

WHY CAGE A TREE? USE OF WHOLE-TREE ENCLOSURES TO ASSESS INTRODUCED PREDATORS OF HEMLOCK WOOLLY ADELGID, *ADELGES TSUGAE*

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ABSTRACT

While commonly used approaches (petri dishes, small arenas, growth chambers, greenhouse studies, sleeve cages, etc.) for evaluation of natural enemies provide important information, does the small size of these arenas limit their usefulness when evaluating introduced natural enemies for release against pests of tree species? Can methods be improved to evaluate natural enemies of these pests? A project was developed to assess the use of large tree cages to enhance our understanding of the survival, colonization, and establishment of introduced biological control agents against the hemlock woolly adelgid (HWA), *Adelges tsugae* Annand, on eastern hemlock, and to assess the impact of these agents on population densities of this serious invasive pest and on tree health. This project focuses on the use of large (ca. 9 m [30 ft]) screened whole-tree canopy enclosures (cages) to assess the successful field application of three introduced biological control agents (*Laricobius nigrinus* [Ln] [Fender], *Sasajiscymnus tsugae* [St] Sasaji and McClure, and *Scymnus sinuanodulus* [Ss] Yu and Yao) of HWA. This study is being conducted at Blackberry Farm near the Great Smoky Mountains National Park in eastern Tennessee.

Trees (n=12) were caged from October to December 2007 and biological control agents were placed in the cages: Ln

adults (190/cage, 11 Jan. 2008), Ss adults (90/cage, 20 March 2008), and St adults (300/cage, 27 March 2008). Three caged trees without beetles and three noncaged trees served as control trees. Trees were sampled for beetles and HWA assessed every 2 to 3 months.

All three species of introduced natural enemies survived and reproduced within the cages. Larvae of each species were recovered in 2008. Adult Ln was found in March and November, adult Ss was found in April, June, and July, and adult St was found in April, May, June, July, and November. Adult Ln and St were recovered on 19-20 November 2008 (about 1 year after Ln was initially placed in the cages and about 8 months after St was placed in the cages). No Ss were found in the cages after 8 months (November 2008 sample). After 11 months, HWA densities in all beetle cages had declined. Of the release cages, the lowest decline in HWA densities was observed in the Ss cages, while the greatest decline was found in the Ln cages. Canopy enclosure cages are a new and innovative approach to assess natural enemies for release (single species or species complexes) against insect pests of trees. This research is expected to provide a better understanding of the role of natural enemies in suppressing HWA in forests.