

Seed dispersal by native animals: Restoring functioning ecosystems



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Outline

1. Why does seed dispersal matter?
2. Bird dispersal of large-seeded fruits
3. How well is seed dispersal working?
4. Can we restore seed dispersal mutualisms?
5. Seed dispersal by lizards

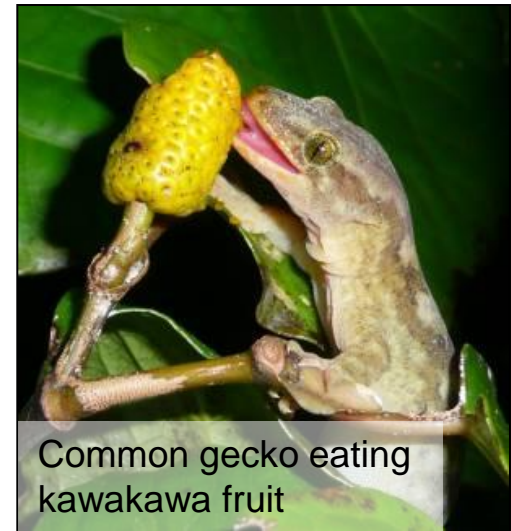


1. Why does seed dispersal matter?

- Enhanced germination
- Escape high mortality beneath parent plant
- Reach suitable establishment sites
- Colonise new sites
- Gene flow between populations



Kereru eating taraire fruit (Nga manu images)



Common gecko eating kawakawa fruit

New Zealand frugivory

- 59% of trees have fleshy fruits (12% total flora) (Kelly et al. 2010 NZJ Ecol 34: 66-85)
- No native land mammals, except bats
- Fruits mostly eaten by birds
- Lizards also eat fruits



2. Bird dispersal of large-seeded fruits



Kereru eating tarairi fruit (Nga manu images)

New Zealand bird losses

- New Zealand no longer has an avifauna, just the wreckage of one
- 24% land birds & 41% forest birds extinct since human arrival
- Worst region, with >80% of species extinction-prone

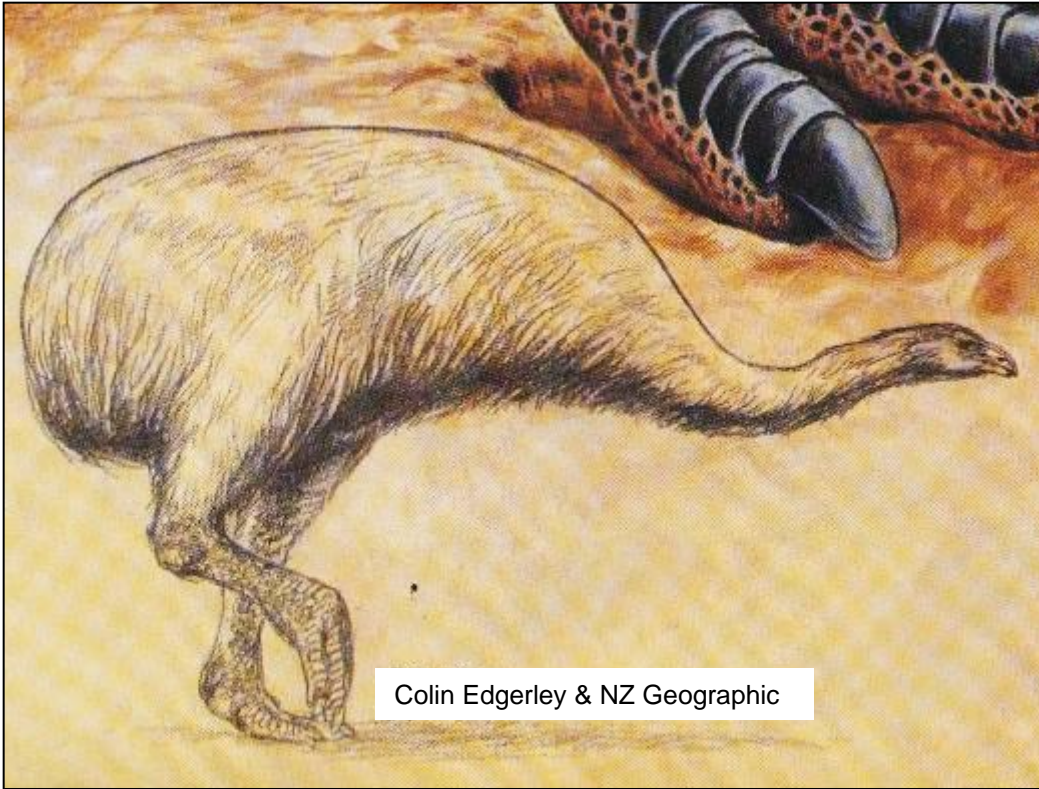
Diamond 1984. NZJECOL 7: 37–55

Tennyson 2010 NZJECOL 34: 6–27

Innes et al. 2010 NZJECOL 34: 86–114

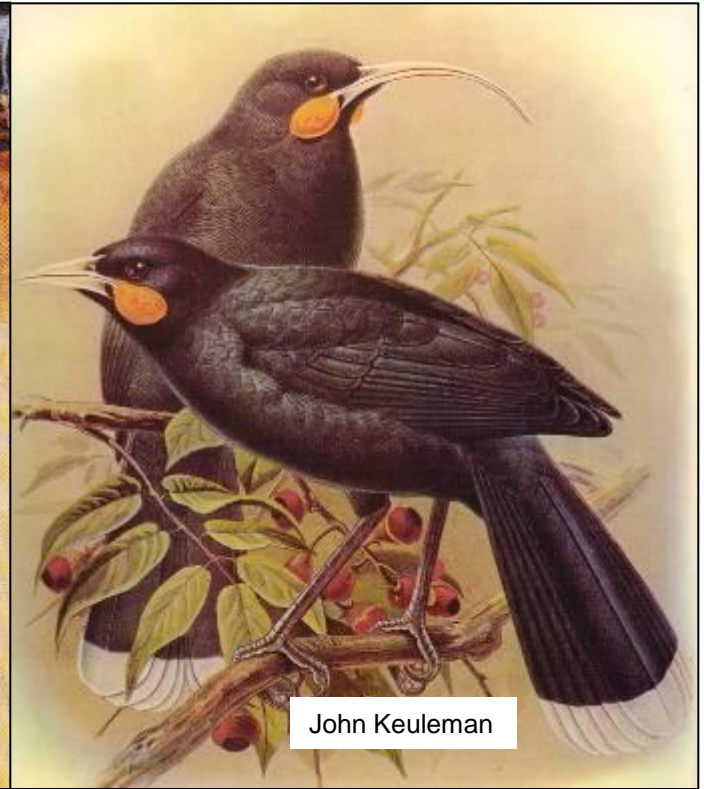
Sekercioglu et al. 2004. PNAS 101: 18042–18047

Frugivore extinction in NZ



Giant Moa (*Dinornis* spp.)

Gape > 50 mm



Huia (*Heteralocha acutirostris*)

Gape = 15 mm

Frugivore range restriction



Kokako (*Callaeas cinerea*). Gape = 13 mm



Saddleback (*Philesturnus carunculatus*). Gape = 8 mm

Frugivore population decline



Tui (*Prosthemadera novaeseelandiae*)

Gape = 9 mm



Kereru (*Hemiphaga novaeseelandiae*)

Gape = 15 mm

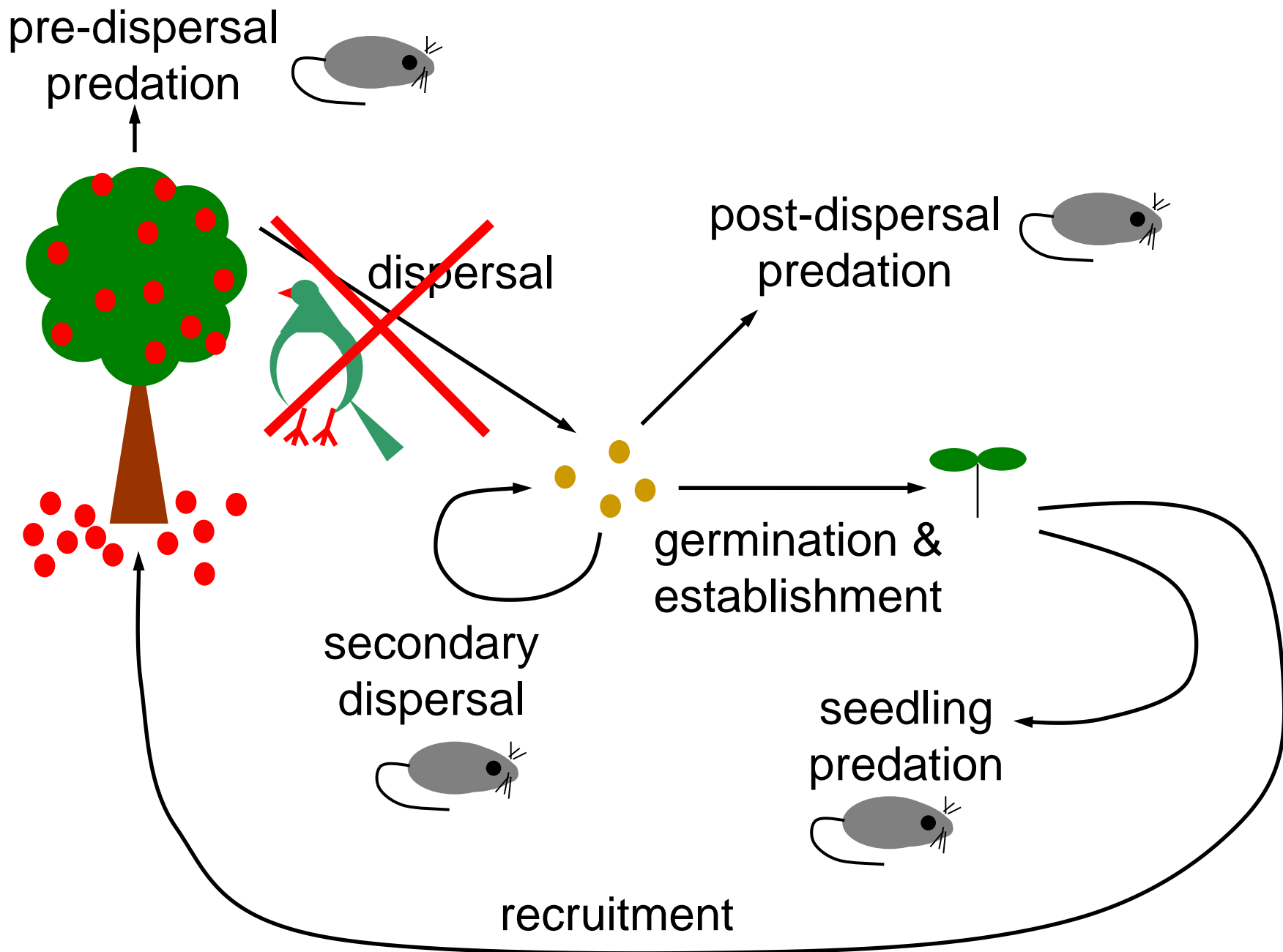
Dispersal of large fruits

- Plants with large fruits (>15 mm diam) largely rely on kereru for dispersal



Clout & Hay 1989 NZJ Ecol 12: 27-33

Kelly et al. 2010 NZJ Ecol 34: 66-85



Dispersal failure & large seeds

Do large-seeded trees regenerate if their seeds are not dispersed?



What effect do introduced mammals have on recruitment?



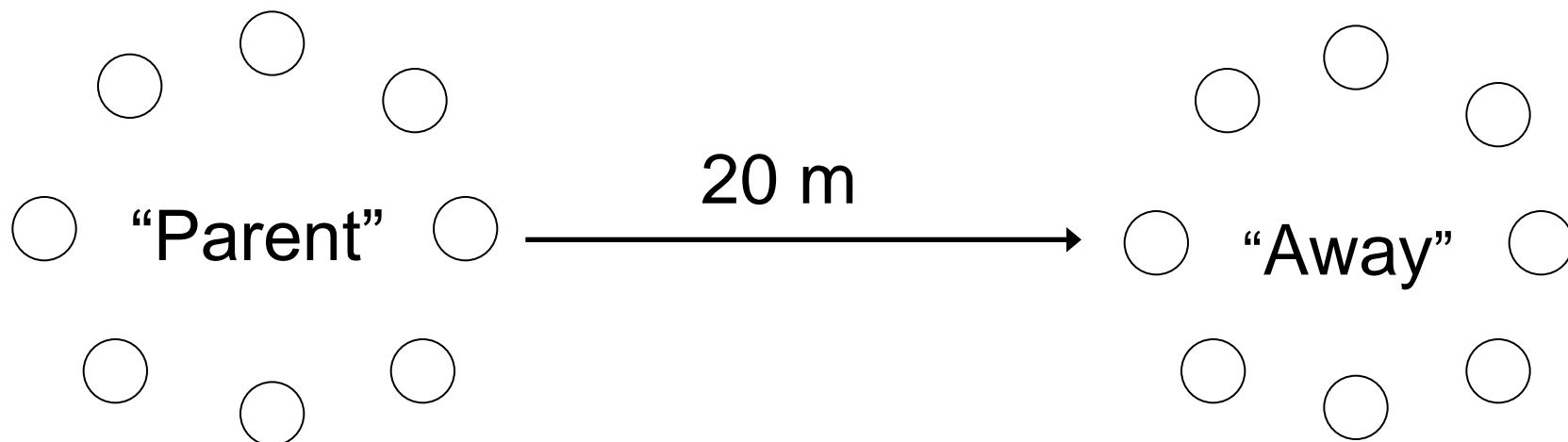
Effect of dispersal on survival

Treatment	+ Bird	– Bird
fruit	clean	whole
location	20 m away	under “parent”
density	4 seeds	20 seeds
mammals	caged	uncaged

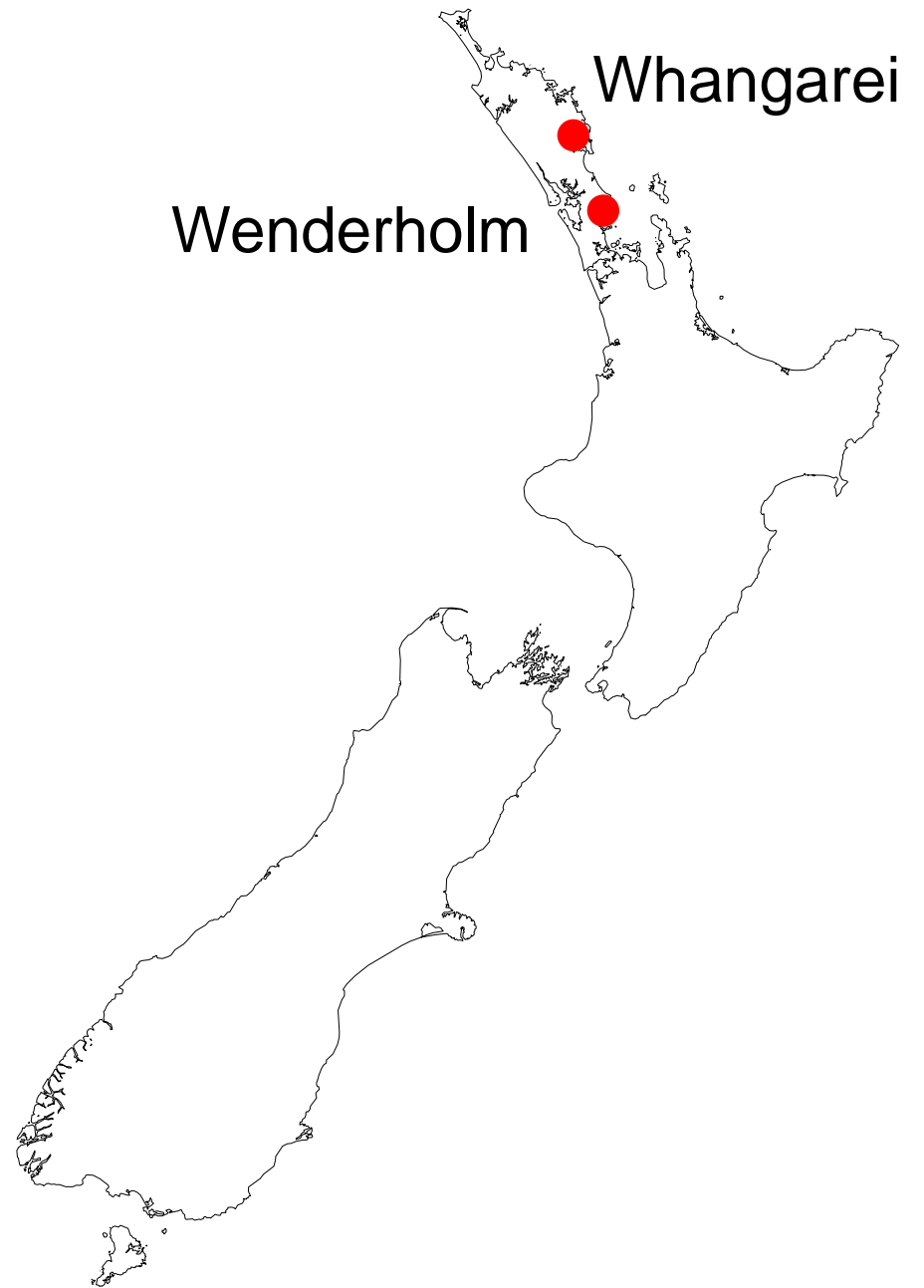
Pre-human

Post-human

Experimental design



- 5 “parents” per species per site
- Full factorial design

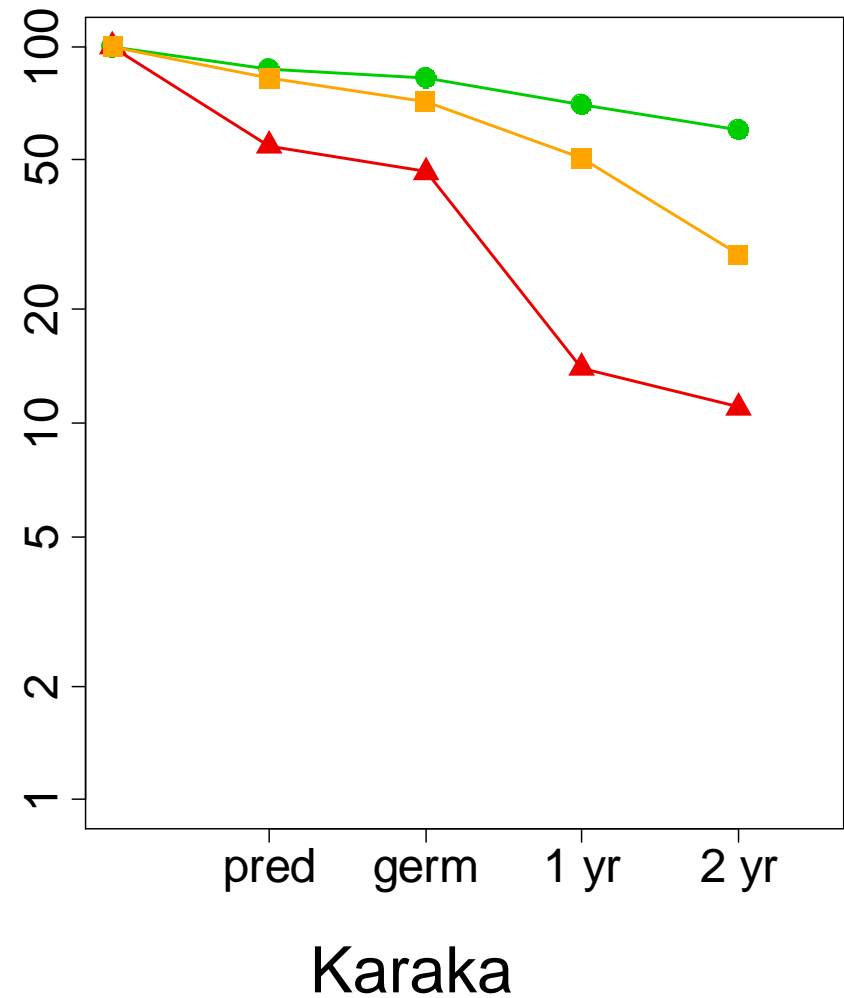
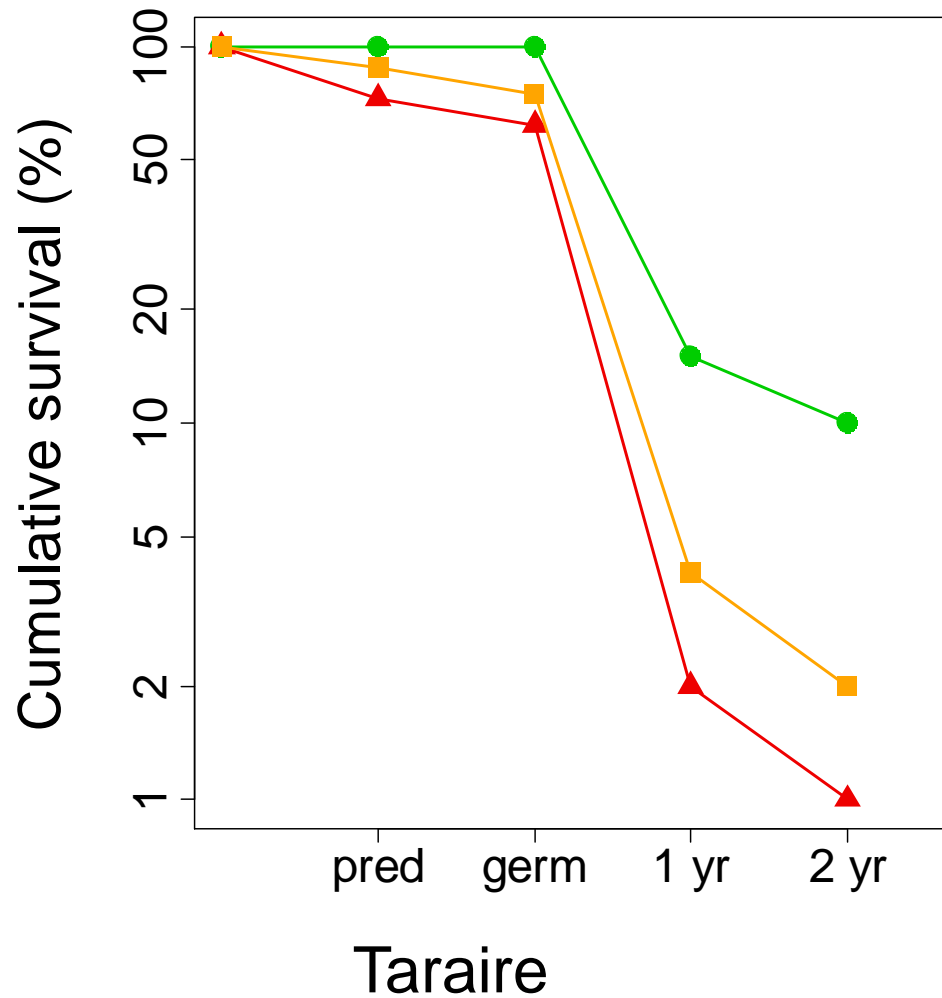


Survival without dispersal is poor

▲ mammals present, not dispersed

■ exclude mammals

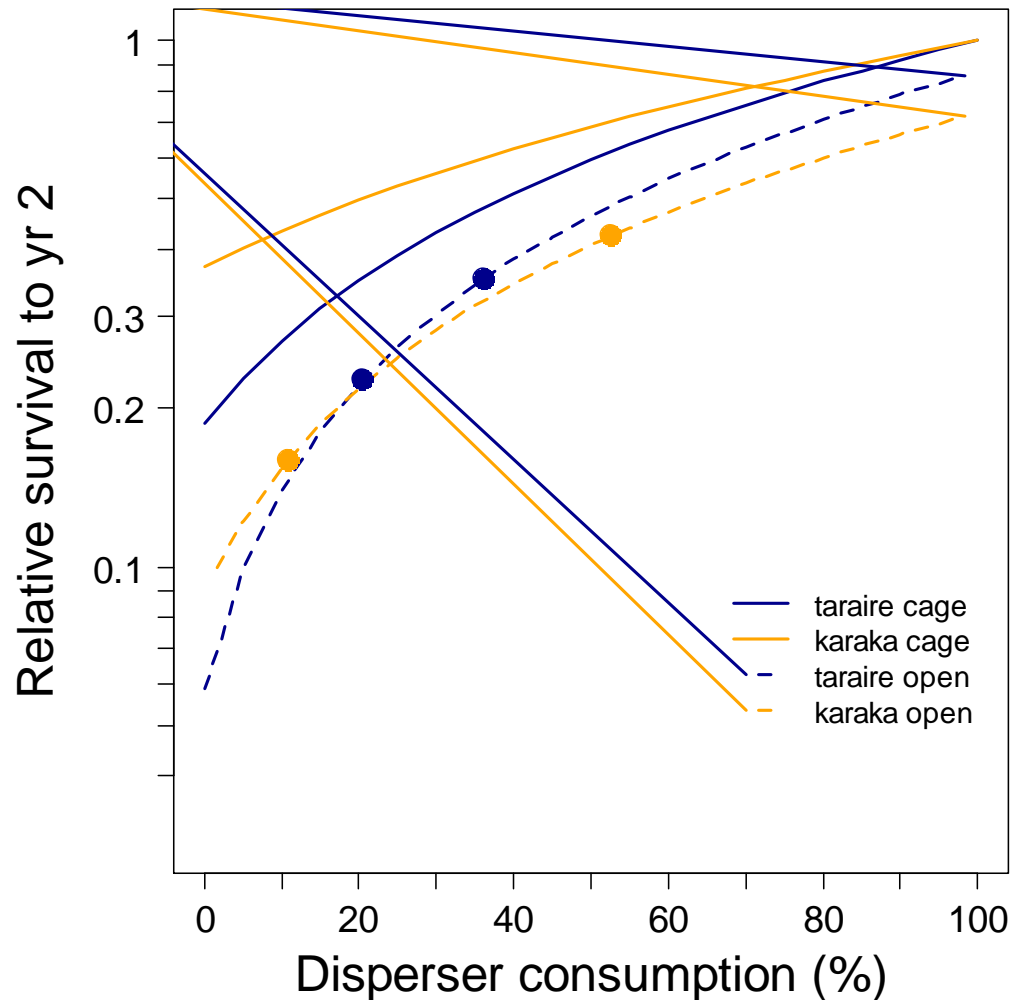
● restore birds



3. How well are seed dispersal interactions working?



Survival with current fruit consumption

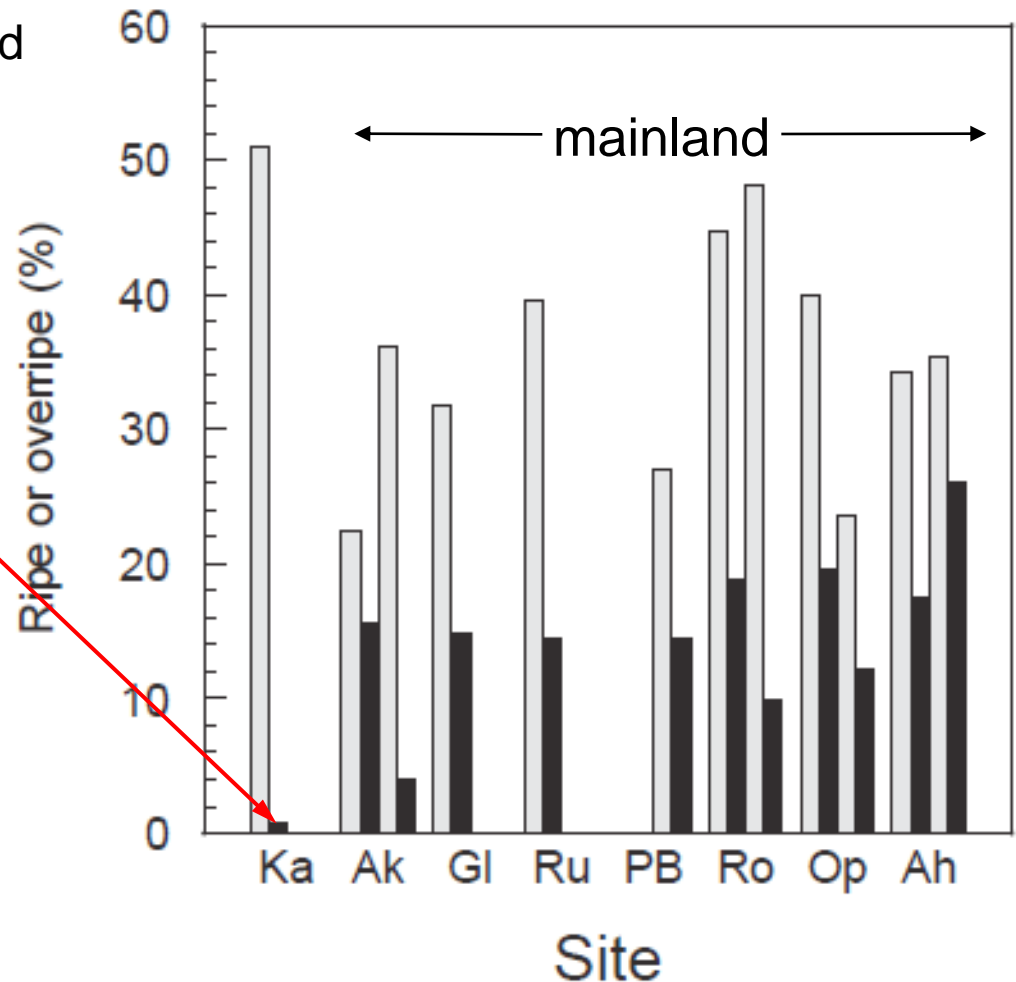


Tree fuchsia fruit removal

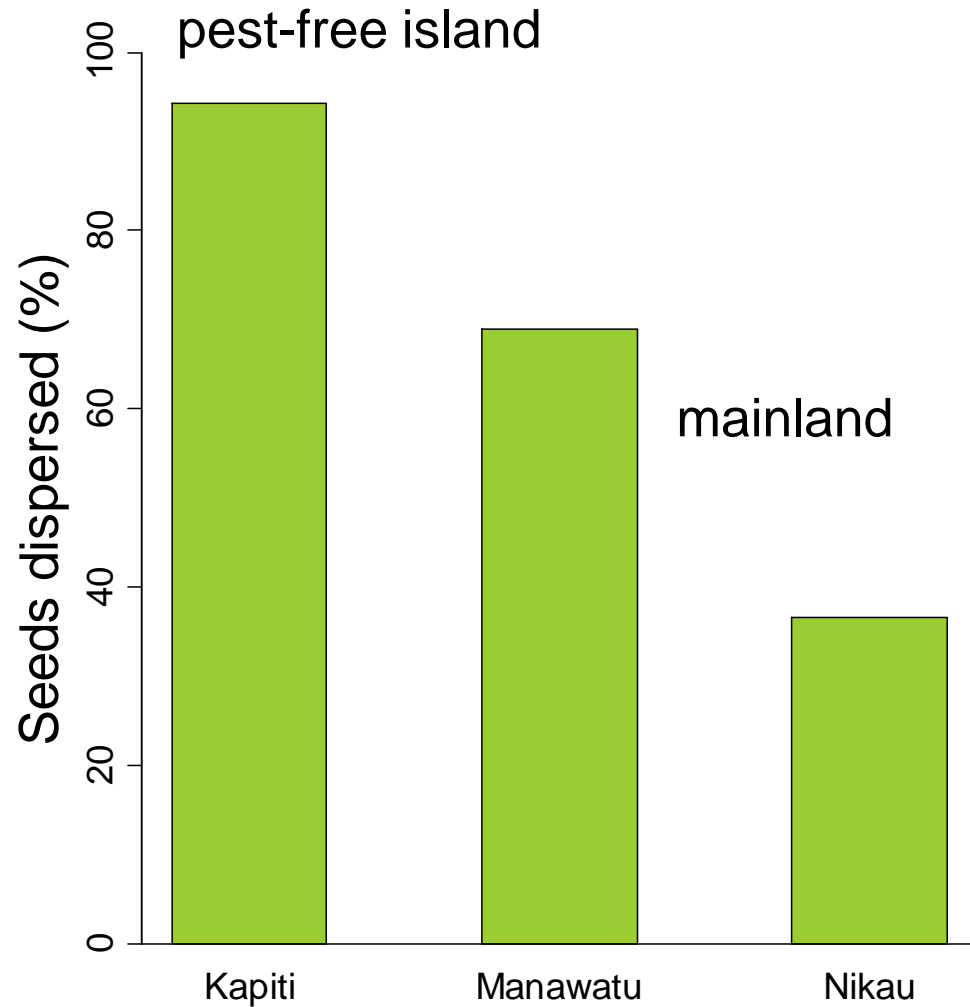


pest-free island

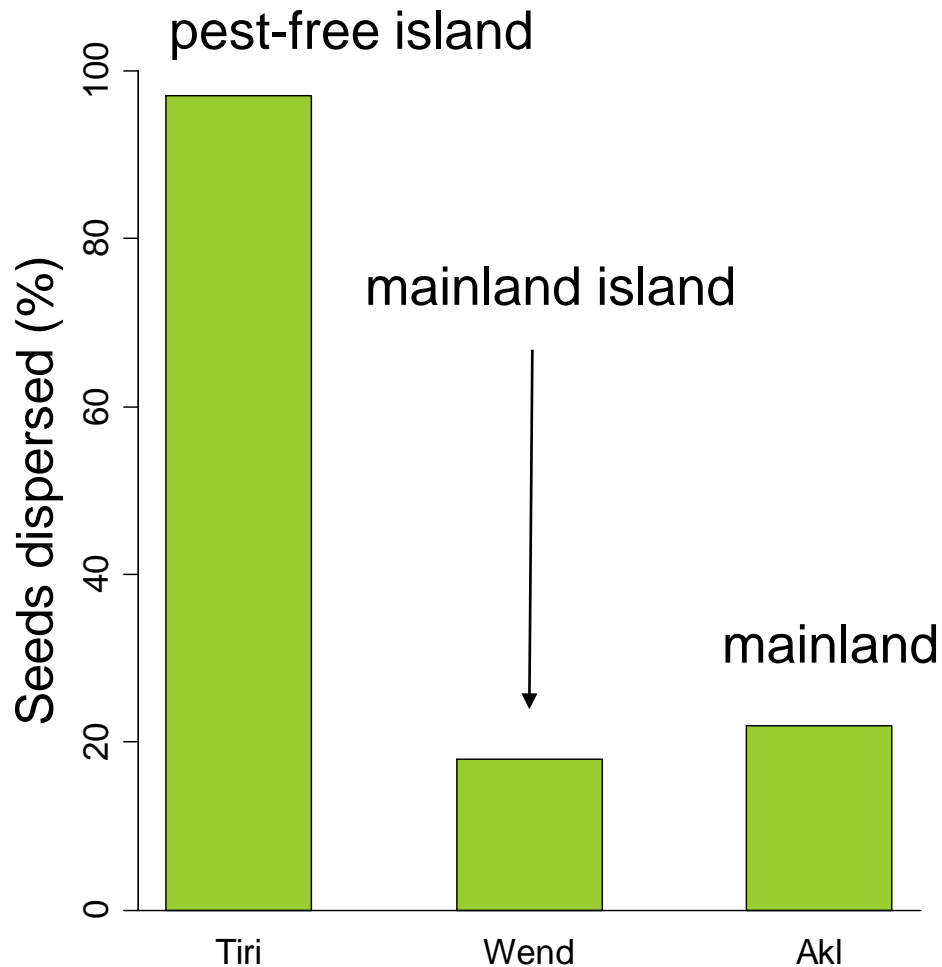
□ caged
■ open



Nikau fruit removal



Karo fruit removal



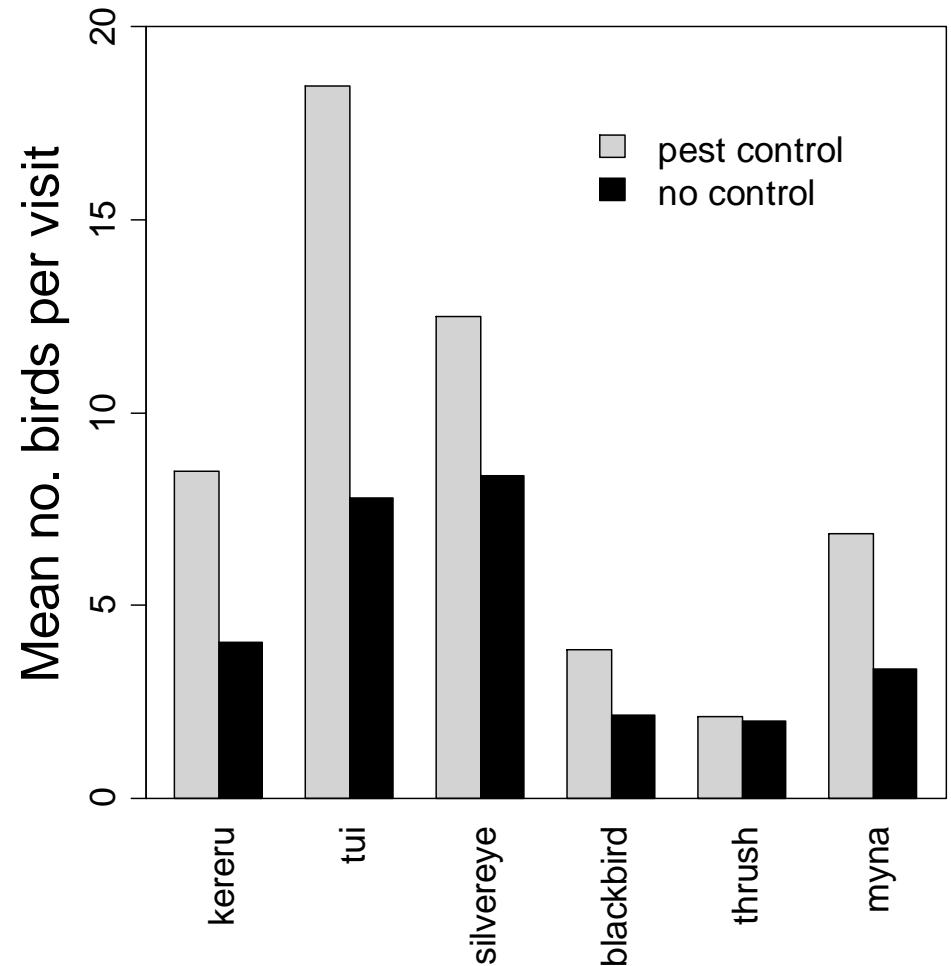
4. Restoration: can we fix it?

- Can conservation management increase frugivore numbers on the mainland?
- Do increased frugivore numbers restore a functioning ecosystem?

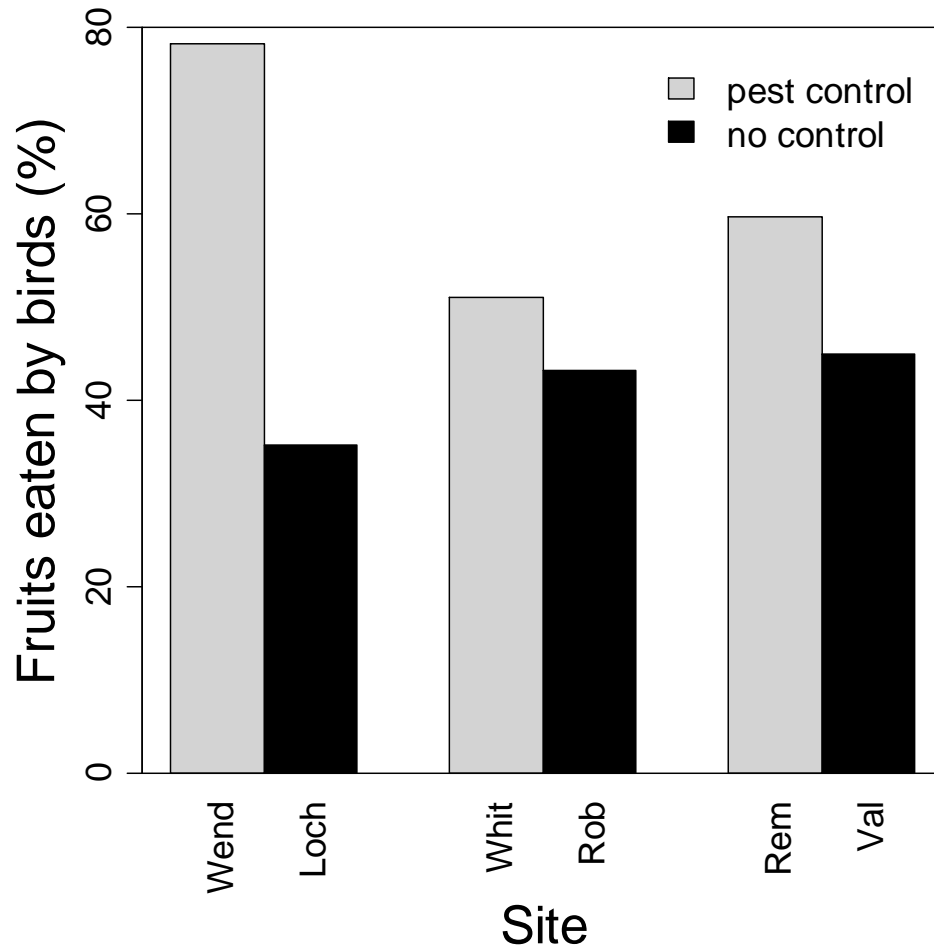


Does pest control increase bird numbers?

- Mainland sites, Auckland
- 3 pest control sites vs 3 paired no control sites



Does pest control restore dispersal service?



- range of fleshy-fruited species

5. Lizards as seed dispersers



Common gecko eating kawakawa fruit

Lizard declines in NZ

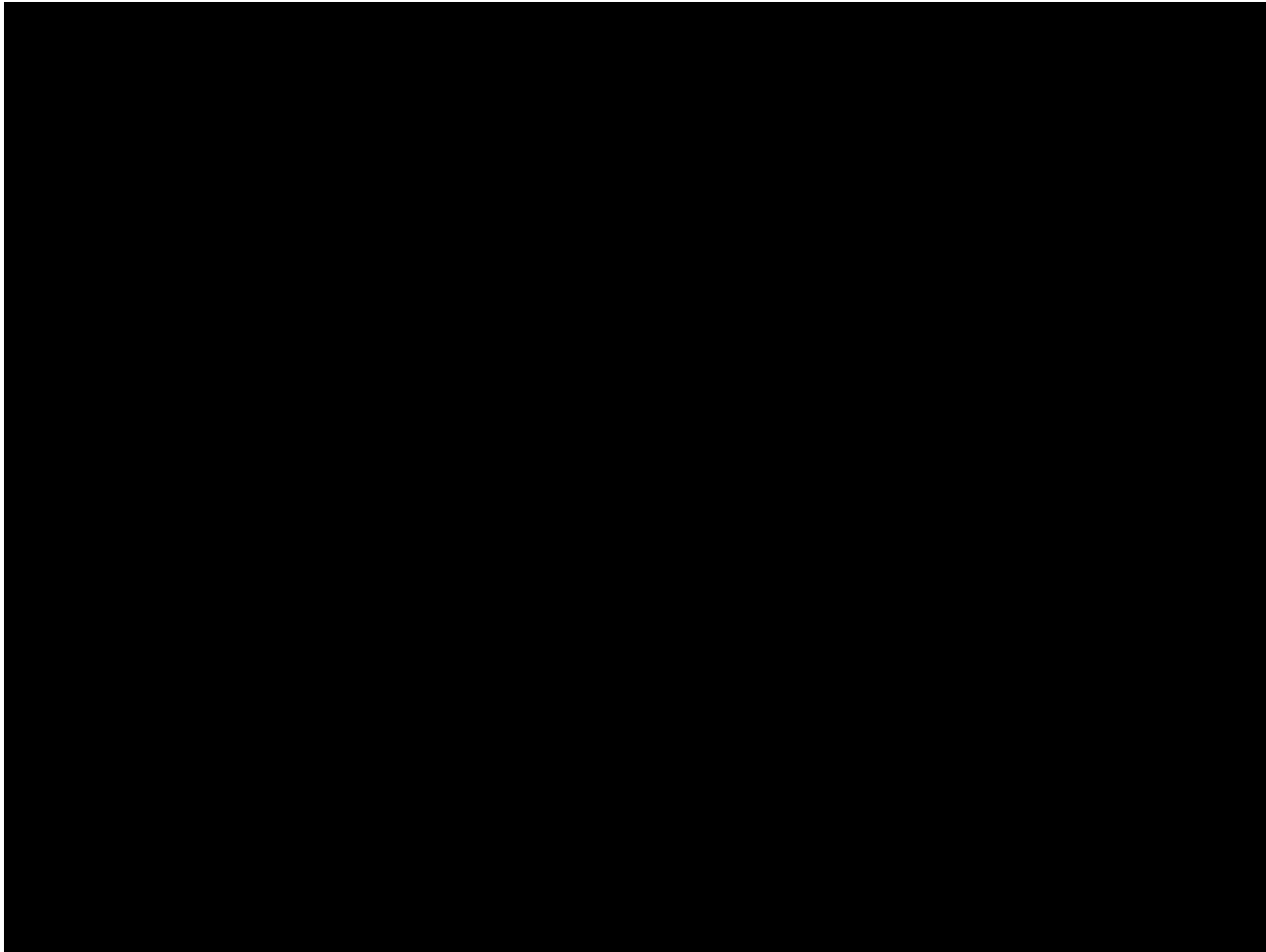


- 99 native species
- 2% extinct
- 63% threatened or at risk
 - 11 island relicts



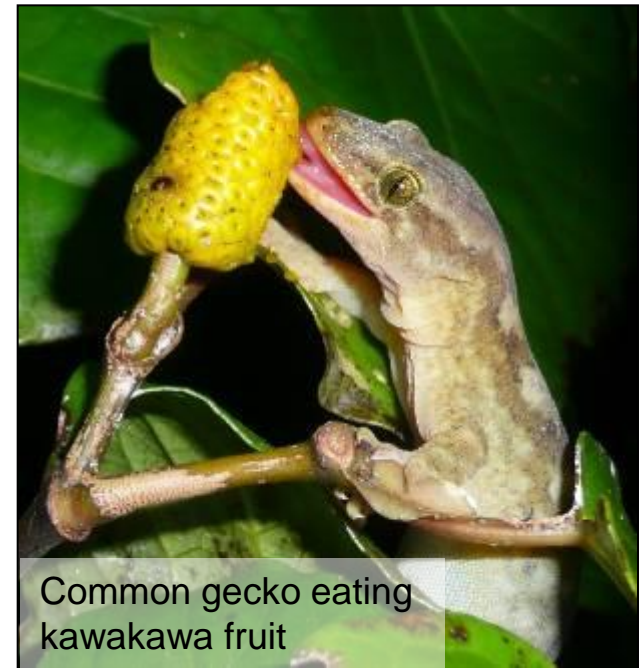
Grand skink

Kawakawa dispersal on Stephens Island



Stephens Island

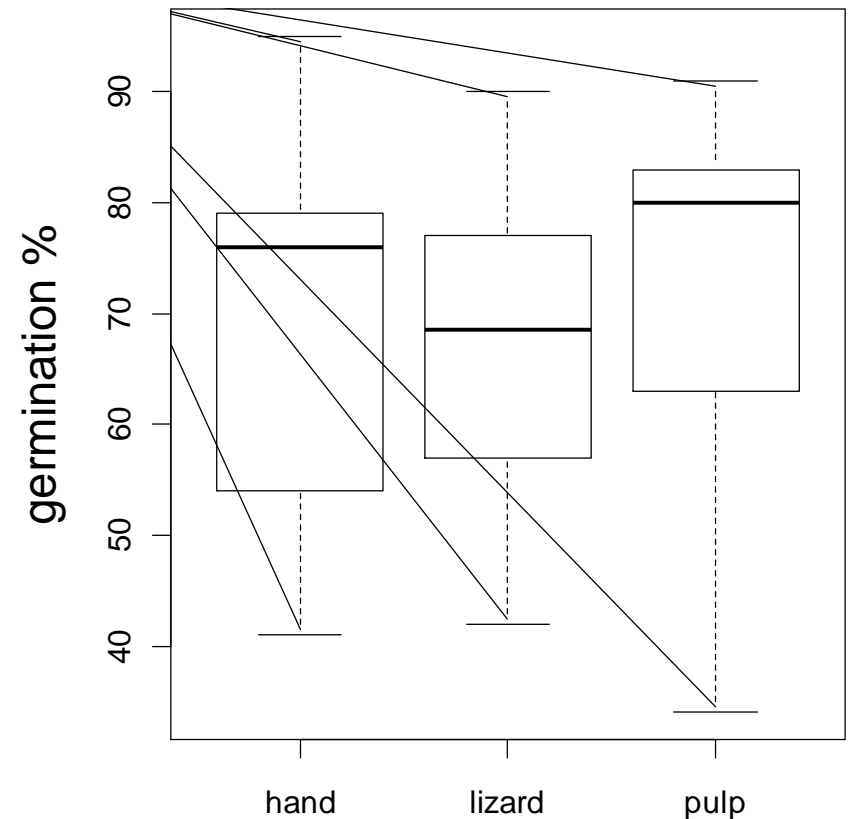
- 80 scats
- 82.5% with seeds
- kawakawa & *Muehlenbeckia australis*
- Mean 30.8 seeds/scat
- Max 76 seeds/scat



Common gecko eating
kawakawa fruit

Stephens Island: germination

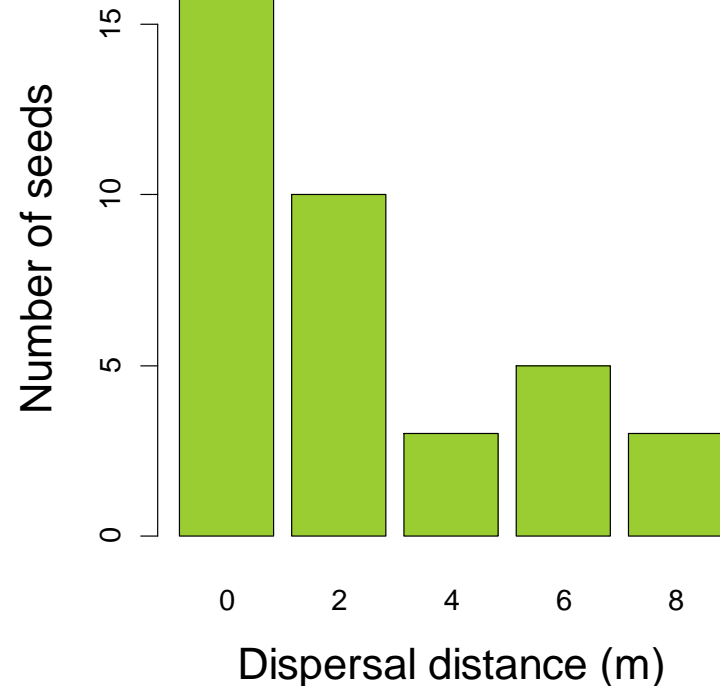
- 3 tmts: hand-cleaned, lizard & pulp
- 100 kawakawa seeds per pot
- 14 replicates



Kaitorete Spit

- 527 lizard scats
- 9.3% with seeds (*Muehlenbeckia astonii* & *M. complexa*)
- Mean 1.2 seeds/scat (max 3)
- Mean dispersal distance 2.3 m

Wotton unpubl. data



How effective are lizards as seed dispersers?

Mana Island, Wellington



Coastal shrubland



Coprosma propinqua



Common gecko



Fruit removal

All frugivores excluded



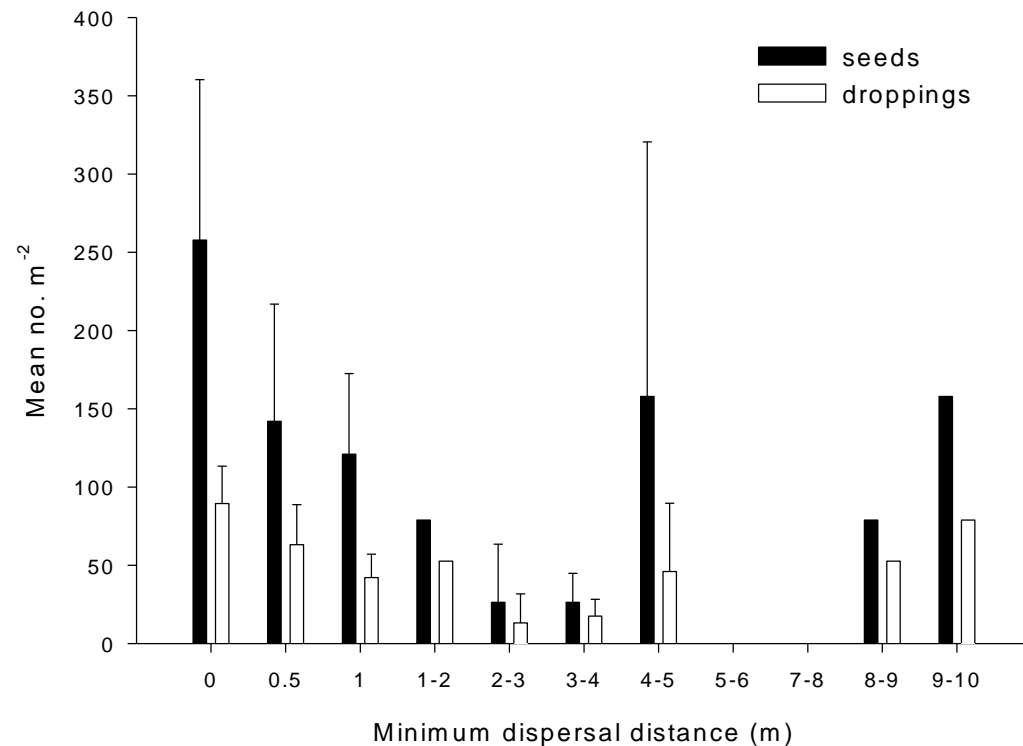
Lizards only (birds excluded)



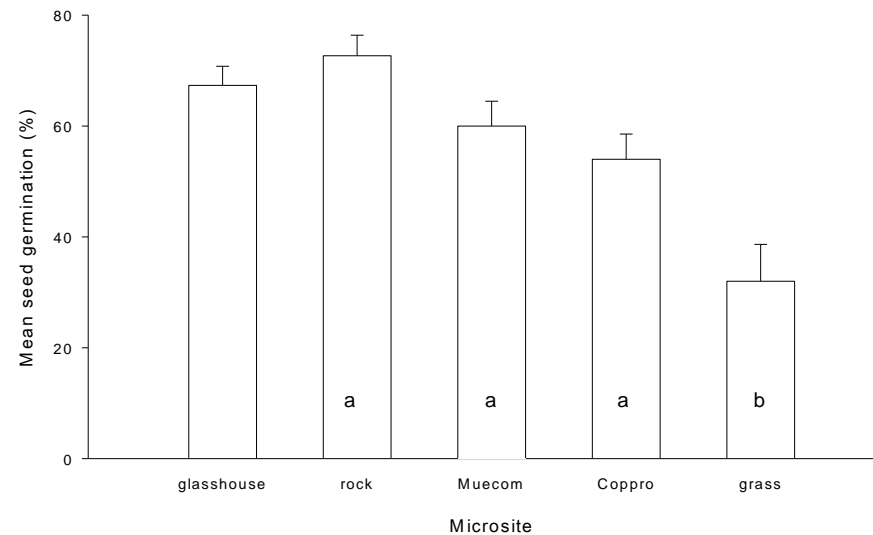
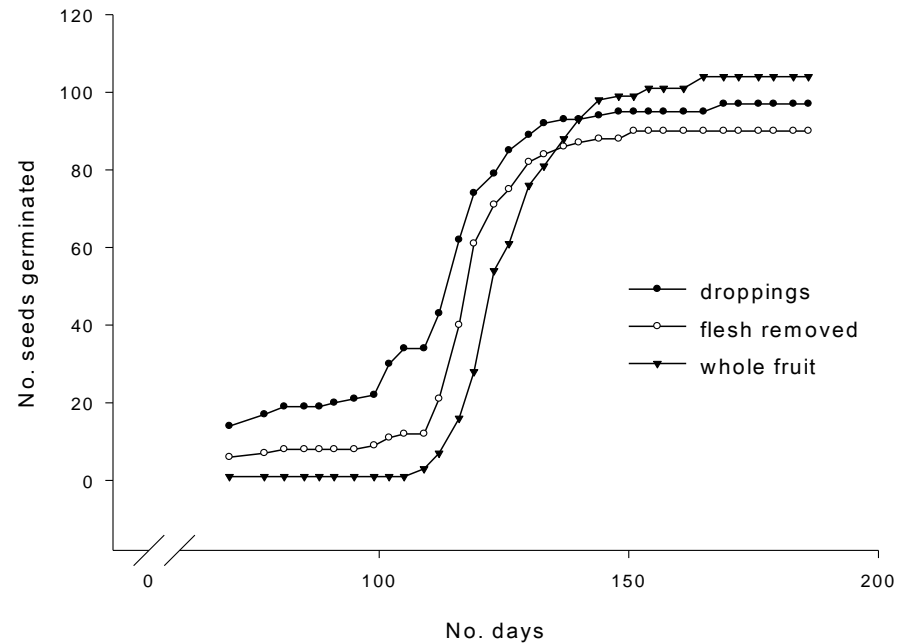
Frugivore access	Mean fruit removal (%)
No frugivores	46.62
Lizards	93.27
Lizards + birds	96.02

Lizard dispersal quantity & distance

- 154 scats
- 39% with seeds
- *Coprosma propinqua* & *Muehlenbeckia complexa*
- Mean 2.6 seeds/scat
- Max 10 seeds
- Mean minimum distance 1.65 m



Lizard dispersal quality



Summary: large-seeded trees

- Kereru dispersal important for large-seeded trees
- 53-80% lower survival without dispersal
- Dispersal failure + introduced mammals decreased survival by 82-90%



Summary: restoring functioning ecosystems

- Dispersal service poor on mainland
- Mammal pest control can restore seed dispersal interactions
- But ecosystem resilience important
 - sometimes key player missing



Summary: lizard seed dispersal

- Lizards are effective seed dispersers
 - Seeds germinate well
 - Move seeds away from parent plant
 - Deposit seeds in suitable establishment sites
- Don't know how well lizard-dispersed plants are being dispersed on the mainland

