

INTERACTIONS BETWEEN INVASIVE HERBIVORES: *ADELGES TSUGAE*, *FIORINIA EXTERNA*, AND THEIR IMPACT ON EASTERN HEMLOCK GROWTH AND FOLIAR CHEMISTRY

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ABSTRACT

The rapid population growth rates and high population densities of invasive species often leads to strong competition between invasive herbivores (Denno et al. 1995). Eastern hemlock (*Tsuga canadensis*) forests are threatened by two invasive herbivores, the elongate hemlock scale (EHS), *Fiorinia externa*, and the hemlock woolly adelgid (HWA), *Adelges tsugae*. Despite predictions that HWA would largely extirpate hemlocks in southern New England by the late 1990s, healthy hemlock stands still exist in areas where HWA has been present for more than 15 years (Preisser et al. 2008). One possible explanation of the slower rate of hemlock mortality in these areas is the range expansion of EHS into southern New England in the mid-1970s. Although recent surveys have shown hemlock mortality to be more strongly related to HWA density than to EHS density (Preisser et al. 2008), the interactions between these two species remain largely unexplored (McClure 2002).

In spring 2007, we inoculated previously-uninfested hemlock foliage with one, both, or neither herbivore species. After four months, 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. EHS densities were significantly lower in the presence of HWA; however, EHS had no impact on HWA density. In terms of foliar chemistry, we found HWA-infested foliage (in both the HWA and HWA+EHS treatments) was lower in percent nitrogen (%N) and had a higher carbon-to-nitrogen (C:N) ratio than uninfested foliage. In contrast, the EHS and control treatments did not differ in %N and C:N ratio. These findings represent the first part of a three-year study to determine the impact of these species' interactions at a landscape level over time.

REFERENCES

Denno, R., M. McClure, and J. Ott. 1995. Interspecific interactions in phytophagous insects: competition reexamined and resurrected. *Annual Review of Entomology* 40:297-331.

- McClure, M. 2002. The elongate hemlock scale, *Fiorinia externa* Ferris (Homoptera: Diaspididae): a new look at an old nemesis. Pp. 248-253 in Onken, B., R. Reardon, and J. Lashomb (eds.), Proceedings: Symposium on Hemlock Woolly Adelgid in the Eastern United States, February 5-7, 2002, East Brunswick, NJ. New Brunswick, NJ: Rutgers University.
- Preisser, E., A. Lodge, D. Orwig, and J. Elkinton. 2008 Range expansion and population dynamics of co-occurring invasive herbivores. *Biological Invasions* 10(2):201-213.