Mortality of Ash in Forested Riparian Zones Drives Prolonged ET Depression and Hydric Soil Formation

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Abstract

Emerald ash borer (EAB) (*Agrilus planipennis* Fairmaire), an invasive, phloem-feeding beetle native to Asia, has killed hundreds of millions of ash (*Fraxinus* spp.) trees in the USA and Canada since it was detected in southeast Michigan in 2002. Consistently high mortality of black ash (*Fraxinus nigra*) and green ash (*F. pennsylvanica*) is a particular concern given the role both species play in regulating soil moisture and shallow groundwater levels in riparian forests. Here we present the first longitudinal observations documenting hydrologic effects resulting from EAB-caused ash mortality in a riparian zone at the W.K. Kellogg Experimental Forest in southwest Michigan. From 2018-2022, we monitored soil moisture, depth to groundwater and meteorological observation at 15-min intervals throughout the growing season in two adjacent plots (gap, forest) in the Augusta Creek riparian zone. We estimated groundwater evapotranspiration (ET $_G$) using a groundwater level fluctuation (WLF) method. Significant differences in volumetric soil moisture content (16-26% higher in the gap than forest), average depth to water (10 cm in the gap vs 70 cm below land surface in the forest) and mean daily ET $_G$ (0.6 in the gap vs 3.0 mm per day in the forest) persisted across four growing seasons. Prolonged saturation of the near surface is driving hydric soil formation, contributing to an ecosystem regime shift from forested riparian to herb and sedge-dominated wetland. These changes have important implications for riparian zone ecosystem services including nutrient cycling, sediment transport, and greenhouse gas emissions, especially when considering the extent of ash mortality already sustained in much eastern North America.

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