

Fire and climate interact to foster an expansion of seedling aspen after the 1988 Yellowstone Fires

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Background/Questions/Methods

In many forested landscapes, understanding effects of disturbance and warming climate on tree-species distributions is an increasingly pressing issue. Fire can trigger rapid reorganization of biotic communities and may interact with changing environmental conditions to alter species' distributions. Following the severe 1988 wildfires in Yellowstone National Park, WY, aspen seedlings (*Populus tremuloides*) unexpectedly established throughout burned lodgepole pine (*Pinus contorta*) forests, well beyond their historical range. This recruitment event provided an opportunity to evaluate postfire aspen persistence and performance as climate warmed across a large landscape. We re-sampled permanent plots to ask: How do presence, persistence, density, and size of aspen seedlings vary across the postfire landscape, and what factors (e.g., climate, competition, browsing, soils) explain these patterns? We expected aspen to have declined in locations farther from prefire aspen and where competition with lodgepole pine or browsing pressure was high. In areas burned in 1988, we sampled 72 widely distributed 0.25-ha plots to quantify aspen presence, persistence and density in 1999 and 2012. We recorded aspen size (i.e., height and basal diameter) at 22 smaller plots in 1996, 2000, and 2013. Regressions evaluated effects of climate, soils, and lodgepole pine competition on aspen response variables.

Results/Conclusions

Aspen seedlings occurred in 45 of 72 plots in 1999 with a mean density of 522 stems/ha, where present. Aspen persisted to 2012 in 26 plots; mean density declined to 280 stems/ha. In 1999, aspen were present at warmer 1990-1999 mean growing-season temperatures. By 2012, aspen persisted at cooler locations; 2003-2012 mean growing-season temperature warmed approximately 1°C, compared to 1990-1999. Aspen density and persistence were unrelated to lodgepole pine productivity. Aspen height nearly doubled between 1996 and 2013 (from 29.0 to 58.0cm), and basal diameter increased (from 7.0 to 9.7mm.) Aspen height and diameter were positively related to soil pH and unrelated to lodgepole pine in all years. Ungulate browsing was high (>80% of individuals) in 1996 and very low (<3%) in 2013, suggesting release from herbivory. Aspen height and diameter declined with distance to prefire aspen in 1996, but increased with distance in 2013. After 25 years, stand-replacing fires, followed by climate warming, appear to have facilitated aspen expansion into sites unoccupied before 1988. Aspen have thrived far from their prefire distribution, with negligible effects from lodgepole pine. As climate warms, expansion or contraction of tree species distributions in western forests may be evident during recruitment windows following wildfires.