

# Host defenses influence dynamics of local populations of *Dendroctonus frontalis*

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## ABSTRACT

All biological populations are subject to population regulation via density-dependent feedback on survival and reproduction. *Dendroctonus frontalis*, a major pest of pines in the southeastern U.S., has population dynamics that are influenced by tree resin defenses. The tree defense system forces the beetles to aggregate to overwhelm the tree. Aggregating organisms have density-dependant population regulation based on competition. I tested for density-dependence during different life-stages of *D. frontalis*. Using this data, I made a generic model of population regulation. This model, which incorporates dominant variables into population dynamics, may describe population dynamics of other aggregating bark beetles.



## Southern Pine Beetle (*D. frontalis*)

- Common outbreak insect in pine forests in southern U.S.
- Beetles overwhelm host trees via mass attack (aggregation)
- Outbreaks have ecological and economic consequences
- Spend +97% of the lifecycle in the bark and phloem of trees
- Major predator is the checkered beetle (*Thanasimus dubius*)



## METHODS

Study Sites: Mixed Coniferous forests in Alabama, Mississippi

Data gathered from bark:

Samples: Paired bark samples 20cm x 30cm at trunk height of 3m.

Sample size: n=334

- \*Adult attack density
- \*Gallery length
- \*Estimated Egg density
- \* Larval Density
- \*# Surviving larvae

## Important Life-cycle Information

- Beetles mass attack trees to overwhelm the resin system of trees
- There is variation in resin production between trees
- There is subsequent variation in attack density between trees
- Adult beetles compete for space in the phloem to lay eggs
- Larvae compete in the phloem for nutrients



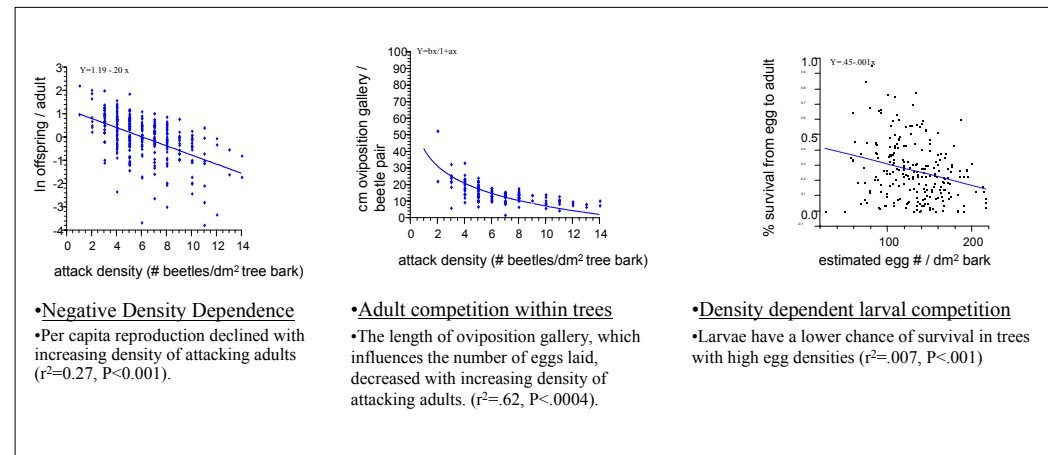
## The Pivotal Question

Is there evidence of density dependent intraspecific competition?

- Is there competition among *adult* beetles for gallery space, and /or among *larvae* for phloem nutrients?



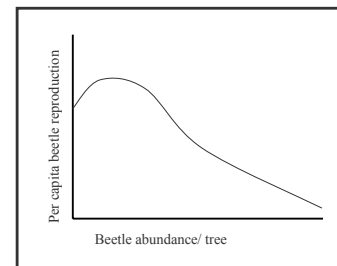
## RESULTS



## What do these results tell us?

- There is strong, immediate adult competition for gallery space
- Some competition for food resources among larvae (based on egg density)

A BASIC MODEL OF DENSITY-DEPENDENCE



This model is based on compiled data gathered from the stages of *D. frontalis*. (Results)

## Theoretical Implications?

- Populations without some form of regulation cannot persist
  - Density dependence explains much of the variation in populations dynamics of *D. frontalis* and is linked to important aspects of the ecology of the organism. (i.e. aggregating to overwhelm host defenses)

## Is this a pattern for other bark beetle populations?

- Other bark beetles also aggregate.
  - Those populations also experience competition and density-dependence.
- Are the same variables also important in describing population dynamics of other similar organisms?

\*We know many of the factors that lead to the dynamics of *D. frontalis*. By gathering similar data for other species of bark beetles, and fitting the model to those data, we can deduce characteristics about their biology, ecology, and behavior based on how those variables differ from, or are similar to *D. frontalis*.