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# Changing climate and novel fire regimes alter tree recruitment and postfire succession in northern conifer forests

Monica G. Turner and Jill F. Johnstone

**Background/questions/methods**
Global change drivers are altering ecosystems and natural disturbance regimes in ways that may produce novel trajectories in regional ecosystems during the 21st century. In northern conifer forests, changing fire regimes could interact with climate warming to alter postfire succession qualitatively. Understanding ecological mechanisms that underpin potential successional changes is needed to detect impending shifts and anticipate the future state of forest landscapes. However, it remains difficult to determine whether forests are transitioning to new states when disturbances (e.g., stand-replacing fires) are relatively infrequent, and processes (e.g., forest succession) play out slowly. Whether increased fire activity will alter succession will depend on how well forests have recovered from prior disturbances when affected by fire and whether recovery capacity has been reduced, both of which may be affected by changing climate. Additionally, fire size and severity will interact with species' functional traits. Relay dynamics play a limited role in many northern conifer forests, and consequently patterns of initial community assembly strongly shape subsequent succession. Based on field evidence from recent fires in conifer forests of Greater Yellowstone, Alaska, and Yukon Territory, we propose four mechanisms that can alter postfire tree recruitment and thus change succession.

**Results/conclusions**
First, increased disturbance frequency can compromise tree recruitment if disturbance intervals are less than those required to produce an adequate seed crop. Short-interval fires were associated with substantially reduced regeneration of lodgepole pine (*Pinus contorta* var. *latifolia)* in Yellowstone and black spruce (*Picea mariana*) in Alaska and Yukon. In large stand-replacing fires in Yellowstone, Douglas-fir (*Pseudotsuga menziesii)* recruitment was absent where recent pre-fire bark-beetle outbreaks had killed mature trees and reduced seed supply. Second, increased disturbance severity can reduce seed supply and/or alter environmental conditions for tree establishment. Increased fire severity in Alaskan black spruce forest was associated with shifts to deciduous-dominated successional trajectories dominated by species capable of postfire resprouting. Third, increased extent of severe fire can alter tree regeneration if patch sizes exceed effective seed-dispersal distances. Douglas-fir seedlings in Yellowstone established only near live, mature trees in large stand-replacing fire patches. Fourth, even if propagules are available, unfavorable climate during early postfire years can change succession. In Yellowstone, lodgepole pine regeneration was 98% lower when fire was followed by subsequent-year drought. Multiple mechanisms may catalyze rapid change in postfire landscapes. Regional-scale studies of early succession following recent fires can reduce key uncertainties regarding future ecosystem structure and resilience.