

# Causes and consequences of dynamic feedback in population dynamics of *Dendroctonus frontalis* (Coleoptera: Scolytidae)

Matthew P. Ayres<sup>1</sup>, Sharon Martinson<sup>1</sup>, Tiina Ylijoja<sup>1</sup>, Richard Hofstetter<sup>1</sup>, and Kier Klepzig<sup>2</sup>

<sup>1</sup> Department of Biological Sciences, Dartmouth College, Hanover, NH 03755; <sup>2</sup> Southern Research Station, USDA Forest Service, Pineville, LA 71360

## Introduction

- High impact herbivores are frequently those that display intermittent outbreaks.
- Outbreaks can result from dynamic feedback systems that include delays and/or nonlinearities in per capita growth rates as a function of population size or density.
- Dendroctonus* bark beetles display frequent outbreaks that can kill vast areas of pine forest.
- Dendroctonus* typically employ pheromones to organize mass-attacks of individual trees, apparently as a means of overwhelming tree defenses

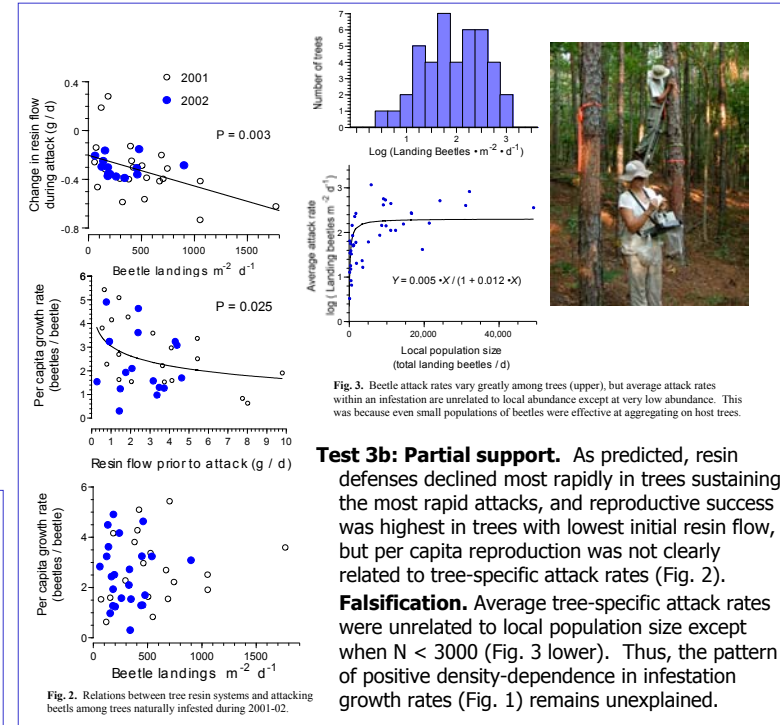
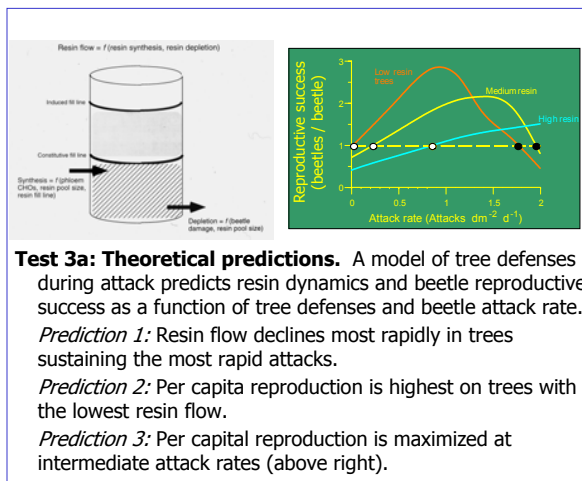
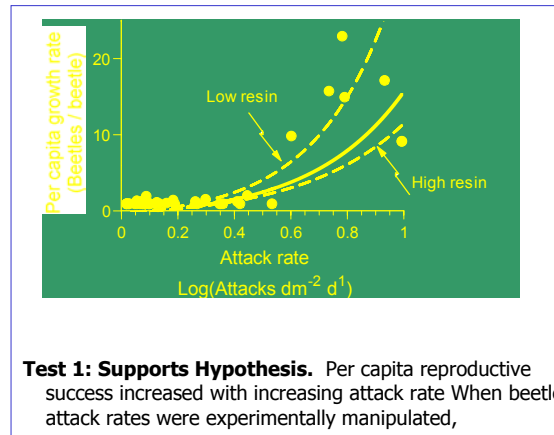
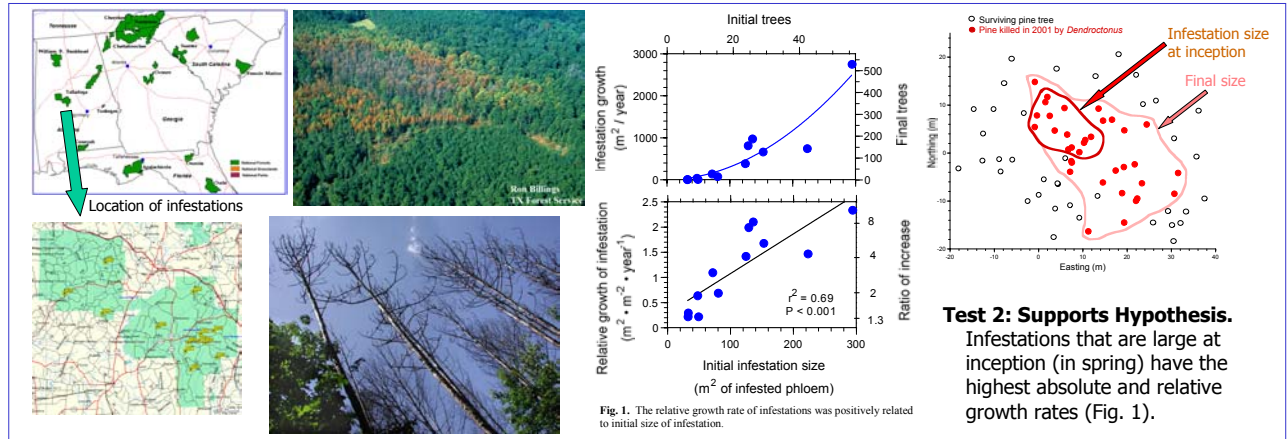


## Hypothesis

Interactions between *Dendroctonus* and their host trees generate destabilizing positive feedback (allee effect) in which per capita reproduction tends to increase with increasing abundance of beetles to participate in attacks

## Tests

- Manipulate attack rates to test for benefits of aggregation on beetle attack success.
- Compare growth rates of local infestations that began at a range of population sizes. Test whether relative growth of infestations was positively related to initial size
- Develop a theoretical model that predicts dynamics of the tree resin system during attacks and eventual reproductive success of the beetles, and test model predictions by measuring attack rates, resin dynamics, and reproduction within natural infestations.



## Conclusions

- The existence of strong positive density-dependence (Fig. 1) must have a strong impact on landscape epidemiology but a heretofore promising explanation for this allee effect (left) no longer seems valid because tree-specific attack rates are largely unrelated to local population size.
- There are significant challenges in understanding the consequences for population dynamics of multiple demographic processes that operate on different hierarchical levels.

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