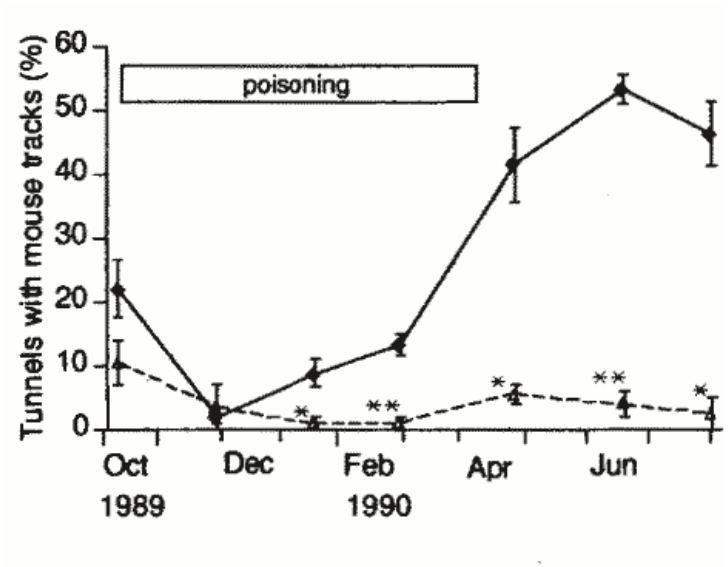
Investigating mechanisms and implications for the relationship between house mice and ship rats

Lucy Bridgman

lb63@students.waikato.ac.nz

Background

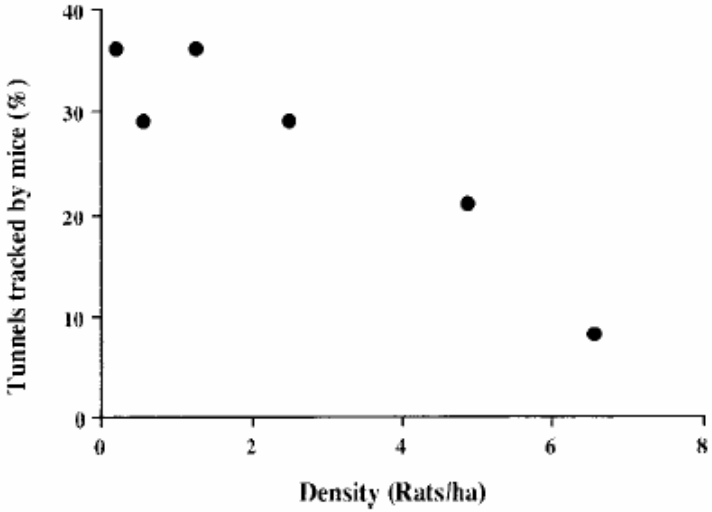
- ↓ rats = ↑ mouse detections



Brown *et al.* (1996)

Innes *et al.* (1995)

- Change in **abundance?**
- Unwanted management outcome!



- Change in **detectability?**
- Implies uncertainty in monitoring

Background

- ↓ rats = ↑ mouse detections
- Mechanism?
- **Exploitation/resource competition**
  - Use the same resources
- **Interference competition**
  - Rats ‘bully’ mice for access to resources
- **Intraguild predation**
  - Extreme form of interference competition
  - Rats compete with AND prey on mice

Two approaches:

1. Mechanism
   - studying behaviour of individuals
2. Abundance and detectability
   - studying populations

1.

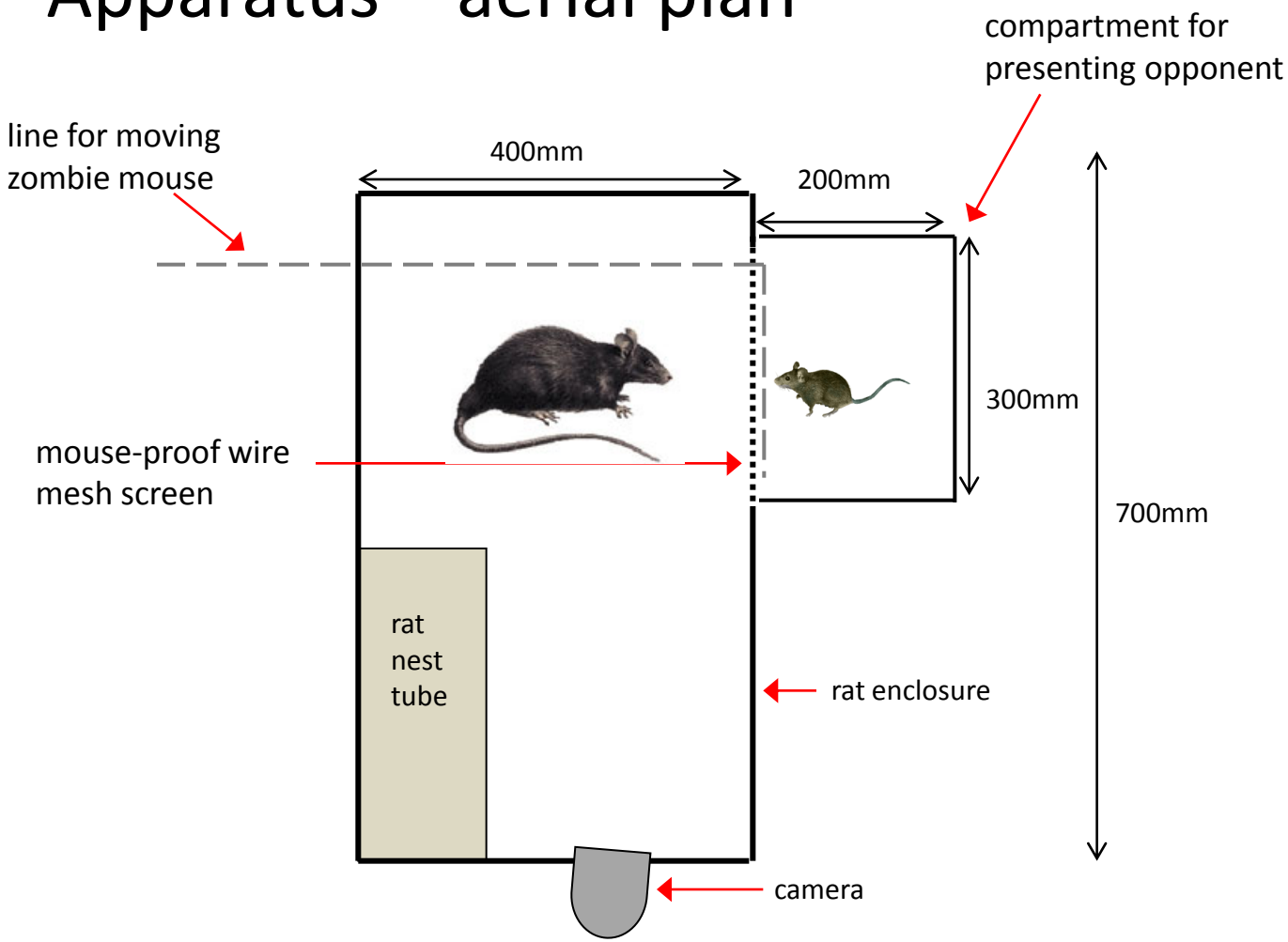
- Mechanism - INDIVIDUALS
  - How do ship rats behave toward mice?
  - Is their behaviour predatory?
    - Topographically different from other aggressive behaviour
    - Associated with feeding

1. methods

- Ethical considerations!!!
- Wire mesh screen
- Zombie mice

1. methods – zombie mice

- Apparatus – aerial plan



1. methods

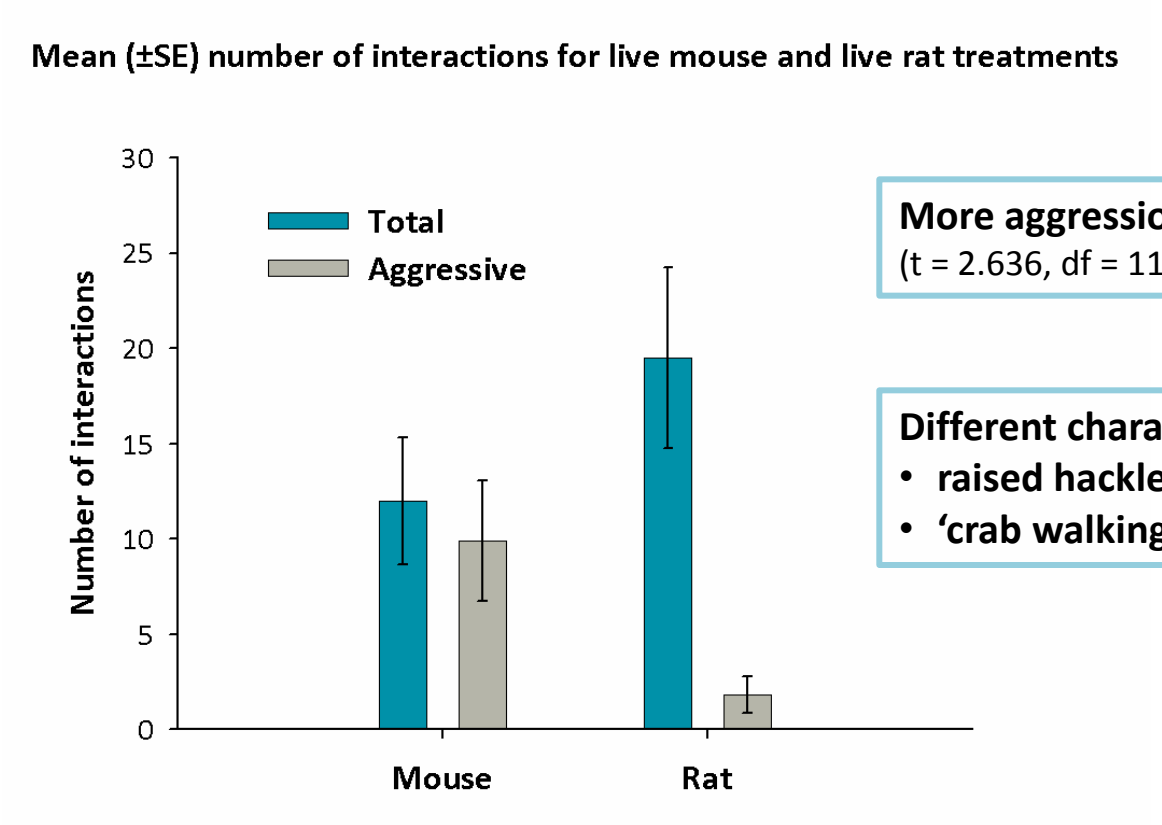
- Switched light/dark cycle – infra-red light
- 4 nights habituation time
- Each rat presented with:
  - **live rat**, **live mouse**, & **zombie mouse** on a different night
- 12 subject ship rats
  - 6 food ad lib, 6 food restricted

1. methods

- 100mins to begin interacting
- Interacting time =
  - 10 mins - live opponents
  - 20 mins - zombie mouse
- Observe for **live opponents**:
  - No. of **interactions** (close contact)
  - No. of **aggressive** interactions (biting/clawing)
- Observe for **zombie mice**
  - '**Attack**', **restraint**, **eating**
  - Mass of mouse eaten

1. results

- Is behaviour topographically different from other aggressive behaviour?

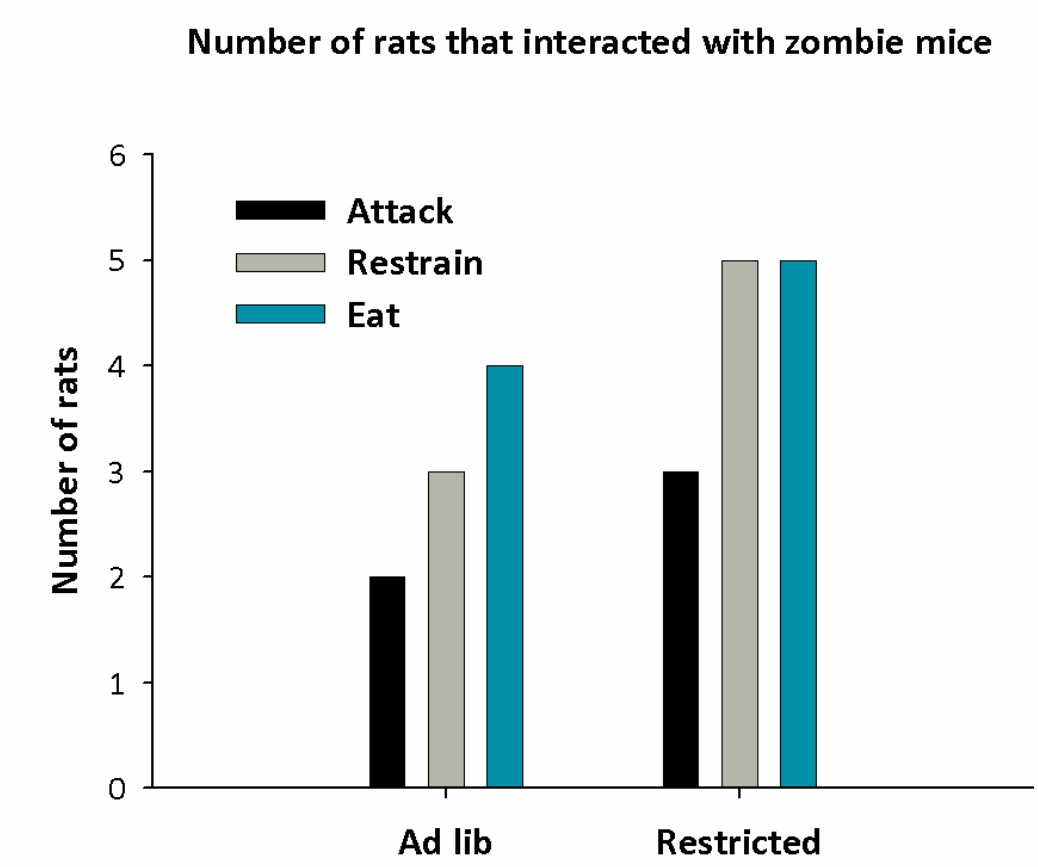


More aggression toward mice
(t = 2.636, df = 11, p-value = 0.023)

Different characteristics
- **raised hackles**
- **'crab walking'**

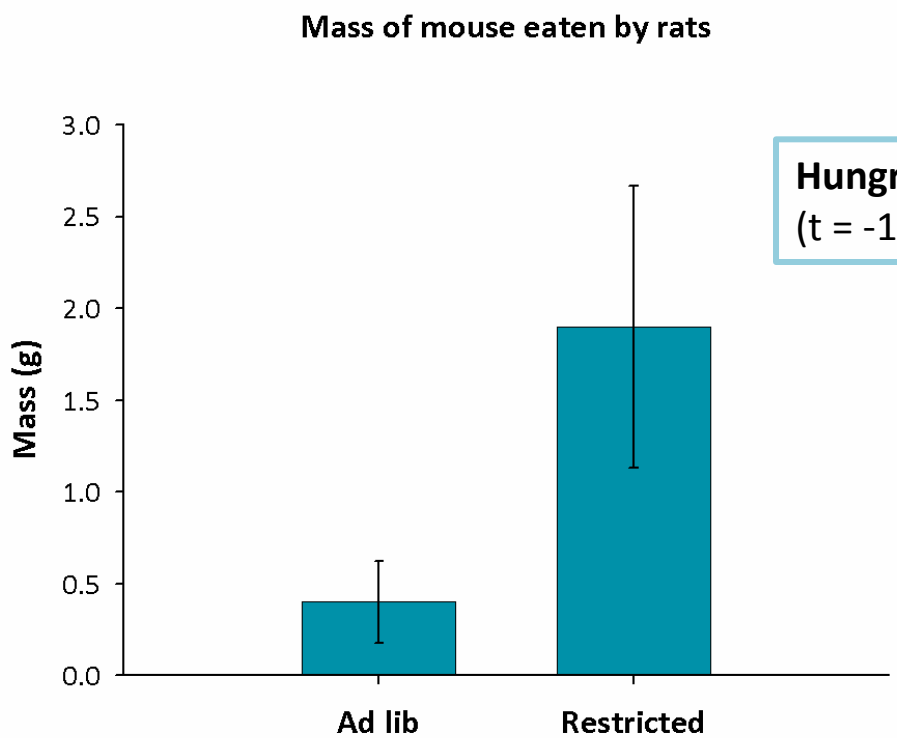
1. results

- Is aggression associated with feeding?



1. results

- Eating focused on eyes and ears
- Gut also opened by some rats



Hungry rats eat more!
(t = -1.875, df = 10, p-value = 0.045)

1. Conclusions

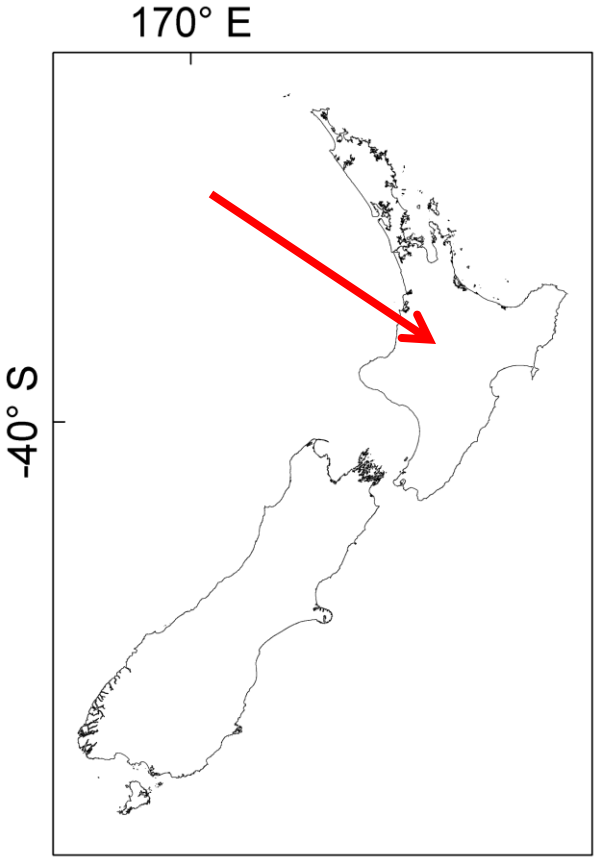
- Topographically different from intraspecific behaviour
- Associated with feeding
- Potential for intraguild predation
  - Reduce competition & get a meal!
  - Major threat for house mice
- But consider:
  - Artificial conditions
  - Mouse avoidance behaviour
  - Predation events could be rare, but risk of predation can influence behaviour, abundance and distribution

2.

- Abundance or detectability - POPULATIONS
  - Compare **abundance** from trapping vs. **activity** from tracking tunnels
  - How does rat abundance influence **probability of detecting** a mouse?

2. study Area

Waipapa Ecological Area, Pureora Forest Park



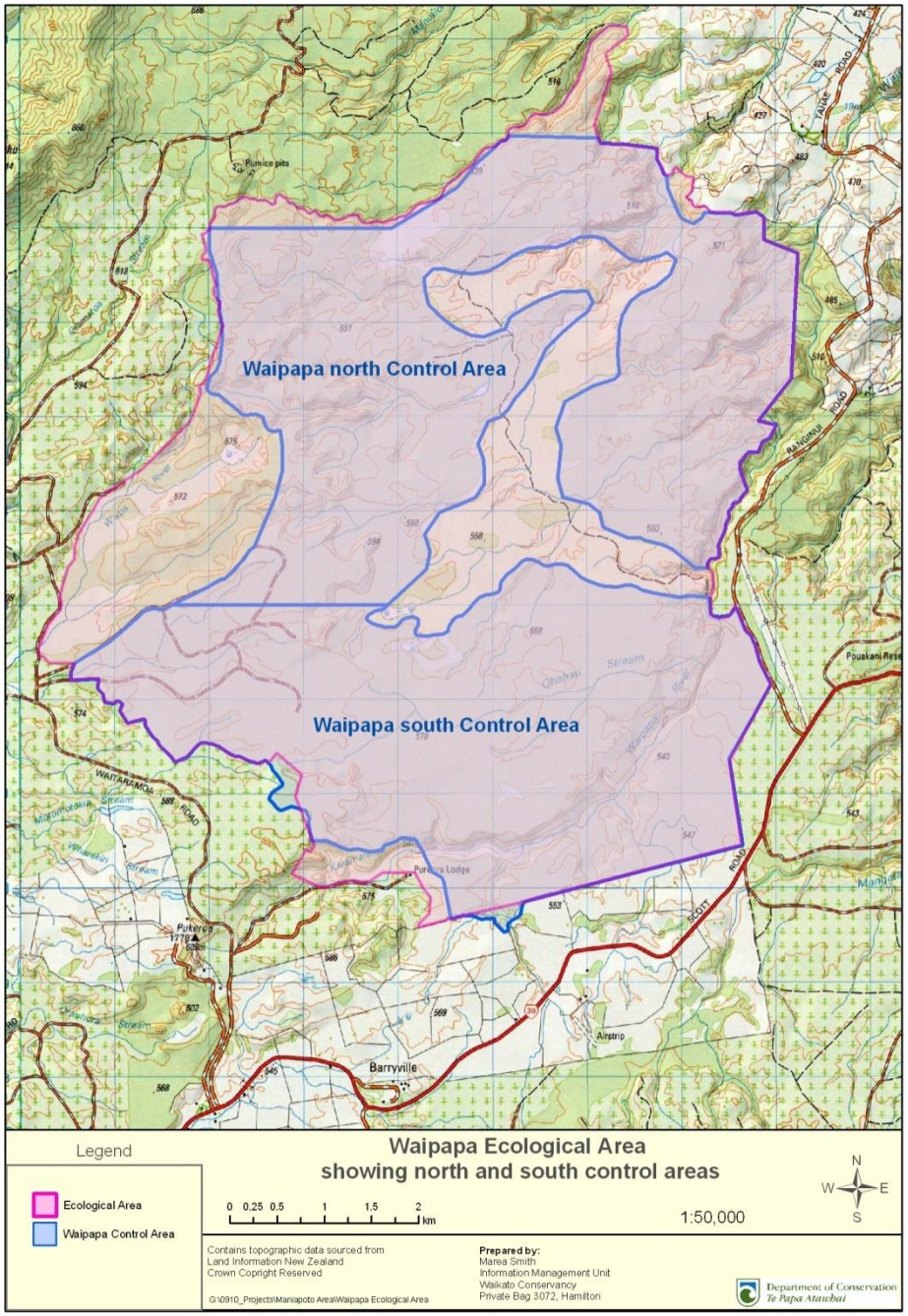


Image courtesy of Department of Conservation

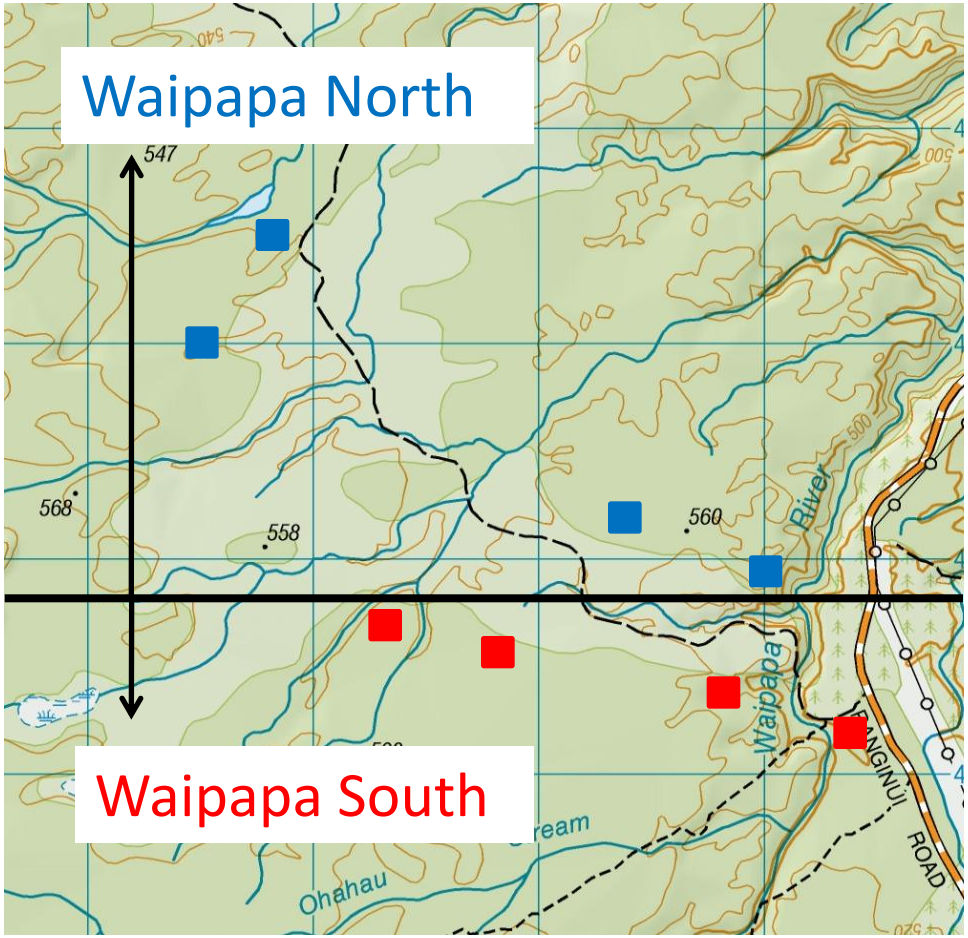
2. study Area

Image from DOC

- Tawa dominated podocarp-hardwood forest
- Each year, rats controlled in either WN or WS
  - Bait stations, ~150x50m spacing
  - 2009/2010 - WS
  - 2010/2011 - WN

2. methods - Grids

- 8 grids
  - 4 in WN
  - 4 in WS
- Grid spacing > 400m



2. methods – rodent Monitoring

- 16 tracking tunnels, 4x4 50m spacing

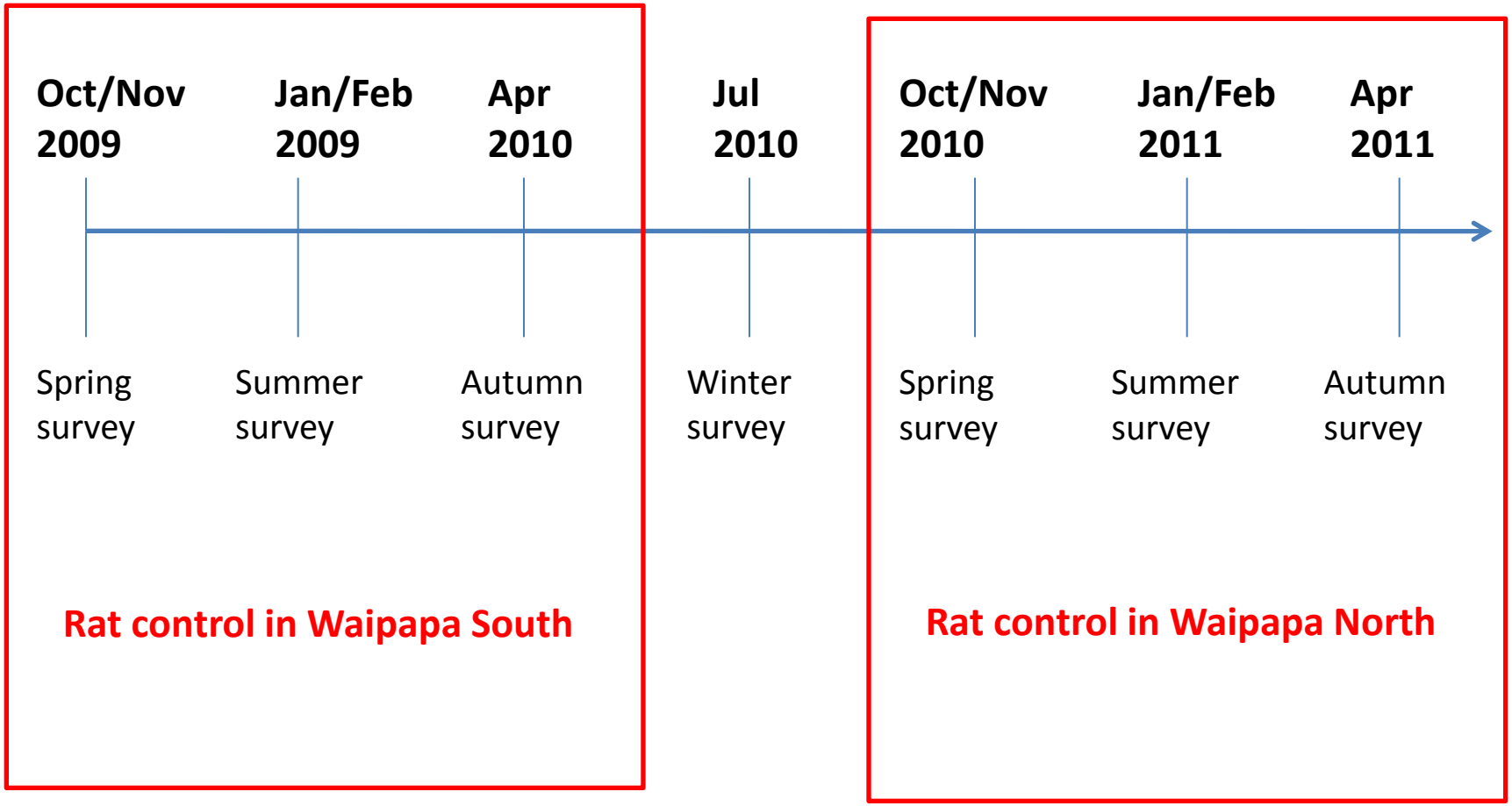
- 42 Longworth traps, 6x7 16.5m spacing

Trap image from alanaecology.com

2. methods – rodent monitoring

- Survey =
- **1 night tracking index**
  - Presence/absence of rats & mice
  - No. of tunnels tracked per grid = **ACTIVITY**
- **5 nights of live trapping**
  - Mice marked - ear-hole punched
  - Minimum Number Known Alive (MNKA) per grid = **ABUNDANCE**
  - Capture histories used to investigate **DETECTABILITY (capture probability)**

Timeline of Events

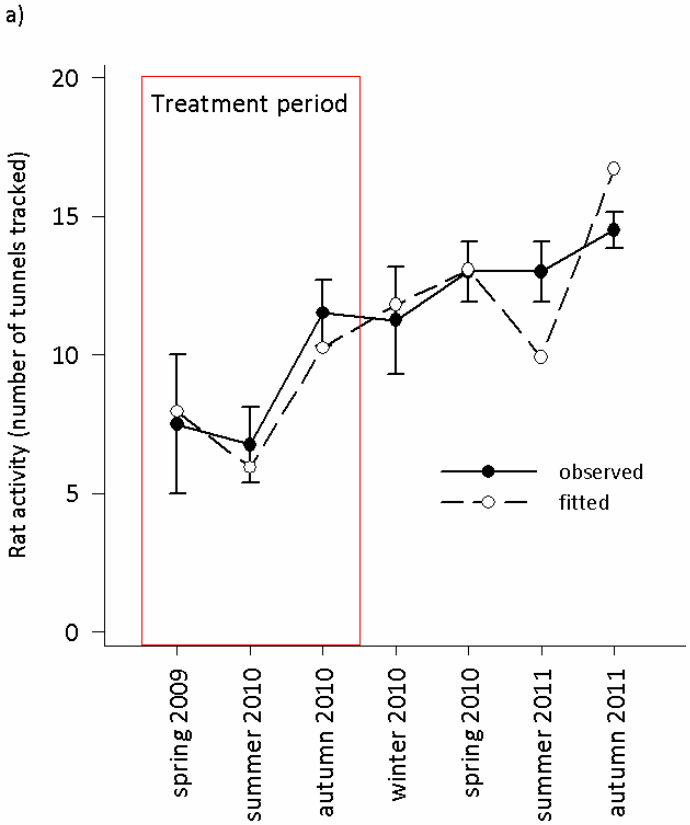


2. results

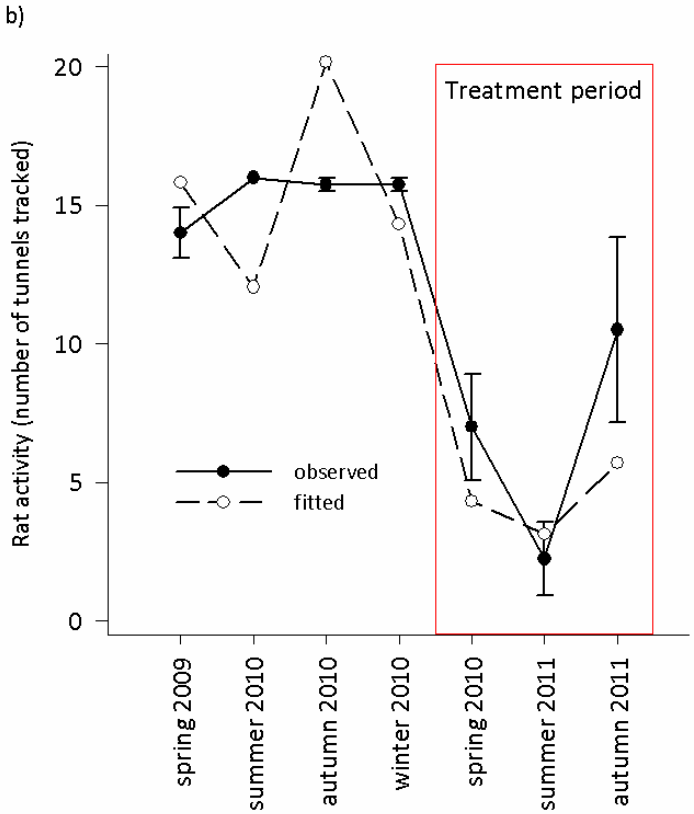
Treatment = **↓ rat activity/abundance** ($F_{[3,49]}$ = 15.054, P < 0.001)

Seasonal effects – autumn populations higher than summer ($F_{[3,49]}$= 4.013, P = 0.012)

WS sites



WN sites



Error bars are 1 SE

WS sites:

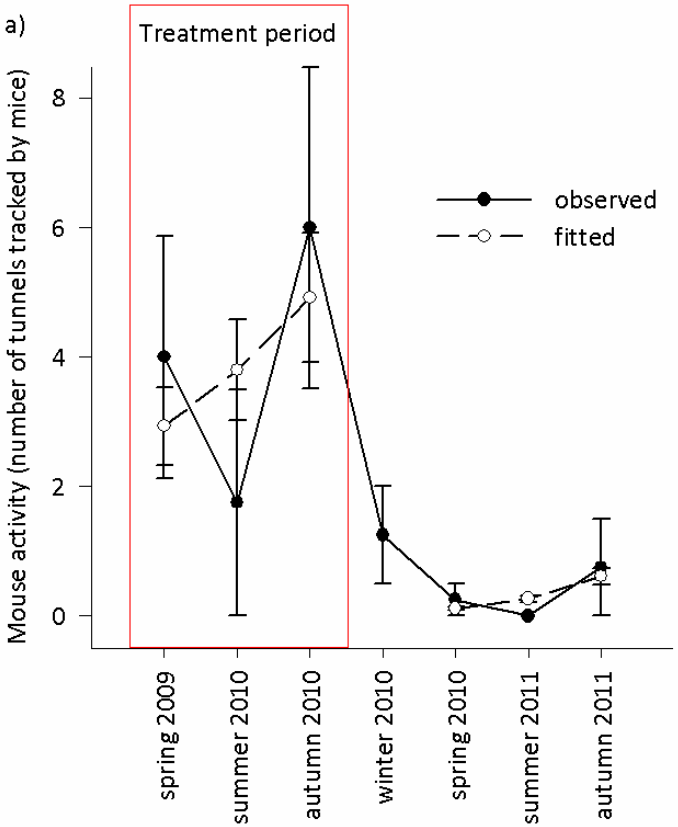
Treatment = ↑ **mouse activity** general

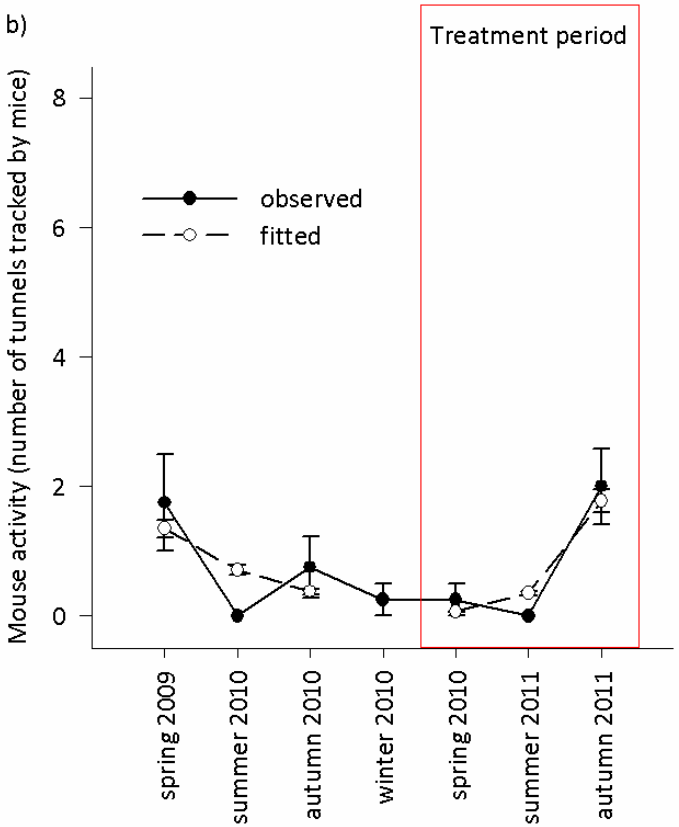
(Z = 3.507, P < 0.001)

WN sites:

Treatment = ↑ **mouse activity** over time

(Z = 2.764, P = 0.006)





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WS sites:

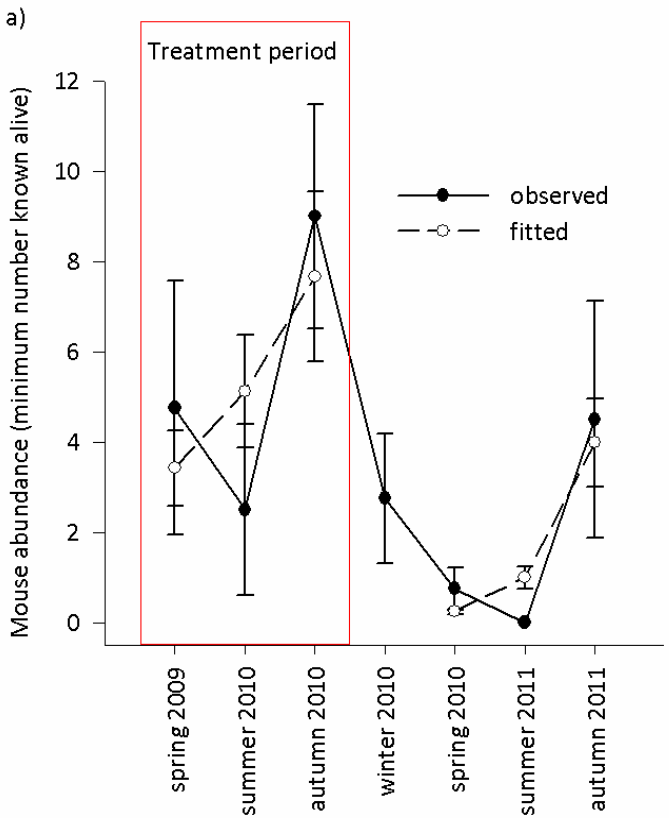
Treatment = ↑ **<u>mouse abundance</u>** general

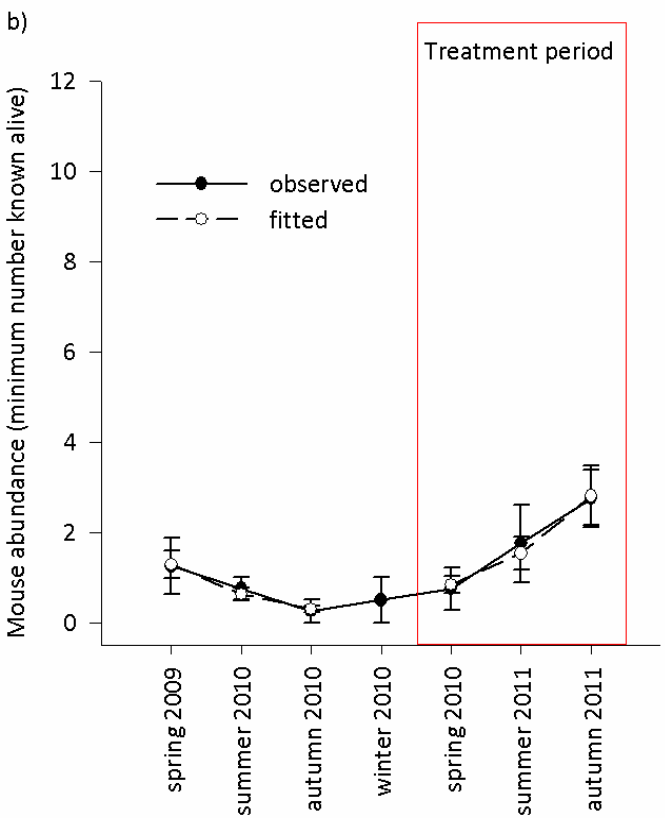
(Z = 3.911, P < 0.001)

WN sites:

Treatment = ↑ **<u>mouse abundance</u>** over time

(Z = 2.415, P = 0.016)





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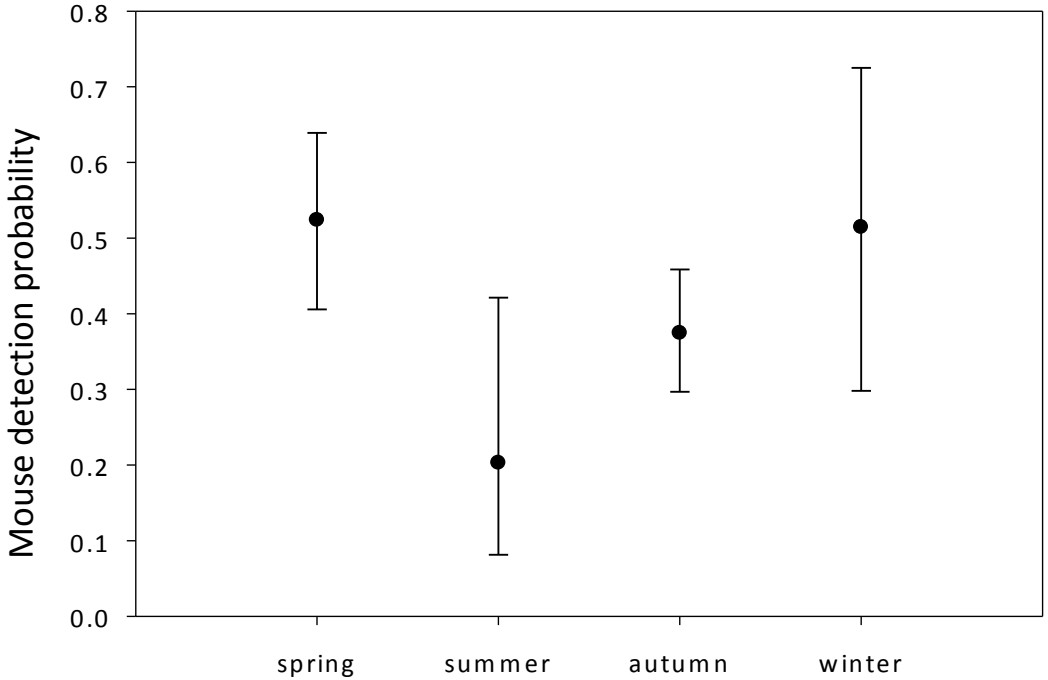
3. results - detectability

Huggins closed capture models (Program MARK)

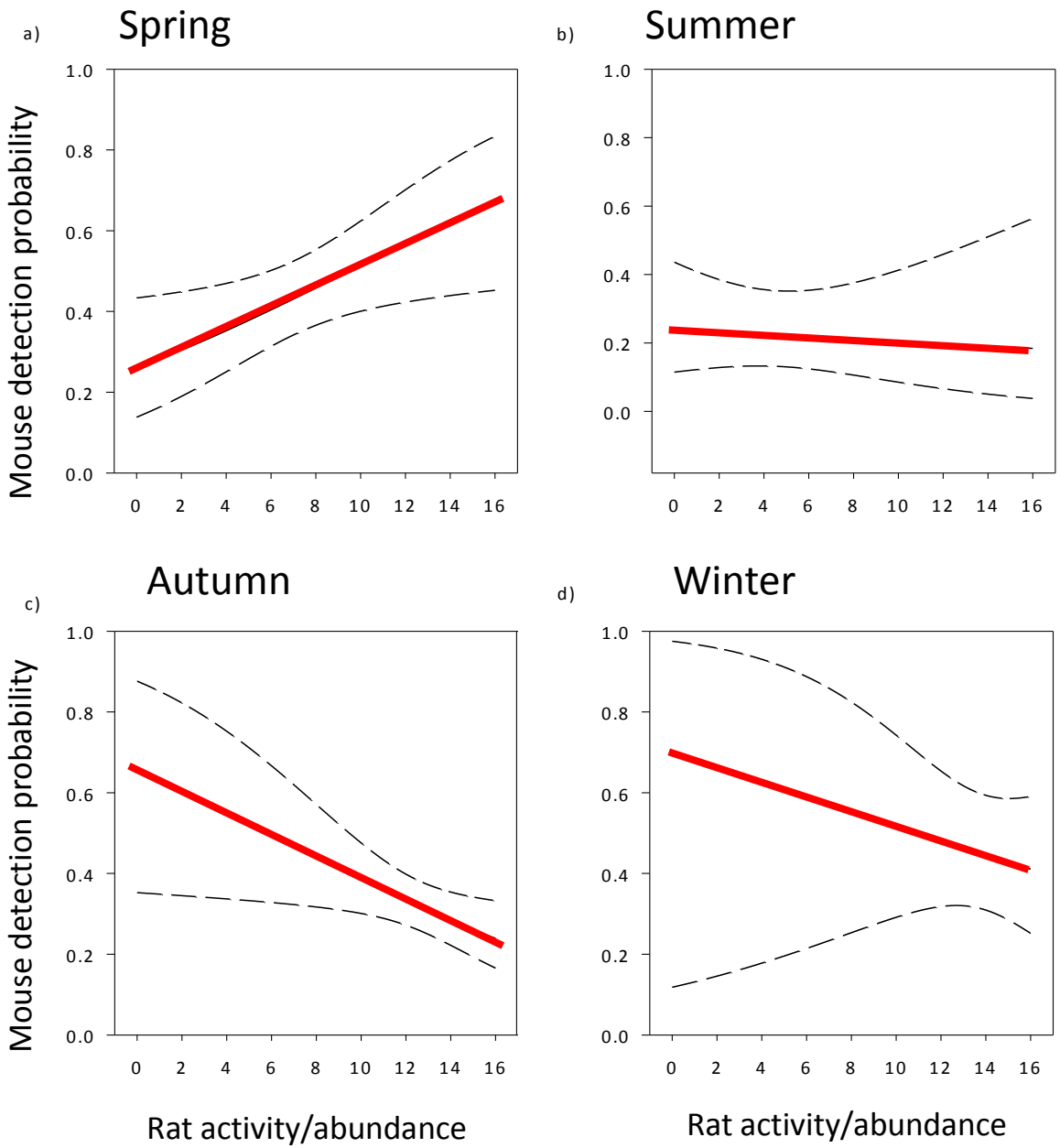
Seasonal influences on detectability



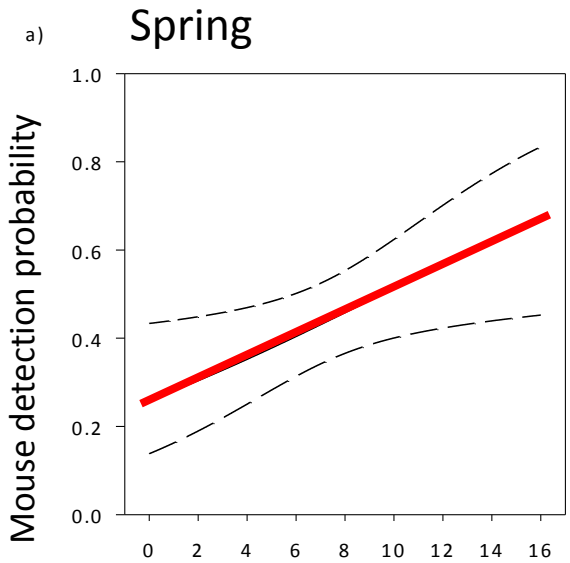
Resources lowest in winter & spring

Resources highest in summer

Sample sizes are: spring 29, summer 18, autumn 65, winter 11.
Error bars are 95% confidence intervals.



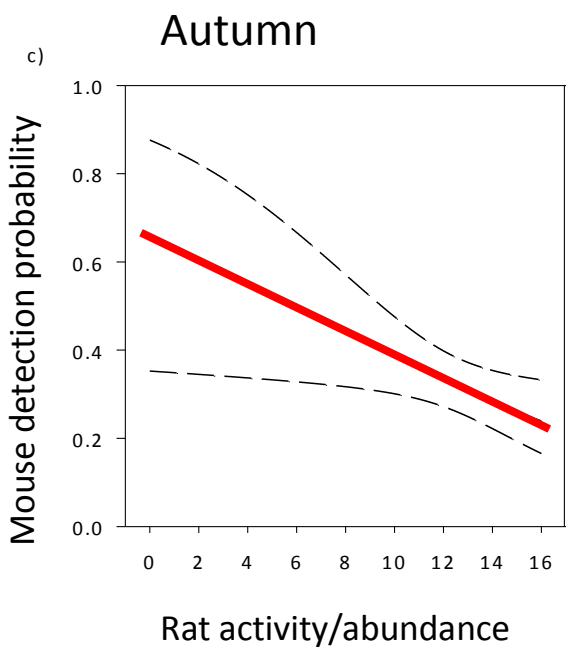
Solid red lines = estimates, broken lines = upper and lower 95% confidence intervals.



Spring = fewer animals and resources

- Emphasis on resource competition

?



Autumn = more animals and resources

- Emphasis on interference competition/intraguild predation

?

2. Conclusions & implications

- Rats influenced mouse abundance...
  - Activity reflected abundance
    - Supports use of tracking activity to monitor mouse pop. trends
- **AND** detectability
  - But, complicated seasonal relationship
    - Resource vs. interference competition?
    - Need to consider resource availability & interactions when managing species – optimal exposure to traps/bait stations etc.

Acknowledgements

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