ABSTRACT

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Looking beyond the mean: Drivers of variability in postfire stand development of Rocky Mountain conifers

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Abstract

High-severity, infrequent fires in subalpine forests shape landscape mosaics of stand age and structure for decades to centuries, and forest structure can vary substantially even among same-aged stands. We used a individual-based forest process model (iLand) to ask: *(1) How do early postfire regeneration density, climate, and soil characteristics influence among-stand variation in structure (stand density, basal area) of same-aged forest stands over stand development, and (2) How does the relative influence of these drivers vary among species?* We parameterized iLand for lodgepole pine (*Pinus contorta* var. *latifolia*), Douglas-fir (*Pseudotsuga menziesii* var. *glauca*), Engelmann spruce (*Picea engelmannii*), and subalpine fir (*Abies lasiocarpa*). Simulations were initialized with field data on regeneration following stand-replacing fires in Greater Yellowstone, and stand development was simulated for 300 years under current climate without further disturbance. We expected variation in regeneration density to drive structural variability among young stands and variation in climate and soils to become increasingly important as stands aged. We expected regeneration to influence stand structural variability of lodgepole pine more than other conifers, due to its wider range of initial stem densities. Simulated stand structures fell within observed ranges, and among-stand variation persisted over time. For over 75 years postfire, variation in stand densities was due primarily to initial differences in regeneration density. Climate or soils were more important drivers of variation in Douglas-fir, Engelmann spruce, and subalpine fir stand densities by 170 years postfire, but early regeneration densities had the greatest influence on among-stand variation in lodgepole pine densities for nearly 300 years. Among-stand basal areas converged faster than densities, and by 50 years postfire, climate was a more important driver of variation in lodgepole pine basal area than early regeneration density. Understanding dynamics of postfire stand development is increasingly important for anticipating future landscape patterns as fire activity increases.

Keywords: Stand structural variability; stand development; process-based modeling; Greater Yellowstone Ecosystem; fire