Distributional responses of desert trees to climate change: factoring in disturbance legacies and dispersal limitations

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Spatial distributions of trees develop from complex interactions between population processes, environmental conditions, and disturbance over long time periods, frequently resulting in a disparity between the potential and actual distributions of a species. These disparities reduce our ability to predict shifts in distribution in response to climate change. We used object-based classification of LiDAR and QuickBird data to develop maps of individual trees for velvet ash (*Fraxinus velutina*), honey mesquite (*Prosopis glandulosa*), and screwbean mesquite (*P. pubescens*) at Ash Meadows National Wildlife Refuge, a desert springs complex in southern Nevada. Maps representing the potential distribution of each species were developed from greenhouse and field experiments identifying the probability of seedling establishment in relation to water availability and salinity. We found discrepancies between the actual and potential distributions, reflecting unidentified effects of population processes, environmental conditions, and disturbances. We focused on seed dispersal, fire, and human land use as potential explanations for these discrepancies. We used our tree distribution maps to develop seed dispersal probability response surfaces for wind-dispersed velvet ash using measured seed dispersal distances, and for gravity- and animal-dispersed mesquite species, using locational data for coyote scat. A map of fire probability was based on recent fire occurrences and site environment. Roads, agriculture, hydrological alterations, and mining were extracted from aerial photos. Based on the spatial location of discrepancies between the actual and potential distributions, land use appears to have the greatest effect on the distribution of velvet ash, while seed dispersal has the greatest effect on honey and screwbean mesquite distributions. These results suggest how even similar species may respond idiosyncratically to climate change due to differing responses to changing water availability, affecting their potential distributions, and changing land use and fire regimes, which affect their realized distributions.