Shifts in Canopy and Ground Cover Following Lehmann's Lovegrass Invasion

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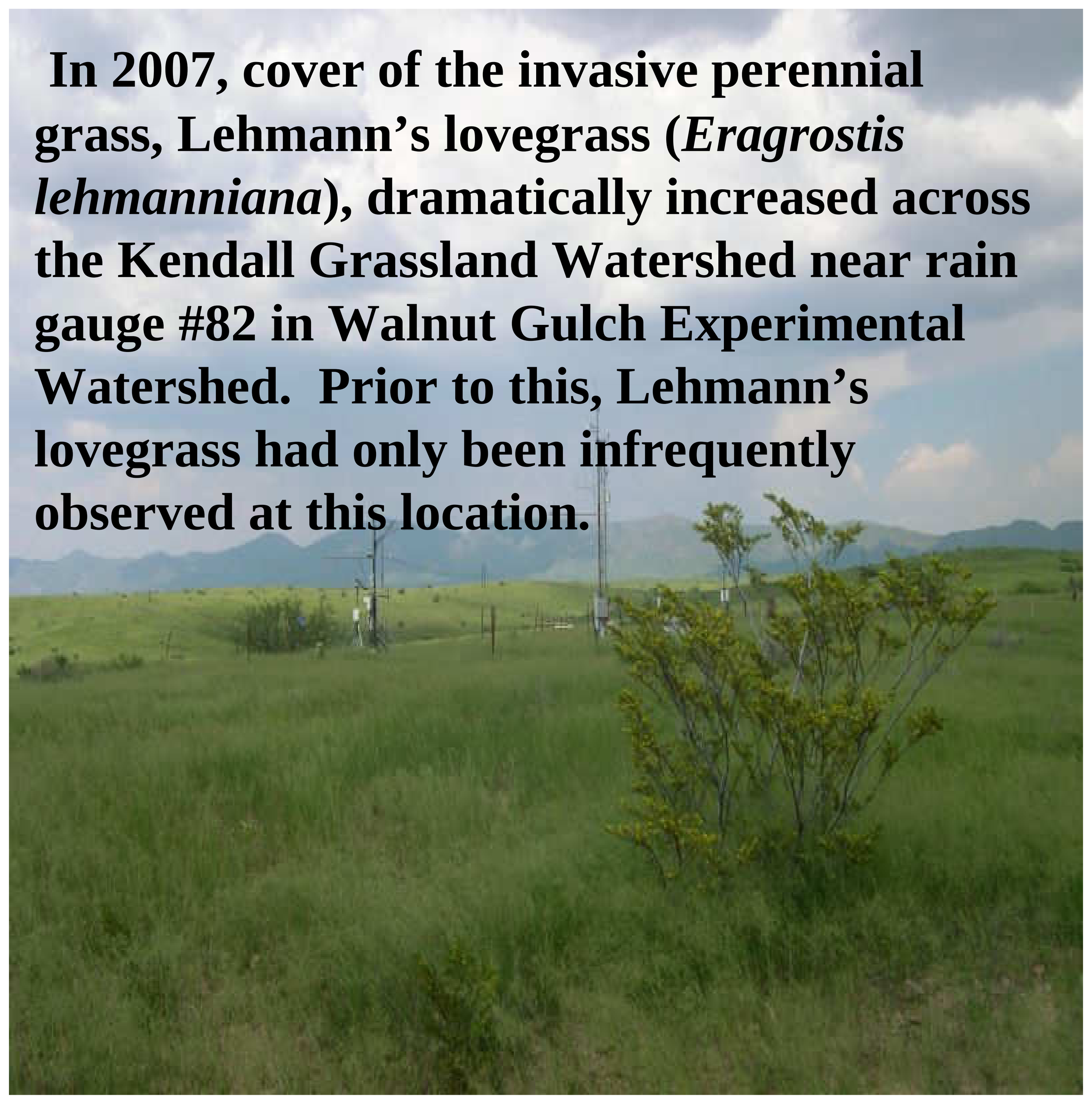
Abstract

Following partial release of recent protracted drought, plant communities within the Kendall Grassland Watershed in Walnut Gulch Experimental Watershed shifted from a diverse desert grassland assemblages to near complete dominance by the invasive perennial grass, Lehmann's lovegrass. Using pre- and post-drought vegetative ground cover surveys collected for a variety of hydrological and remote sensing efforts at Kendall Grassland, we found that the recent dominance by Lehmann's lovegrass was accompanied by distinct changes in total projected canopy, basal area, and litter coverages, and that there were changes in the fundamental relationships between these variables. These changes could likely contribute to the observed changes in watershed function, and might also indicate the imposition of potential positive feedbacks that might favor the persistence of Lehmann's lovegrass dominance at this site.

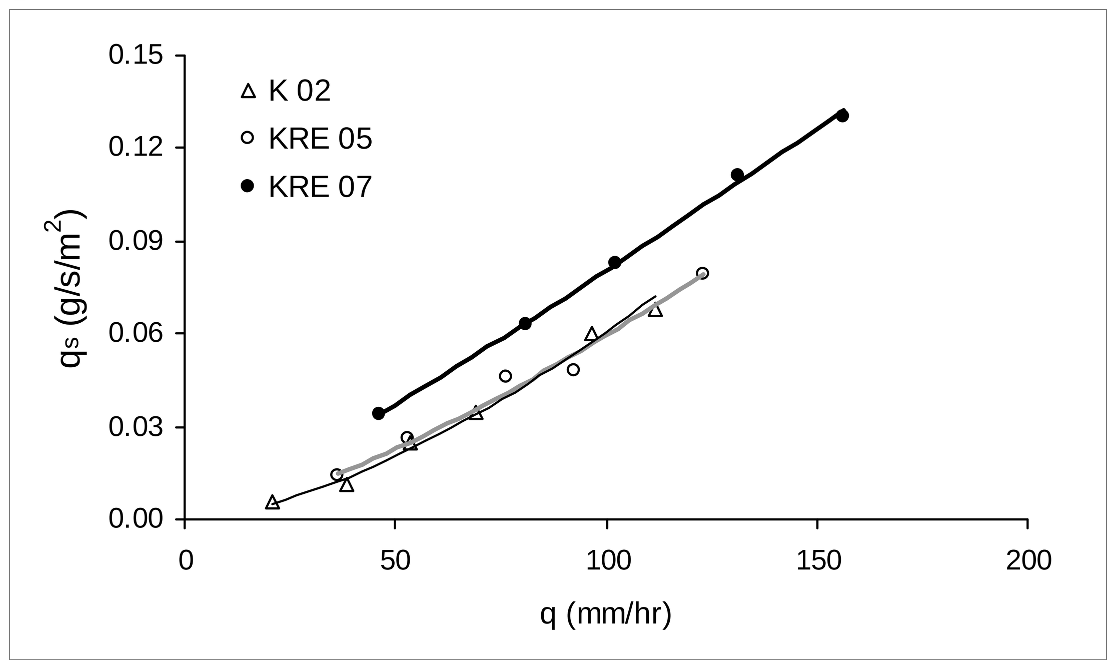
In 2007, cover of the invasive perennial grass, Lehmann's lovegrass (*Eragrostis lehmanniana*), dramatically increased across the Kendall Grassland Watershed near rain gauge #82 in Walnut Gulch Experimental Watershed. Prior to this, Lehmann's lovegrass had only been infrequently observed at this location.



Concurrently, two unusual hydrological events occurred:

1: Massive sediment loads clogged the nearby K12 gauging station; this had been noted only once before in 1983.

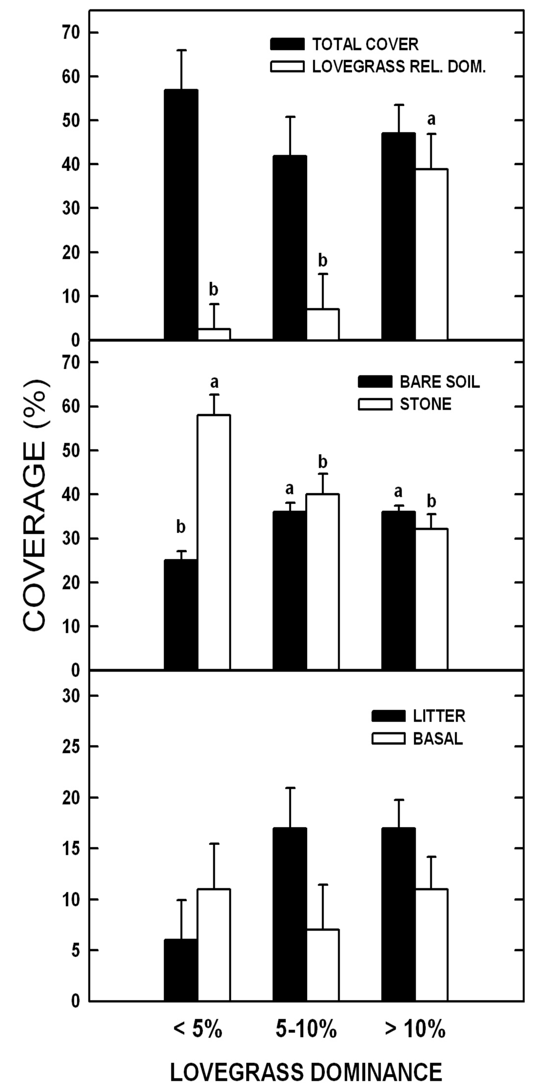
2: Sediment discharge rates (q_s) in 2007 doubled per change in unit run-off rates (q) in rainfall simulation field experiments compared to two years when lovegrass was not present in the experimental plots:



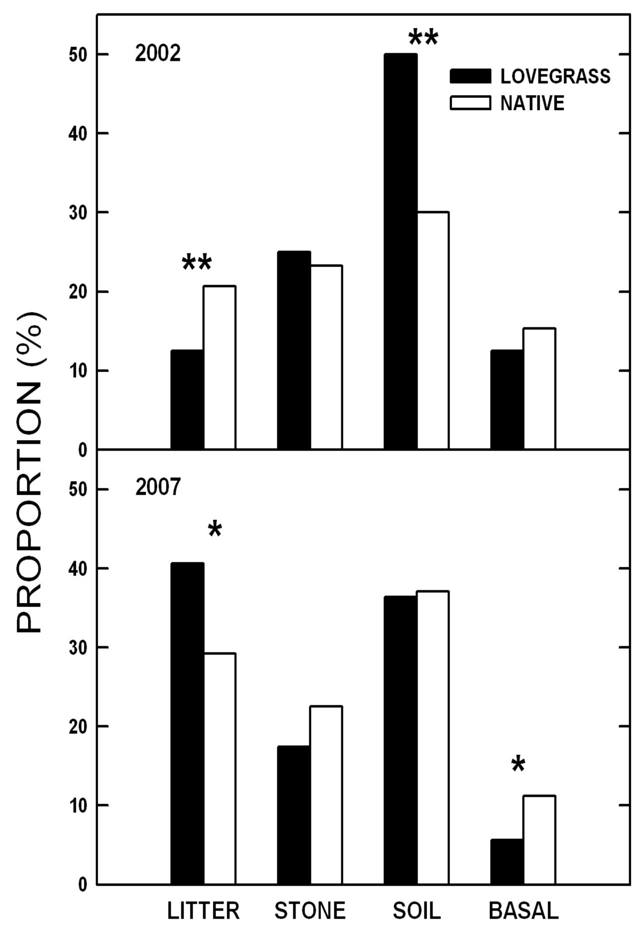
These observations led us to examine vegetation and ground cover data sets gathered by SWRC researchers before and after Lehmann's lovegrass invasion to see if increasing lovegrass dominance was associated with changes in canopy/ground cover relationships, and if these might clarify the observed increased sediment transport efficiency of this grassland's surface hydrology.

1) **Transect and plot data taken across WGEW show greater relative dominance of Lehmann's lovegrass was associated with significantly**
a) increased bare soil cover
b) decreased stone cover

Total canopy cover and basal area reduced, while litter cover increased, but large variance in these resulted in no significant differences.



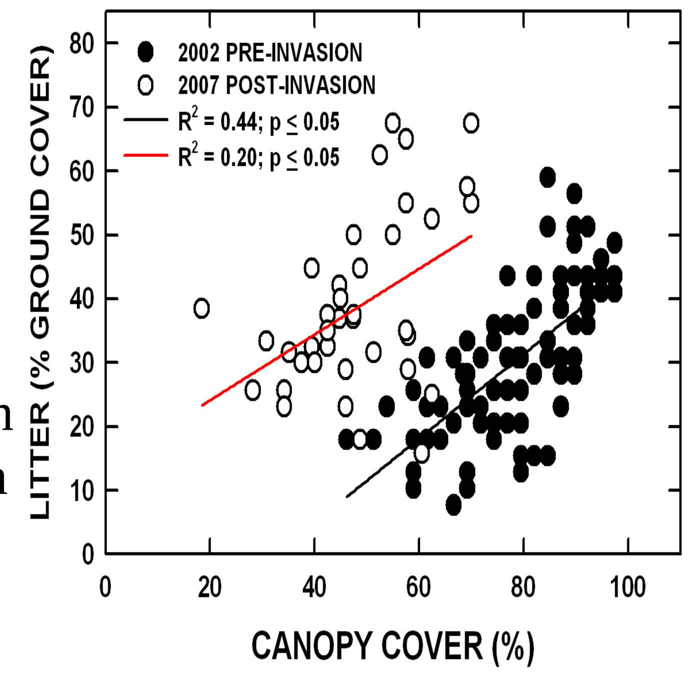
2) Basal area ground cover decreased under Lehmann's lovegrass plants compared to native bunch-grasses between pre- and post-invasion conditions in the experimental rainfall plots.



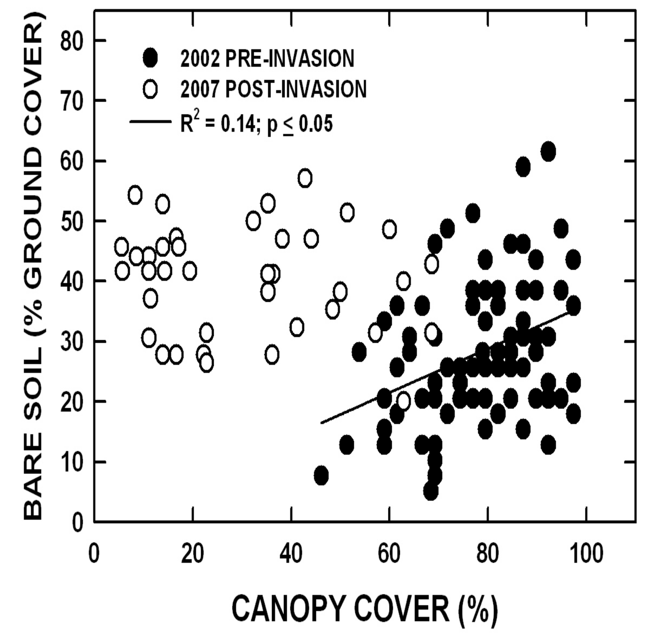
Chi-square analysis of point-intercept data taken from the rainfall simulation plots show that from pre-invasion (2002; lovegrass relative dominance = 0.8 %) and post-invasion (2007, lovegrass relative dominance = 34-81%), plant basal area contributed proportionally less to ground cover under lovegrass canopy intercepts compared to native bunch-grass intercepts.

3) Lehmann's lovegrass invasion changed the relationships between total canopy, litter and bare ground cover.

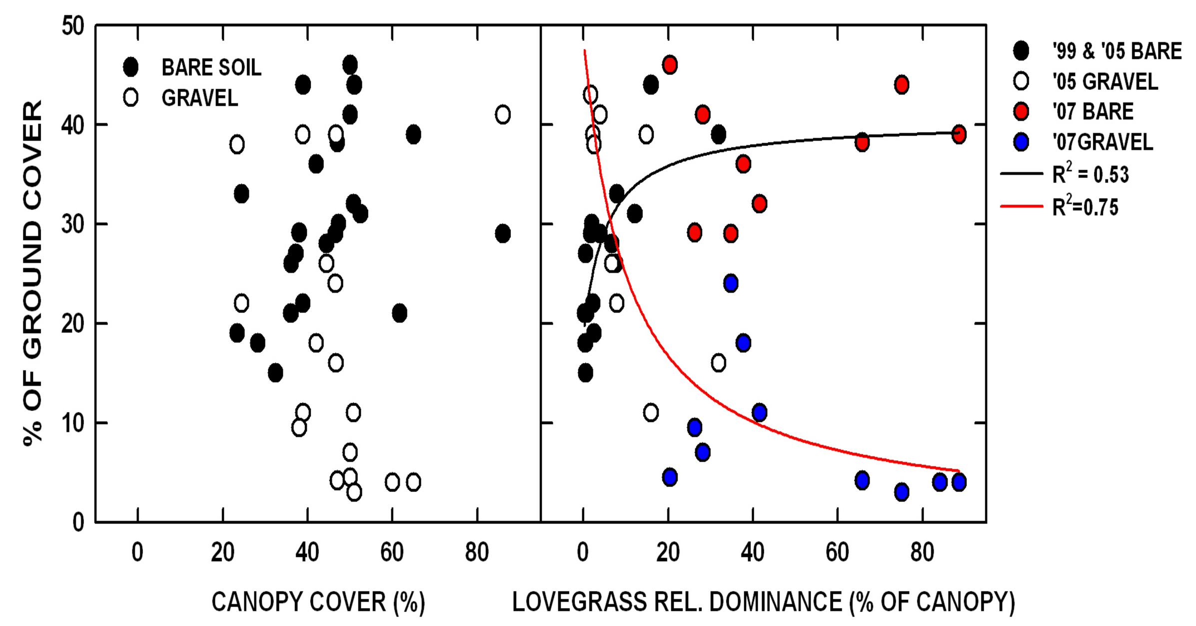
Under both conditions, canopy cover was positively and significantly related to litter cover. However, lower canopy coverage in 2007 was associated with higher proportional litter cover.



A weak, though significant, positive relationship between canopy cover and bare soil in 2002 disappeared in 2007.



4) The progression of Lehmann's lovegrass dominance best explains changes in small stone and bare soil coverage.



The poor relationship between bare soil and canopy cover extended across plots and years.

Underlying this, however, increasing dominance of Lehmann's lovegrass through time results in significant, and inverse, non-linear relationships between gravel (2-20 mm) and bare soil.

Discussion and Implications

Based on these results, it seems a reasonable assertion that Lehmann's lovegrass acts as a surface hydrological engineer, and provides the essential structure to the canopy that facilitates sediment movement and loss from desert grasslands. This can be seen most clearly in Finding 4, which suggests this loss occurs when lovegrass accounts for about 20% of the canopy. Two features of Lehmann's lovegrass may account for this disproportionate effect. First, Lehmann's lovegrass produces similar total leaf area index (m^2 leaf area per m^2 ground area) compared to native grasses, but maintains more active green tissue (Yepez et al. 2005; Ignace et al. 2007). Thus, while total percent cover may be similar, higher plant water use results in drier, less stable soils (Huxman et al. 2004; English et al. 2005; Ignace et al. 2007). Secondly, establishing lovegrass have smaller basal areas compared to established native bunch-grasses, further reducing soil stability and facilitating particle transport. These two features, along with well-documented differences in seasonal phenology (Fraiser and Cox 1994), could result in a positive feed-back loop whereby Lehmann's lovegrass engineers a soil hydrology most favorable to itself as it invades an area.

Literature Cited

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