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Warmer climate and increased fire frequency in Greater Yellowstone: Does field evidence suggest that forest resilience could change?

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Background/Questions/Methods
Two of the most important changes anticipated for Rocky Mountain forests in coming decades are warming climatic conditions and increased fire frequency. These changes could potentially compromise forest resilience through at least two mechanisms. First, warmer and drier conditions in the years after fire could depress postfire tree seedling establishment and thus subsequent carbon recovery, even with an abundant seed source. Second, increased fire frequency could (a) reduce postfire tree regeneration if fires recur before seed supply is replenished in developing stands, and (b) reduce carbon storage if legacy wood from previous fires is combusted in the subsequent fire. In this study, we asked whether any field evidence is consistent with these potential mechanisms of forest change following recent stand-replacing fires in Greater Yellowstone (Wyoming, USA). We sampled postfire tree seedling density, vegetative cover, and coarse wood biomass in 0.25-ha plots two years after the Glade and Moran Fires of 2000 (n = 10 plots) and the Bearpaw Fire of 2009 (n = 8 plots). Changes in climate and fire over the past three decades in Greater Yellowstone have been well documented, and extensive data collected after the 1988 fires provide a valuable baseline for comparison.

Results/Conclusions
The Glade and Moran Fires burned mature forests (*Pinus contorta* or *Picea engelmanii-Abies lasiocarpa*) and were followed by unusually dry conditions. Relative to comparable areas burned in 1988 (which was followed by average climate), postfire coarse wood abundance was similar, but postfire tree seedling establishment was 10 to 100 times lower, despite high prefire serotiny. The Bearpaw Fire re-burned *Pinus contorta* forests only 28 years after a previous fire and was followed by average climate. Relative to comparable areas burned in 1988, postfire tree seedling establishment was of similar magnitude (11,600 seedlings ha^{-1}), suggesting adequate seed supply. Postfire coarse wood abundance was similar to amounts recorded in young forests that re-burned in 1988 but 50-75% lower than in mature forests that burned in 1988 or 2000. Although the number of sampled fires was small, these results are consistent with warm, dry conditions subsequent to fire depressing postfire tree establishment, and with short-interval fires reducing carbon storage via increased combustion of legacy wood. Monitoring postfire tree establishment and carbon storage in many different future fires will be needed to fully evaluate these mechanisms, and such studies may be critical for detecting when and where Rocky Mountain forests could be changing qualitatively.