Relationships of Eastern Hemlock (Tsuga canadensis) to the Ecology of Small Streams in Delaware Water Gap National Recreation Area

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Abstract

Hemlock ravines in Delaware Water Gap National Recreation Area (DEWA) are highly valued because of their distinctive aesthetic, recreational and ecological qualities. We conducted a comparative study designed to determine the potential long-term consequences to aquatic communities of the suspected transition from hemlock-dominated forests to mixed hardwood forests as a result of hemlock woolly adelgid (HWA; *Adelges tsugae*) induced mortality. A landscape analysis of DEWA using Geographic Information Systems (GIS) was used to select 14 hemlock and hardwood site-pairs that were similar in topography (i.e., slope, terrain shape, aspect, light levels) and stream size (first or second order) but differed in forest composition. This paired watershed approach provided a powerful means to discern the influence of hemlock forests on stream communities. This study was designed to provide an aquatic perspective on potential losses of biological diversity should hemlock forests die.

Streams draining hemlock forests supported more aquatic invertebrate species than streams draining hardwood forests. Fifteen of the 184 invertebrate taxa collected were strongly associated with hemlock, three of which were found only in streams draining hemlock. The trophic composition of aquatic invertebrate communities also was different between forest types, suggesting that ecosystem function also may be disrupted by changes in forest composition. Additionally, streams draining hemlock forests had a higher proportion of predators and lower proportion of grazing invertebrates than corresponding hardwood forests. Similarly, fish trophic structure differed, with streams draining hemlock supporting a significantly larger number of predators. In contrast, fish diversity and abundance were higher in streams draining hardwood forests although brook trout was more common in streams draining hemlock. Habitat data collected concurrently suggests hemlock modifies the stream environment by creating a larger variety of microhabitat types and/or a more stable thermal and hydrologic regime. Based on these results, we predict a significant decline in average within-site and park-wide diversity should widespread hemlock mortality result from the HWA infestation.

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