

WHOLE-TREE CANOPY ENCLOSURES: WHY CAGE A TREE?

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ABSTRACT

The use of whole-tree canopy enclosures (i.e., cages) is not a typical approach to assessing biological parameters and interactions in a forest setting. However, the successful application of this technology may enable researchers to better understand certain types of tree/organismal interactions. One of these interactions that may be better evaluated using whole-tree canopy enclosures is the predator/prey relationship associated with the use of an introduced biological control agent against an invasive forest insect pest. Typical assessments of introduced biological control agents of invasive insect pests usually occur in the laboratory, either in petri dishes or small arenas, in larger predator/prey arenas established in a greenhouse, or in sleeve cages placed directly on the plant in the field. While these approaches provide important information, does the small size of these arenas limit their usefulness when evaluating introduced natural enemies of pests of tree species? Can whole-tree canopy enclosures improve our assessment of introduced natural enemies of pests of trees?

As part of this pilot project to assess the use of whole-tree canopy enclosures, research is underway to use these enclosures to evaluate introduced biological control agents against hemlock woolly adelgid, *Adelges tsugae* Annand, on hemlock trees. This research will enhance our understanding of the survival, colonization, and establishment of introduced biological control agents against this invasive insect pest, and it will allow us to assess the impact of these selected agents on population densities of this introduced insect pest and on tree health. This project focuses on the use of large (ca. 9 m [30 ft]) screened

whole-tree canopy enclosures to assess the successful field application of three introduced biological control agents of hemlock woolly adelgid. This research includes the use of qualitative and quantitative measurements to assess and determine the colonization and impact of introduced biological control agents. This study is being conducted at Blackberry Farm near the Great Smoky Mountains National Park in eastern Tennessee.

Several needs must be considered in using whole-tree canopy enclosures in forest settings. These include the availability of a suitable location for 2+ years (the location must be easily available for use, generally secure, few activities in area, etc.), trees of appropriate height (20 to 30 feet tall) for canopy enclosures, trees that are healthy and consistently shaped, trees infested with appropriate densities of the targeted insect (a relatively new infestation is best), trees with new growth, trees that are easily accessible using a bucket truck or lift, trees that are “solitary” (none intermingled/side-by-side), a ground surface that is relatively flat or slightly slanted, and whole-tree canopy enclosures. Once these needs are satisfied and a design has been developed, canopy enclosures can be constructed and deployed into the field for use in biological assessments.

Once the enclosures are deployed, researchers must consider the potential advantages and disadvantages to the use of these enclosures. Whole-tree canopy enclosures have several advantages to their use. They provide a more realistic field assessment of introduced biological control agents (than previous methods);

they enable long-term monitoring of the impact of natural enemies on an invasive pest and on tree health, as well as predator performance and survival; they provide a way to assess single species or combination of species of natural enemies, and they provide a better understanding of actual predatory expectations in the field. However, there are several disadvantages or limitations to the use of whole-tree canopy enclosures. Enclosures provide an assessment of a “controlled” environment (how similar is “inside” to “outside”?) (in our cages, however, research has shown that temperature and humidity levels vary little between open and caged trees.); all stages of organisms cannot be removed from the trees before they are “caged”; and the environmental stresses to cages (e.g., high

winds, snow, rain, hail, animals, humans) are difficult to control.

In summary, whole-tree canopy enclosure cages are a new and innovative approach to assessing natural enemies for release against invasive insect pests of trees. These types of enclosures could be used to assess single species or species complexes of natural enemies. This research is expected to enhance our knowledge of the establishment and effectiveness of introduced biological control agents and provide a better understanding of the role of natural enemies in suppressing invasive insect pests. Whole-tree canopy enclosures also could be used to assess other types of tree/organismal interactions.