Overview of the Third Hemlock Woolly Adelgid Symposium (including balsam woolly adelgid and elongate hemlock scale)

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ABSTRACT

While the emphasis of this symposium is the hemlock woolly adelgid (HWA), there are presentations on a closely related insect, the balsam woolly adelgid (BWA) and on an insect frequently found infesting the same trees as HWA, the elongate hemlock scale (EHS). The conference begins with a discussion of the foundation of our science and the challenges of adelgid systematics. Other sessions will discuss economic and ecological impacts, survey and detection, research and technology development, and management. The final presentation will provide a discussion of where we are now and where do we need to go in the research and development of HWA.

ELONGATE HEMLOCK SCALE (*FIORINIA EXTERNA*)

Elongate hemlock scale (EHS) was first reported in 1908 on Long Island, NY (Sasscer 1912). It was introduced from Japan, where densities are much lower than those reported in this country. There are at least 57 host species noted in Connecticut by McClure and Fergione (1977) and McClure (1979), including species of hemlock, cedar, fir, pine, spruce, and yew. The scale is found only on undersides of needles, but the damage is visible from above. EHS is found from North Carolina northward to southern New England and westward to Ohio. The damage includes yellow banding on top of needles and premature needle drop. Concurrent infestations of scales and adelgids hasten hemlock decline, and hemlock borer or *Armillaria* root rot may attack weakened trees.

Presentations on EHS at this symposium will cover classical biological control; natural enemies in the southern Appalachians; management with entomopathogenic fungi; effects of systemic insecticides, a growth regulator, and oil on EHS and associated natural enemies; and reproductive success, mass release and recovery of *Cybocephalus* sp. on EHS.

BALSAM WOOLLY ADELGID: *ADELGES PICEAE* AND HEMLOCK WOOLLY ADELGID: *A. TSUGAE* (HOMOPTERA: ADELGIDAE)

It is interesting to compare the initial significance and spread of hemlock woolly adelgid (HWA) and balsam woolly adelgid (BWA). BWA was found in natural stands of balsam fir in 1908 and in Fraser fir of the southern Appalachians in 1955. Severe mortality was immediately apparent. HWA was found on ornamental eastern hemlock in 1952 or ‘54 in Richmond,

Virginia, and was not considered a serious pest because it was easily controlled with pesticides. HWA became a pest of concern in the late 1980s when it had spread to natural stands. Since then it has caused widespread mortality. Neither adelgid is considered a pest in its native range.

BWA attacks all fir species, but Fraser fir is one of the most susceptible. Usually, mature trees in natural stands are attacked, but trees in Christmas tree plantations are also attacked. The insect can be found on all parts of the tree, but it primarily infests the trunk. Old-growth Fraser fir stands are virtually eliminated, but individual trees still survive. In many cases, vigorous Fraser fir reproduction has replaced the old growth, begging the question what will happen to these trees as they approach the age of maximum susceptibility to BWA. Early research on BWA emphasized biological control. Six European predators are known to be established. They are *Laricobius erichsonii* (Coleoptera: Derodontidae), *Pullus impexus* (Coleoptera: Coccinellidae), *Aphidecta obliterata* (Coleoptera: Coccinellidae), *Aphidoletes thompsoni* (Diptera: Cedidomyiidae), *Cremifania nigrocellulata* (Diptera: Chamaemyiidae), and *Leucopis obscura* (Diptera: Chamaemyiidae). However, there has been no clear demonstration that any of the predators have had a significant impact on BWA populations.

Current research on BWA is emphasizing host factors. BWA presentations at this conference will deal with impacts in the southern Appalachians, host interactions, chemical composition of wood and infested bark, metabolite profiling and microarray analysis of infested and uninfested fir species, and an artificial feeding system development for both adelgid species.

Unlike BWA, HWA will attack all ages of its host in natural stands and, consequently, represents a more serious threat to hemlock than BWA does to fir. Eastern and Carolina hemlock are very susceptible to HWA, while the western and Asian species are not. The basic challenge that we face is to understand why the western and Asian hemlocks are not impacted by HWA the way Eastern and Carolina hemlocks are: is it biological control, host resistance, a combination of the two, or something else? Perhaps the information presented at this conference will begin to answer this question.

The vast majority of presentation will deal with various aspects of HWA. They will include impacts on residential landscapes, recreation areas, and headwater streams; various sampling schemes, use of hyperspectral technology, satellite imagery, and landscape scale models; GIS-based risk assessment, biological and chemical control, host resistance, gene conservation, population dynamics, and use of mitochondrial DNA for determining the range of HWA. During the last session of the conference, management strategies of the various landowners will be covered.

The final topic of the conferences will be a discussion of where we are now and where do we need to go. This will be an assessment, based upon the information presented at this conference, about the HWA Strategic Plan, what has been accomplished, and what still needs to be accomplished.

REFERENCES

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