Shrub Expansion in Northern Chihuahuan Desert Grasslands: Spatial Patterns of Transition and Biophysical Constraints

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Among the greatest contemporary threats to the structure, function and biological diversity of desert grassland and shrub savanna ecosystems of the southwestern United States is the displacement of mesophytic grasses by xerophytic woody plants. Through a combination of field sampling and spatial modeling we sought to create a predictive understanding of the biophysical conditions under which grasslands are converted to shrublands. We asked: What are the physiographic settings of persistent grass or shrub patches and what environmental factors contribute to their persistence? In communities that are a mosaic of grass and shrub patches, which of these are stable and which are in the process of transitioning to shrub dominance? We characterized landscape-scale perennial plant cover across grassland-to-shrubland gradients within the Jornada Basin near Las Cruces, NM. Changes in shrub and perennial grass patch structure and distribution were quantified using time-series aerial photography (1940s-2000s). Soil was characterized to 150 cm or to restrictive calcium carbonate horizon and the relationships between perennial plant assemblages and soil characteristics were explored using multivariate statistics. Field survey and aerial photography data were then used to develop a model of patch structure dynamics focused on characterizing patterns of vegetation structure and cover that indicate future shifts in shrub-grass abundance. Remnant grass patches were associated with petrocalcic and argillic horizons. Expansion of shrub patches was dependent on local soil characteristics and the context of the surrounding landscape (e.g., landform and adjacent vegetation structure). The signatures of soils and landscape position can be used to distinguish at-risk areas from areas with high, inherent grassland or savanna resilience.

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