Drought-induced woody plant mortality and community composition shifts in an encroached Texas savanna: comparing the 1950s and the 2000s

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Location

Texas Agrilife Research Station, Sonora, Texas, USA (30.1°N 100.3°W)
Objectives

• How do recent patterns of drought-induced woody plant dieback in Texas semiarid savanna compare to the exceptional drought of the 1950s?

• Does the relative composition of the woody plant community shift ubiquitously across the landscape or are shifts dependent on differences among soils, land use, and plant demography?
Methods

40 belt transects in four pastoral units

Pastoral units:
- livestock exclosure unit
- high-fenced livestock and deer exclosure unit
- two units annually stocked with livestock under Merrill’s deferred rotation system

10 transects per unit

Woody plants intersecting each transect were identified to species and classified into three categories: (i) plants alive, (ii) plants with trunks or stems dead but with resprouting stems from the base, and (iii) plants dead

Each transect was characterized as being located on one of three soil categories: deep soils, shallow soils, and rock draws
Methods
Data

Total cover for each transect: cover of all individuals minus distances where canopies of individual trees overlapped.

Percent reduction in canopy cover: comparison of predrought cover with the total cover of live woody plants measured after the drought.

Dieback: proportion of dead individuals in 2011 relative to the total number of woody plants that occurred prior to the drought.
Soils

Tarrant soils - tops and sides of hills (subsoil of porous, fractured limestone)

Kavett & Valera soils - depressions and narrow valleys among the hill slopes (petrocalcic horizon)
Rock Draws
Comparison results 1959-2000

1959: cover decreased 44% compared to pre-drought estimates taken in 1949 (Merrill & Young 1959)

Droughts since 2000: reduced woody plant cover 18%

Persimmon not killed in the drought of the 1950s, least drought resistant species in 2000s
water flows more readily through coarse textured Tarrant soils

water remains trapped in the finer textured Valera and Kavett soils by the petrocalcic horizon
patterns of dieback for individual species contingent on interrelationships among topoedaphic factors
Percentage of dead:live trees

Livestock exclosure
Livestock-Deer exclosure
Livestock rotation units

Shin Oak
\[ X^2 = 70; P = 0.030 \]

Persimmon
\[ X^2 = 6.3; P = 0.044 \]
Density dependent mortality of understory (< 2.1 m tall) shin oak trees in shallow soils

\[ R^2 = 0.55 \]
\[ P < 0.05 \]
Grass cover did not vary with total woody plant density ($r^2=0.02$, $p=0.18$) or overstory woody density ($r^2=0.01$, $p=0.41$).
Conclusions

Patterns of woody mortality were relatively similar following both drought periods.

Neither resulted in widespread shifts in woody vegetation.

Species-specific patterns of dieback contingent on localized interactions between topoedaphic factors and long-term land use.

Implications:

Multi-scale assessments needed to understand and predict vegetation shifts as a result of climate change.