



Population dynamics of the non-native house mouse (*Mus musculus*) in pasture–cropping systems, New South Wales, Australia

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The Department of Primary Industries & Regional Development acknowledges that it stands on Country which always was and always will be Aboriginal land.

We acknowledge the Traditional Custodians of the land and waters, and we show our respect for Elders past and present.

Background

- mouse plagues since pre-1900
- 2021 house mouse plague affected 180,000 km² in western and northern NSW
- crop losses of \$510 million, societal costs of \$660 million
- observations suggested that pasture could be an important source of mice that subsequently spread into crops
- pasture important part of these farming systems
- no information on the extent to which mice use, and move between, pasture and crop habitats in western NSW

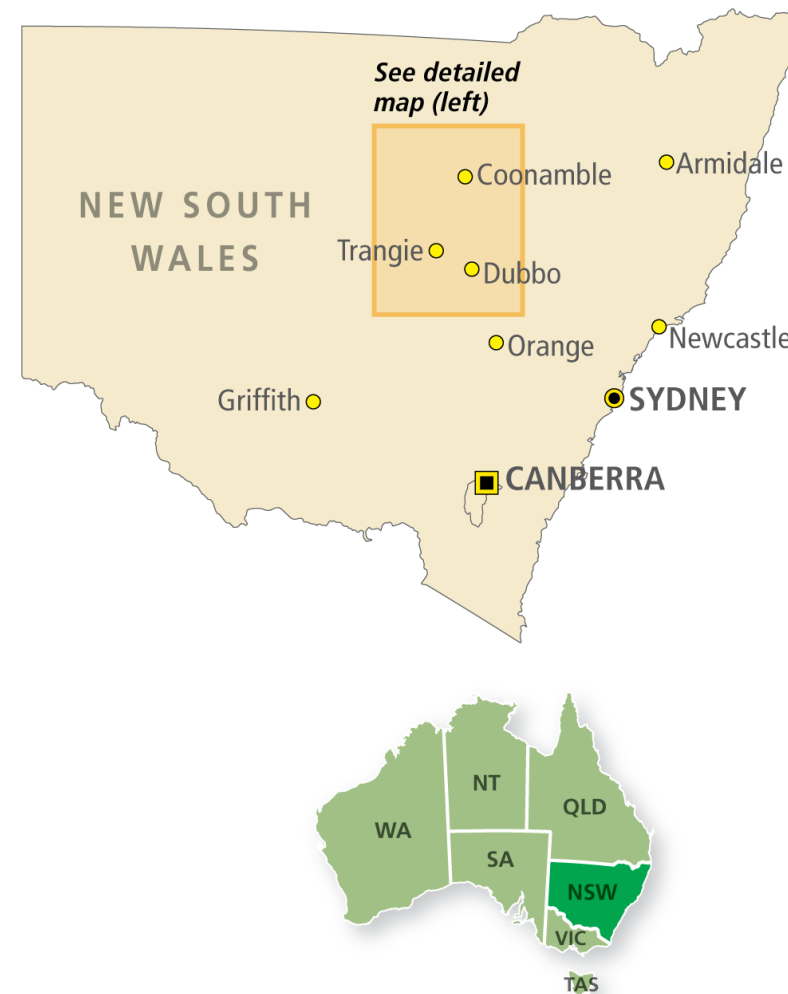
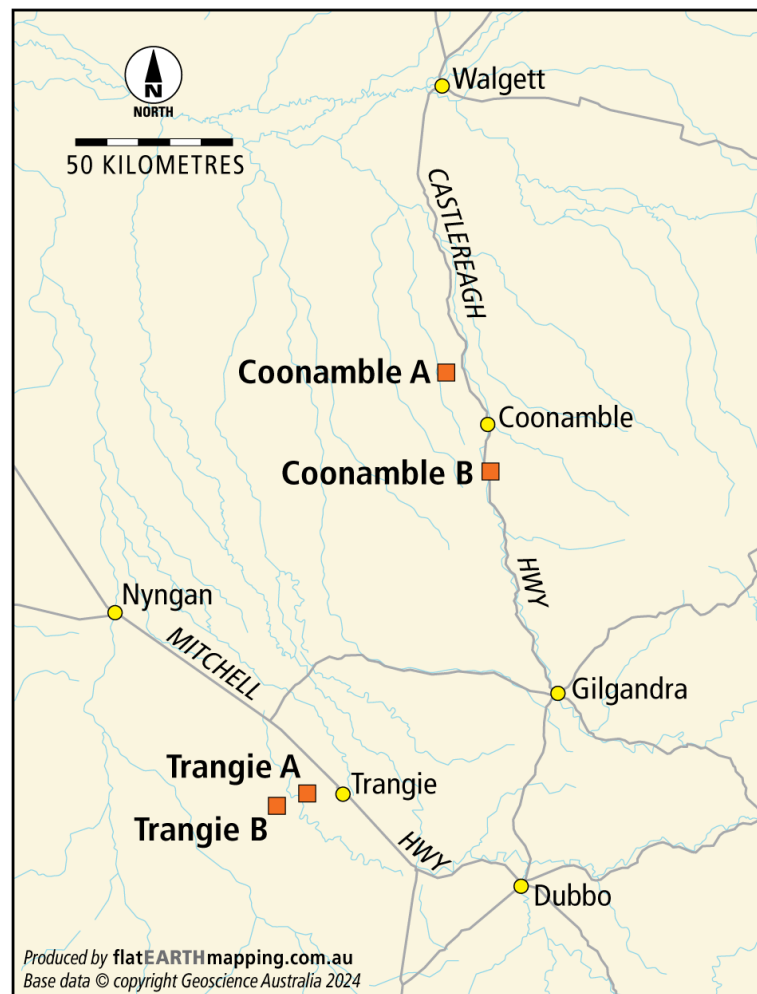


Study objective

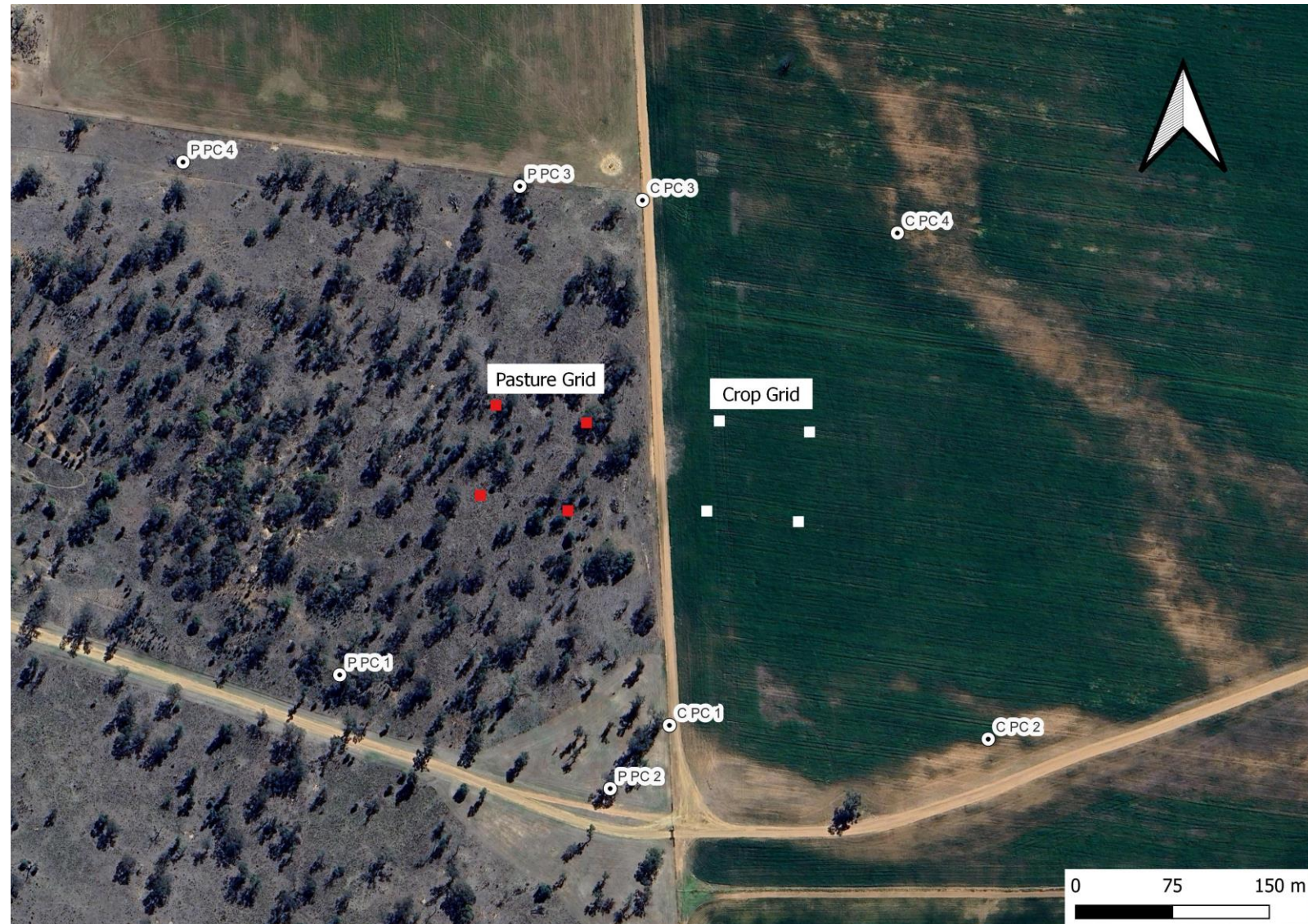
To understand population dynamics and movements of mice in adjacent pasture and crop habitats.



4 study areas



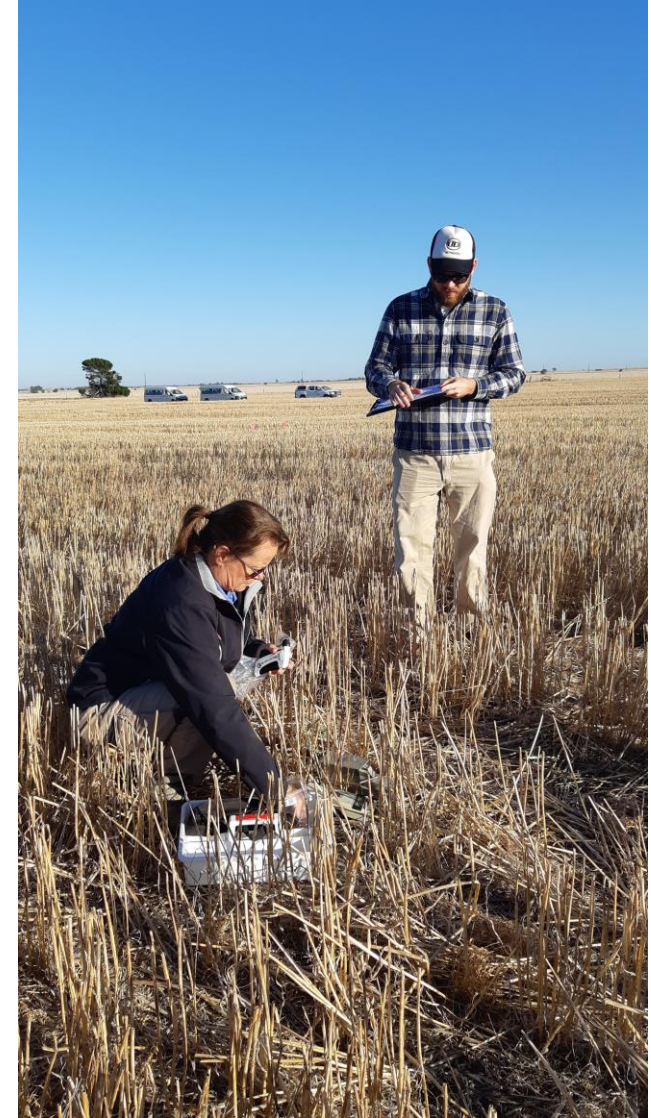
Field methods at the 4 sites



Rosedale site (Coonamble)



Crops



Crops



Field methods – mouse dynamics

At each site...

- 2 grids of 64 Longworth traps - one in crop and one in pasture 100 m apart
- 5 nights of trapping every two months for two years (traps closed during day)
- sex, weight and length recorded
- mice PIT tagged and released



Field methods – feral cat/fox activity

At each site...

- 8 Reconyx cameras - 4 in crop, 4 in pasture
- baited with peanut butter & oat balls, fish oil
- deployed for 5 nights during mouse trapping
- >60 seconds between cat/fox images = new event
- predator events an index of predator activity



Analysis

Integrated Population Model (Bayesian) to estimate:

- 1) density (Huggins estimator)
- 2) survival and capture probabilities (Pollock's robust-design CMR) with covariates: sex, habitat (pasture, crop), site, camera index of cat/fox predator abundance, rainfall.
- 3) recruitment (integrating above models)

Some Practical Aspects of a Conditional Likelihood Approach to Capture Experiments

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SUMMARY

The use of conditional likelihood methods in the analysis of capture data allows the modeling of capture probabilities in terms of observable characteristics of the captured individuals and the trapping occasions. The resulting models may then be used to estimate the size of the population. Here the use of conditional likelihood procedures to construct models for capture probabilities is discussed and illustrated by an example.

SHORT COMMUNICATIONS

A CAPTURE-RECAPTURE DESIGN ROBUST TO UNEQUAL PROBABILITY OF CAPTURE

KENNETH H. POLLOCK, Department of Statistics, North Carolina State University, Box 5407, Raleigh, NC 27650.

This author believes that the design of capture-recapture experiments deserves more attention from statisticians and biologists. Study design should be oriented around satisfaction of as many model assumptions as practically possible so that a simple and reasonably efficient model can be used for estimation.

At the basis of many capture-recapture sampling models is the assumption that all animals are equally likely to be caught in each sample (The Equal Catchability Assumption). This assumption is often violated in wildlife populations (Seber 1973:81) and 2 general types of alternatives exist (Pollock 1981):

(1) Heterogeneity: The probability of capture in any sample is a property of the animal and may vary over the population. That is, animals may vary in capture probabilities according to age, sex, social status, and many other factors.

(2) Trap response: The probability of capture in any sample depends on the animal's prior history of capture. That is, animals may become "trap shy" or "trap happy" depending upon the type of trapping method used. Either 1 or both of these 2 types of alternatives may be acting in a particular animal population.

The traditional capture-recapture model used by biologists for closed populations (populations closed to additions or deletions) in short-term studies is the Schnabel Model (Schnabel 1938) that requires The Equal Catchability Assumption. In recent years there has been substantial research on models for closed

populations that allow heterogeneity and/or trap response of the capture probabilities. Otis et al. (1978) published an important monograph on these models that allows their routine use by biologists.

The capture-recapture model becoming used by biologists for open populations in long-term studies is the Jolly-Seber Model (Seber 1973). This model requires The Equal Catchability Assumption and the complexity of open population models is likely to preclude general models that allow heterogeneity and/or trap response.

During the preparation of a review of capture-recapture methods (Pollock 1981), I realized that statisticians have drawn a sharp distinction between closed and open population models that is perhaps rather artificial. Here I describe a design for long-term studies that is robust to heterogeneity and/or trap response. It allows an analysis that uses methodology from closed and open population models. There is a brief examination of its robustness properties using simulation and an example is given in detail to illustrate the methodology for biologists.

THE DESIGN

Consider the following representation of a capture-recapture sampling experiment:

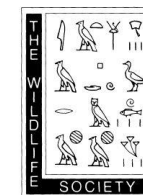


where we have K primary sampling pe-

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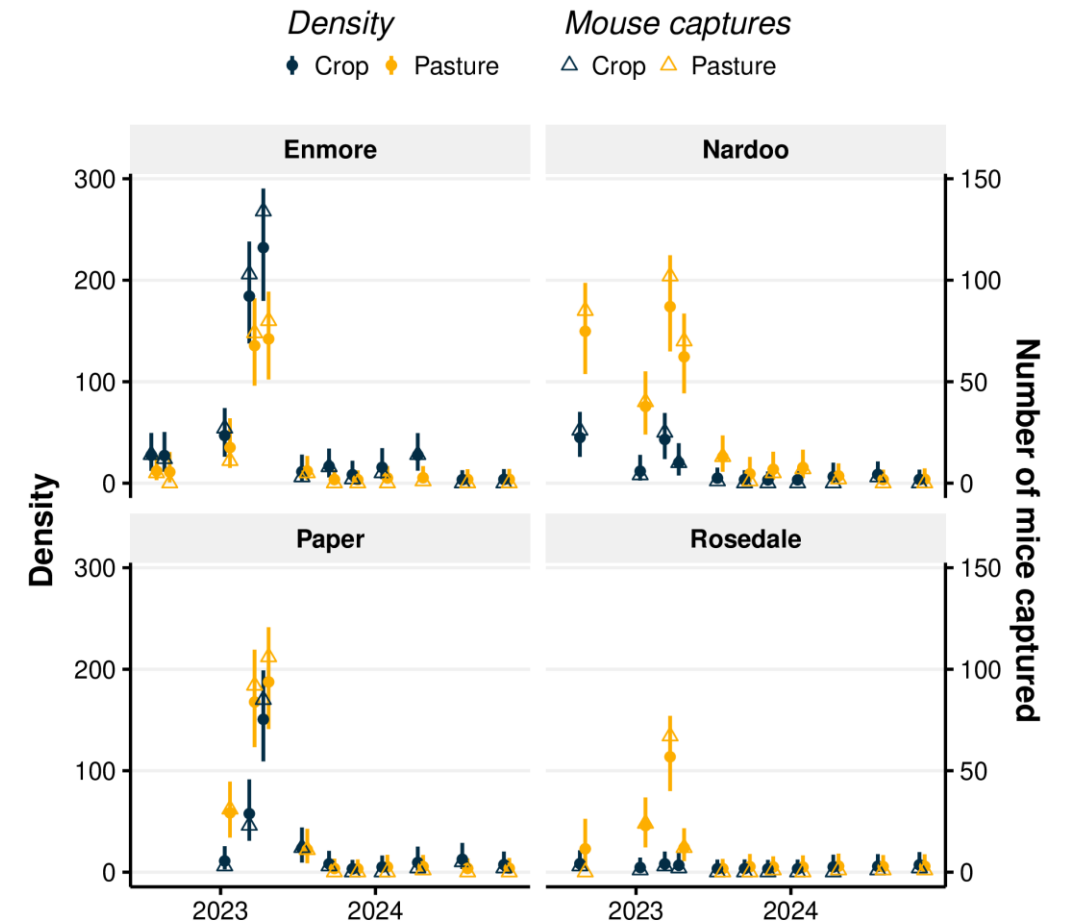
STATISTICAL INFERENCE FOR CAPTURE-RECAPTURE EXPERIMENTS

by

KENNETH H. POLLOCK, JAMES D. NICHOLS,
CAVELL BROWNIE, AND JAMES E. HINES

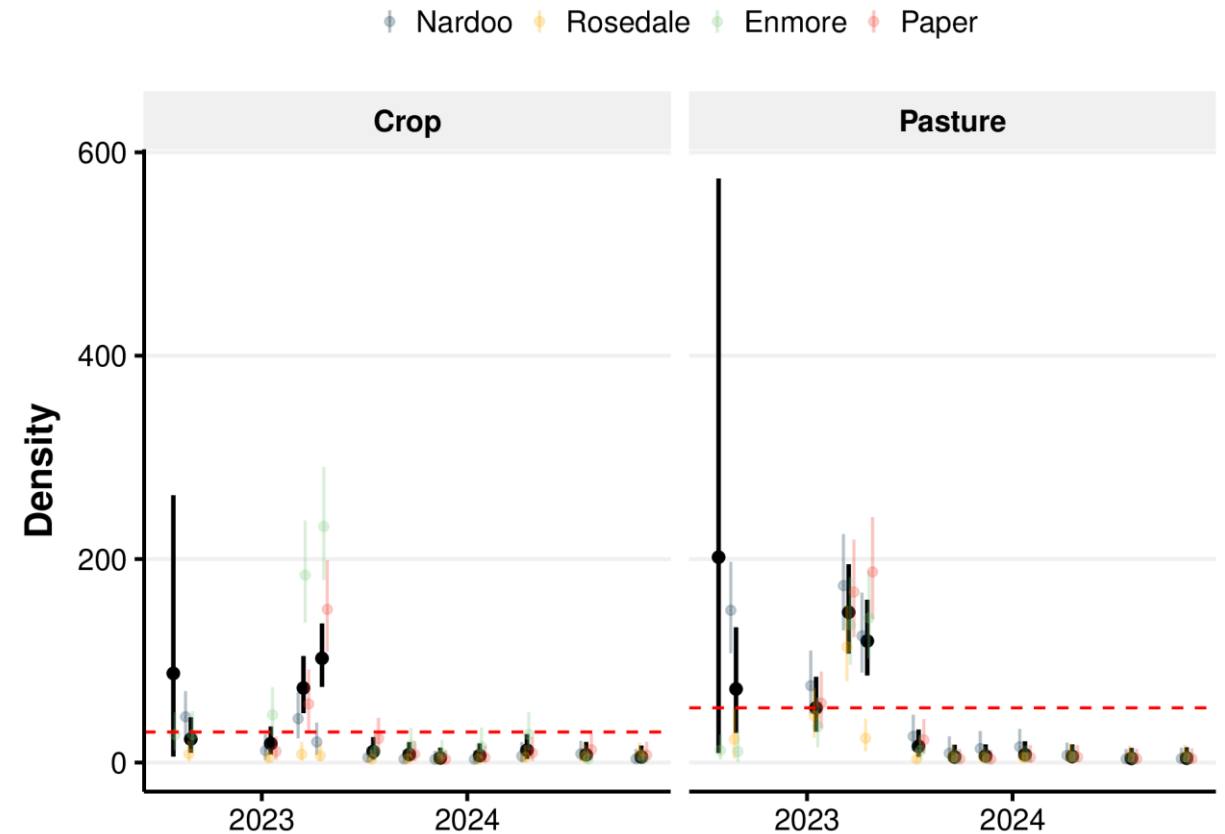
Results – mouse captures & density

- mouse densities highest in year 1 (max. 230/ha)
- declined to near zero in year 2
- modelled mouse densities tracked captures well



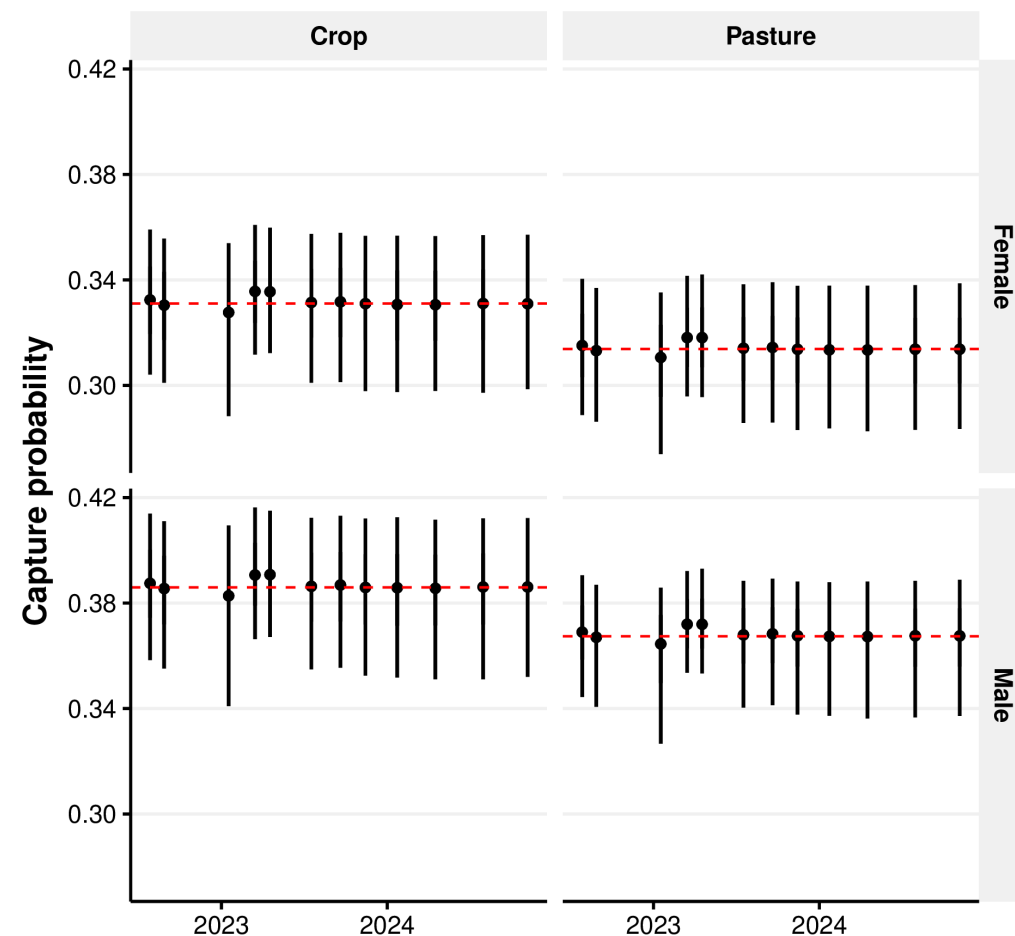
Results – mouse captures & density

- average mouse densities higher in pasture



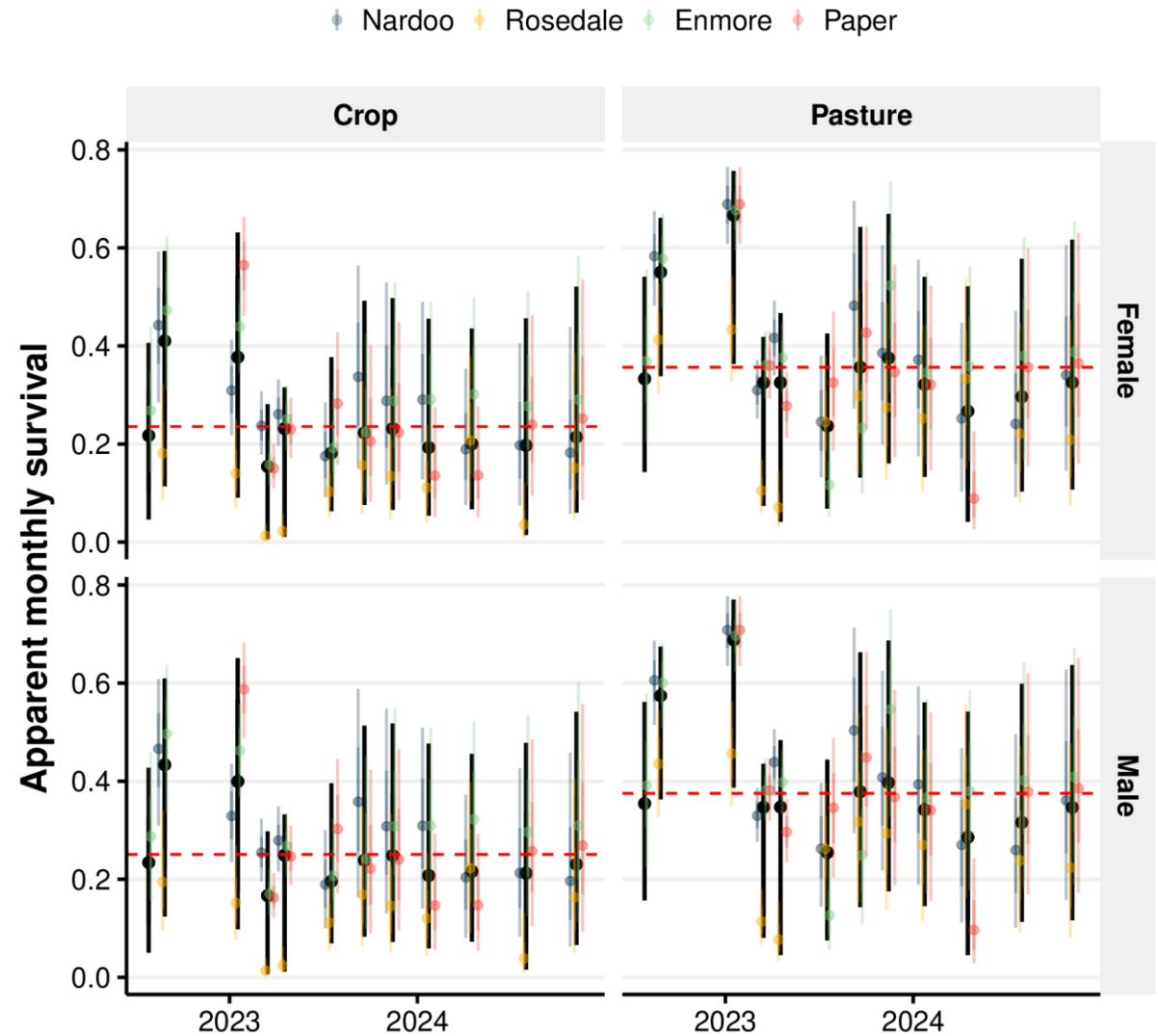
Results – nightly capture probability (p)

- higher for males (0.37) than females (0.32)
- similar in crop (0.36) and pasture (0.34)
- in a five-night trapping session, a nightly capture probability of 0.35 corresponds to a probability of being captured at least once of ~ 0.88 .

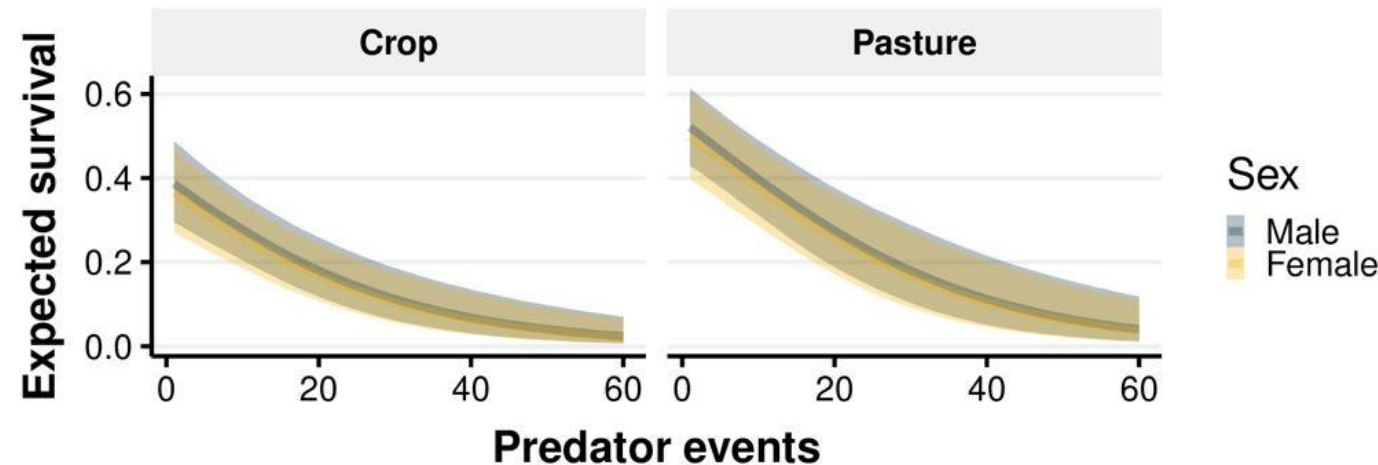
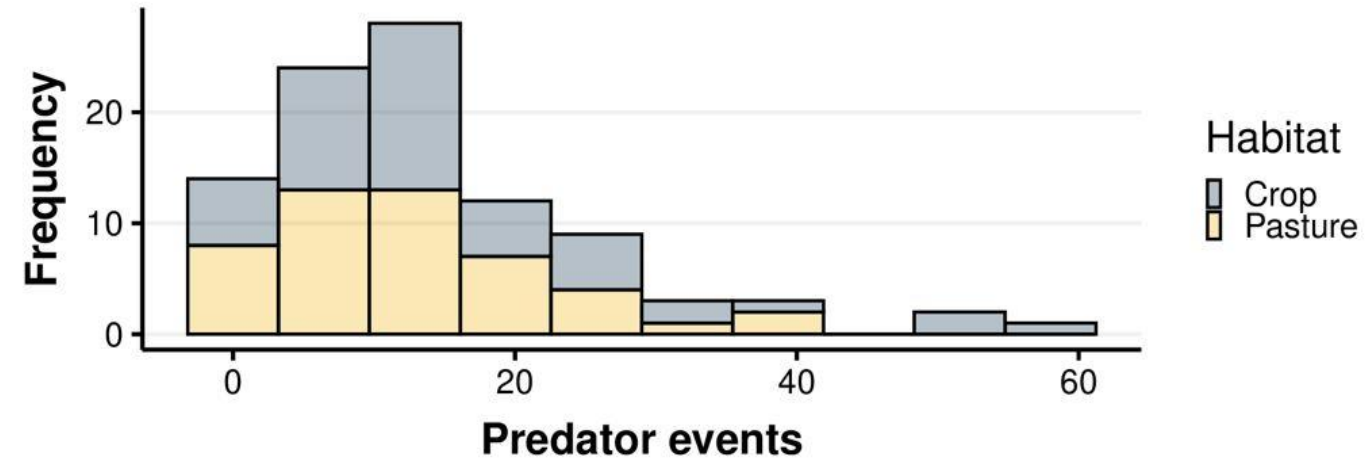


Results – monthly survival

- survival similar for males (0.30) and females (0.31)
- higher survival in pasture (0.37) than crop (0.24)



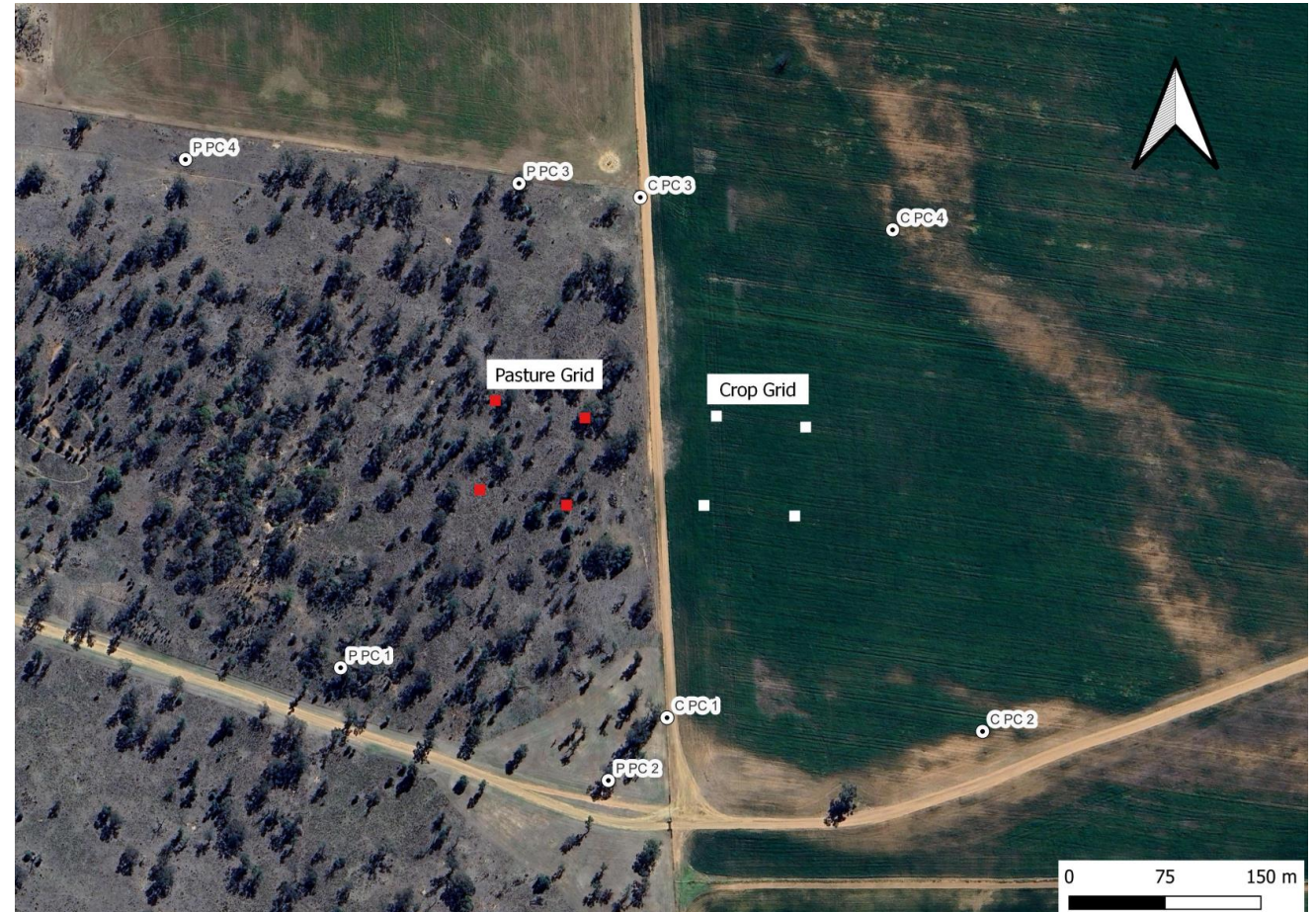
Results – cats/foxes and mouse survival



Movements between pasture-crop grids

12 tagged mice moved between grids (100 m):

- 7 from crop to pasture
- 5 from pasture to crop



Conclusions

1. Pasture is an important habitat for mice in western NSW
 - average mouse densities higher in pasture than crop (but highly variable)
 - mouse survival higher in pasture than crop
 - mice commonly move between pasture and crop



Conclusions

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 - average mouse densities higher in pasture than crop (but highly variable)
 - mouse survival higher in pasture than crop
 - mice commonly move between pasture and crop
2. A role for feral cats and foxes
 - mouse survival declined with increasing predator abundance



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