

Are spatial patterns of burn severity changing with warming climate and increasing wildfire?

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The last three decades have seen a sharp rise in wildfire activity across the western US (e.g., number of large fires, total area burned), but little is known about how spatial patterns of wildfire may also be changing (e.g., patch size and shape of severe [stand-replacing] fire). Spatial heterogeneity of burn severity is ecologically important, particularly in areas of stand-replacing wildfire where the burn mosaic creates patterns, such as distances to seed source, which can affect post-fire forest reestablishment. Anecdotal reports have suggested that recent wildfires are burning with more homogenous patterns of large, severe burn patches, but little research has tested for changes in the spatial heterogeneity of burn severity over time and space.

We used a spatially extensive network of post-fire field measurements ($n = 371$ plots) and satellite measures of burn severity (RdNBR) to generate maps of stand-replacing fire (> 90% of pre-fire live tree basal area was killed by fire) for all forested areas in the Northern Rockies (USA) from 1984 to 2010. We used these field-calibrated maps to test for changes over time in landscape metrics of stand-replacing fire. Specifically, we asked whether the composition (e.g., proportion that burned as stand-replacing) and configuration (e.g., stand-replacing burn patch size and shape) have changed over this period of increased wildfire activity.

Stand-replacing fire was mapped reasonably well (71% overall accuracy). The mean proportion of stand-replacing burned area within wildfires increased from 25 to 30%, and the edge-to-area ratio of stand-replacing burn patches decreased from approximately 800 to 750 meters per hectare. Despite these trends, the mean patch size of stand-replacing fires did not change over time (12.5 hectares), nor did the mean amount of stand-replacing fire that was more than 150 meters from the edge of a stand-replacing burn patch (380 hectares per fire). These results indicate that recent increases in fire activity are associated with an increase in the proportion of fires burning as stand-replacing fire but no change in the size and shape of patches of severe fire; rather heterogeneity of burn severity has remained relatively constant over the period 1984-2010. As fire-generated heterogeneity is integral to post-fire forest recovery processes and maintenance of forest ecosystem services, our results are encouraging for management of post-fire landscapes.