

Hitchhikers and their baggage: Effects of mites and their mutualistic fungi on southern pine beetle population dynamics

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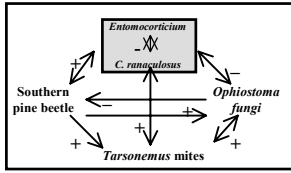
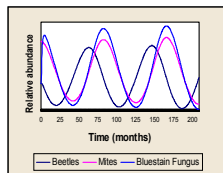
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INTRODUCTION

- Southern pine beetles, *Dendroctonus frontalis* (Coleoptera: Scolytidae), are subject to extreme population fluctuations and cause massive mortality of pines during outbreaks.
- D. frontalis* larvae feed upon mutualistic fungi, *Entomocorticium* sp. A and *Ceratocystiopsis ranaculosus*, that are transported in specialized, prothoracic mycangia of adult females.
- Tarsonemus* mites have the potential to disrupt the interactions between bark beetles and their mutualistic fungi by transporting and introducing antagonistic fungi (*Ophiostoma* sp.) into beetle galleries and surrounding phloem.
- Tarsonemus* mites cause no direct harm to adult beetles and are dependent upon them for dispersal (phoretic) between trees.

HYPOTHESIS

The population dynamics of the southern pine beetle is influenced by negative feedback through community interactions involving beetle mutualists, mite mutualists, and mites (see diagrams below).



Pictures:(1) *D. frontalis* galleries in loblolly pine. Dark area is bluestain fungus. Light area around pupal chamber (white arrow) is phloem infested with the *Entomocorticium* fungus.(2) *Tarsonemus* mites on *D. frontalis* (3) Female *Tarsonemus* mite with bluestain ascospores in swollen sporotheca.

Figure 1

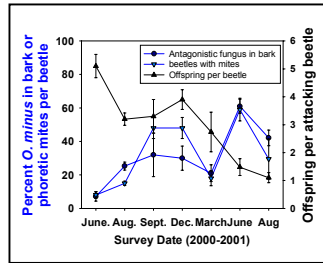


Figure 3

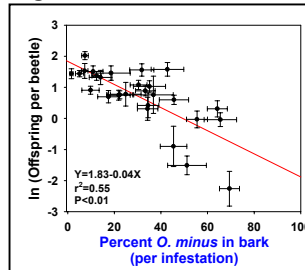


Figure 2

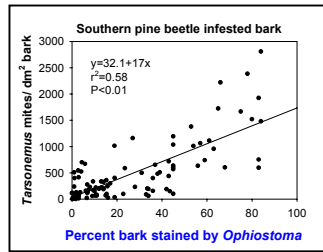
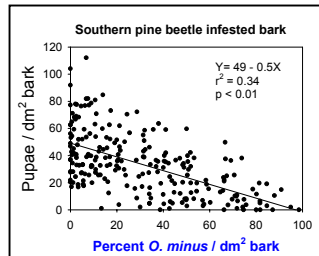


Figure 4



METHODS

- Beetle population growth rates were estimated in multiple infestations in Alabama and Mississippi from June 2000-Sept. 2001. *D. frontalis* reproduction and larval survival were recorded each generation.
- Ophiostoma* (mite fungi) abundances were measured by 1) tracing the percent of bark area covered with blue stain and 2) identifying beetles and phoretic mites that carried *O. minus* spores.
- Mycangial fungi (beetle fungi) abundances were estimated by collecting and dissecting flying female beetles/ generation/ infestation.
- Phoretic mite and beetle attack densities were experimentally altered within infested trees to determine the effects of *Ophiostoma* on beetle survival, and mite and beetle-fungi abundance.

RESULTS

- Ophiostoma minus* abundance within bark was positively correlated with phoretic mite abundance (Fig. 1; left axis) and mite density in bark (Fig 2).
- O. minus* gradually increased as beetle infestations progressed through time, hypothetically affecting the eventual decline of beetle populations (Fig. 1;right axis).
- Experimental increases of phoretic mites/beetle resulted in increased *O. minus* within bark. (no figure)
- An intermediate level of *O. minus* within bark resulted in the greatest abundance of phoretic mites. (fig2 x fig4)
- Larval survival (Fig. 4) and population growth within infestations (Fig. 3) declined with increased mite and *O. minus* density.
- Populations that crashed all had > 40% bark covered with *O. minus*, >40% of adult beetles with phoretic mites, >75% phoretic mites with *O. minus* spores (avg. 20 spores/mite), and *C. ranaculosus* was the dominant mycangial fungus carried by adult beetles.

CONCLUSIONS

- Mite dynamics and behavior, and *O. minus* ecology in bark, likely play an important role in the population dynamics of the southern pine beetle.
- Because mites propagate and increase the occurrence of bluestain fungi in infested bark, it may be possible to control southern pine beetle outbreaks by influencing mite densities and fecundity.
- Phoretic mites are frequent residents on bark beetles and their impacts on beetle and fungal communities are just beginning to be understood. Mite-fungi-beetle interactions likely influence the population dynamics and community composition of other bark beetle species throughout the world.

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