

# Red Oak Borer (Coleoptera: Cerambycidae) Larval Mortality Resulting from Intraguild Predation



V. L. Ware and F. M. Stephen

Department of Entomology, University of Arkansas, Fayetteville, AR 72701

E-mail: vware@uark.edu



## Introduction

An outbreak of red oak borer *Enaphalodes rufulus* (Haldeman) in the Ozark National Forest of Arkansas is contributing to tree mortality (Fig. 1) in a widespread oak decline event. Historically, red oak borer has been a minor pest of oaks with populations averaging less than one larva per tree. Our lab's intensive sampling showed an average of >70 live larvae per tree. The cause of this outbreak is unknown.

Red oak borer is considered phytophagous, burrowing and feeding in woody plant tissues (Fig. 2). However, as populations of red oak borer increase, competition for limited food resources, i.e. phloem, also increases. As food becomes scarce, larval conspecific predation in this non-carnivorous species may occur.



Figure 1: Oak mortality associated with *E. rufulus* infestation.



Figure 2: Second year *E. rufulus* larvae found in the same phloem gallery in a northern red oak tree.

## Objectives

- Experiment 1: Determine if *E. rufulus* larvae exhibit conspecific predation, and if so, the frequency of this behavior.
- Experiment 2: Determine if *E. rufulus* will actively seek/consume other *E. rufulus* when initially placed in separate arenas.
- Experiment 3: Determine if cannibalism results in significant weight gain compared to controls.
- Experiment 4: Determine the nature/frequency of elaterid, nitidulid and carpenterworm predation on *E. rufulus*.

## Methods



Figure 3: Phloem sandwich.

*E. rufulus* larvae were obtained from infested red oak trees felled in the Ozark National Forest in northern Arkansas. Phloem sandwiches (Fig. 3) were constructed following methods developed by Dodds et al. (2001). Phloem was removed from the cambium using a Sawzall® reciprocating saw and sanded smooth. A disk of phloem was cut on a band saw to fit into the top half of a disposable polystyrene Petri dish (d = 9 cm). Circular holes in the center of the phloem were made using cork borers (Fig. 4). These holes create an arena in which the larvae can begin to feed. Phloem samples were then sterilized in a weak bleach solution (approx. 0.05%). Before larvae were introduced into the phloem, their weights were recorded using an electronic scale (0.0001g). After larval insertion, the outside of the small, bottom half of the Petri dish was inverted to push phloem disks flat. To prevent desiccation, Parafilm® was wrapped around edges of the sandwich. Sandwiches were stored in the dark at 80°F for 1 to 2 weeks and checked daily.

Experiment 1: To ensure encounters, *E. rufulus* larvae were paired according to size and introduced into same arena.

Experiment 2: To observe potential encounters, *E. rufulus* larvae were paired according to size and introduced into separate arenas.

Experiment 3: *E. rufulus* larvae were paired according to size and randomly assigned to treatment or control group. Treatment larvae were paired in the same arena and control larvae were placed singly in a phloem disc. All larvae were marked by permanent markers.

Experiment 4: *E. rufulus* larvae were paired with an elaterid, nitidulid or carpenterworm larva and introduced into the same arena.



Figure 4: Using cork borer to construct larval arena.

## Results

Experiment 1: Eighty-four percent of 50 encounters resulted in conspecific predation (Fig. 5) (partial or complete consumption) while 16% resulted in partitioning of the arena (Fig. 6).

Experiment 2: Fifty-five percent of 33 potential encounters resulted in conspecific predation (partial or complete consumption).

Experiment 3: Treatment larvae gained significantly more weight than control larvae (df =64, P=0.001, Fig. 7).

Experiment 4: Five trials with elaterid and *E. rufulus* encounters (Fig. 8) resulted in 100% predation of *E. rufulus*. Five trials between nitidulid and *E. rufulus* resulted in 100% avoidance. Four trials of carpenterworm and *E. rufulus* encounters resulted in 75% facultative predation on *E. rufulus* (partial or complete consumption).



Figure 5: Marked *E. rufulus* larvae exhibiting aggressive intraspecific behavior.



Figure 6: Wall building by *E. rufulus* larvae.

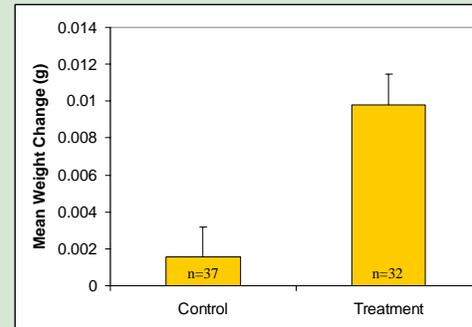


Figure 7: *E. rufulus* mean weight gain. Control larvae ingested only phloem. Treatment larvae ingested both phloem and larva.



Figure 8: Elaterid larva preying on red oak borer larva.

## Conclusions

The primary food source of *E. rufulus* is red oak phloem and xylem, but at current epidemic levels, conspecific predation may be occurring frequently enough to be an important mortality factor. These experiments indicate that not only will larvae engage in conspecific predation but that these encounters are beneficial to survivors as more competitive individuals receive a high-nitrogen meal. The nutritive value gained in this manner appears to be important because of significant larval weight gain.

This research has important implications in red oak borer population dynamics as it attempts to imitate encounters of *E. rufulus* larvae within red oak trees. Currently, the mortality factors affecting red oak borer populations are unknown. These data indicate that at least some larval mortality is the result of conspecific predation.

## Acknowledgments

The authors wish to thank Rose Anne Barnhill, Virgil Piazza and Joshua Jones for assistance in this project. This project was funded in part by a USDA Forest Service, Forest Health Protection Challenge Cost-Share Agreement with the University of Arkansas.