

Disturbance severity and post-disturbance biomass recovery in western subalpine forests: a comparison of bark beetle outbreaks and wildfires

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Forested landscapes throughout the West are periodically affected by fires and bark beetle outbreaks of different severity, extent, and spatial configuration. Rates of vegetation biomass recovery can influence important ecological processes like ecosystem carbon balance but are typically difficult to assess because of a lack of long-term data over large areas. We analyzed remote sensing data in a chronosequence framework to address the following question: how does disturbance type (fire vs. bark beetles) and severity (low vs. high) influence post-disturbance rates of vegetation biomass recovery in the Greater Yellowstone Ecosystem (GYE)? From knowledge of disturbance effects on forest components and post-disturbance recovery mechanisms, we hypothesized that biomass recovery rates would be explained by an interaction of disturbance type and severity. Specifically, we expected higher recovery rates in low-severity burns than in high-severity burns, and lower recovery rates in low-severity bark beetle infestations than in high-severity infestations. We used a 9-year (1999-2007) time series of Landsat imagery coupled with field data to estimate forest biomass across the GYE landscape. We then sampled pixels from the satellite images according to their disturbance type, disturbance severity, and time-since-disturbance, using as a template historical fire and bark beetle infestation maps (US Forest Service and National Park Service) derived from aerial mapping and photointerpretation. Analyzing multiple short time series according to their time-since-disturbance allows quantification of changes in forest characteristics over large areas and long time scales, effectively combining the advantages of remote sensing, chronosequence approach, and time series analysis. These results will increase our ability to predict the effects of potential changes in the frequency and severity of disturbances on ecosystem resilience and landscape stability and equilibrium.

273 words

keywords: fires; bark beetle infestations; insect outbreaks; remote sensing; forest succession