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Is Increased Fire Frequency Likely to Erode Resilience of Lodgepole Pine Forests in Yellowstone?

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Novel fire regimes have the potential to erode forest resilience (ability to tolerate disturbance without shifting to a new state) in fire-prone forest landscapes. In Greater Yellowstone (Wyoming, USA), lodgepole pine (*Pinus contorta* var. *latifolia*) forests have been highly resilient to large, stand-replacing fires that historically burned at 100 to 300-yr intervals. However, fire-return intervals (FRI) are projected to decline substantially by mid-century as climate warms, increasing the likelihood that forests will re-burn prior to recovery from previous fire. Opportunities to study ecological effects of short-interval fires remain rare in any landscape, but the Yellowstone fires of 2016 included >18,000 ha of short-interval (<30 yrs) fire. During summer 2017, we studied young lodgepole pine stands that re-burned as stand-replacing fire (16 and 28-yr FRI) and asked whether short-interval fires were associated with increased burn severity (e.g., tree mortality, charred surface cover), decreased initial postfire tree regeneration, and reduced woody carbon storage. Similar to long-interval fires, short-interval fires created a mosaic of fire severities, but the range of stand-replacing burn severities expanded to include areas of extremely high burn severity. Prefire biomass (e.g., trees, downed wood) was completely combusted in some re-burned stands--which had not been observed in long-interval fires. Postfire tree seedling density in re-burns declined with increasing burn severity and was 72-99% less than regeneration after the previous (long-interval) fire. Tree seedlings were recorded in all re-burned stands, but our data indicate conversion from high-density (>70,000 stems/ha) to sparse (<1000 stems/ha) forest in short-interval, high-severity burns far from unburned forest. Postfire coarse wood abundance declined similarly with increasing fire severity, indicating substantial reductions in carbon stocks. Short-interval fire was alone insufficient to catalyze a transition to non-forest, but more extreme and variable burn severity plus slower forest recovery may indicate erosion of forest resilience in the Yellowstone landscape.

Key words: Disturbance regime; reburns; subalpine forest; Northern Rocky Mountains; climate change