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### Fire Regime Dynamics Following the Mid-Holocene Hemlock Decline in Eastern North America

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**Abstract**  
Approximately 5,000 years ago, eastern hemlock (*Tsuga canadensis*) experienced a sudden, rapid, range-wide decline most probably due to pest, disease, or climate change. An aphid-like defoliating insect, the hemlock woolly adelgid (*Adelges tsugae*), recently (1950's) introduced to eastern North America has been spreading across the eastern United States. The adelgid attacks all size and age classes of hemlocks causing up to 95% mortality in affected stands. The potential for another range-wide hemlock decline has raised a number of concerns including the increased threat of wildfire. Altered fuel loadings in modern adelgid-affected stands and the effects of presumably similar changes in fuels and subsequently altered fire regimes following the prehistoric decline are examined. Fuels data from an adelgid-infested stand in Connecticut and an uninfested stand in Massachusetts were used to generate custom fuel models and predict fire behavior in each stand. Sediment cores were extracted from three sites in western Massachusetts and analyzed for fossil pollen and charcoal around the period of the prehistoric decline.

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Fossil data from two previously studied sediment cores from coastal Maine are included in the analysis. Results demonstrate a clear and highly significant increase in both fuel loadings and predicted fire behavior in the modern, adelgid-affected stand. Three of the coring sites reflect distinct, significant, short-lived increases in charcoal associated with the prehistoric decline; two do not. Results from the first three sites suggesting increased fire activity also were associated with changes in vegetation which indicate disturbance. Increased fire activity after the decline seems most pronounced in areas where fire was common before the decline. Results indicate that fire was not universally a significant factor driving post-decline succession. Research across a broader geographic area is needed to clarify the relationship between fire and hemlock following the mid-Holocene decline, but the results presented here suggest that managers of modern stands affected by the adelgid should include the possibility of intense fires as a threat to landscapes heavily affected by hemlock decline.

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