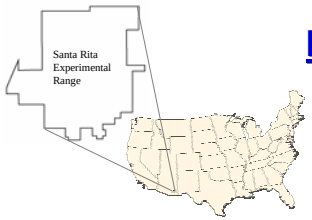
Dawn M. Browning [1], Steven R. Archer [1], Gregory P. Asner [2], Mitchel P. McClaran [1], and Carol A. Wessman [3]

Land use and soils: Impacts on woody cover assessments. A case study in southeastern Arizona

Figure 1. Repeat ground photography on Santa Rita Experimental Range (SRER) available online at: http://ag.arizona.edu/srer/



Environmental Issue:

- The abundance of trees and shrubs (woody plants) in grasslands and savannas (rangelands) has increased worldwide over the past 100 yrs.
- Little is known of the rates and spatial patterns of this shift in physiognomy.
- Woody plant encroachment is a potentially important but largely unknown facet of the North American carbon cycle.

Objectives:

- Quantify temporal changes in cover of velvet mesquite (*Prosopis velutina*) in desert grasslands of southwestern USA using repeat aerial photography
- Describe the spatial patterns of change at landscape scales
- Interpret changes in light of soils and land management

Approach:

- Supervised classification of time-series and texture analysis to delineate shrub vs. non-shrub patches on the SRER in southeastern Arizona
- Quantify changes in total woody plant cover and patch size class distribution

Results:

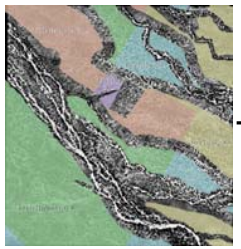
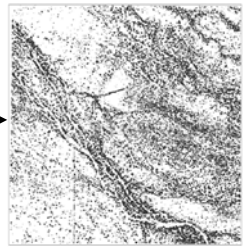


Figure 2. 1936 aerial photograph depicting arrangement of soil/land use partitions (CSL = coarse sandy loams, SCL = sandy clay loams



Figures 3 - 5. Classified woody plant cover 1936 to 2002. 1936 = 30.6% woody plant cover

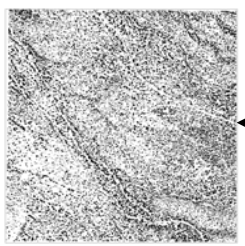


Figure 5. 2002 = 26.5% woody plant cover

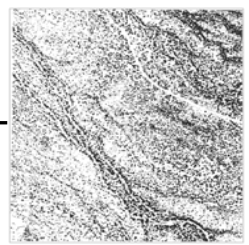


Figure 4. 1966 = 31.5% woody plant cover

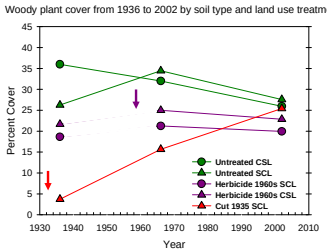


Figure 6. Woody plant cover by soil [coarse sandy loams (CSL), sandy clay loams (SCL)] and land use history. Arrows represent date of disturbance event.

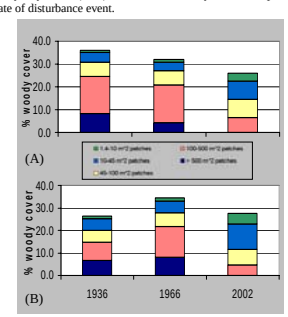


Figure 7: Contributions of shrub patch size classes to total woody plant cover on untreated (A) coarse sandy loam (CSL) and (B) sandy clay loam (SCL) uplands.

- Net woody plant cover for this landscape appears to have reached a dynamic equilibrium during the past 68 years (Figs. 3-5).
- Soils and land use history have mediated local-scale changes in woody plant cover (Fig. 6).
- Landscape has undergone spatial rearrangement of WP resources (Fig. 7)
  - 4-fold increase in number of small patches (1.4 - 10 m^2) from 1966
  - Large (100 – 500 m^2) patches dominated landscapes in 1936 and 1966, but not in 2002.
- Similar total WP cover values may mask significant changes in vegetation structure that influence ecosystem C and N pools (Figs. 6 and 7).

Impacts:

- Enhanced understanding of ecosystem carbon uptake and storage
- Improved estimates of the North American terrestrial carbon sink
- Knowledge of carbon sinks and pools in southwestern rangelands is required to formulate effective strategies to mitigate increases in atmospheric CO_2 (i.e., carbon sequestration)

Affiliations:

[1] School of Natural Resources, University of Arizona, [2] Carnegie Institute, Stanford University, and [3] Cooperative Institute for Research in Environmental Science, University of Colorado. Future work will include (1) incorporating additional photo dates, (2) examining sites with contrasting land use and grazing histories along an elevation gradient, and (3) validating woody plant cover estimates from Landsat TM imagery.

Research funded by NASA Land Cover Land Use Change-Carbon Cycle Initiative and EPA Science to Achieve Results (STAR) Fellowship Program