

Water availability and disturbance structure tree populations at a desert springs complex

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Desert springs are rare ecosystems that function as centers of productivity and biodiversity, providing crucial ecosystem services to wildlife and humans in arid ecosystems. These areas are highly sensitive to water availability, which is likely to decrease with climate change. Trees are a dominant feature of some desert springs complexes, including Ash Meadows National Wildlife Refuge in the Mojave Desert. Our primary research goal is to identify the environmental factors and ecological processes controlling tree distributions at Ash Meadows to understand how these trees may respond to climate change. Here, we examine how water availability, land use, and fire structure tree populations. We mapped and classified trees by species, size, and vigor at field plots and used point pattern analysis to quantify tree establishment and mortality patterns within each plot. We then modeled tree population dynamics as a function of depth to groundwater, surface water, historical land use for agriculture, and recent fires using generalized linear models. Water availability strongly affected tree population processes at Ash Meadows. Distributions of the dominant tree species were structured by water availability, with velvet ash (*Fraxinus velutina*) dominant on wetter sites, screwbean mesquite (*Prosopis pubescens*) on intermediate sites, and honey mesquite (*P. glandulosa*) on the driest sites. Establishment of velvet ash was fairly continuous on wet sites and establishment of all species was more episodic on drier sites. Mortality also appeared to have been episodic, with large numbers of dead trees of similar size within some plots. Some of these mortality patches were associated with recent fires, but most are likely due to recent drought events. Decreased water availability associated with a warmer, drier climate is likely to shift tree species distributions to mesquites over ash, and lead to greater fluctuations in tree cover as a result of episodic mortality and establishment.