Ecological filters mediate postfire expansion of seedling aspen (*Populus tremuloides*) in Yellowstone

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Background/Questions/Methods.

Determining how ecological filters (e.g., climate, soils, competition, herbivory) influence where species succeed in heterogeneous landscapes is challenging if environmental conditions are changing. Opportunities to study effects of ecological filters on tree-species distributions are particularly rare, because trees are long lived and may persist through gradual environmental change. Stand-replacing fires create opportunities for tree-species establishment and can accelerate forest response to environmental change. Following severe 1988 wildfires in Yellowstone National Park (WY), aspen (*Populus tremuloides*) seedlings established throughout burned lodgepole pine (*Pinus contorta*), beyond their historical distribution. We resampled the postfire aspen cohort to ask: *What ecological filters have shaped patterns of aspen seedling presence, density, and size across the postfire landscape?* We hypothesized that aspen presence and density would be strongly influenced by climate and herbivory during early postfire years, but soil conditions and lodgepole-pine competition would become increasingly important for aspen persistence and size. Within 1988 fire perimeters, we recorded aspen presence and density in 1999 and 2012 at 72 0.25-ha plots. We measured aspen size at 22 smaller plots in 1996, 2000, and 2013. We also excavated aspen individuals in 1996 and 2014 to characterize root and clonal development. Effects of ecological filters were assessed with regressions. <<200 words>>

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 310 stems/ha. Aspen height nearly doubled between 1996 and 2013 (from 29 to 59 cm), and basal diameter increased (from 7.2 to 9.7 mm). Climate and fire severity influenced aspen presence in 1999, but only soil fertility was correlated with aspen persistence from 1999 to 2012. Soil pH was positively correlated with aspen size. Ungulate browsing declined over time, indicating release from herbivory, and lodgepole-pine density became increasingly important and negatively correlated with aspen stem and root size. Clonal development has been substantial; only 10% of excavated aspen had ramets in 1996, compared to 70% with ramets in 2014. Collectively, warming climate, declining ungulate browsing, increasing lodgepole pine competition, and variation in soils have facilitated postfire expansion of seedling aspen into areas of the landscape unoccupied by aspen before 1988. Understanding the fate of colonizing tree cohorts in heterogeneous landscapes, across which ecological filters vary, provides powerful and broadly applicable insights into how species distributions are shaped over time. <<189 words>>