

**THE FOLIAR CHEMISTRY DYNAMIC IN EASTERN HEMLOCK  
AND HOW IT RELATES TO THE COMPETITIVE MECHANISM  
BETWEEN TWO INVASIVE HERBIVORES:  
*ADELGES TSUGAE* AND *FIORINIA EXTERNA***

**Mailea R. Miller-Pierce<sup>1</sup>, Evan L. Preisser<sup>1</sup>, and Dave A. Orwig<sup>2</sup>**

<sup>1</sup>University of Rhode Island, Biology Department, Kingston, RI 02881

<sup>2</sup>Harvard Forest, 324 North Main Street, Petersham, MA 01366

**ABSTRACT**

While invasive species themselves have been examined, little work has addressed the question of competition between two invasive specialists on a shared host. An example of this situation exists in the eastern United States, where eastern hemlock (*Tsuga canadensis*) forests are threatened by two invasive herbivores: the elongate hemlock scale *Fiorinia externa* (EHS) and the hemlock woolly adelgid *Adelges tsugae* (HWA). EHS was introduced into New York City in 1908 and began to spread into southern New England by the mid-1980s. EHS can reduce tree growth and cause premature needle drop in hemlocks. However, mortality is rare and occurs only in already stressed trees. Infestation of HWA is more severe. High HWA densities can kill mature hemlocks in 4 to 15 years. It has been hypothesized that HWA causes a hypersensitive response in eastern hemlocks; if correct, this may explain why HWA has a greater effect on plant growth and survival than otherwise expected. Prior research has shown competition between sap-feeding herbivores increases as plant nutritional quality decreases. We present the results of work assessing whether interspecific

competition occurs between HWA and EHS, and the effect of this interaction on host plant foliar chemistry.

In spring 2007, we inoculated previously uninfested hemlock saplings with HWA only, EHS only, both, or neither herbivore species. In October 2007, March 2008, and October 2008, we measured the impact of each herbivore on the population density of the other species as well as their individual and combined effects on foliar chemistry. Although EHS densities were lower in the presence of HWA, the presence of EHS did not significantly decrease HWA density. The HWA-only foliage was significantly lower in percent N and had a higher C:N ratio than all other treatments. The EHS-only, HWA&EHS, and control treatments did not differ in percent N, percent C or the C:N ratio. Interestingly, resource depletion (measured as percent N) in the HWA-only treatment was significantly higher than in the combined HWA&EHS treatment. Our findings suggest that the presence of multiple herbivore species in this system do not enhance detrimental impacts.