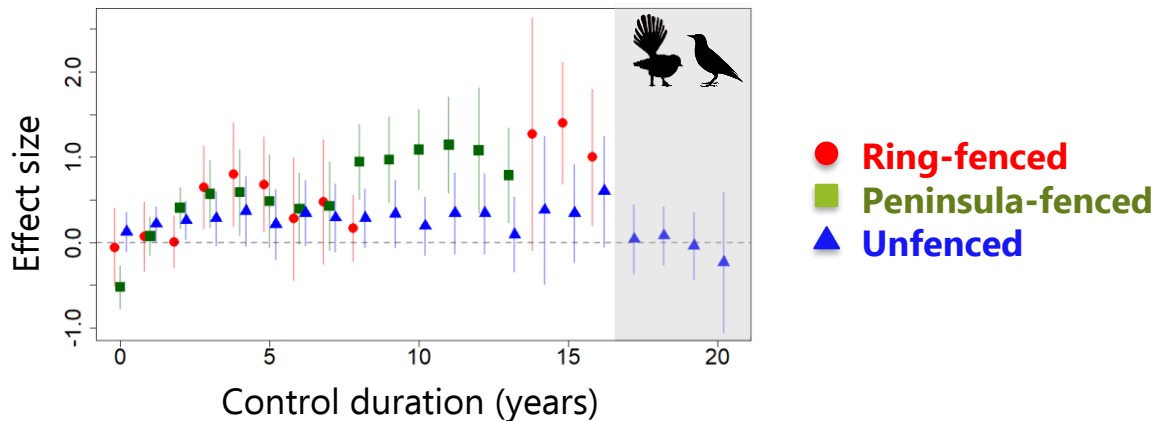
62.5% (n=50)



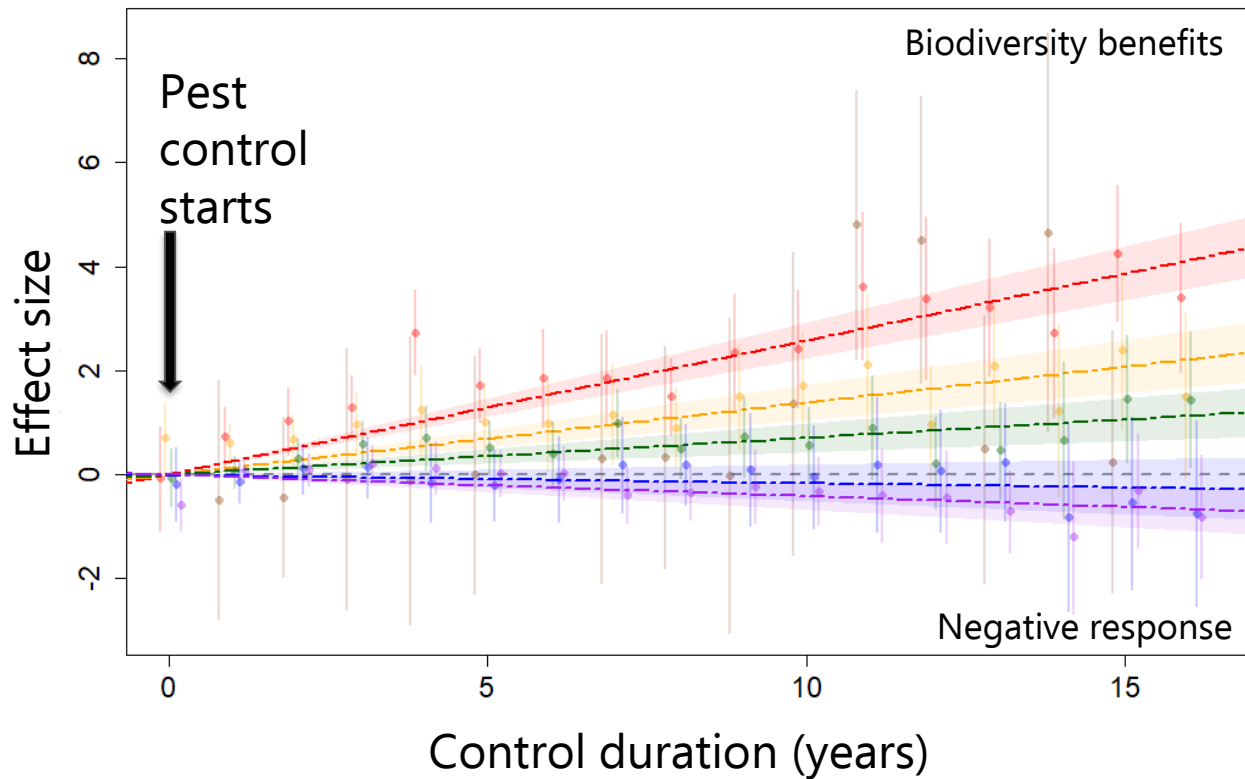
(n=31)



Trajectories differ among predator control regimes



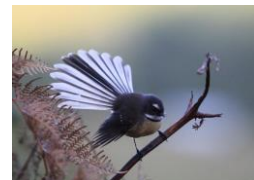
Endemic bird species benefit most from predator control



Deep
endemics



Recent
natives &
introduced



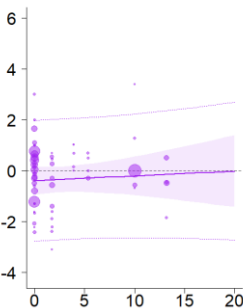
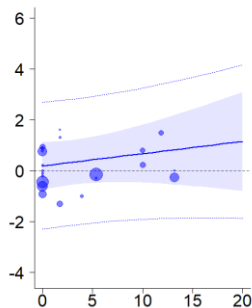
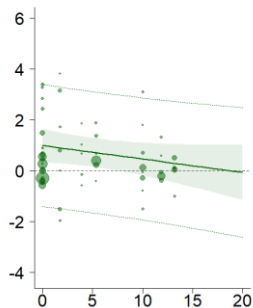
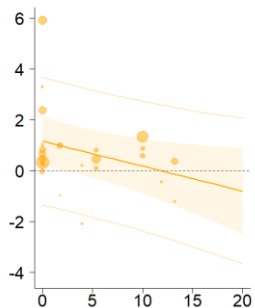
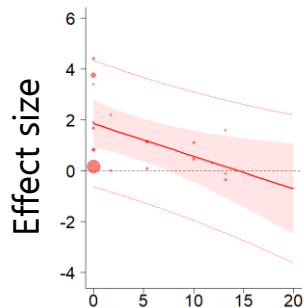
Deep endemics are most vulnerable to increases in pest abundance



Deep endemics



Recent natives & introduced



Ship rat tracking rate (%)

What limits NZ's bird populations?



Predation



Competition



Food supply



Disease



Habitat



Innes, J., Kelly, D., Overton, J. M., & Gillies, C. (2010). Predation and other factors currently limiting New Zealand forest birds. *New Zealand Journal of Ecology*, 34(1), 86-114.

What limits NZ's bird populations?



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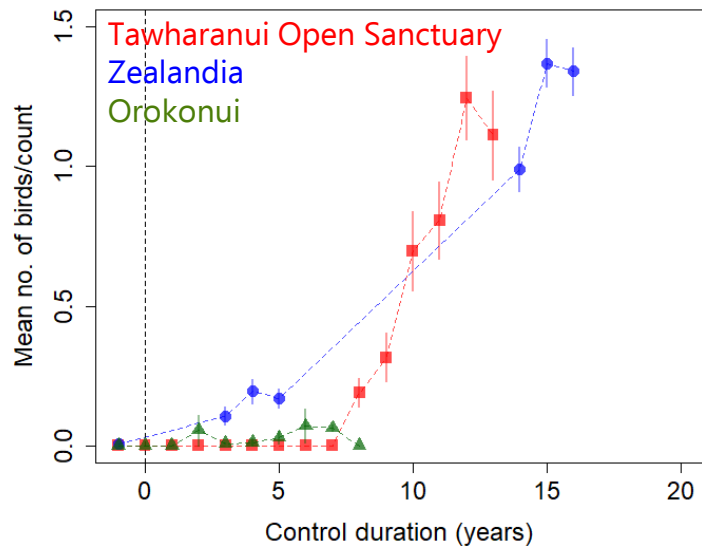
Innes, J., Kelly, D., Overton, J. M., & Gillies, C. (2010). Predation and other factors currently limiting New Zealand forest birds. *New Zealand Journal of Ecology*, 34(1), 86-114.



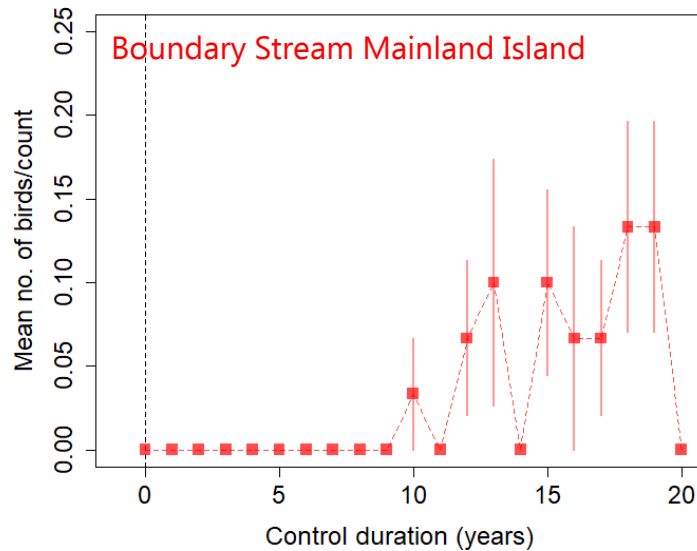
Bird communities in NZ sanctuaries



Saddleback




NI kōkako

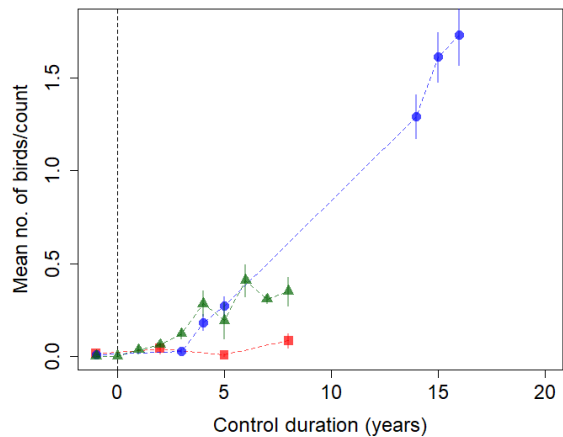




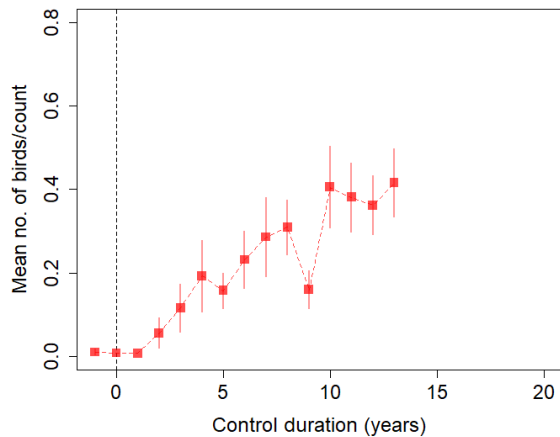
Kaka

Note, vertical axes differ 

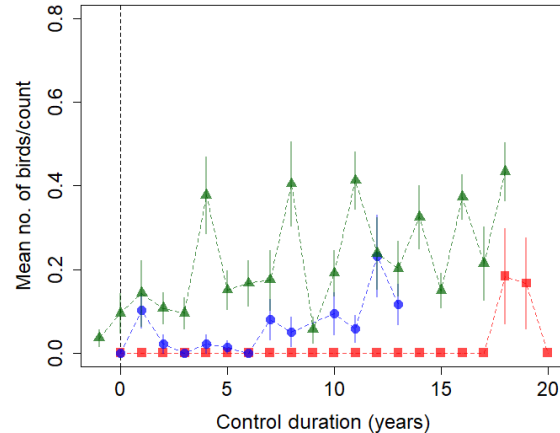
Maungatautari
Zealandia
Orokonui



Tawharanui Open Sanctuary




Boundary Stream Mainland Island
Halfmoon Bay Habitat Restoration Project
Rotoiti Nature Recovery Project

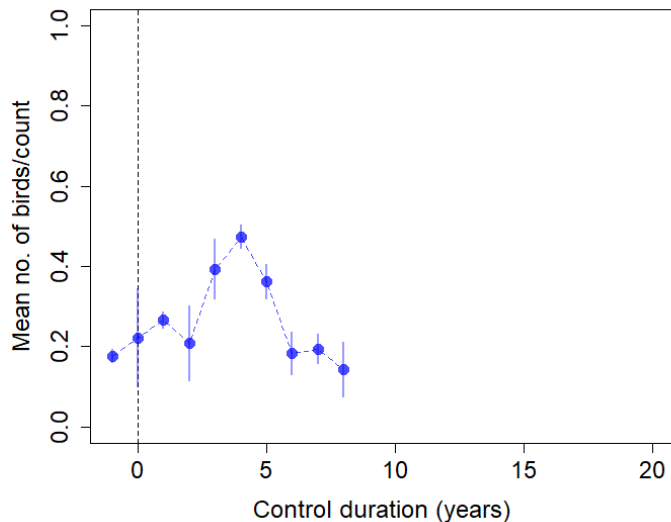




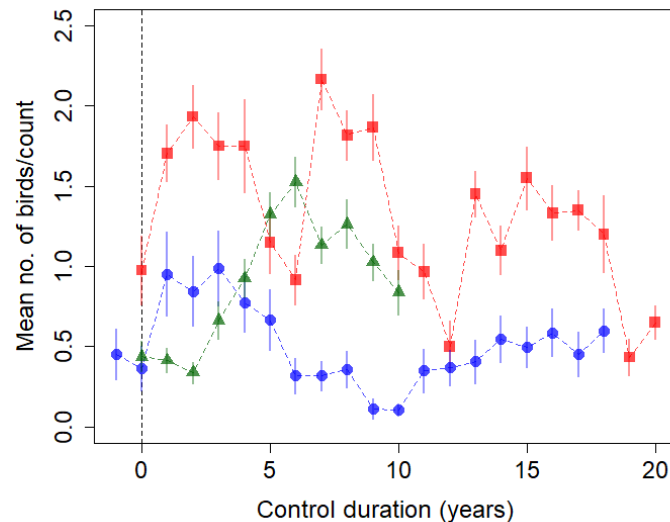
Rifleman

Note, vertical axes differ 

Orokonui



Boundary Stream Mainland Island
Rotoiti Nature Recovery Project
Wainuiomata Mainland Island

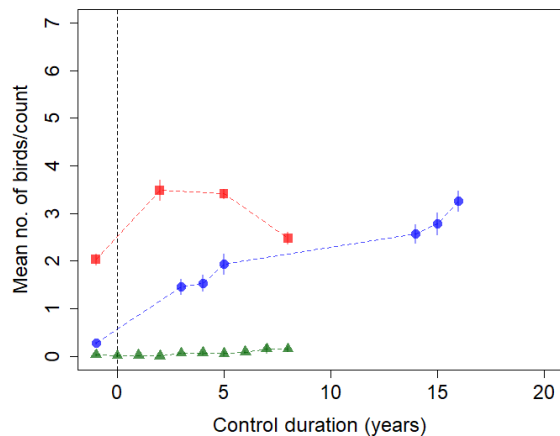




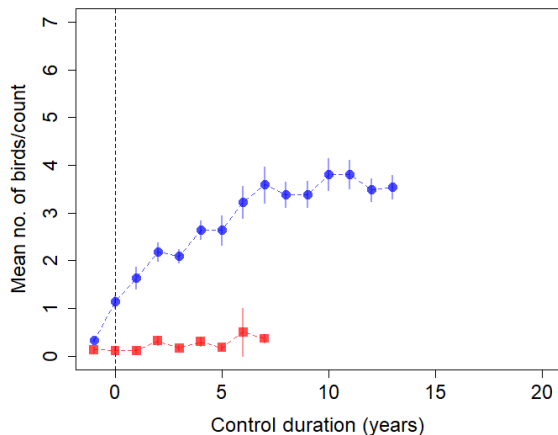
Tui



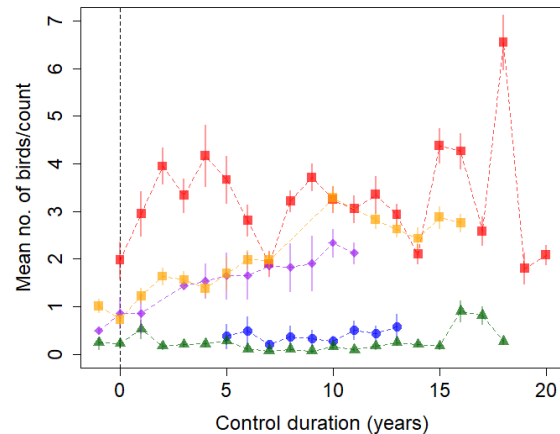
Maungatautari
Zealandia
Orokonui



Tawharanui Open Sanctuary
Cape Sanctuary



Boundary Stream Mainland Island
Ark In The Park
Rotoriti Nature Recovery Project
Mainland Island Restoration Operation
Trounson Kauri Park

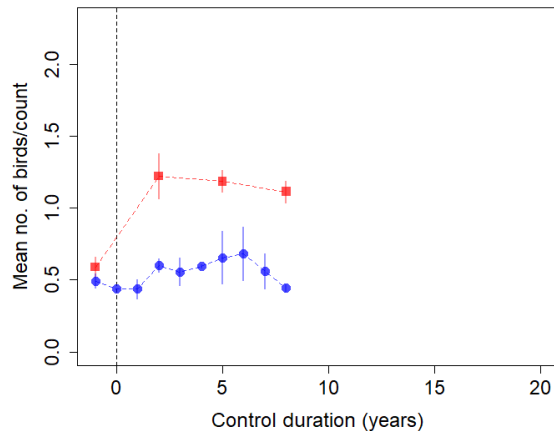




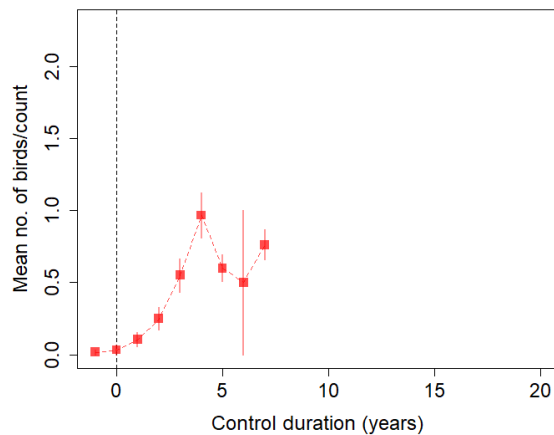
Tomtit



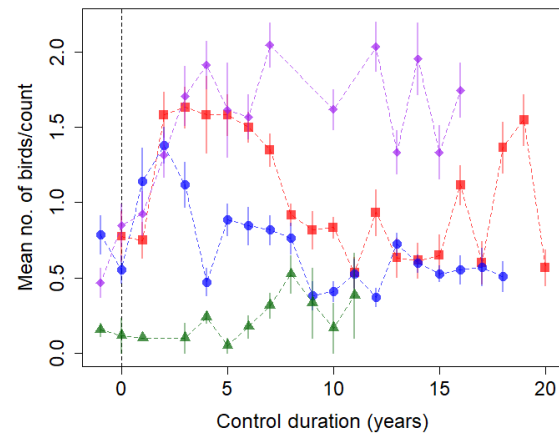
Maungatautari
Orokonui



Cape Sanctuary



Boundary Stream Mainland Island
Rotoiti Nature Recovery Project
Mainland Island Restoration Operation
Trounson Kauri Park

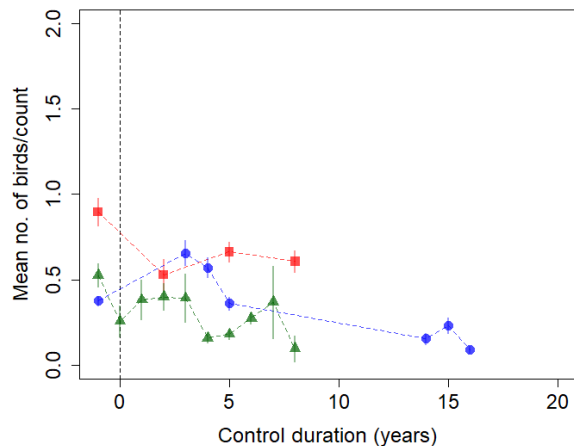




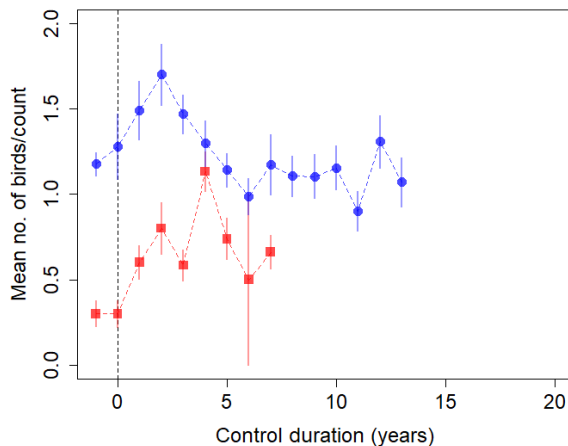
Fantail



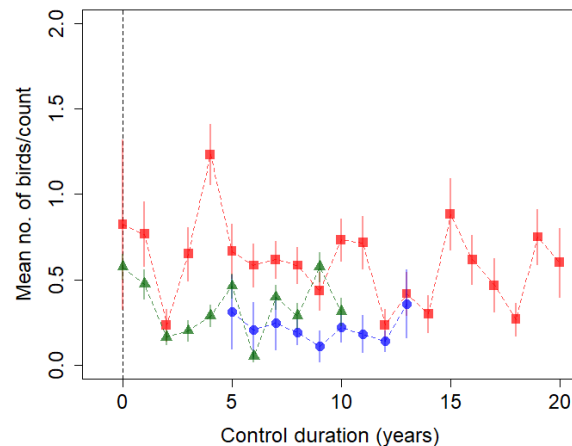
Maungatautari
Zealandia
Orokonui



Tawharanui Open Sanctuary
Cape Sanctuary



Boundary Stream Mainland Island
Ark In The Park
Wainuiomata Mainland Island





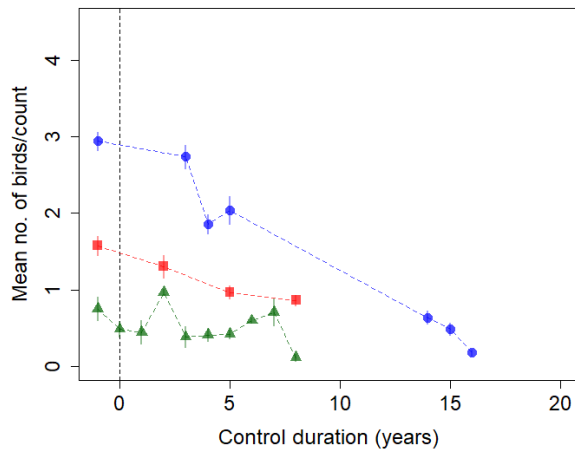
Silvereye



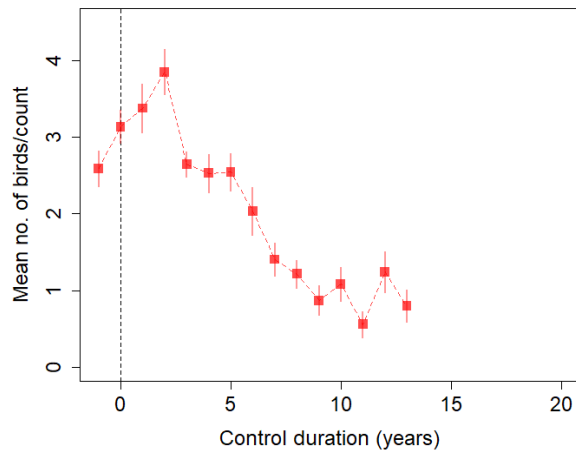
Maungatautari

Zealandia

Orokonui



Tawharanui Open Sanctuary

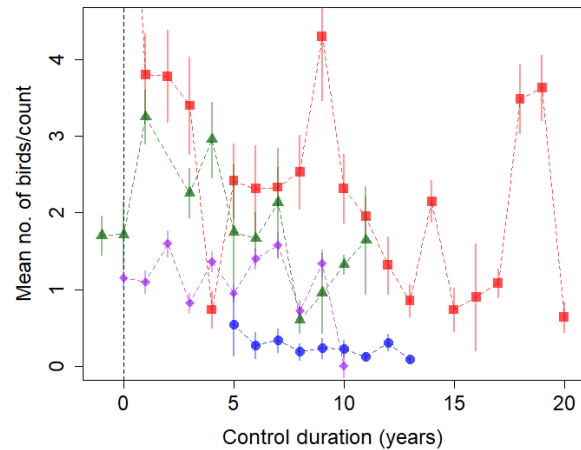


Boundary Stream Mainland Island

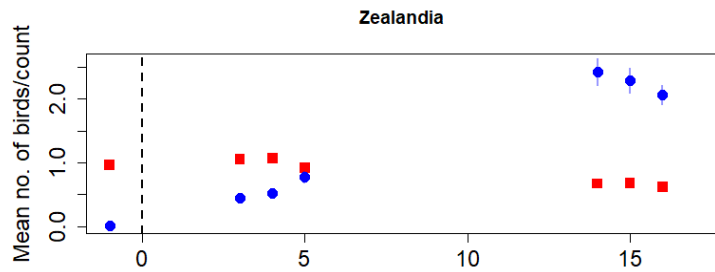
Ark In The Park

Mainland Island Restoration Operation

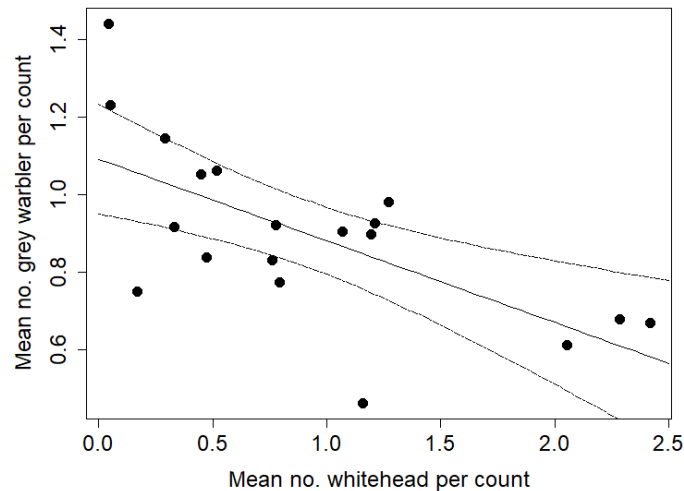
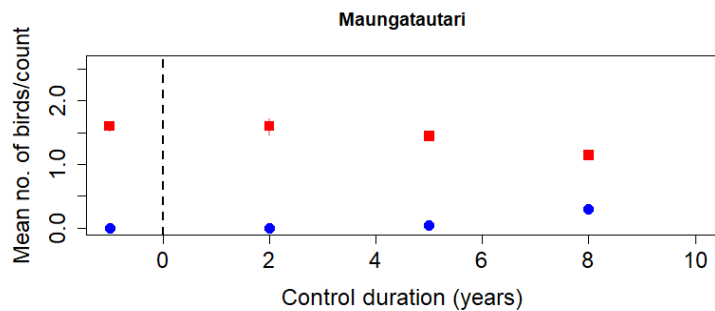
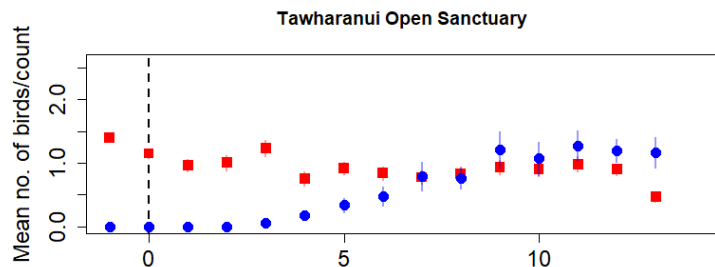
Wainuiomata Mainland Island



Competition between species



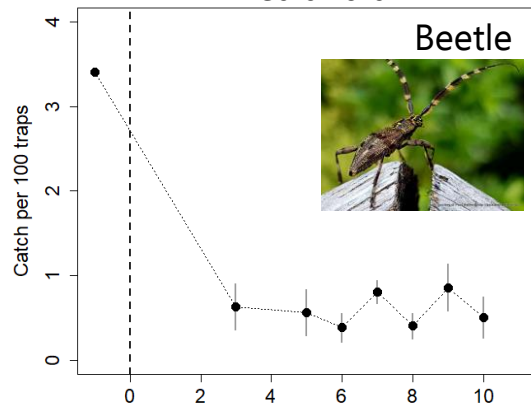
Whitehead
Grey warbler



Food supply

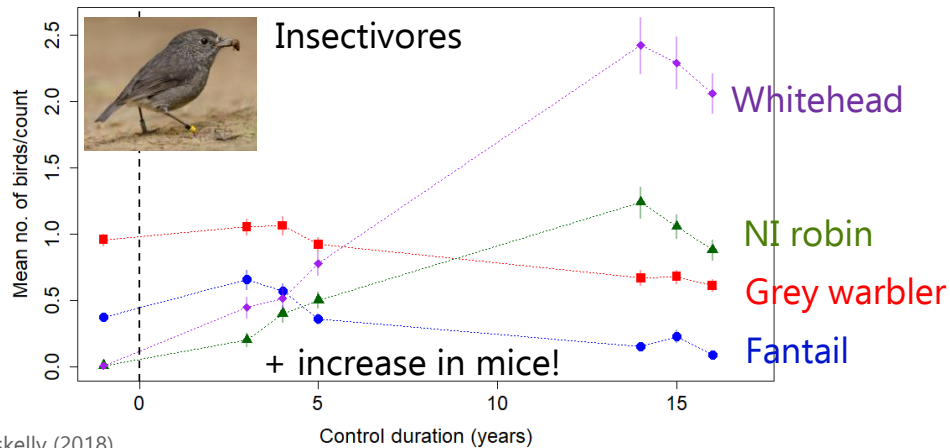
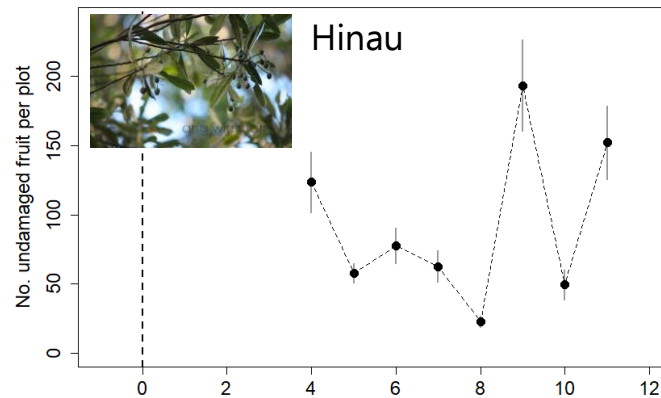


Zealandia

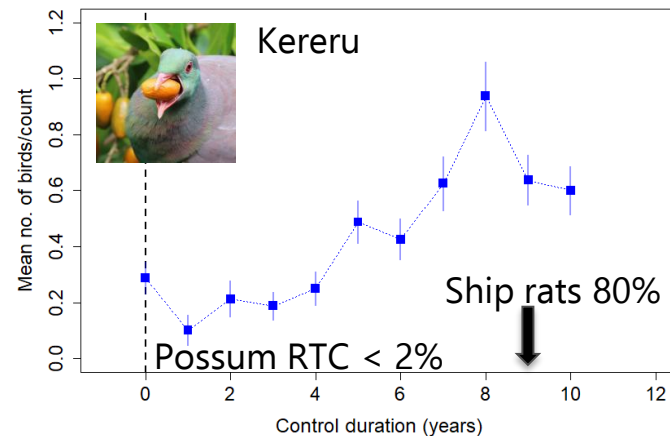


Watts *et al.* (2014)

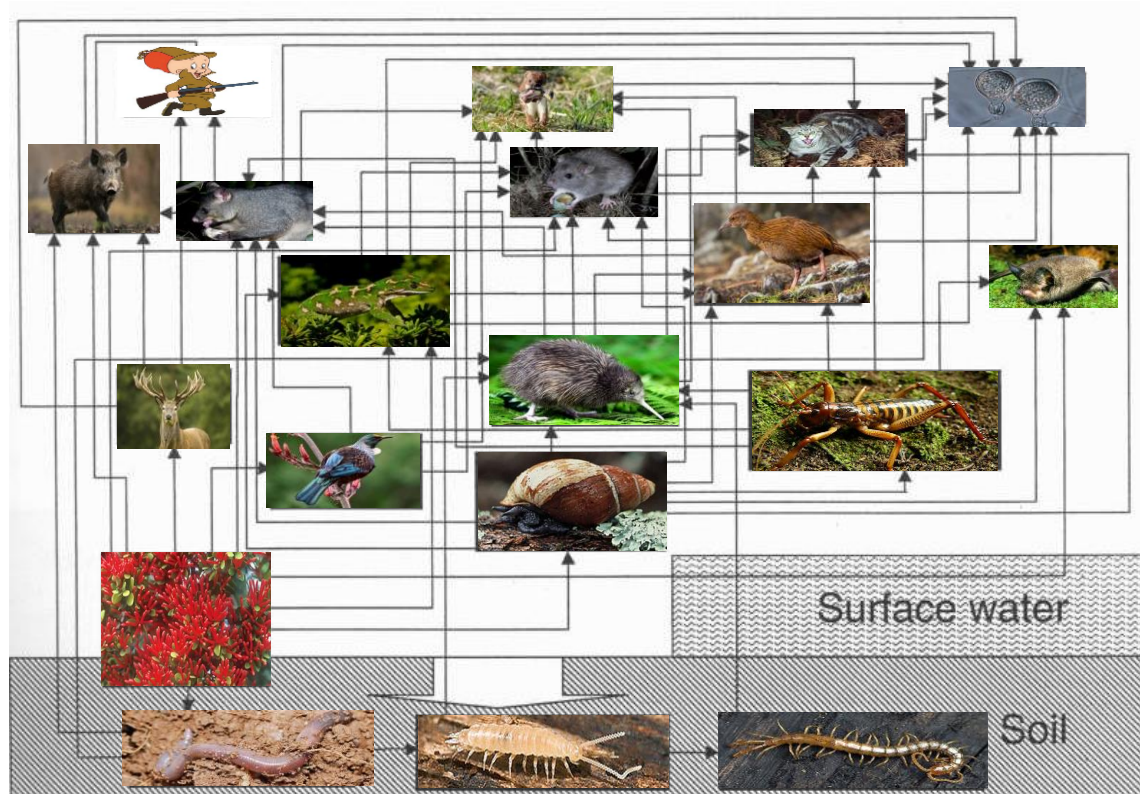
Wainuiomata MI



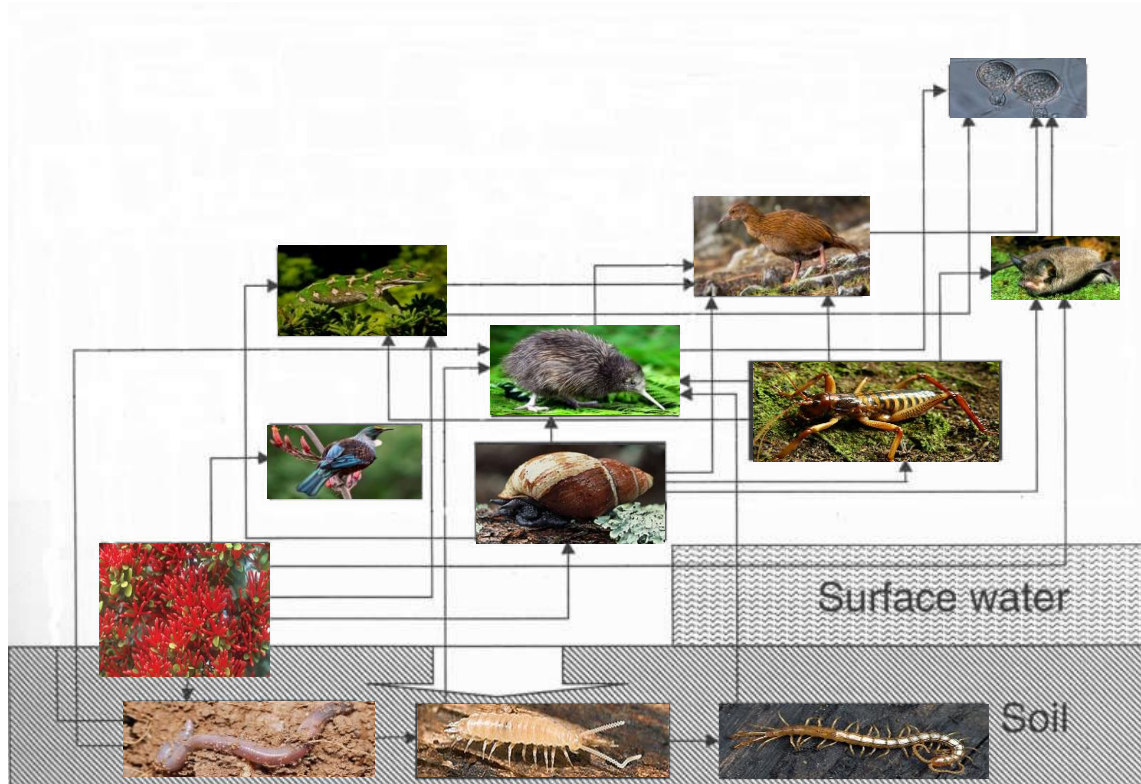
Miskelly (2018)



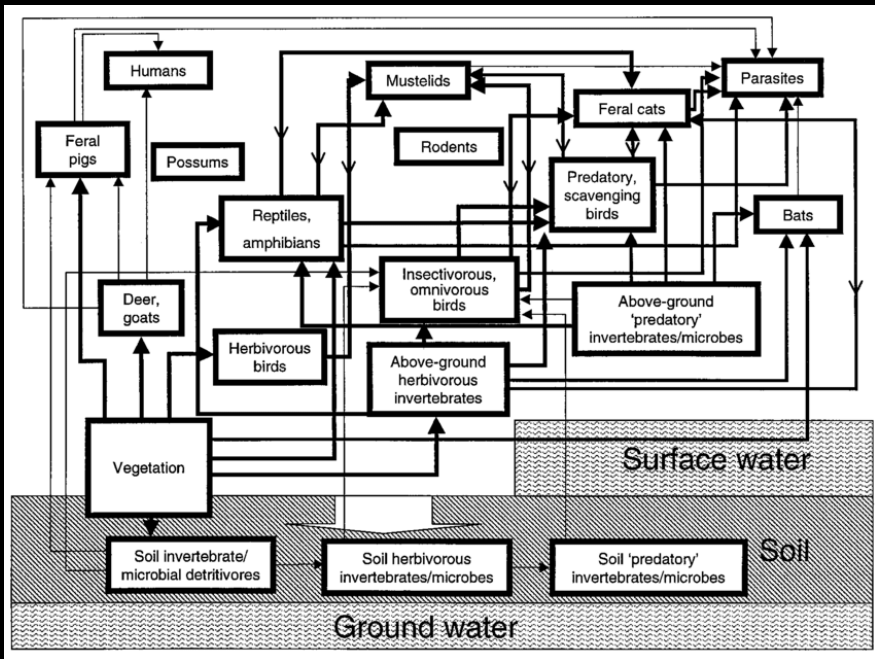
Complex ecosystems



Complex ecosystems



Unravelling the complexity



Innes & Barker (1999)

Station
Site j
Spr k
Time t

observed index in a stippled area
 $Z_{jkt} \sim \text{Bin}(\text{round}(N_{jkt}), \tau_{jkt})$

latent index at site j
 $\tau_{jkt} \sim \text{Beta}(c, d)$

Priors: $\sigma^2 \sim \text{IG}(a, \beta)$
 $a, b \sim N(\theta_0, \tau_0^*)$

for new fixed's learn
 $\tau_{jkt} = \tau_{jkt-1} + a + b\tau_{jkt-1} + X/\beta$

Complete:
 $p(\theta|y) \propto p(y|\theta)p(\theta)$

Full joint posterior: $(j=1, k=1)$
 $f(Y, \sigma^2, a, b, \tau|Z) \propto \prod_t \prod_k \text{Bin}(Z_{jkt} | N_{jkt}, \tau_{jkt})$

[obs. process]

$\times \prod_{t=1}^{19} N(Y_t | [\tau_{t-1}(1+b) + a + X/\beta], \sigma^2) \times \prod_{t=0}^{19} N(Y_{t+1} | [\tau_t(1+b) + a + X/\beta], \sigma^2)$

[biol. process]

Priors

MH if large τ with real data
 $\sigma^2 Y_t \sim \text{IG}(\frac{19}{2} + 0.1, 0.1 + \sum_{t=1}^{19} Y_t^2)$

$b = \alpha_0 + \alpha_1 \text{Pred}$
 $\tau_{jkt} | Z_{jkt} \sim \text{Beta}(c + y, d + (n - y))$

for density dep. predation
 $\sum_{j=1}^J \sum_{k=1}^K \tau_{jkt} = n \text{ Observed}$
 $\sum_{j=1}^J (N_{jkt} \times \text{stations}) = n \text{ trials}$

- Hunter-Schmidt

- Charles Darwin's theory

$Z_{jkt} \sim \begin{cases} \text{Bin}(\text{round}(N_{jkt}), \tau_{jkt}) & \text{if } N_{jkt} > Z_{jkt} \\ ? & \text{else} \end{cases}$

σ^2 :
① Truncated Y post dist? \Rightarrow try larger N_j



What can we take home?

- Predation, competition and food supply are all factors in any ecosystem
- BUT we want indigenous species to dominate these processes
- Which species compete and when?
- Need more 'food productivity' monitoring (e.g. seedfall, fruiting/flowering, invertebrates) and residual pest abundance



Credit: Neil Fitzgerald



Acknowledgements and thanks

- DOC MI data access: Craig Gillies and Oliver Gansell (Department of Conservation, Hamilton)
- DOC MI staff for field data collection and reporting
- Robbie Price (Manaaki Whenua–Landcare Research)
- 24 Sanctuaries: Auckland Council (Shakespear Open Sanctuary, Tawharanui Open Sanctuary), Ark in the Park, Bluff Hill/Environment Southland, Bream Head Scenic Reserve, Bushy Park, Doug Armstrong & Faline Drummond (Massey Uni), Bushy Point, Cape Sanctuary, Colin Miskelly (Te Papa), Corinne Watts (Manaaki Whenua), East Taranaki Environment Trust, Forest Lifeforce Environment Trust, Glenfern Sanctuary, Greater Wellington Regional Council (Wainuiomata Mainland Island), Halfmoon Bay Habitat Restoration Project, Horizons Regional Council (Totara Reserve), Kaipupu Point Wildlife Sanctuary, Mainland Island Restoration Operation, Maungatautari, Orokonui, Pirongia, Pomona and Rona Islands, Puketi, Rotokare Scenic Reserve Trust, Windy Hill, Zealandia.

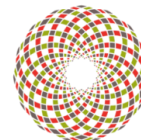


Manaaki Whenua
Landcare Research

NEW ZEALAND'S
BIOLOGICAL
HERITAGE

Nga Kolora
Tuku Iho

National
SCIENCE
Challenges



Te Pūnaha Matatini
Data ■ Knowledge ■ Insight

