Hydrologic Responses of High Elevation Watersheds to Mountain Pine Beetle

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Abstract

The hydrologic effects of human-caused land or vegetation cover changes are well documented. However, the spatial and temporal variability of natural land cover changes such as tree mortality caused by insect outbreaks make these hydrologic changes more difficult to measure and interpret. Since 1995, Colorado's high-country watersheds have been experiencing landcover changes due to the mountain pine beetle epidemic sweeping the Rocky Mountain region. This study combined annual aerial survey geographic information system (GIS) data on insect-caused tree mortality from the USDA Forest Service with annual streamflow data from US Geological Survey gauges to examine the hydrologic effects on high elevation forested watersheds resulting from beetle-induced vegetation cover changes.

A GIS analysis allowed us to quantify the cumulative beetle damage by year to over 20 watersheds in north-central Colorado and southern Wyoming. The study then takes the approach of a paired watershed experiment, comparing a "control" watershed with minimal beetle impact to watersheds with heavier beetle activity, and using an analysis of covariance (ANCOVA) procedure to determine if there are changes in hydrologic variables, including annual water yield, instantaneous peak flow, and timing of peak flow. Preliminary results are mixed. Most watersheds show no statistically significant response as assessed by existing streamflow records, while some watersheds do show increased annual water yields. Additional watershed characteristics and spatial metrics are being investigated to improve our understanding of hydrologic effects of beetle killed forests on water resources.