Introduction

Among the greatest contemporary threats to the structure, function, and biological diversity of desert grassland and shrub savanna ecosystems is the displacement of mesophytic grasses by xerophytic woody plants. Information needed by land managers falls into two categories: (i) how to prevent shrub encroachment; and (ii) how to restore grasslands once shrub encroachment has occurred. Managers need to anticipate which landscapes are most susceptible to shrub encroachment and which are most likely to be restored once shrub encroachment has occurred. Information currently available from traditional inventory and monitoring programs and small-scale, short-term field experiments is not sufficient to make these predictions.

In order to develop a predictive understanding of shrub encroachment and grassland restorability, we are quantifying:

(i) identifying the biophysical properties of grasslands that put them at risk to woody plant invasion; and
(ii) characterizing the properties of shrub-invaded grasslands that make them suitable candidates for restoration.

Here, we have focused on the first goal and asked:

- What soil characteristics are correlated with the occurrence of persistent grass patches (i.e., those that are unw rapped by shrubs)?
- Can an understanding of historic spatial patterns of shrub expansion help us predict future landscape change?

Assembling Spatial and Plot Data

Site: Jornada Basin Long-Term Ecological Research site near Las Cruces, NM.

Land cover of a 11,700 ha area was digitized from aerial photography (1942) and a Quickbird satellite image (2003) using a combination of hand digitization and image-segmentation software (eCognition). Land cover classes/states included grass, grass-shrub mix, degraded shrub coppice (undeveloped), and dunes. 

Regional setting of the landscape.

- Grass
- Grass–Shrub mix
- Mesquite Coppice
- Dunes

Mesquite cover is constrained by amount of clay in the soil.

Conclusions

- Biophysical properties can be used to understand shrubland encroachment patterns and rates, and generally, spatial patterns of ecosystem resilience. For example, we discovered that remnant grass patches were associated with restrictive soil horizons.
- Shrubland expansion is highly spatially organized, likely due to the interaction of spatial processes (related to shrub colonization and wind-driven soil erosion) with soil heterogeneity and landscape context.
- The patterns revealed here suggest that predictive models of shrubland expansion can be developed.