Climate and logging history influence native forest herb performance in the Southern Appalachians

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Background/Question/Methods

Land-use legacies are known to affect the composition of native plant populations, and climate warming has resulted in range shifts for many species in mountainous regions. However, few studies have examined how these two drivers interact. Forest herbs comprise the majority of diversity in temperate forests and many studies have shown that certain species are slow to recover from past disturbance. Most studies assessing drivers of plant distributions use surveys of adult presence and abundance, but performance measures may be more indicative of a species' sensitivity to changing conditions. We assessed the relative roles of climate and stand age on the performance of native forest herbs in the Southern Appalachians. We identified populations of 4 species (*Arisaema triphyllum, Caulophyllum thalictroides, Prosartes lanuginosum,* and *Sanguinaria canadensis*) within 20 plots spanning gradients of stand age and temperature. "Old" forests were logged prior to 1910, and "young" forests were logged after 1970. We measured morphological characteristics and life-history stage of the same individuals over three consecutive years (2009-2011). 2010 was an abnormally dry spring, while spring 2011 was abnormally wet. We evaluated the effects of stand age, temperature, and other environmental variables on growth (change in above-ground biomass), recruitment, mortality, density, and biomass-allocation.

Results/Conclusions

Across years, young forests were associated with lower recruitment, higher within-plot variability in recruitment, higher mortality, and higher leaf area-to-stem ratios (three species), lower densities (two species), and reduced flowering (one species). Growth varied among species and with stand age during the dry spring, but was unaffected by stand age during the wet spring, indicating that plant growth may be more sensitive to land-use history during periods of drought. In young forests, warmer temperatures increased recruitment and flowering for one species and growth for two species. The effects of temperature were reduced in old forests; thus, climate warming may benefit some species in young forests. However, older forests may provide a buffer against sensitivity to temperature, and appear to enhance plant performance overall. Mortality was higher for all species following the dry year and at higher temperatures for three species across both stand ages. Our results suggest that land-use legacies such as timber harvesting may negatively affect plant performance at various life-stages, and that performance measures can be valuable indicators of a population's ability to persist and recover following disturbance.