Manaaki Whenua
Landcare Research

Impact of Allee effects on the establishment of biocontrol agents

Hester Williams, Ecki Brockerhoff, Sandy Liebhold, Darren Ward

Introduction

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- Biocontrol species characteristics
- Host plant characteristics
- Climate and Habitat
- Time of release
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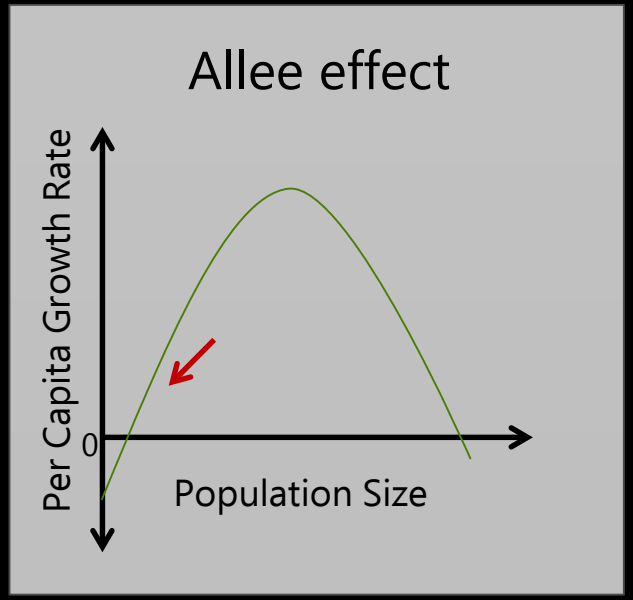
What is the Allee effect?

- Decrease in per capita growth rate with a decrease in population size



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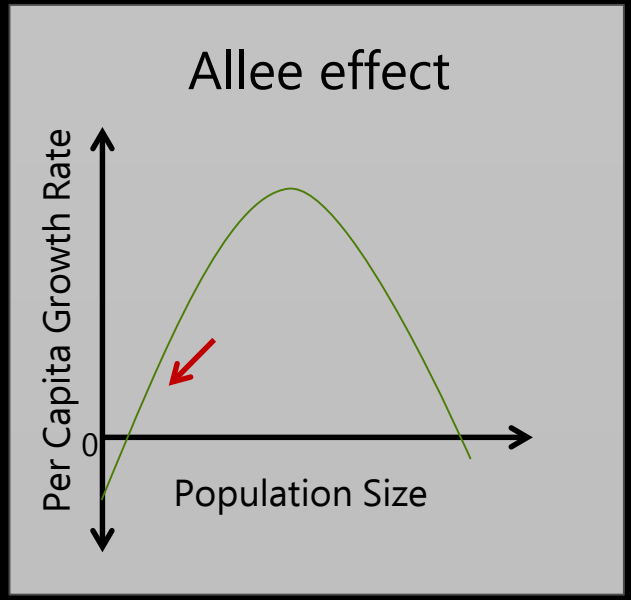

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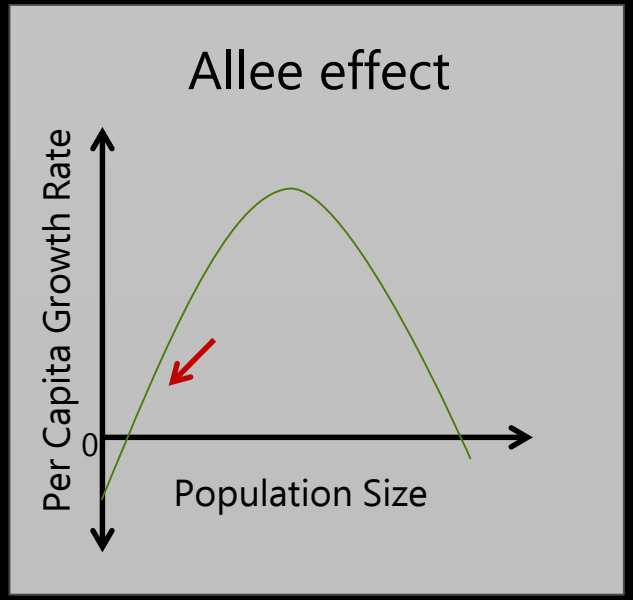

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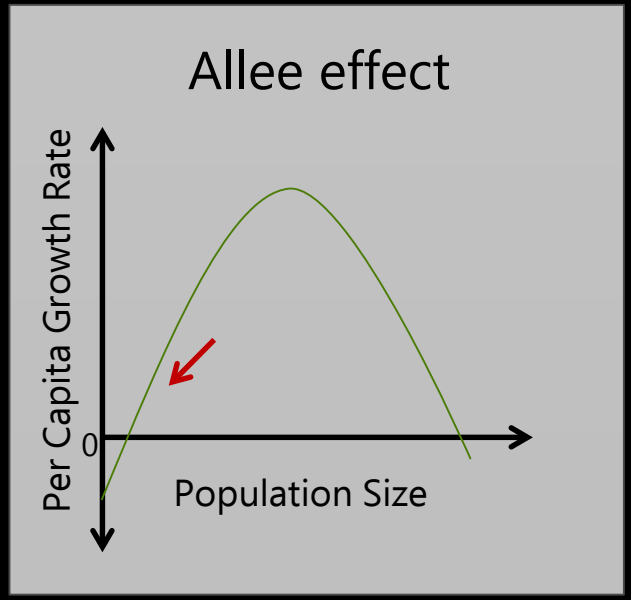

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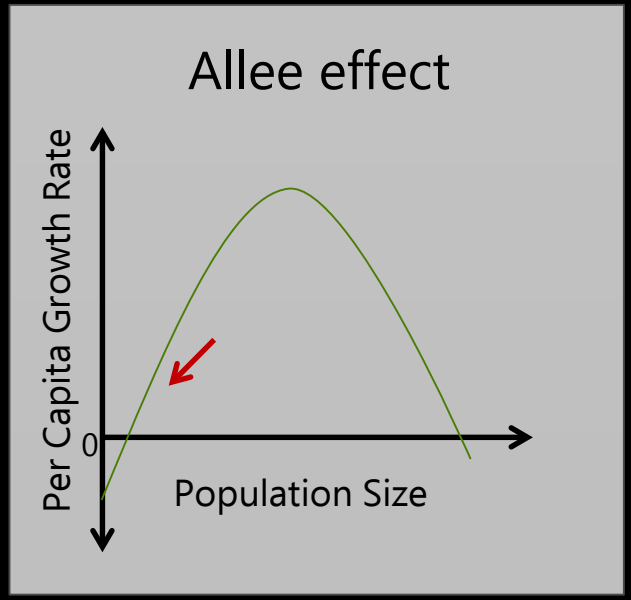

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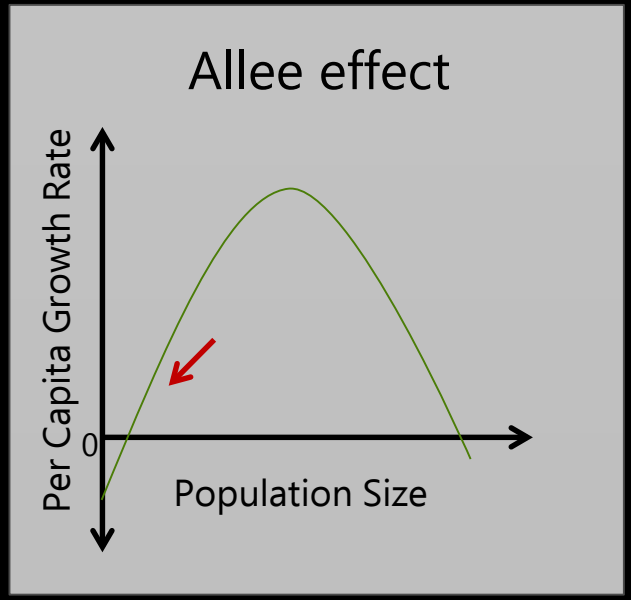

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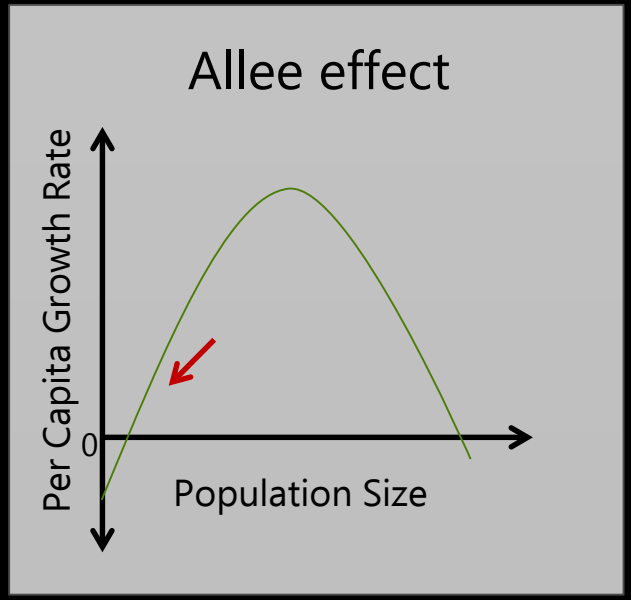

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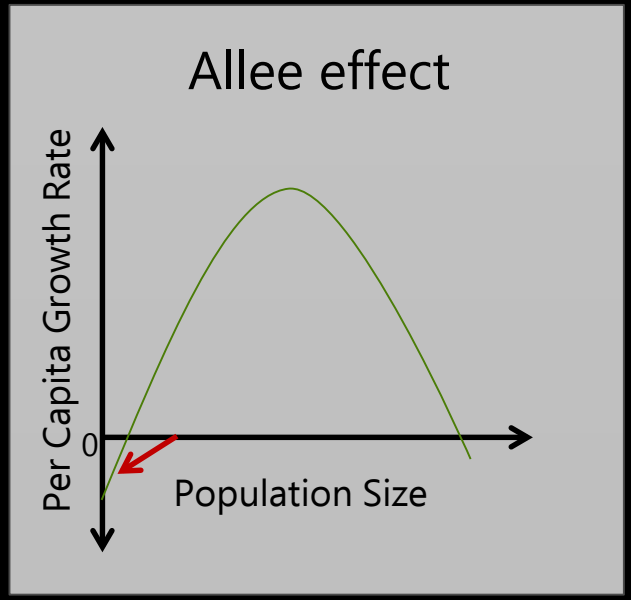

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Typical signs:

- Reduced probability of Establishment at small population sizes
- Reduced per capita growth rate at small population sizes
- Threshold below which negative growth rate is experienced

Objectives

- Theoretical population models indicate Allee effect to be a major factor
- Field evidence scarce

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Invasive Weed :
Tradescantia fluminensis

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Tradescantia fluminensis

Biocontrol agent:
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We asked:

- Allee effect present?
- Which driving mechanisms?

Methods: Detecting Allee effect

- Made several small replicated releases
  - Release sizes: 2, 4, 8, 16, 32, 64
  - 5 replicates per release size

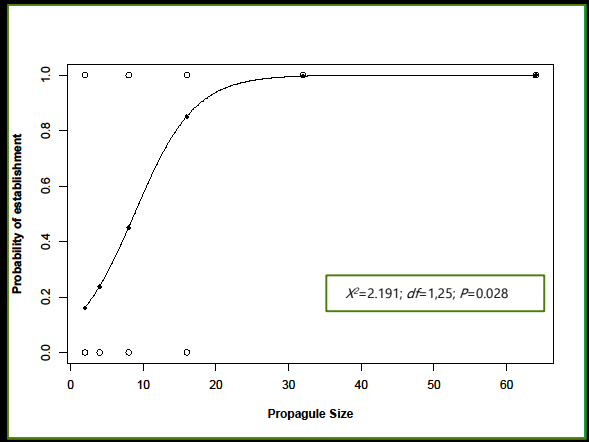
Methods: Detecting Allee effect

- Manipulate initial population size of replicated releases
  - Release sizes: 2, 4, 8, 16, 32, 64
  - 5 replicates per release size

- Evaluated impact of release size on:
  - Probability of establishment
  - Per capita population growth rate

Results: Detecting Allee effect

- Allee effect present
  - Probability of establishment increased with increasing release size



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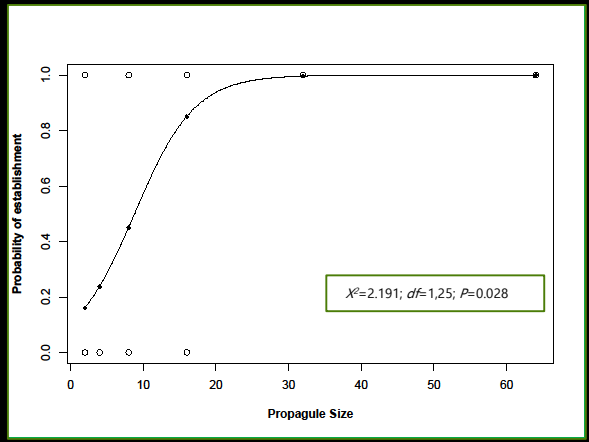

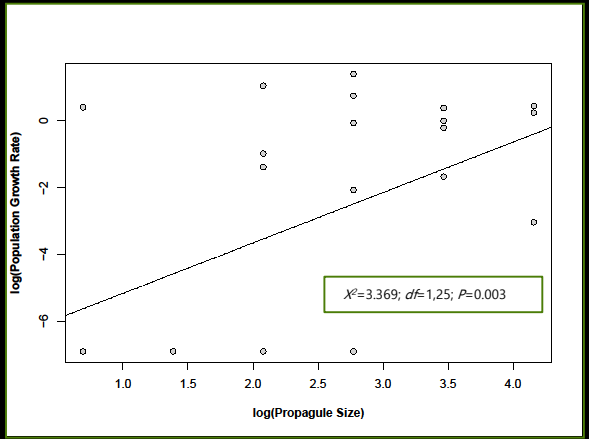

Methods: Determining Driving Mechanism No 1

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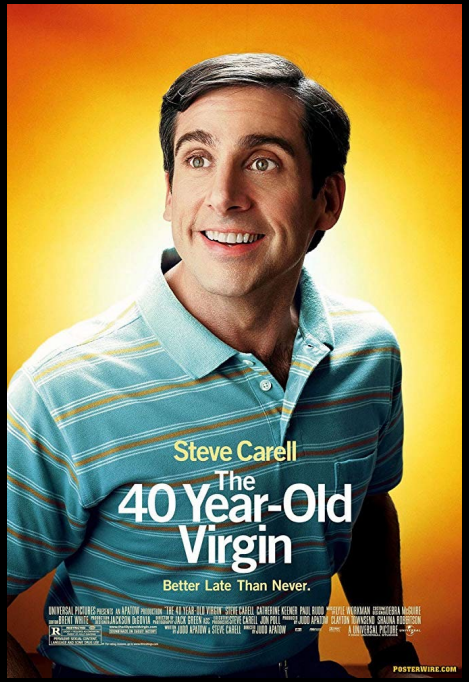

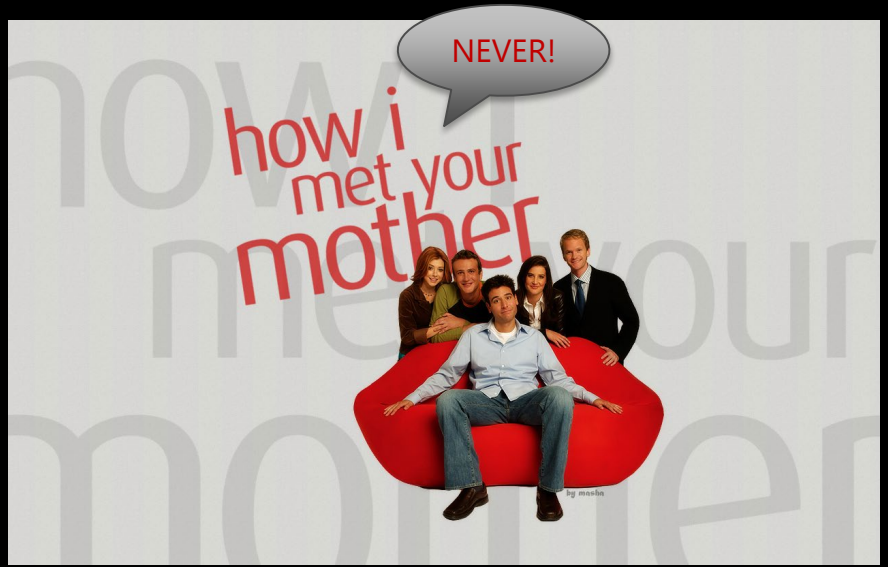

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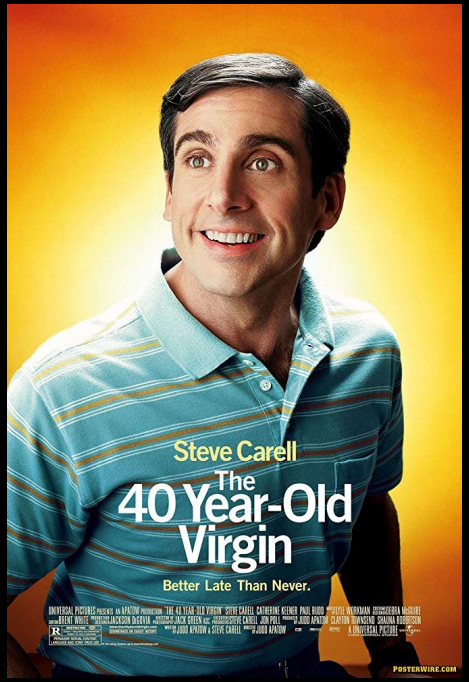

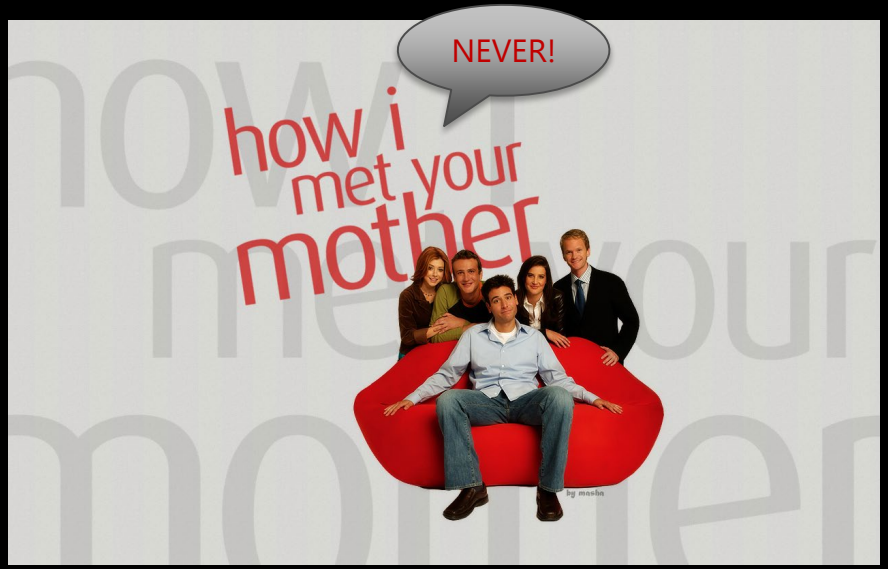

Mate limitation?

Methods: Driving Mechanisms

1) Mate limitation

- Made several small replicated releases
  - Release sizes: 2, 8, 16
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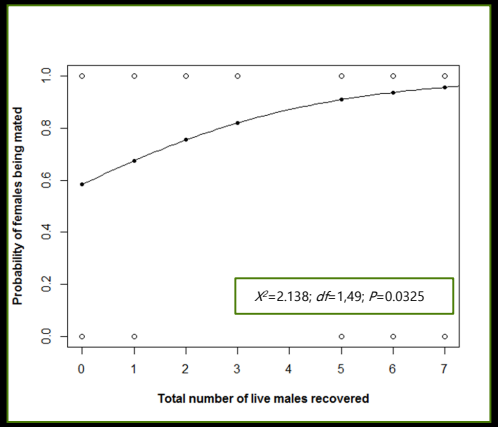
- Evaluated impact of recovered male density on:
  - Mating status of recovered females

Results: Driving Mechanisms

1) Mate limitation

Probability of being mated increased with increasing number of live males recovered



Methods: Driving Mechanism No2

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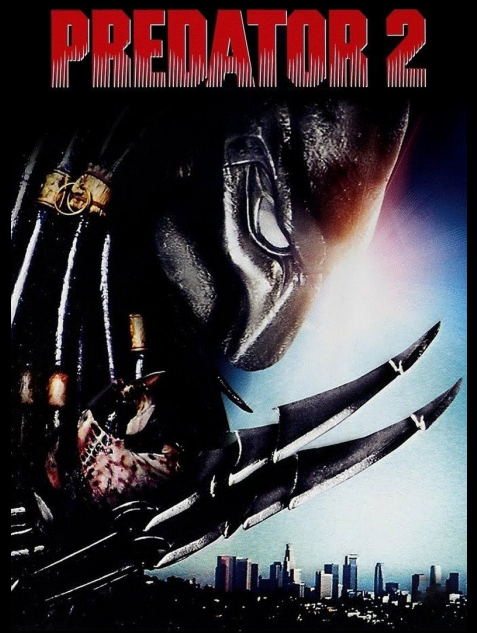

Generalist predation?

Methods: Driving Mechanisms

2) Generalist predation

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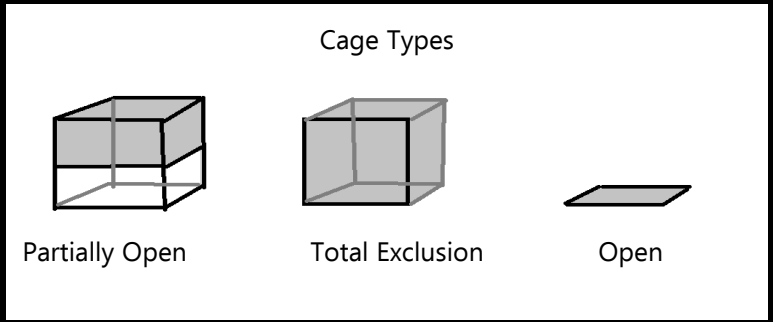
- Predator exclusion field trials
  - Cages:
    - Total exclusion (Closed)
    - Partially open (Sham)
    - Open to predators (Open)
  - Two densities:
    - High (50 eggs)
    - Low (22 eggs)



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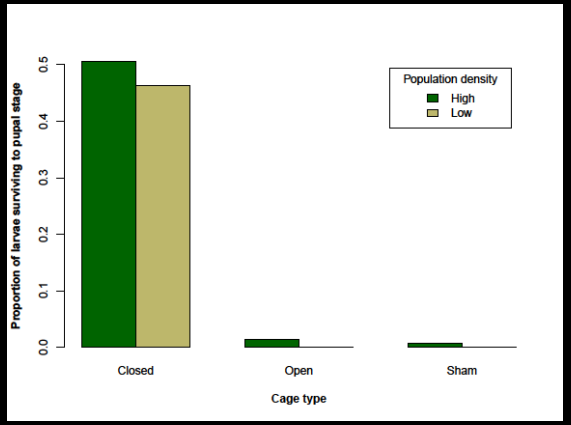
- Proportion of larvae surviving highest in total exclusion cage



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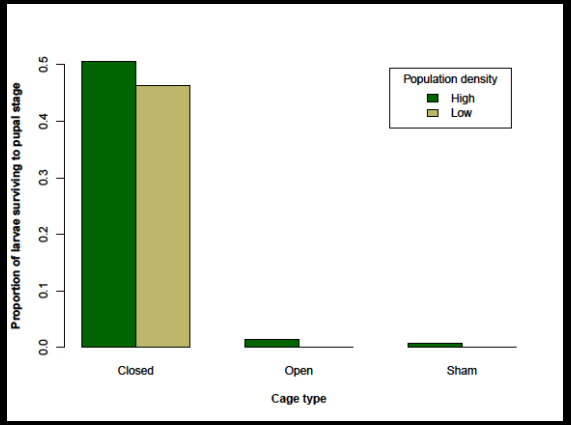
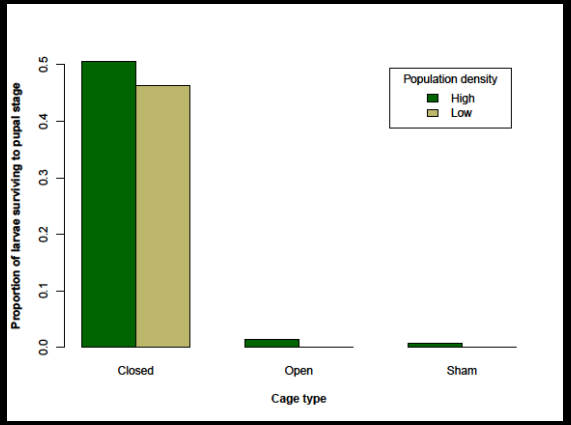


Results: Driving Mechanisms

2) Generalist Predation

- Proportion of larvae surviving highest in total exclusion cage

- *Tested* larval densities had no significant influence on survival
- Additional testing with higher populations is needed



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- Preliminary results indicating predation and mate limitation as driving mechanisms.
- Allee effect potentially impacting establishment and spread of many biocontrol agents.

Thank you

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- MPI
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