Surface and canopy fuels vary widely in 24-yr old postfire lodgepole pine forests

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Extreme fire seasons have become common in western North America, and the extent of young postfire forests has grown as fire frequency and annual area burned have increased. These young forests will set the stage for future fires, but an assessment of fuel loads in young forests is lacking. The rate of fuel re-accumulation and fuels variability in postfire forest landscapes is needed to anticipate future fire occurrence and behavior in the American West. We studied fuel characteristics in young lodgepole pine forests that regenerated after the 1988 fires in Yellowstone National Park to address two questions: (1) How do surface fuel characteristics change with time-since-fire? (2) How do canopy and surface fuels vary across the Yellowstone landscape 24 years postfire? During summer 2012, we re-measured surface fuels in 11 plots that were established in 1996 (8 yrs post fire), and we measured surface and canopy fuels in 82 stands (each 0.25 ha) distributed across the Yellowstone post-1988 fire landscape. In the remeasured plots, surface fuel loads generally increased over the last 16 years. One-hr fuels did not change between sample dates, but all other fuel classes (i.e., 10-hr, 100-hr, and 1000-hr) increased by a factor of two or three. Within the sample timeframe, variability of fuel loads within stands decreased significantly. The coefficients of variation decreased for all fuel classes by 23% to 67%. Data from the 82 plots revealed that canopy and surface fuels in 24-year-old stands varied tremendously across the Yellowstone landscape. Live tree densities spanned 0 to 344,067 trees ha-1, producing a mean available canopy fuel load of 7.7 Mg ha-1 and a wide range from 0 to 47 Mg ha-1. Total surface fuel loads averaged 130 Mg ha-1 and ranged from 49 to 229 Mg ha-1, of which 90% was in the 1000-hr fuel class. The mass of fine surface fuels (i.e., litter/duff, 1-hr, 10-hr, and herbaceous fuels) and canopy fuels (i.e., foliage and 1-hr branches) were strongly and positively related to tree density. In contrast, the mass of coarse fuels (100-hr and 1000-hr fuels) was most related to pre-fire stand structure and site productivity. Crown base height averaged 0.42 m ranging from 0.02 to 1.17 m and was positively related to tree density due to density dependent self-pruning. Our data indicate that that much of the forest that regenerated after the 1988 fire already has adequate fuel to carry fire, and given suitable fire weather, fuel loads in many stands are sufficient to support active crown fire. Should fire occur in these young forests, substantial heterogeneity in canopy, surface and total fuels suggest variability in fire behavior and severity. Fuel mosaics in young forests will increasingly influence fire activity in western forests as climate continues to warm and fire rotations decline.