

Browning, DM, Archer, SR. 2011. Protection from livestock fails to deter shrub proliferation in a desert landscape with a history of heavy grazing. *Ecological Applications* (In Press).

Abstract:

Desertification is often characterized by the replacement of mesophytic grasses with xerophytic shrubs. Livestock grazing is considered a key driver of shrub encroachment, although most evidence is anecdotal or confounded by other factors. Mapping of velvet mesquite (*Prosopis velutina*) shrubs in and out of exclosures in 1932, 1948 and 2006 in semi-arid grasslands of southeastern Arizona, USA afforded the opportunity to quantify livestock grazing effects on mesquite proliferation over 74 years in the absence of fire to test the widespread assumption that livestock grazing promotes shrub proliferation. In 1932, shrub cover, density, and aboveground biomass was comparable on grazed (12%, 173 plants ha⁻¹; 4,182 kg ha⁻¹) and newly protected areas (8%, 203 plants ha⁻¹; 3,119 kg ha⁻¹). By 1948, cover on both areas increased to ~18%; yet, density on the protected area increased 300% (to 620 plants ha⁻¹), nearly twice that of the grazed area (325 plants ha⁻¹). From 1932 to 1948, differences in recruitment of new plants and growth of existing plants were reflected in biomass, which was higher on the protected area (415 plants ha⁻¹; 8,788 kg ha⁻¹) relative to the grazed area (155 plants ha⁻¹; 7,085 kg ha⁻¹), although mortality was equally low (~0.06%). In 2006, 42 years after an herbicide application reset mesquite cover to ~10% on both areas, aboveground mesquite mass was comparable on both areas (ca. 4,700 kg ha⁻¹), but cover and density on the protected area (22%; 960 plants ha⁻¹) exceeded that on the grazed area (15%; 433 plants ha⁻¹). Cover and mesquite mass in 2006 were substantially below their potential, so continued accrual is likely. That shrub recovery from herbicides on a biomass-basis was much less than recovery on a cover-basis suggests remotely-sensed biomass estimates should integrate land management history. Contrary to widely-held assumptions, protection from livestock since 1932 not only failed to deter woody plant proliferation, but actually promoted it relative to grazed areas. Results suggest (a) thresholds for grassland resistance to shrub encroachment had been crossed by the 1930s; and (b) fire management rather than grazing management may be key to maintaining grassland physiognomy in this bioclimatic region.

Keywords: arid rangelands; land cover change; land use legacy; livestock grazing; mesquite; *Prosopis velutina*; shrub encroachment; shrub proliferation; Sonoran Desert; terrestrial carbon