

## Red Oak Borer

*Enaphalodes rufulus* Haldeman

Coleoptera: Cerambycidae

Fierke, M. K.; Kinney, D. L.; Salisbury, V. B.; Crook, D. J.; Stephen, F. M. 2005a. A rapid estimation procedure for within-tree populations of red oak borer (Coleoptera: Cerambycidae). *Forest Ecology and Management* 215: 163-168.

**Objective:** To develop a nondestructive procedure that quickly estimates the population levels of red oak borer in northern red oak, *Quercus rubra* L., during epidemics.

**Abstract:** Red oak borer, *Enaphalodes rufulus* Haldeman, is a serious native pest of red oak, *Quercus rubra* L., and has been recently associated with oak decline, particularly in the Ozark National Forest in Arkansas. This cerambycid can kill stressed trees, such as those affected by oak decline. An accurate method of estimating *E. rufulus* populations through destructive sampling has been developed (Fierke et al. 2005b), but it is labor intensive. A rapid estimation survey procedure was therefore developed to classify tree populations of *E. rufulus* during epidemics.

Overall, the nondestructive rapid estimation survey procedure correctly classifies red oak borer populations in  $\geq 85\%$  of sampled trees. Tree crown condition and red oak borer emergence holes on the basal 2 m of tree bole are used to classify trees into one of three categories ranging from Class 1 (low infestation) to Class III (high infestation). This plan requires  $< 2$  minutes to conduct on each tree, whereas the procedure of Fierke et al. (2005b) required  $> 100$  hours per tree.

**Sampling Procedure:** Assess the percentage of crown dieback on an individual tree using the procedures described by Starkey et al. (2000) and in USDA (2001). Assign a crown condition class (CCC) to the tree following the rating scale for percent defoliation in the crown as presented in Table 1. Count the number of red oak borer emergence holes in the first 2 m of height on the tree bole. Assign a basal emergence hole (BEC) class to the tree based on the number of tallied emergence holes following the scale presented in Table 1. Sum the CCC and BEC to obtain the rapid estimation index (REI), which ranges in value from 0-7. Reference Table 1 to determine the rapid estimation procedure (REP) class for the individual tree based on the calculated REI value. Class I and Class II trees are considered to have a low and moderate infestation level, respectively. Class III trees have a high infestation of *E. rufulus* with dead or mostly dead crowns, numerous emergence holes, and imminent tree mortality. Land managers can use these REP classes to estimate *E. rufulus* population levels and the extent of the infestation throughout stands of red oak, and base management decisions on this information.

**Notes:** This procedure is useful for rapidly estimating populations of red oak borer in a tree during epidemics. However, the authors caution against using it with endemic populations as Class I trees in this study had greater numbers of *E. rufulus* than expected given the levels previously reported in the literature for endemic

conditions. Further work is required to determine the number of trees needed to sample in a stand or forest in order to estimate red oak borer populations at specified levels of fixed precision. See Crook et al. (2007) in this volume for information regarding a sampling plan for *E. rufulus* using a minimal number of samples.

**References:**

# Crook, D. J.; Fierke, M. K.; Mauromoustakos, A.; Kinney, D. L.; Stephen, F. M. 2007. Optimization of sampling methods for within-tree populations of red oak borer, *Enaphalodes rufulus* (Haldeman) (Coleoptera: Cerambycidae). Environmental Entomology 36: 589-594.

# Fierke, M. K.; Kinney, D. L.; Salisbury, V. B.; Crook, D. J.; Stephen, F. M. 2005b. Development and comparison of intensive and extensive sampling methods and preliminary within-tree population estimates of red oak borer (Coleoptera: Cerambycidae) in the Ozark Mountains of Arkansas. Environmental Entomology 34: 184-192.

Starkey, D.; Mangini, S.; Oliveria, F.; Clarke, S.; Bruce, B.; Kertz, R.; Menard, R. 2000. In: Forest Health Evaluation of Oak Mortality and Decline on the Ozark National Forest, 1999. Alexandria, LA: U.S. Department of Agriculture, Forest Service, Forest Health Protection.

(USDA) U.S. Department of Agriculture, Forest Service. 2001. Forest inventory and analysis Southern Research Station Field Guide. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station.

**Table**

Table 1. Rapid estimation procedure variables assessed in the field include crown condition and number of basal emergence holes.

Crown condition	CCC	Emergence holes <2 m	BEC	REI	REP class
<1% dieback	0	0	0	0, 1	Class I
1-33% dieback	1	1-5	1		
34-66% dieback	2	6-20	2	2, 3, 4	Class II
67-99% dieback	3	>20	3		
Dead	4			>4	Class III

Summation of these variables yields indices that were used to classify trees into REP infestation history classes. *Abbreviations:* CCC, crown condition class; BEC, basal emergence hole class; REI, rapid estimation index (CCC + BEC).

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