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

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Background

- ↓ rats = ↑ mouse detections

Innes et al. (1995)

- Change in abundance?
- Unwanted management outcome!

Brown et al. (1996)

- Change in detectability?
- Implies uncertainty in monitoring
Background

- \( \downarrow \) rats = \( \uparrow \) 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**

![Diagram of the apparatus](image)

- line for moving zombie mouse
- mouse-proof wire mesh screen
- compartment for presenting opponent
- 400mm width
- 200mm length
- 300mm height
- 700mm total height
- rat enclosure
- camera
- rat nest tube
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?

Mean (±SE) number of interactions for live mouse and live rat treatments

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
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
2. study Area

- 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

Rat control in Waipapa South

Rat control in Waipapa North
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:
Treatment = \uparrow \textit{mouse activity} general 
\((Z = 3.507, P < 0.001)\)

WN sites:
Treatment = \uparrow \textit{mouse activity} over time 
\((Z = 2.764, P = 0.006)\)

Error bars are 1 SE
WS sites:
Treatment = ↑ **mouse abundance**
general
(Z = 3.911, P < 0.001)

WN sites:
Treatment = ↑ **mouse abundance**
over time
(Z = 2.415, P = 0.016)
3. results - detectability

Huggins closed capture models (Program MARK)
Seasonal influences on detectability

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.
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