

Hemlock Woolly Adelgid Effects on Eastern Hemlock Growth and Vulnerability

Research Issue



Eastern and Carolina hemlocks occupy an important ecological niche in both conifer and hardwood forests. The species are very tolerant of shade and therefore are found throughout all layers of the forest canopy. The hemlock woolly adelgid, *Adelges tsugae* (HWA), a tiny sap-sucking insect related to aphids, is causing widespread decline and death of hemlock trees in the eastern United States. The insect literally sucks the life out of the tree, depleting it of nutrients necessary for production of new foliage. Casual observations indicate that the foliage acquires a gray cast, needles drop, and trees die within four years after infestation, although some survive for more than 15 years.

Our Research

To obtain empirical data on the effect of HWA on tree health over several years, plots were established in the Delaware Water Gap National Recreational Area to monitor changes in crown condition, growth, and mortality of hemlock. These changes were monitored by Forest Health Protection and National Park Service personnel. Northern Research Station (NRS) investigators examined the size of tree rings from core samples of infested trees to determine when tree growth slowed down from adelgid feeding. They compared these growth changes in the stem with 10 years of field measurements on tree stems and crowns as tree health declined from adelgid feeding.

Expected Outcomes

Fajvan, M.A.; Wood, P.B. In press. Eastern hemlock forests: Predicting vulnerability to hemlock woolly adelgid (*Adelges tsugae*). In: Rentch, J.; Schuler, T., eds. Conference Proceedings: Ecology and management of high-elevation forests of the central and southern Appalachian Mountains. 2009 May 14-15; Snowshoe Mountain Resort, Slatyfork, WV.

Research Results

At the beginning of the study in 1993, 95 percent of the hemlocks were rated as healthy; by 2004 none of the hemlocks were completely healthy and 24 percent were dead, although some stands declined in health faster than others. The study results indicated that a tree's canopy position, and the amount and condition of its foliage, are useful for predicting which trees are likely to survive longer than others. This information allows forest managers to target trees with these features during chemical, biological, and silvicultural treatments. The HWA vulnerability model has been tested in other stands during the early stages (up to 4 years) of infestation. Evaluation of hemlock crown vigor attributes from these new areas suggests that crown vigor relates to a predictable pattern of hemlock vulnerability at light and moderate levels of HWA infestation.

Rentch, James; Fajvan, Mary Ann; Evans, Richard; Onken, Bradley. 2009. [Using dendrochronology to model hemlock woolly adelgid effects on eastern hemlock growth and vulnerability](#). *Biological Invasions* 11: 551-563.

Williams, David W.; Montgomery, Michael E.; Shields, Kathleen S.; Evans, Richard A. 2008. [Monitoring methods for forests vulnerable to non-native invasive pest species](#). In: Murdoch, Peter S.; Jenkins, Jennifer C.; Birdsey, Richard A. The Delaware River Basin Collaborative Environmental Monitoring and Research Initiative. Gen. Tech. Rep. NRS-25. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 41-51.

Montgomery, Michael E.; Onken, Bradley; Evans, Richard A. 2005. [Monitoring hemlock crown health in Delaware Water Gap National Recreation Area](#). In: Onken, Brad; Reardon, Richard, comps. Third symposium on hemlock woolly adelgid in the eastern United States; 2005 Feb. 1-3; Asheville, NC. FHTET-2005-01. Morgantown, WV: U.S. Department of Agriculture, Forest Service, Forest Health Technology Enterprise Team.

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Research Participants

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