



Landcare Research
Manaaki Whenua



Rats

Measuring, detecting and modelling
the rascally rodent

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Menu

- Rat impacts on biodiversity
- Habitat selection
- Home ranges
- Movements
- Detection & trappability
- Modelling 'irruptions'



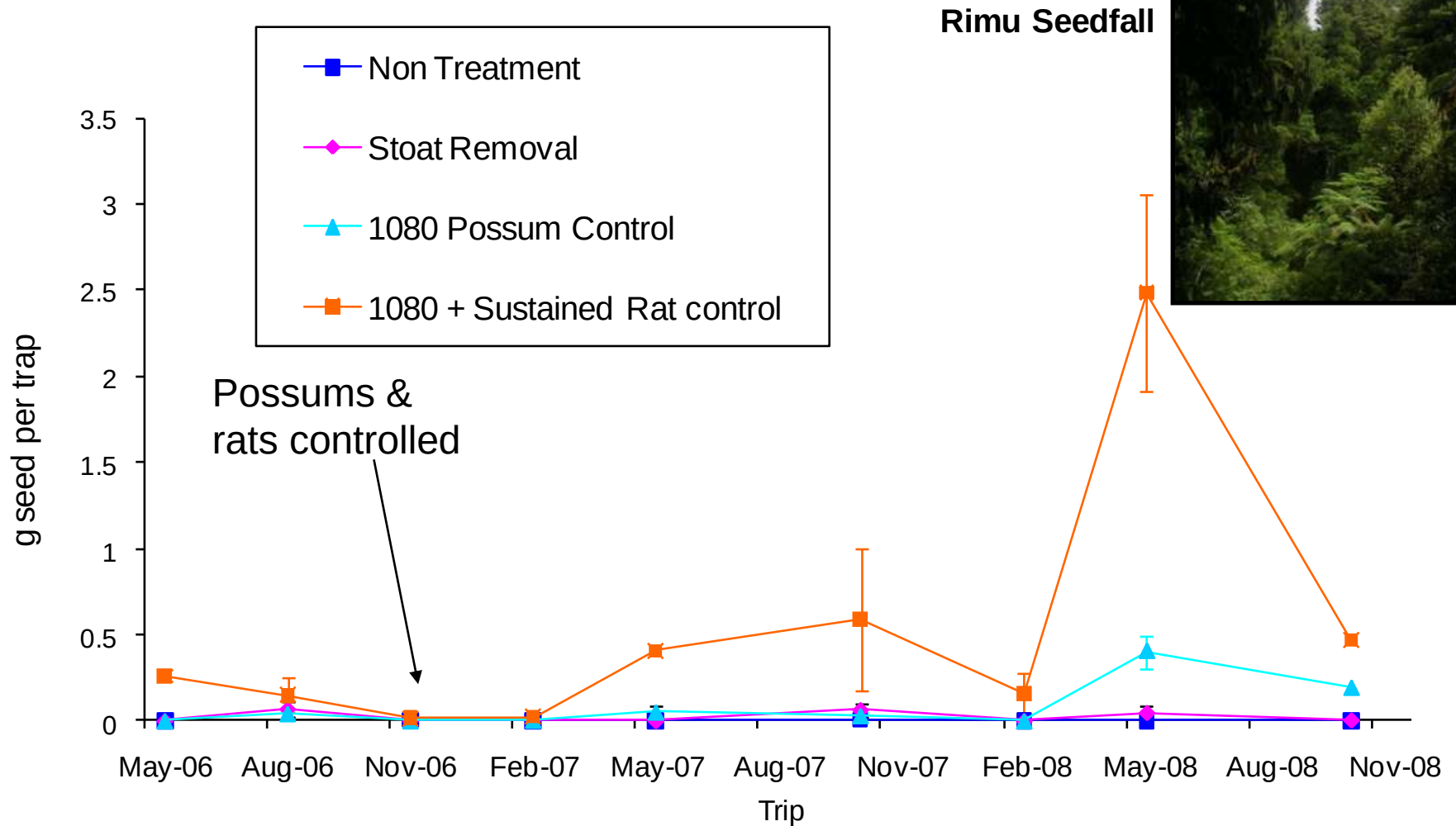
The ratty problem

- Rats as predator of birds, eggs
- Prey on lizards
- Prey on weta & stick insects
- Major threat to native biodiversity



Photo: Nga Manu Images

Rimu seedfall: NI podocarp forest



What might a forest look like, to a rat?

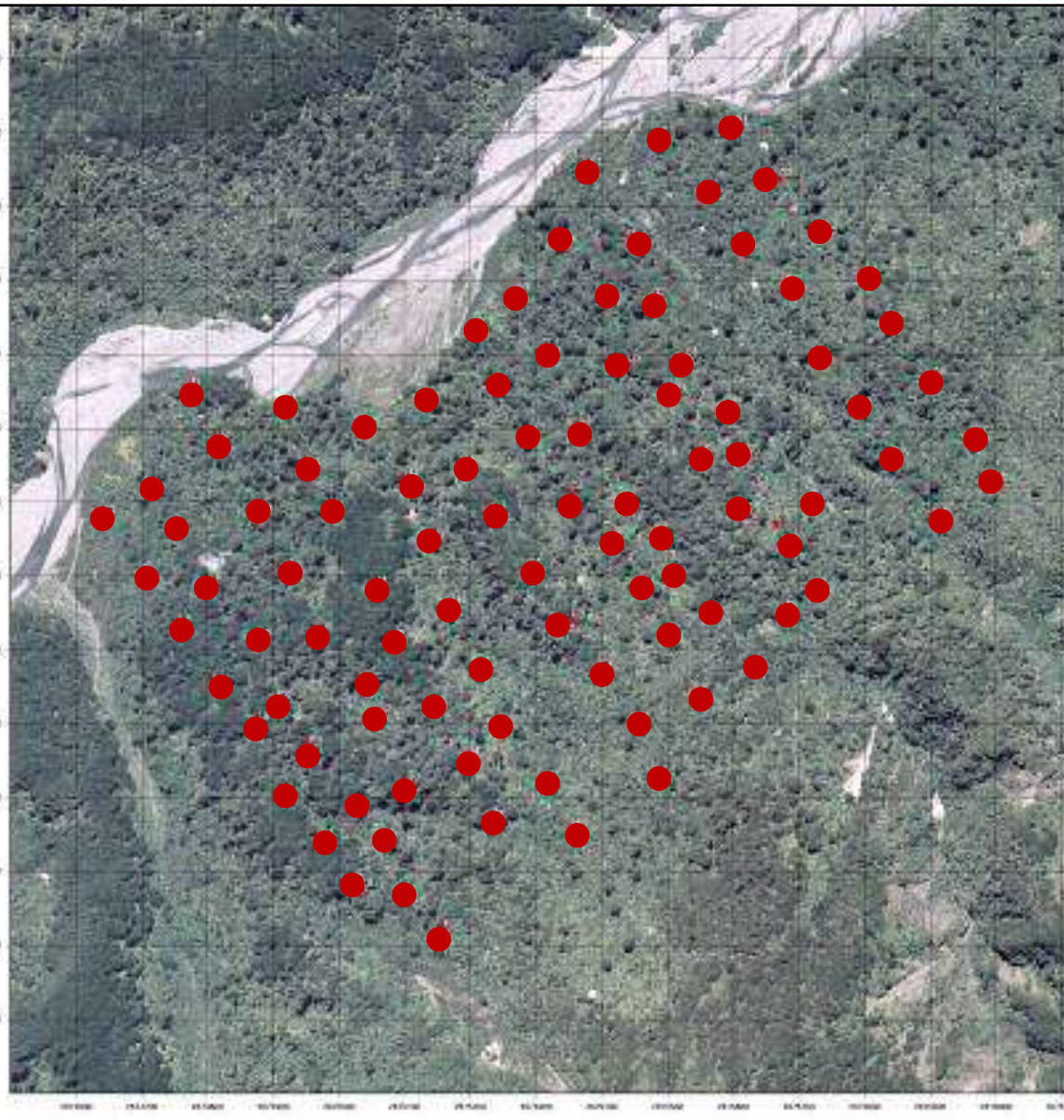


Quantifying habitat use by rats



- Little known about how rats use habitat features in space and time
- Vital in designing pest control programmes
- Critical for managing recovery after control

Live-trapping grids



3 sites:

- 1 km² extent
- 100-metre spacing

2 sites:

- 250 x 250-m extent
- 25-meter spacing

Live-trapping rats



2 seasons x 2
years (4 sessions)

- 2 Spring
- 2 Autumn

5 Nights/Session

Rats marked with
ear tags and PIT
tags



Habitat variables

Measured at each trap site

- Topographic
  - Slope, aspect, terrain, altitude
- Local characteristics
  - % cover moss, rocks, vegetation, etc
- Vegetation
  - Dominant tree spp. & canopy cover

...1



Habitat variables

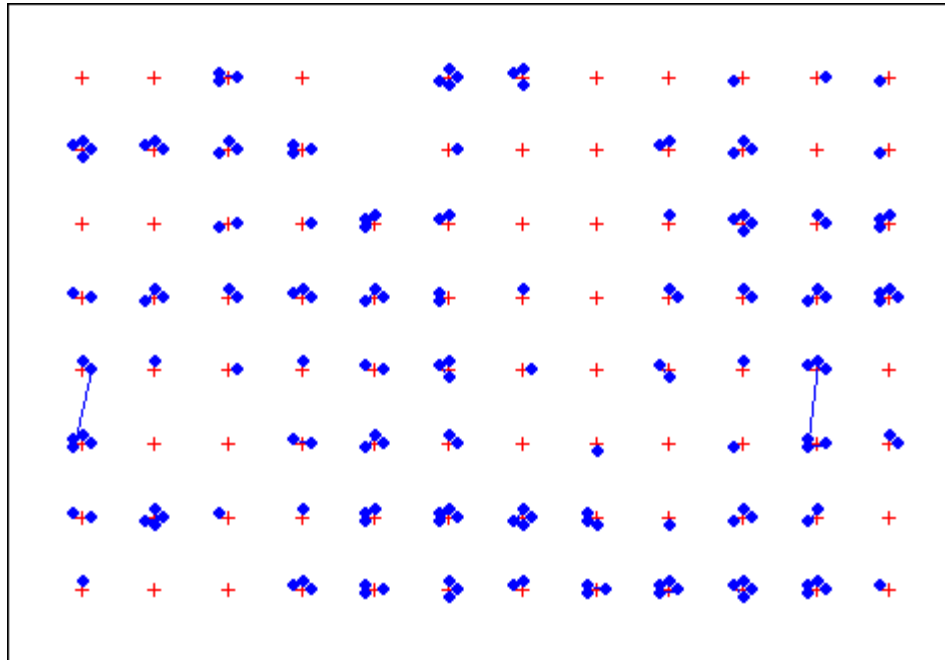
...2

Measured at each trap site

- Cover of potential food plants
- Cover of ground vegetation as measure of predation avoidance
- Supplejack vines (facilitate movement)

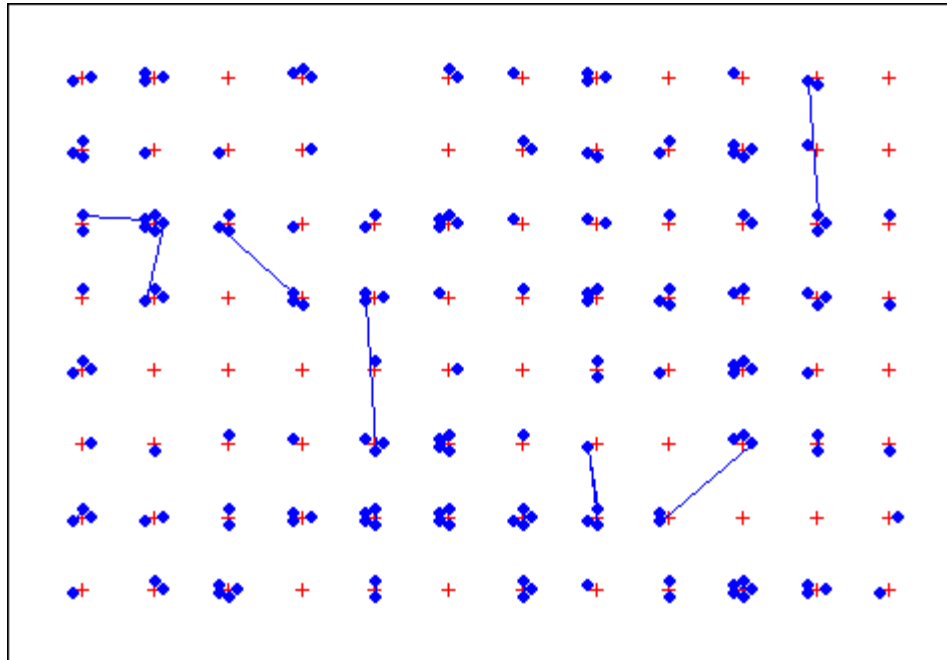


Grid 1: Spring 2006



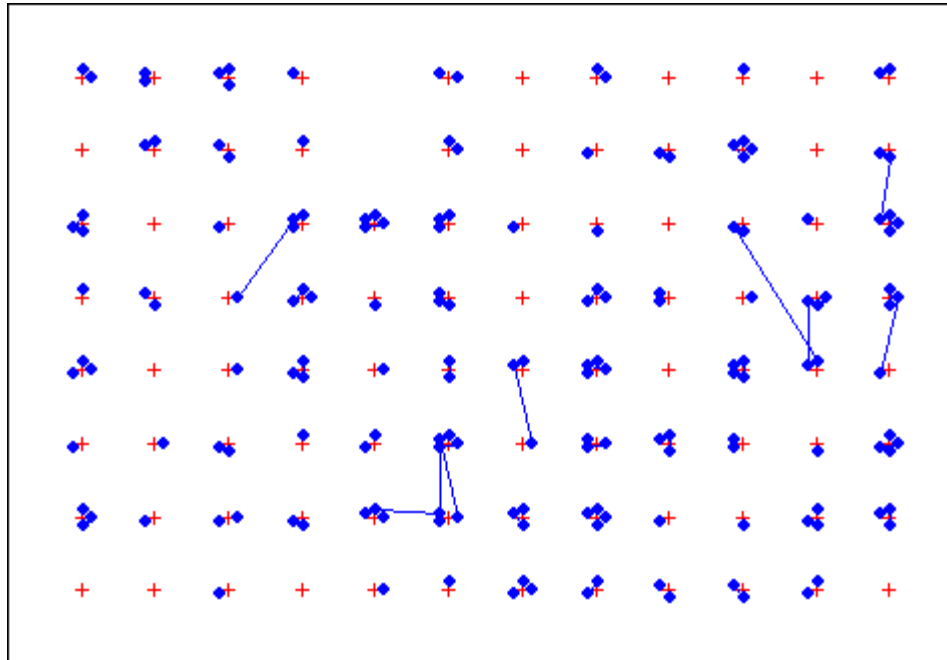
— 100 m

Grid 1: Autumn 2007



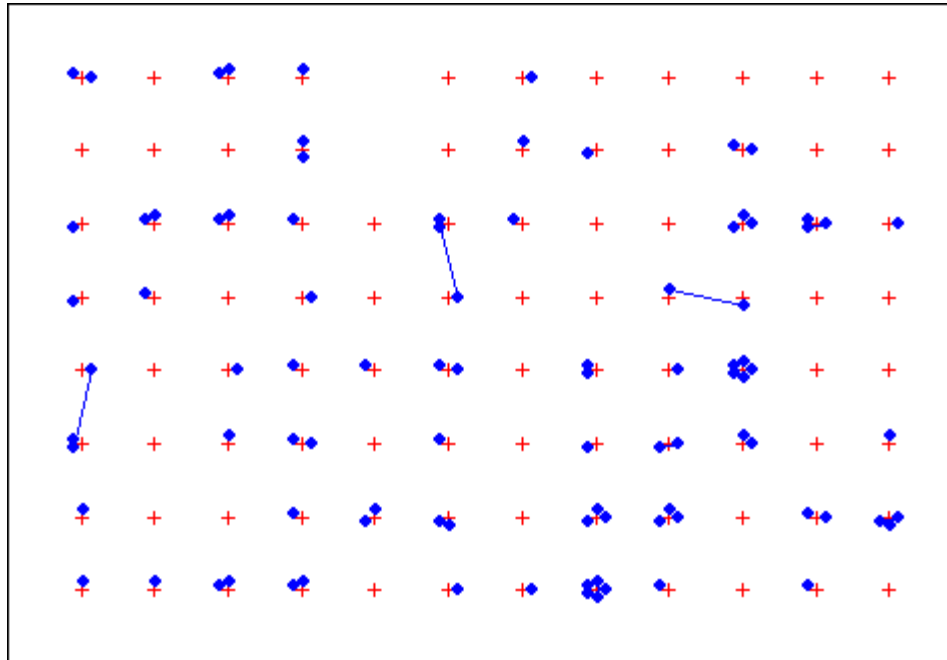
—100 m

Grid 1: Spring 2007



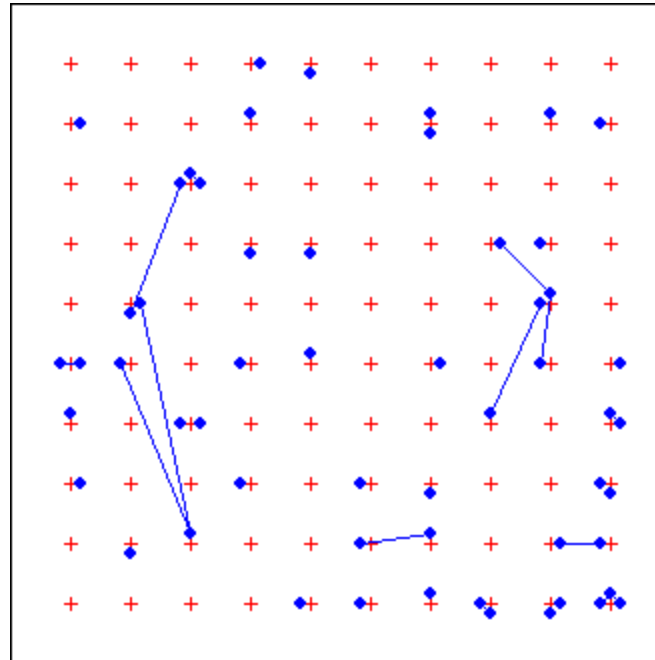
— 100 m

Grid 1: Autumn 2008



— 100 m

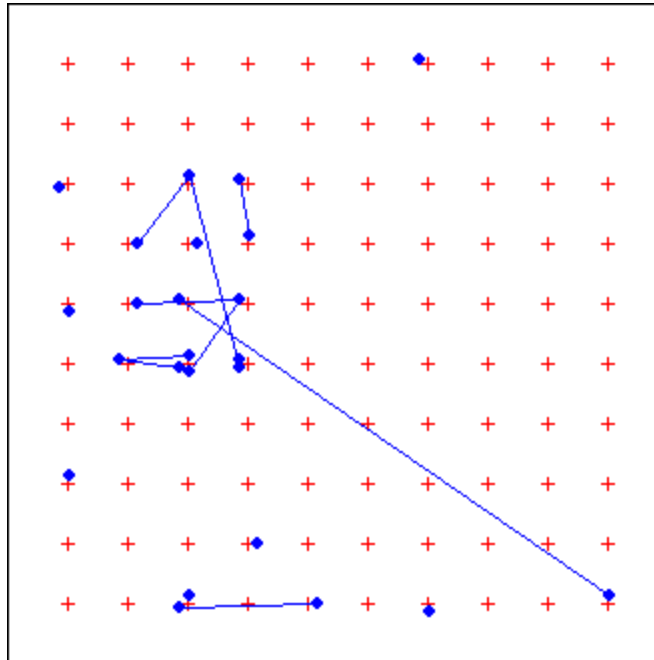
Grid 2: Autumn 2007



— 25 m



Grid 2: Summer 2008



— 25 m

Habitat preference by rats

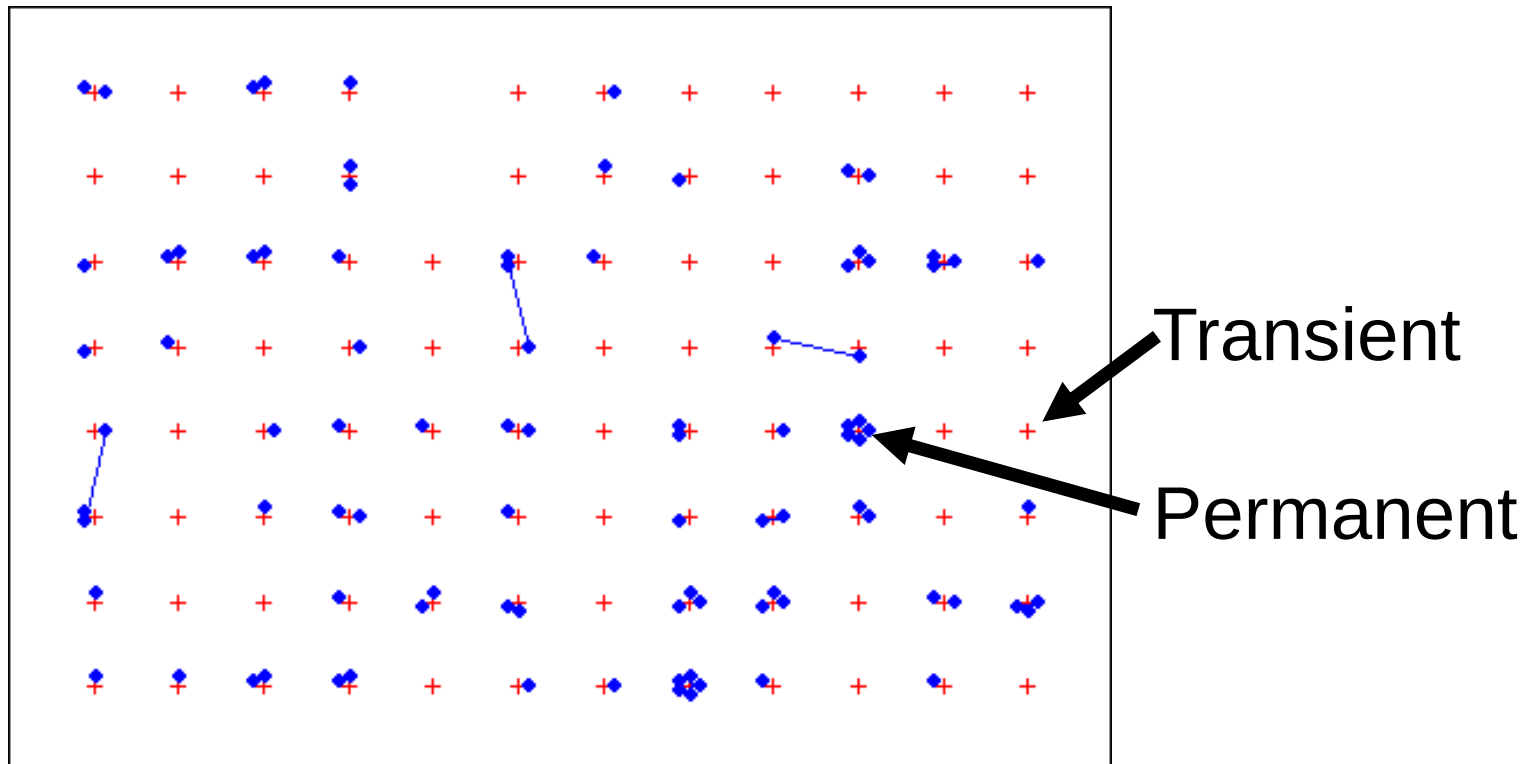


Habitat variable	Influence on rat abundance
Podocarp canopy cover	+
Tree canopy cover	+
Slope angle	+
Northerly aspect	+
Vegetation ground cover	+
Moss ground cover	-
Rock ground cover	-
Litter ground cover	-

Rat captures by season

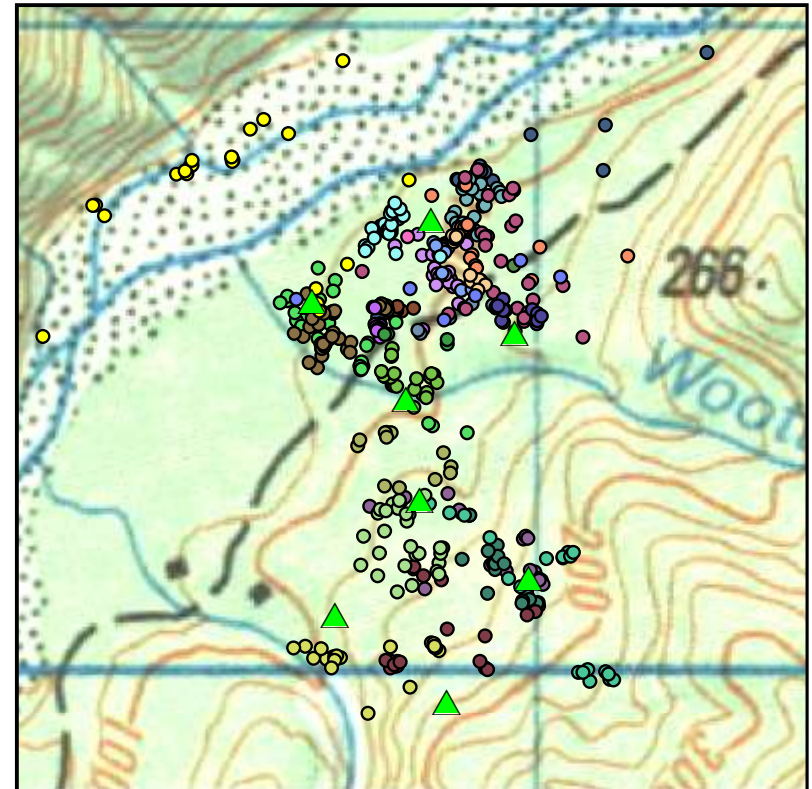


- Trap success varied by season: some parts of trapping grids permanently occupied, elsewhere rats transient



Radio Tracking

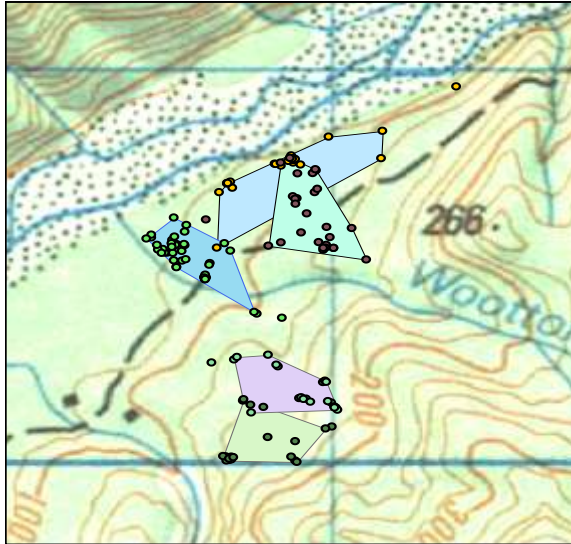
- Autumn: January to May 2008
- 24 rats – 11 Male 13 Female
- Nest/den sites: daylight hours (301 fixes)
- Active period: darkness (219 fixes)
- GPS fix for each location & habitat recorded
- 87% of fixes in canopy or sub-canopy



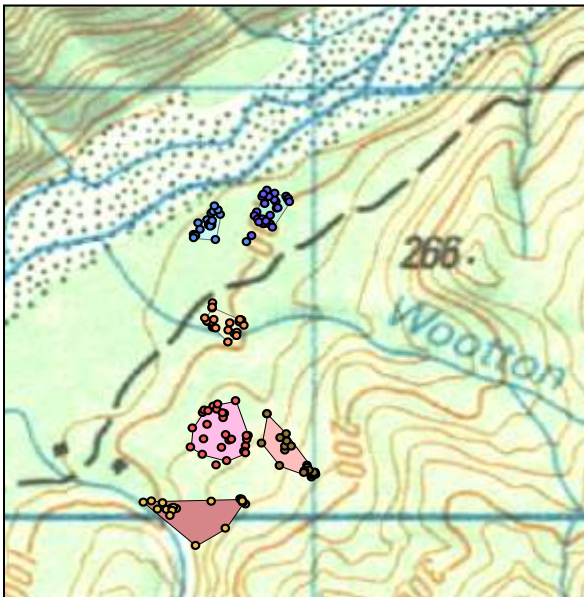
Ship Rat Home Ranges

MCP (95%)

Male

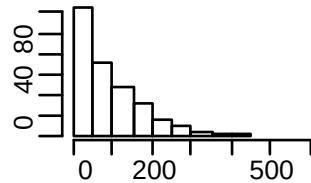


Female

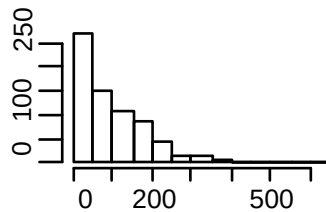


	Home range size (ha)
Females Range	0.17–1.37
Females average	0.70
Males Range	2.28–9.74
Males average	3.64

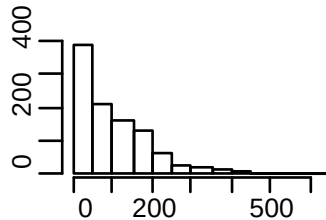
Males



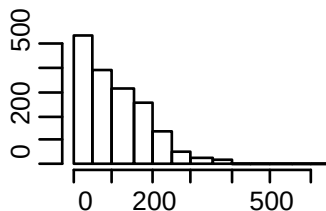
Movement Distance in 1 day (m)



Movement Distance in 3 days (m)

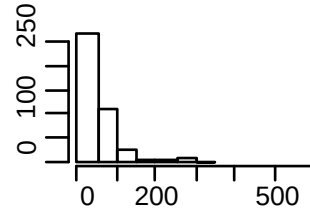
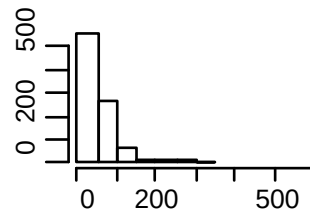
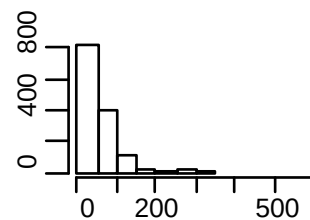
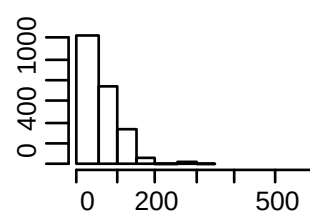


Movement Distance in 14 days (m)



Movement Distance in 28 days (m)

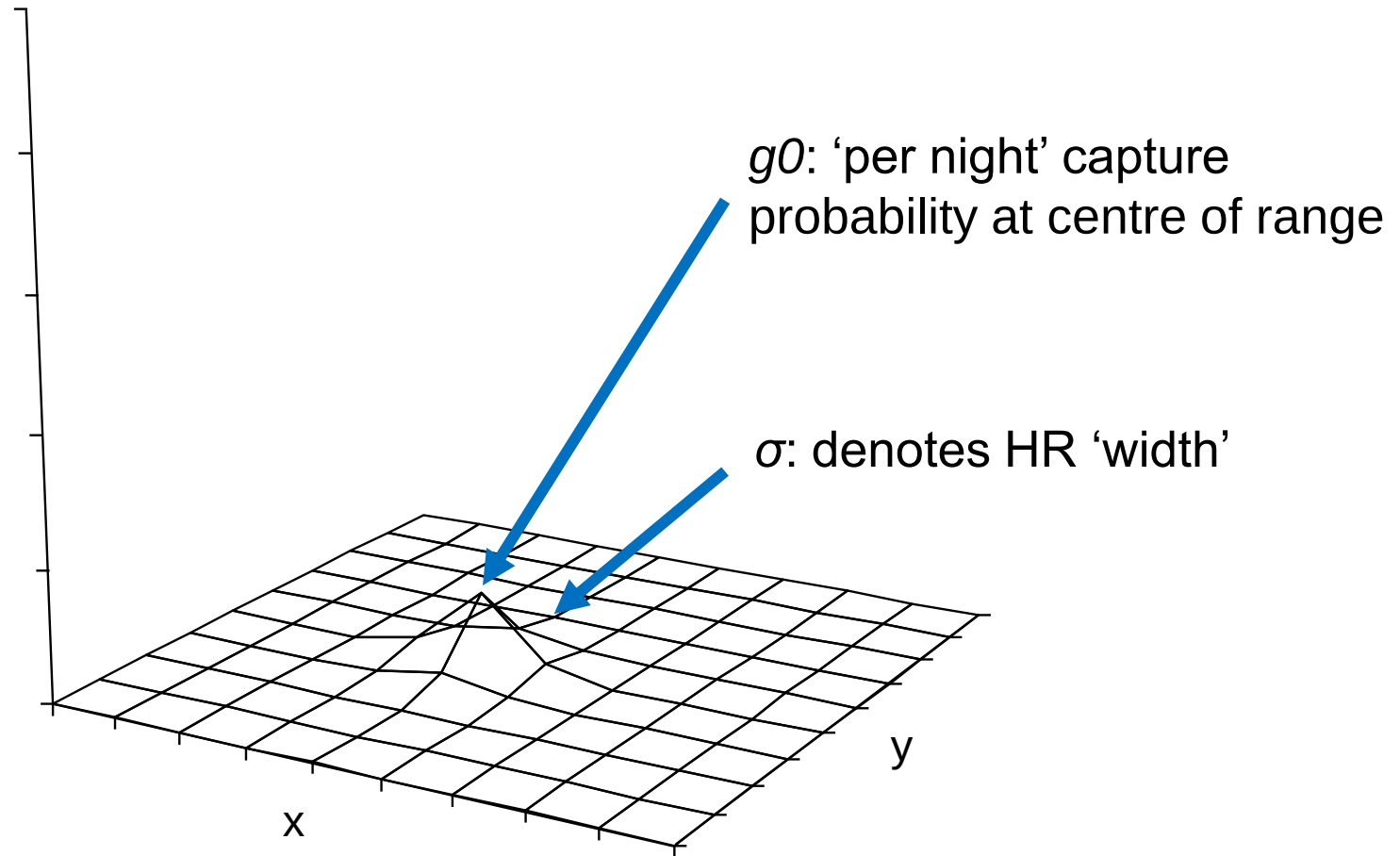
Females



- Median distance:
  - Males:
    - 65 m (1 day)
    - 95 m (28 days)
  - Females:
    - 28 m (1 day)
    - 49 m (28 days)
- Most rats rocket around home range every night



Detection Parameters



A rat has a home range centre at point (x,y)

Detection Parameters

- Data from mark-recapture study

$g0$: varied from 0.02 to 0.11 per night (2 – 11% chance of capturing rat at HR centre on any given night)

σ : varied from 18 – 49 m

home range radius: 44 – 120 m

- Detection parameters can be used to simulate trapping scenarios

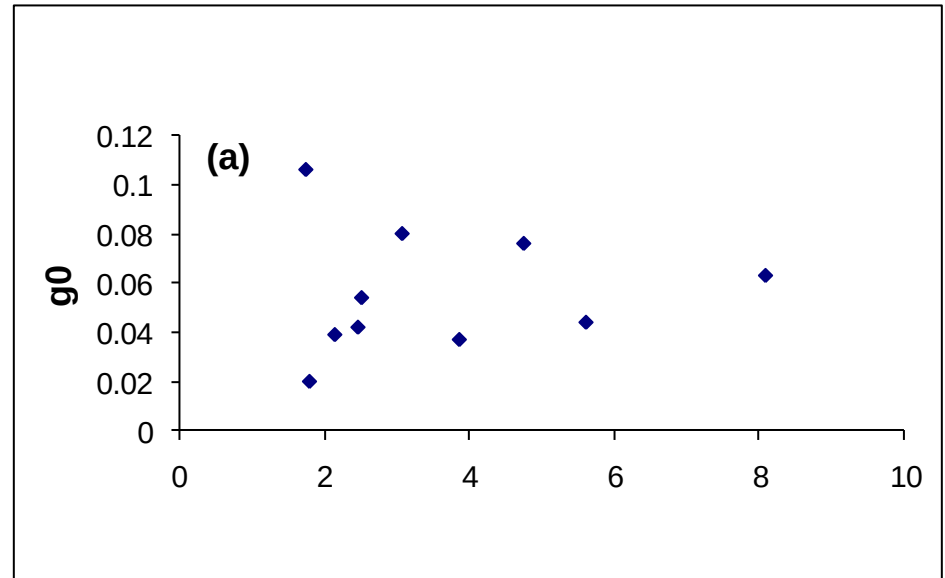
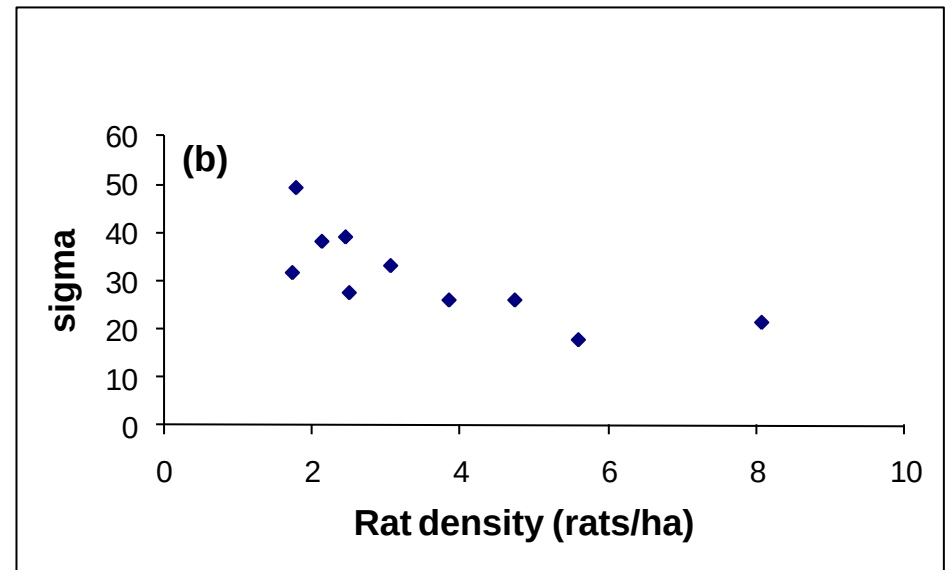


Simulated trapping

- Modeled proportion of rats in Orongorongo Valley that would be captured if kill-traps were set for 7 nights and checked only at the end of the 7-night session
  - 5 rats/ha, 80-ha grid of kill-traps spaced at 20-m intervals
- Conservative values of $g0=0.02$ and $\sigma=18 = 31\%$
- Medium values $g0$ of 0.02, σ of 49 = 77%
- Maximum value $g0$ of 0.1 and σ of 49 = 92%

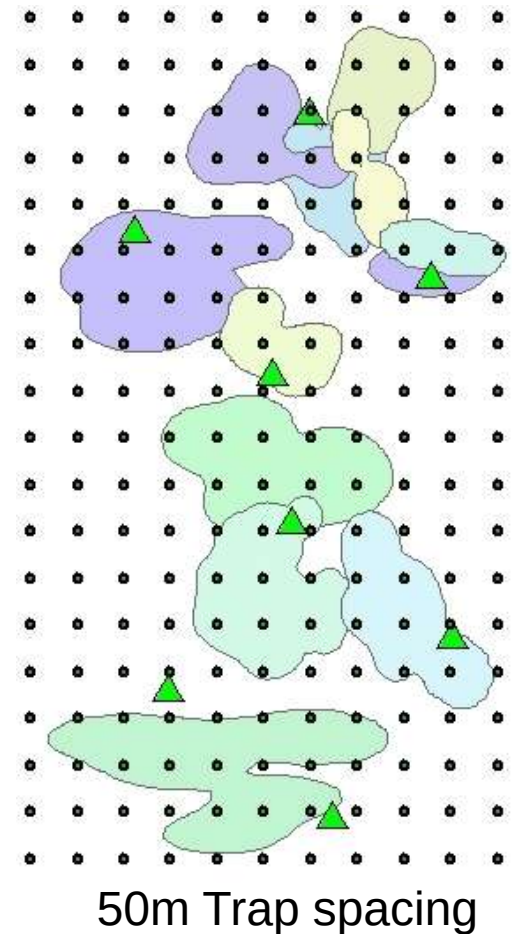


Detection parameters & density



Implications for control ...1

- Ground baiting: 50 m device spacing may be too high
- Longer a kill-trap or bait station is left in the field, the greater the probability that a rat will find it
- Rats with small HR or rats that do not move much, especially females, may not be captured for many days/weeks



Implications for control ...2

- As rat populations decrease and competition declines, rats may increase home range size and foraging distances
- Can target specific habitats   save \$\$
- Aerial 1080 is controversial, but is highly effective at killing rats cf. bait stations or traps on the ground

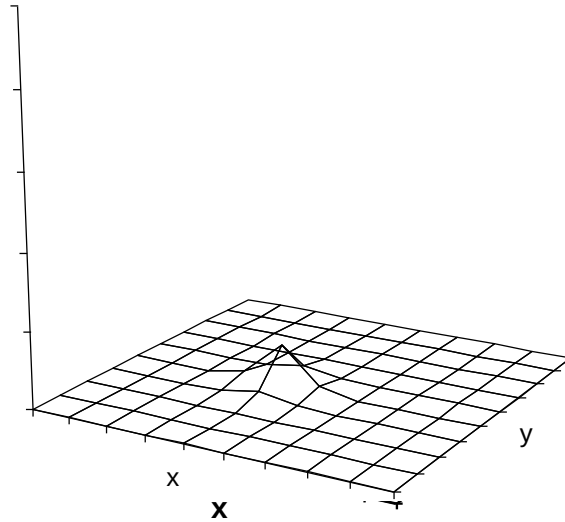


Why a spatial rat model?

- DOC and others control ship rats over large blocks of mainland
- Spatial context is important for predicting outcomes of patchy rat control
  - Need to know timing and frequency of control
  - Rat population recovery post-control depends on in-situ breeding plus immigration from surrounding uncontrolled landscape



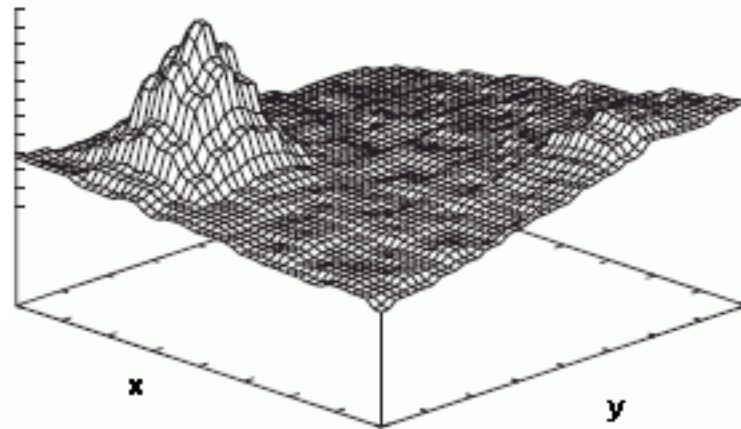
Model structure



A rat has a home range centre
at point (x,y)

Males and females have
different HR sizes

Rat density surface

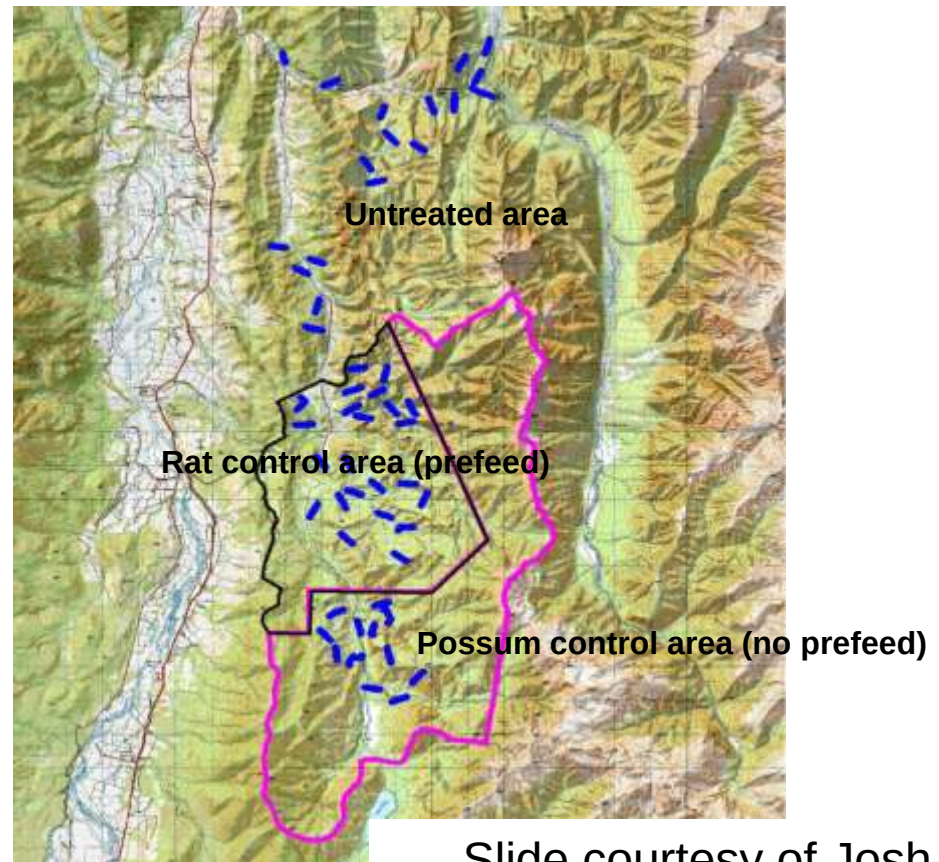


Many rats make up a
density surface

Local density a rat
experiences is height
of density surface

Other aspects of model

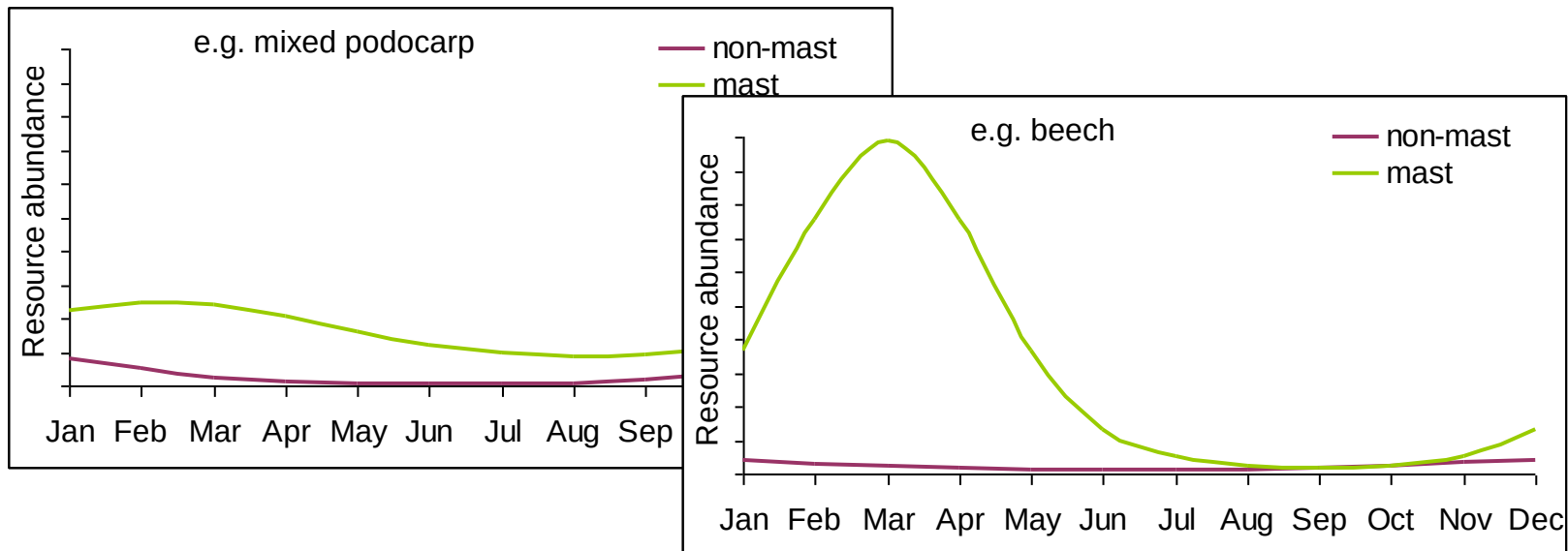
- Fecundity
- Age structure
- Mortality
- Dispersal (reinvansion)
- Heterogeneous landscapes



Slide courtesy of Josh Kemp, DOC

Temporal and spatial variation in resources

- Vary with:
  - habitat type: podocarp > beech forest
  - mast cycle: every 3-5 years
  - season: fruit or seedfall summer-autumn, germination of seed in spring, invertebrates?



Model output

- Predicts correct seasonal peaks, age distributions

