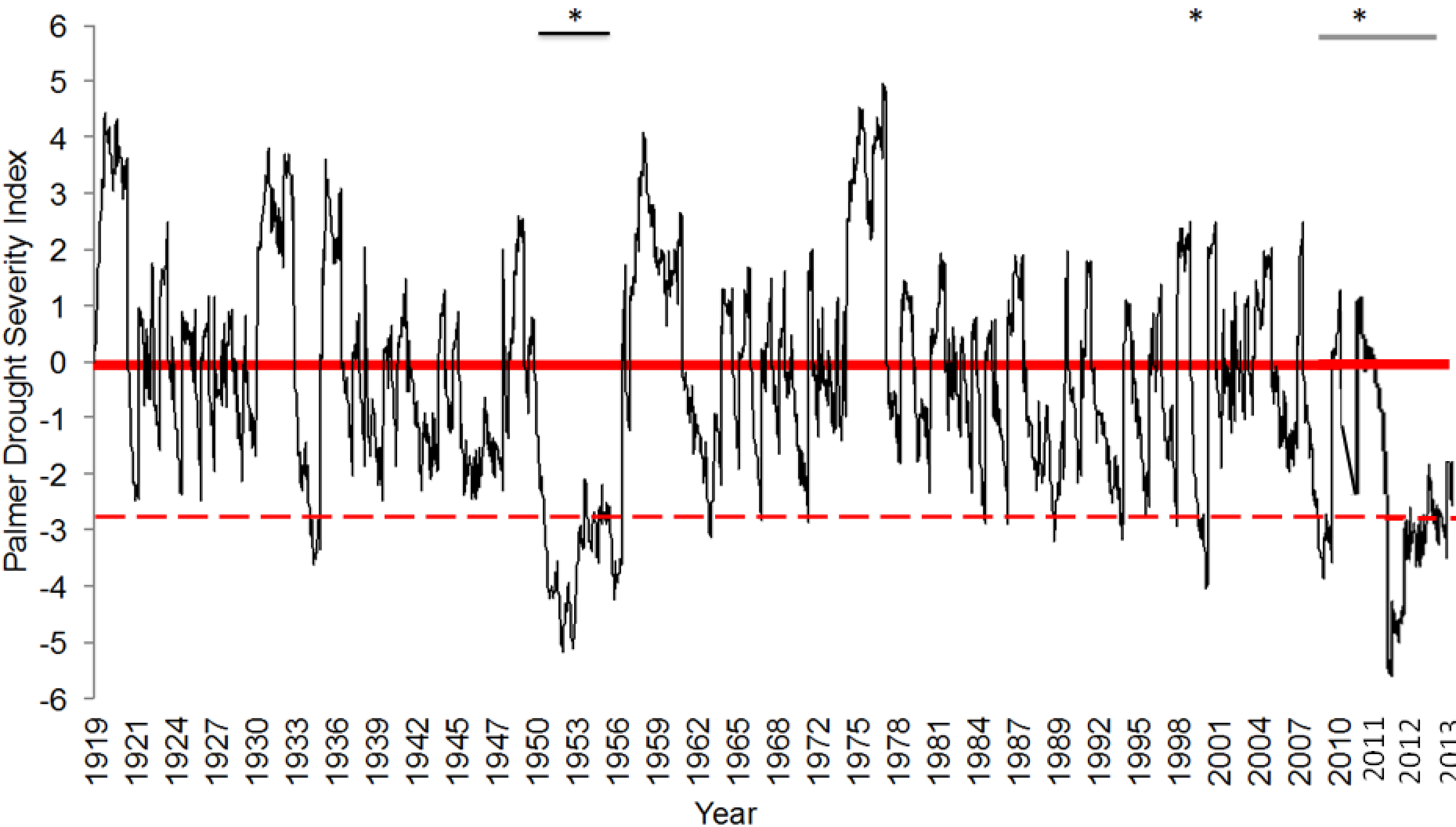
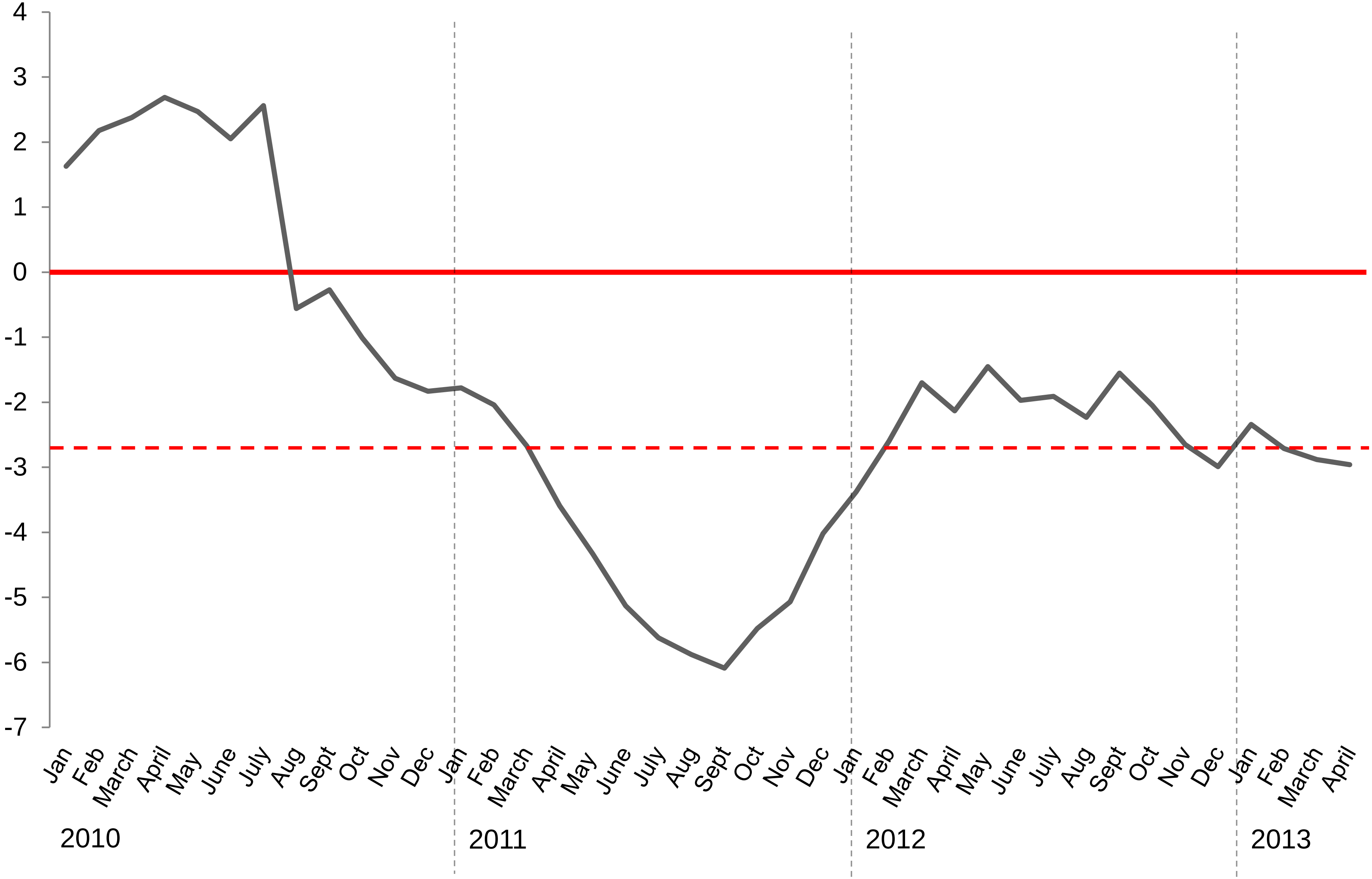
Drought-induced woody plant mortality and community composition shifts in an encroached Texas savanna: comparing the 1950s and the 2000s

Carissa L. Wonkka, Dirac Twidwell,
Charles A. Taylor, Jr., Chris B. Zou,
Jeremiah J. Twidwell, William E. Rogers

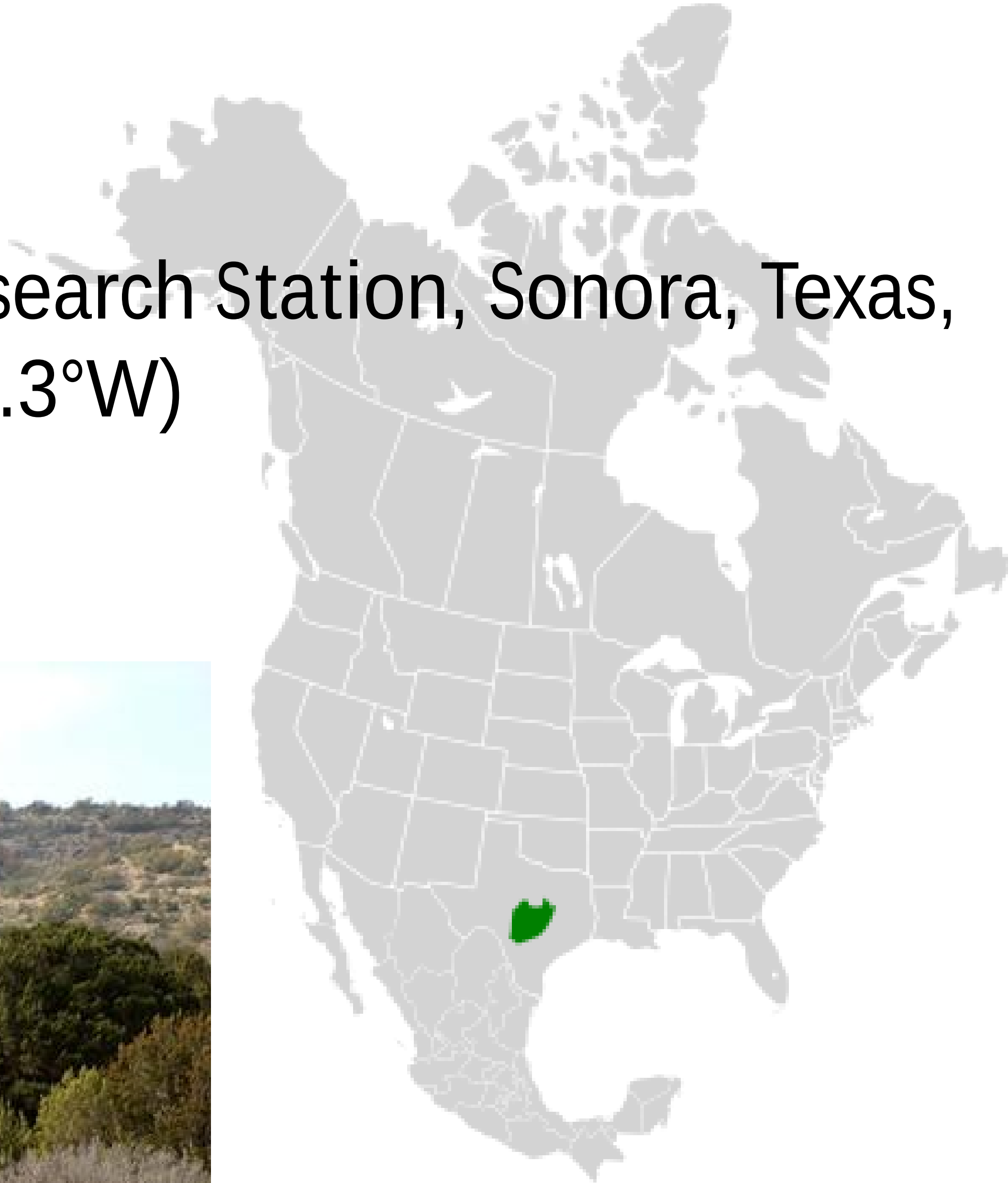


*
*
*
Palmer Drought Severity Index
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
1919
1921
1924
1927
1930
1933
1936
1939
1942
1945
1947
1950
1953
1956
1959
1962
1965
1968
1972
1975
1978
1981
1984
1987
1989
1992
1995
1998
2001
2004
2007
2010
2011
2012
2013
Year


4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Jan
Feb
March
April
2010
2011
2012
2013

Location

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



Merrill, L. & Young, V. 1959. Effect of drouth on woody plants. *Texas Agricultural Progress* 3: 9-10

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

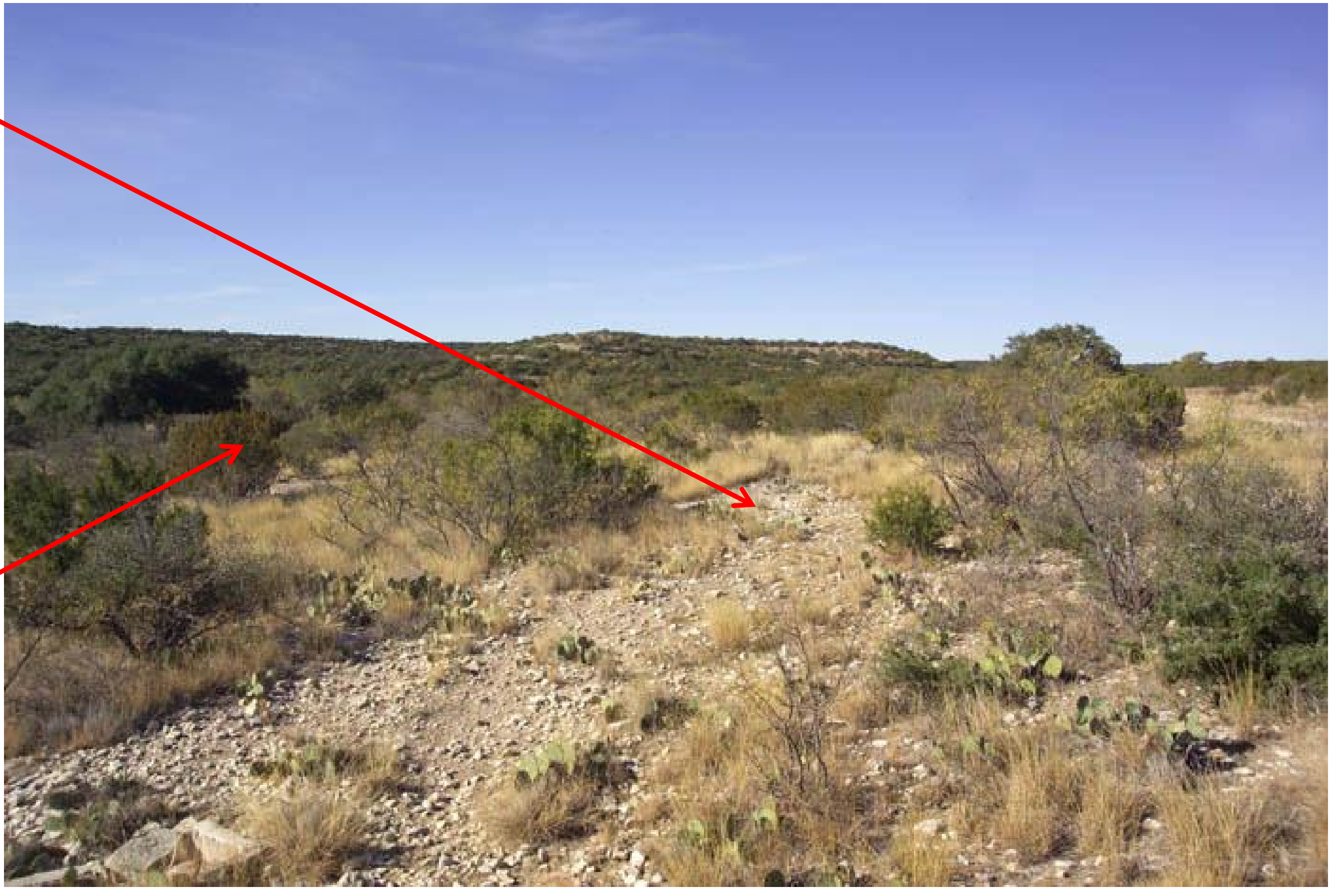
Percent reduction in canopy cover : comparison of pre-drought cover with the total cover of live woody plants measured after the drought

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)



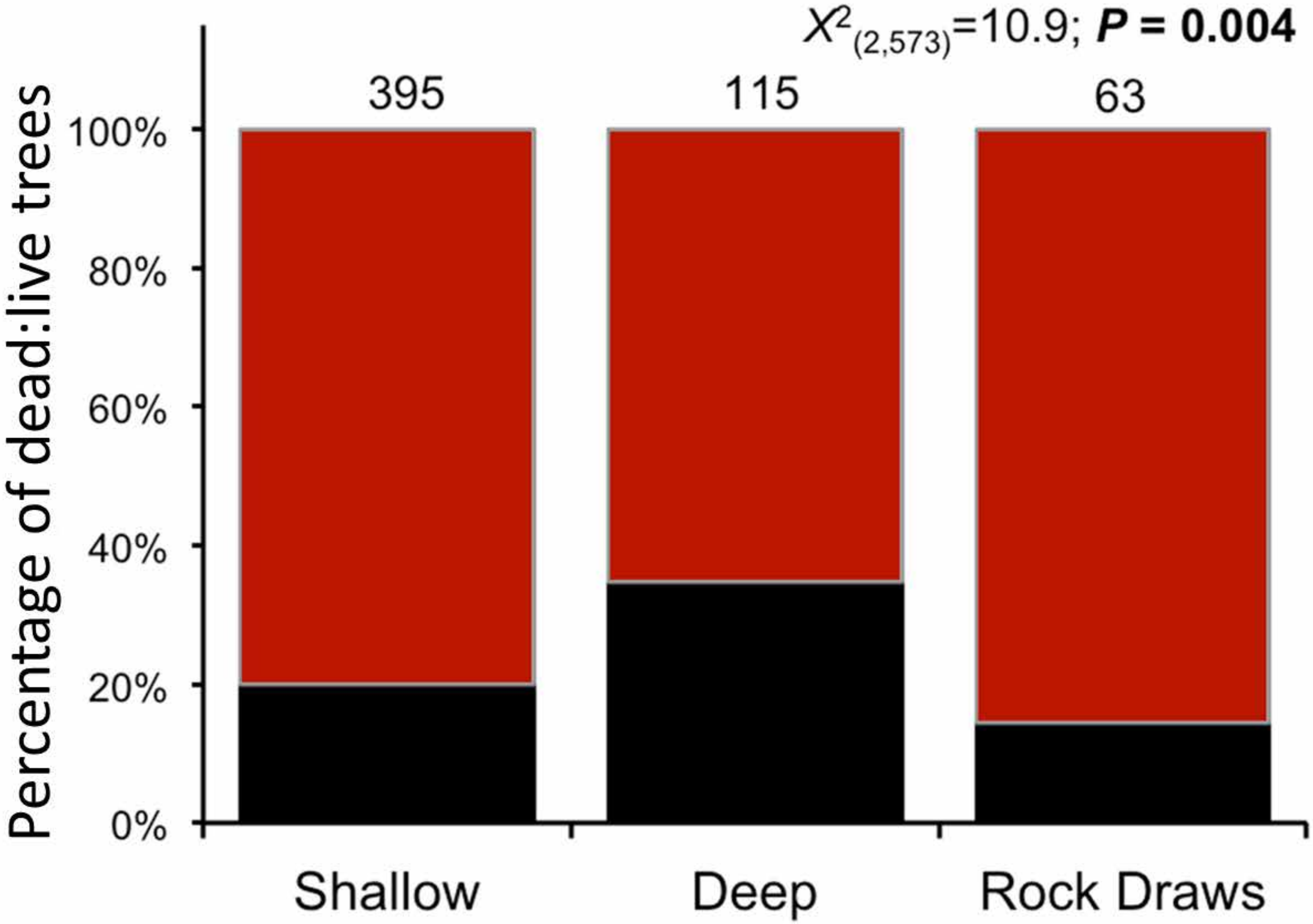
Rock Draws

Comparison results 1959-2000

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

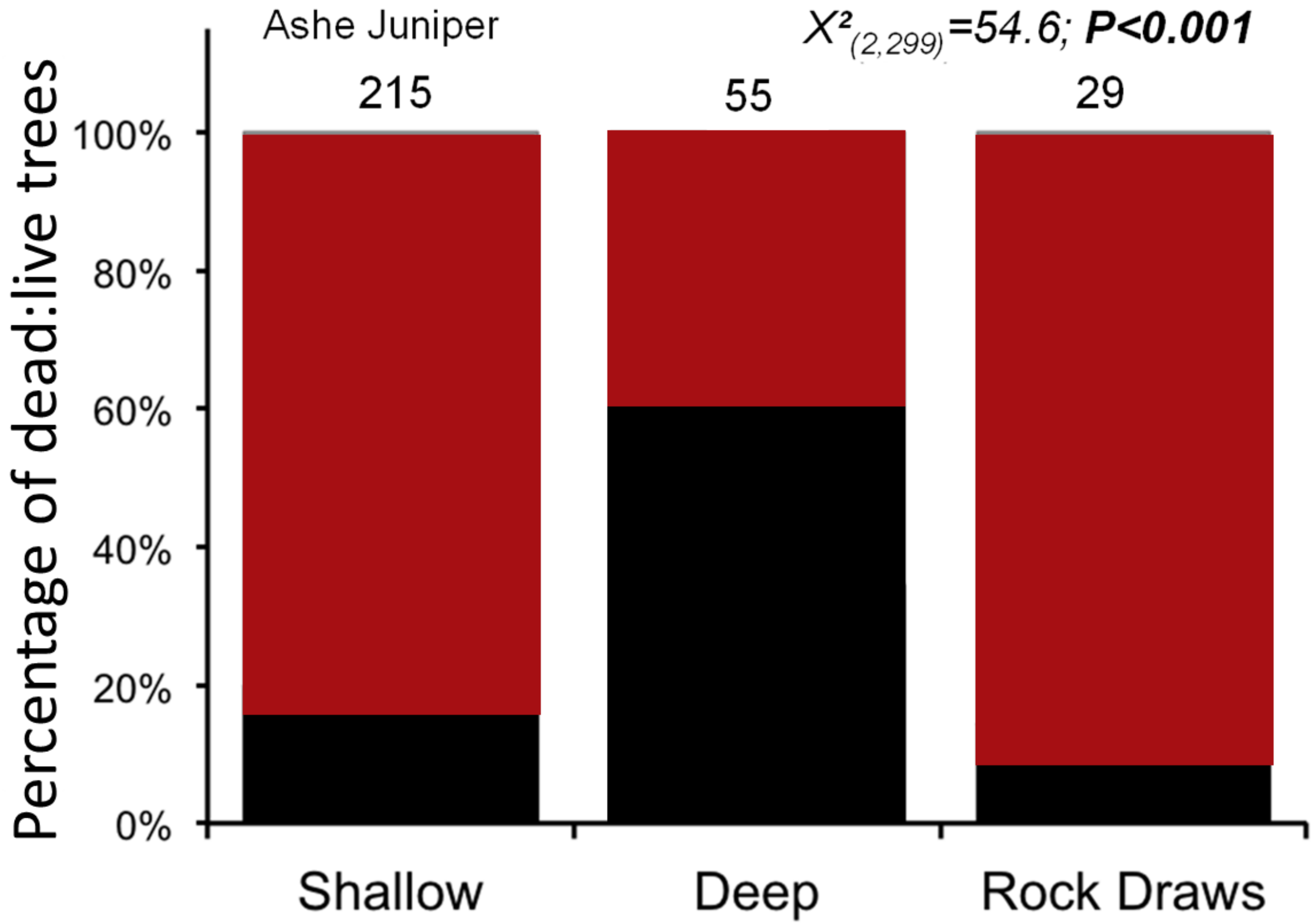
droughts since 2000: reduced woody plant cover 18%

Persimmon not killed in the drought of the 1950s,least drought resistant species in 2000s

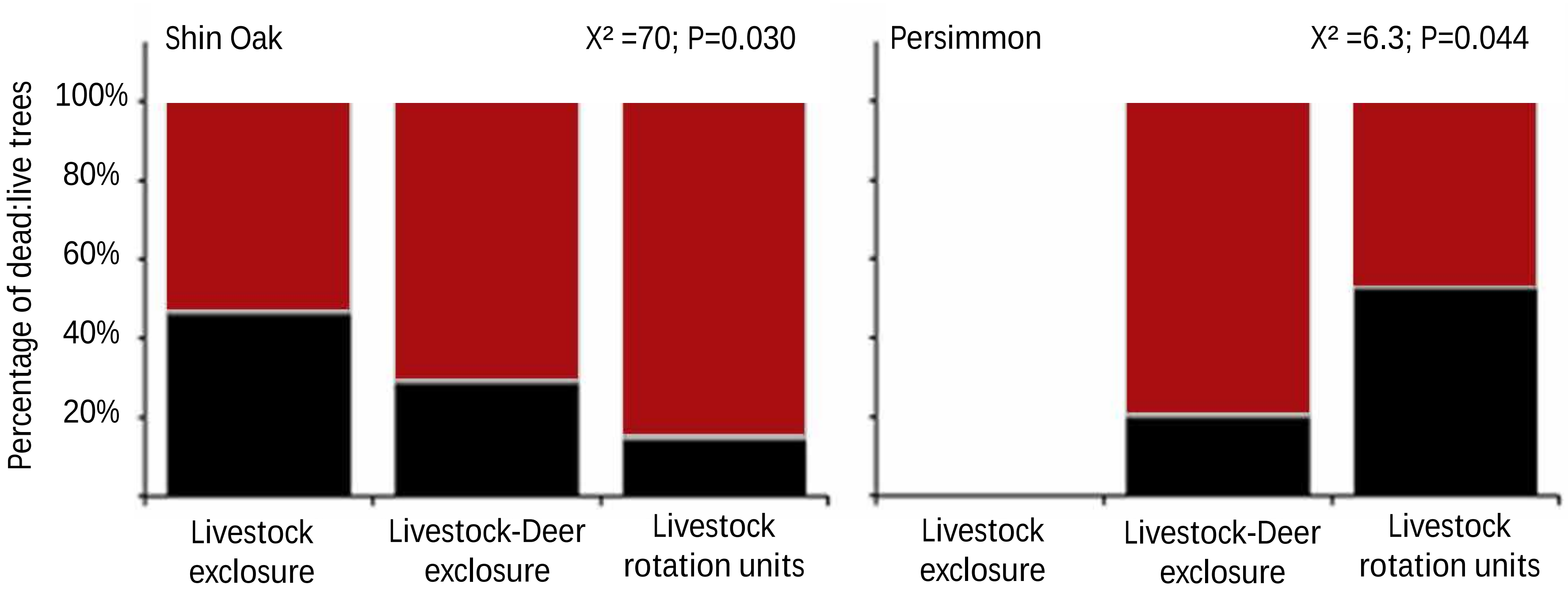


water flows more readily through coarse textured Tarrant soils

water remains trapped in the finer textured Valera and Kavett soils by the petrocalcic horizon

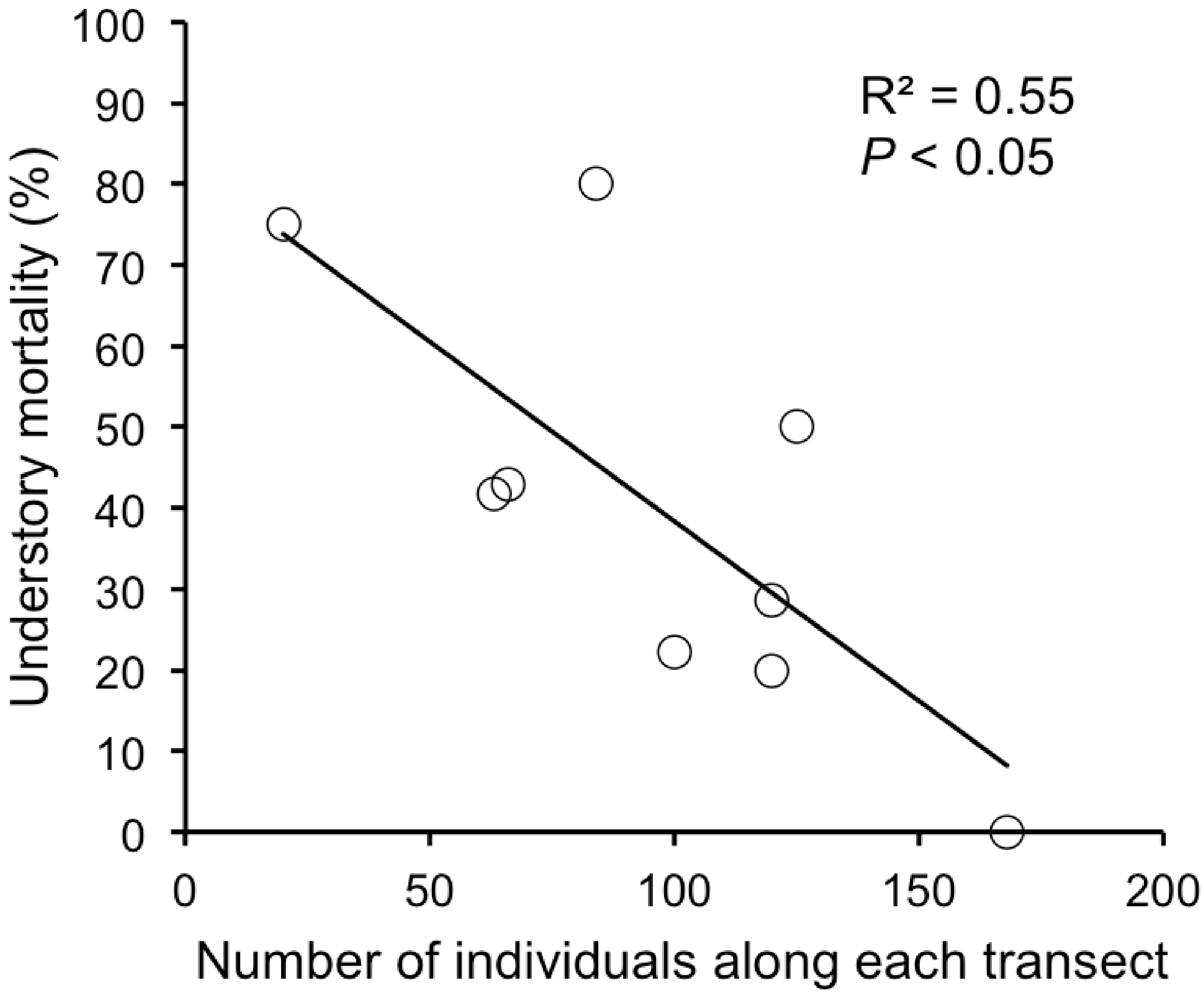


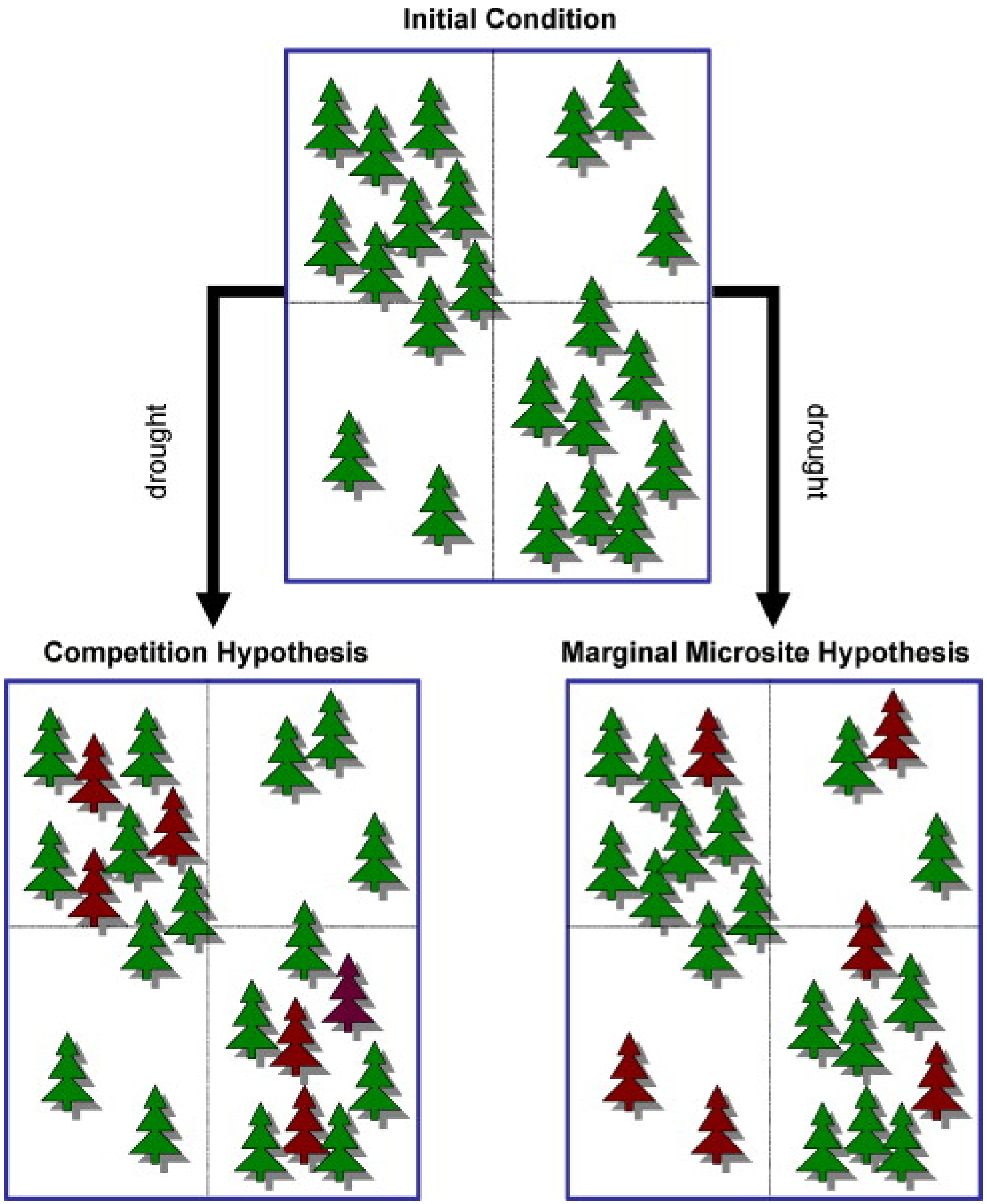
patterns of dieback for individual species contingent on interrelationships among topoedaphic factors



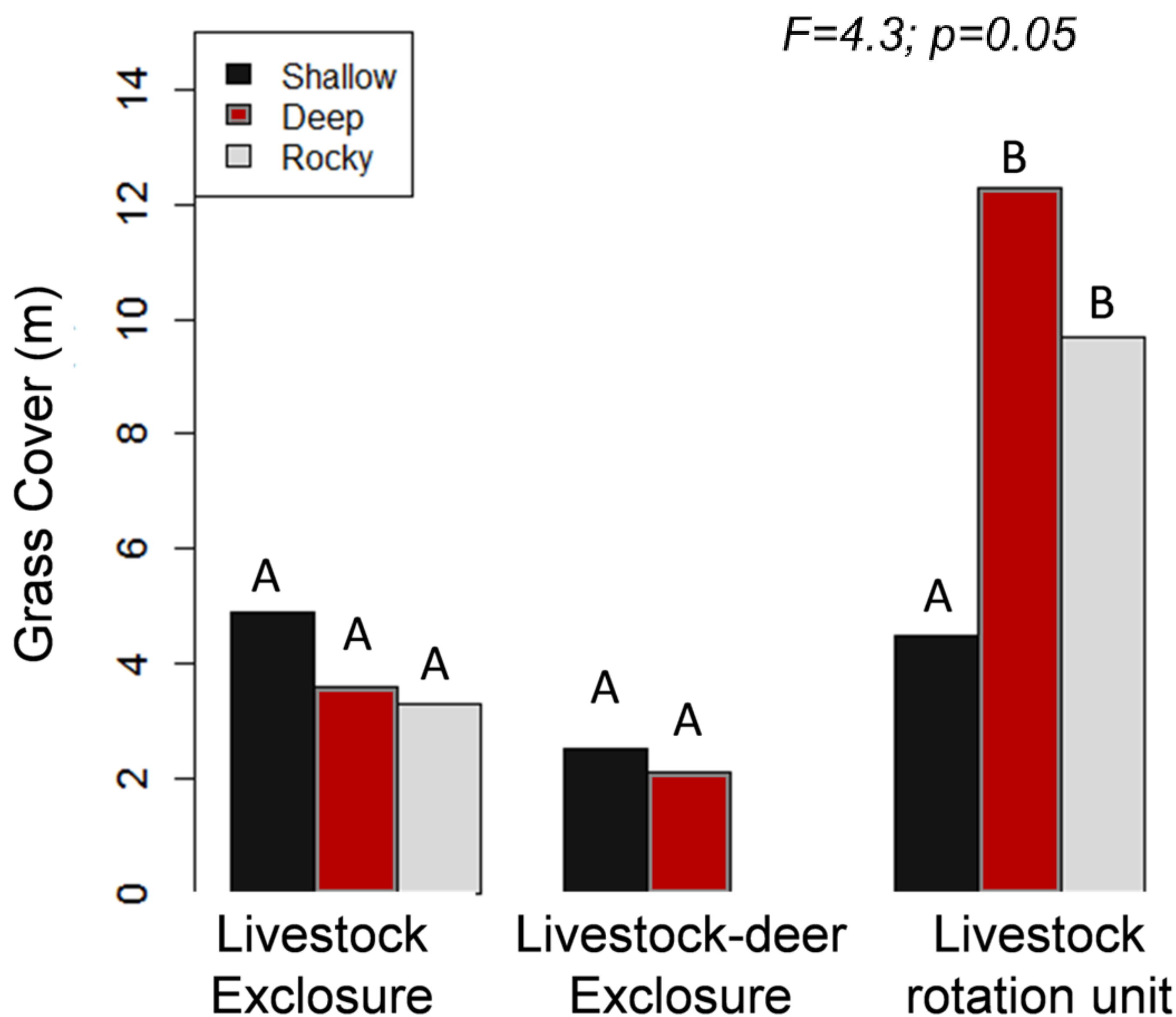
Shin Oak
X² =70; P=0.030
Persimmon
X² =6.3; P=0.044
Percentage of dead:live trees
100%
80%
60%
40%
20%
Livestock exclosure
Livestock-Deer exclosure
Livestock rotation units
Livestock exclosure
Livestock-Deer exclosure
Livestock rotation units

Density dependent mortality of understory (< 2.1 m tall) shin oak trees in shallow soils

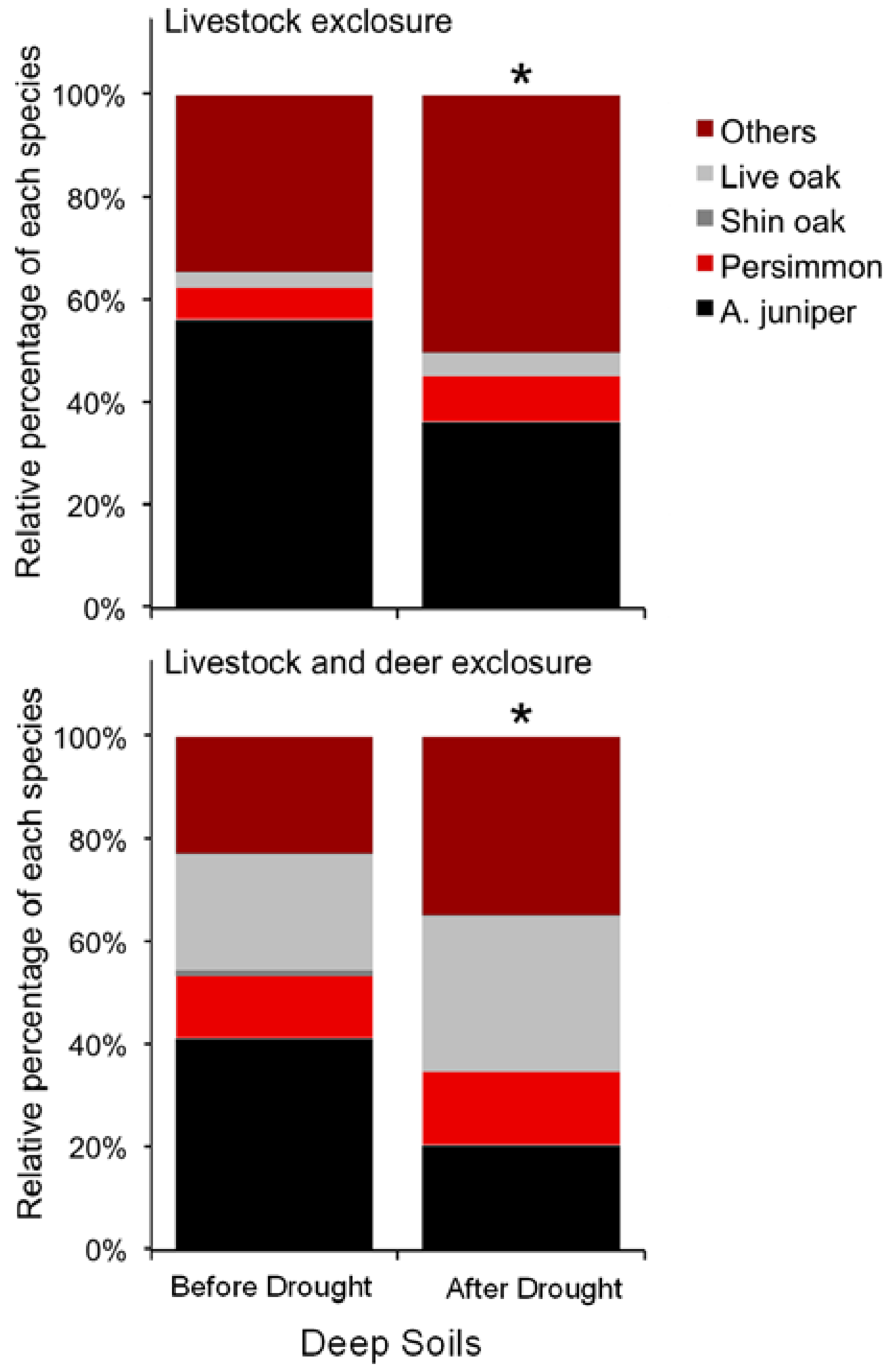




Greenwood and Weisberg 2008



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)



Livestock exclosure
Livestock and deer exclosure
*
*
Relative percentage of each species
100%
80%
60%
40%
20%
0%
Others
Live oak
Shin oak
Persimmon
A. juniper
Before Drought
After Drought
Deep Soils


03.11.2013 09:00

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

Acknowledgments

Funding sources:

Tom Slick Foundation
Rob and Bessie Welder Wildlife Foundation
Texas A&M University Agrilife Research
Texas Water Resource Institute

Contributions:

Tom Peyton
Amanda Bragg
Amy Symstad
David King
Michele Clark
Nick Garza

Twidwell, D., Wonkka, C. L., Taylor, C. A., Zou, C. B., Twidwell, J. J., & Rogers, W. E. (2013). **Drought-induced woody plant mortality in an encroached semi-arid savanna depends on topoedaphic factors and land management**. *Applied Vegetation Science*.