Weather and Climate Effects on Terrestrial Vegetation in Texas

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Introduction

- Two major changes in vegetation in past 300 years
  - Brush invasion
  - Increase in exotic grasses
- Climate and human reactions to climate impact vegetation

Objectives

- Climate-driven changes and human responses to these changes interact to shape vegetation change
- Possible consequences of predicted climatic trends

Brush invasion

- Within past 300 years
- Attributed to overgrazing, lack of fire
- A climatic component?

Brush invasion

- Land use changes probably major driver
- Brush invasion in part from
  - Warming since Little Ice Age?
  - Recovery from severe drought during late 1700s?

Brush invasion in part result of warming?

- San Juan Bautista Mission
- Between Eagle Pass and Laredo
- Father Espinosa – 1703
  - Four months of winter
  - Froze water underground
  - Snow lasted several days
  - Many domestic animals died of the cold
- Cold may have suppressed freeze sensitive woody plants

Weddle, R. S. 1968. Univ. Texas Press.

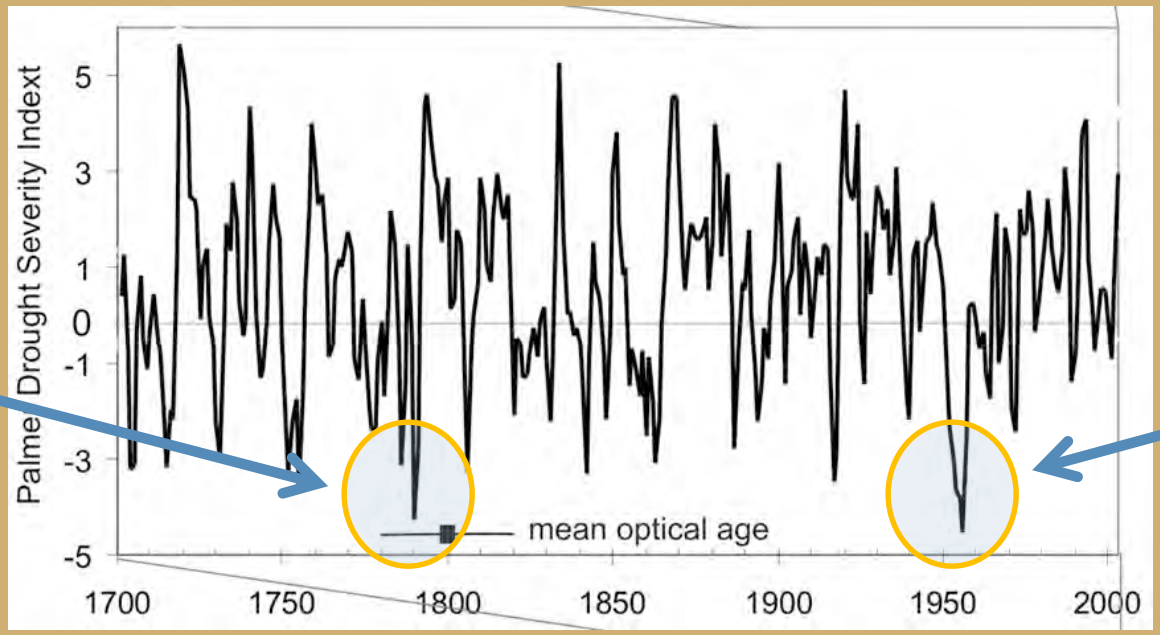
Brush invasion

- Woody plant cover varies with drought cycles
- Drought reduced woody cover reduced during 1941-1960
- 2011 drought killed
  - Oaks in south Texas
  - Juniper in Hill Country

Brush invasion in part recovery from drought?

- Extreme drought during 1789-1790
- Reactivated dune fields in sand sheet

1700s drought

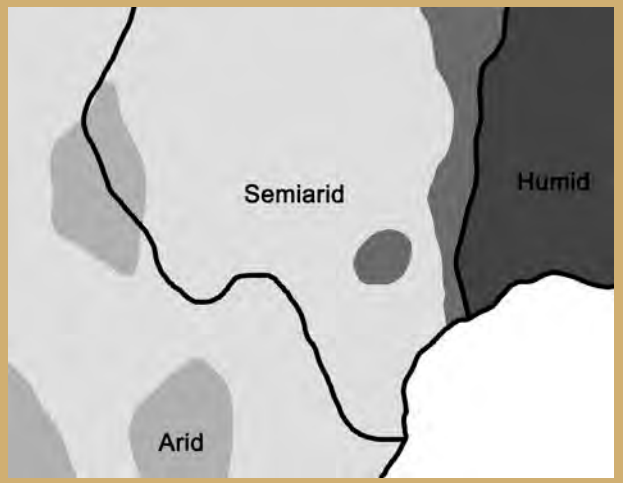


1950s drought

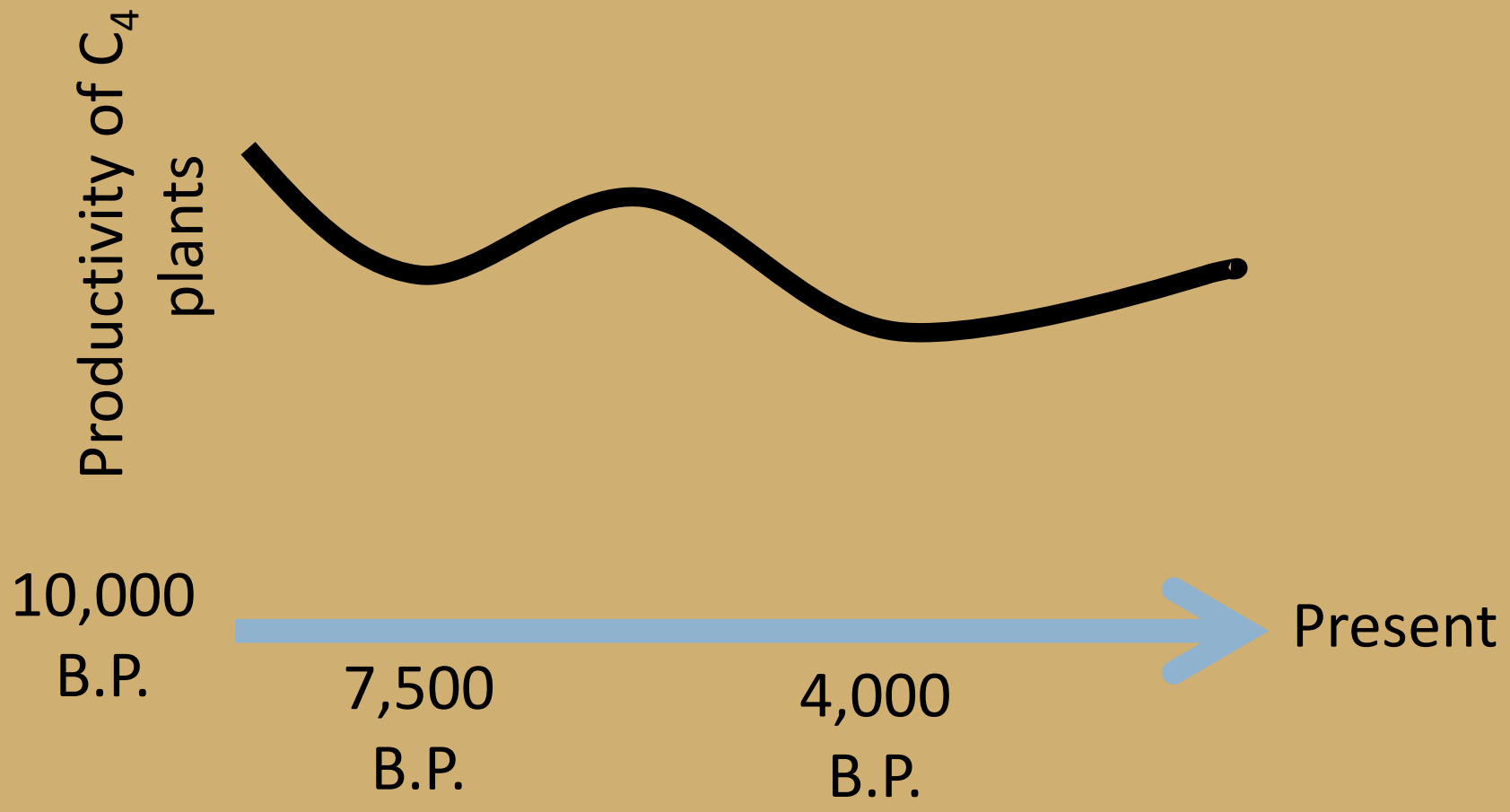
Forman et al. 2009. *Geomorphology* 108:159-170

Human responses to brush invasion

- Millions spent on brush control
- Texas Brush Control Program (Senate Bill 1083)
  - Cost sharing to increase water supply
  - Texas spent $54 million (2000-2011) to subsidize brush control



Will climate drive trend back to grassland?



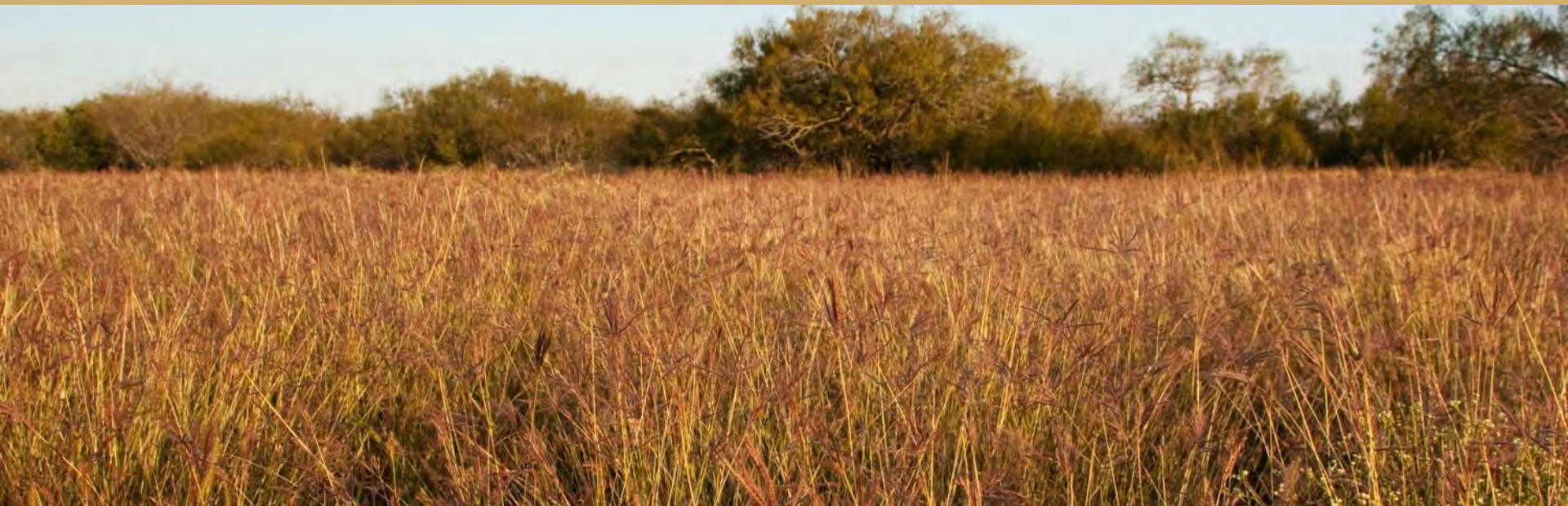
Nordt et al. 2002. Quaternary Research 58:182-188.

Exotic grasses

- Drought of 1950s coupled with overgrazing led to introduction of exotic grasses
- Attempt to increase productivity

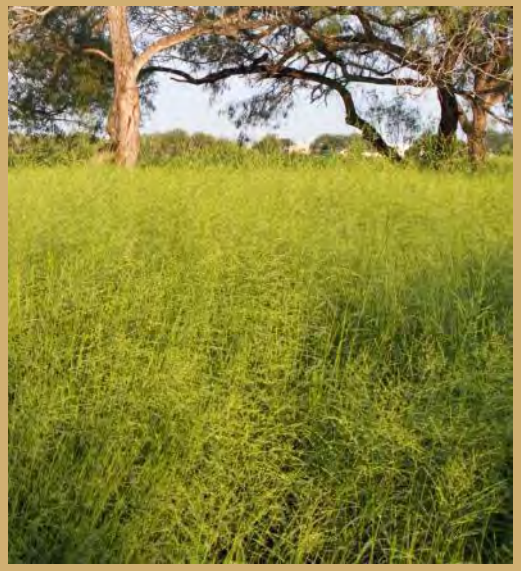
Exotic grass invasion

- Exotic grasses spread from plantings
- Form monotypic stands
- Replace native plant communities



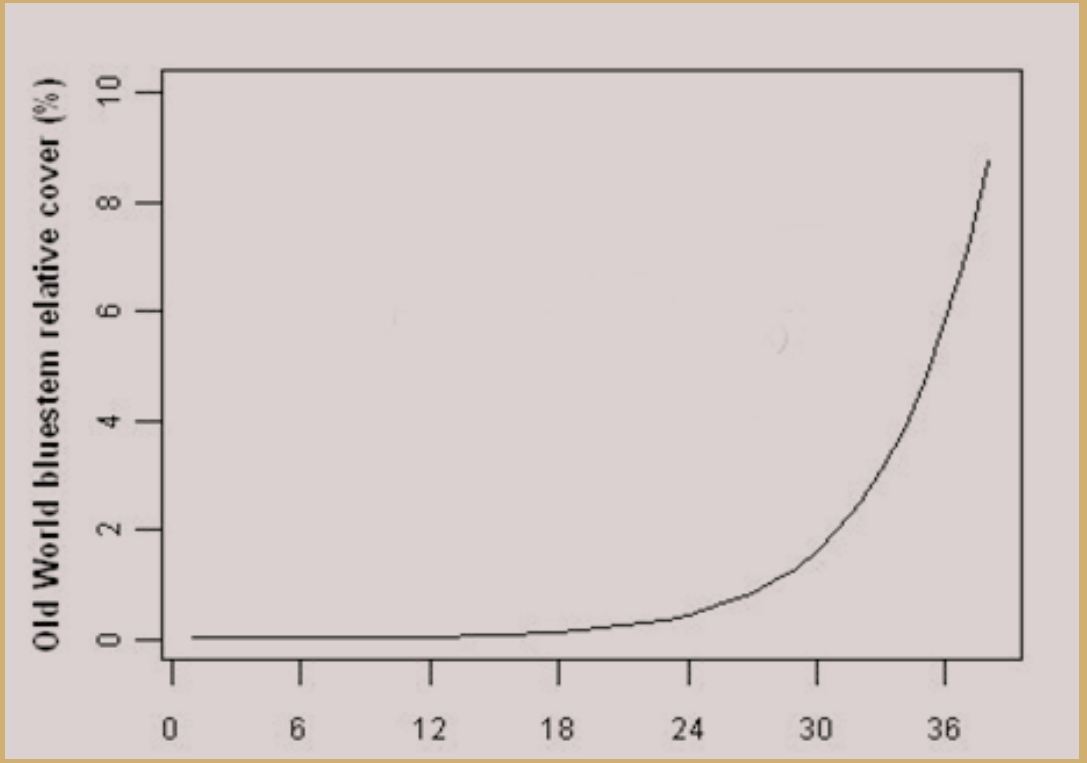
Exotic grasses

- Major invasive grasses
  - Bermudagrass
  - Old World Bluestems
  - Buffelgrass
  - Lehman lovegrass
  - Guineagrass
- Climate trends may exacerbate



Exotic grasses

- Invasion triggers?
- Rainfall patterns
- Temperature changes
- Drought

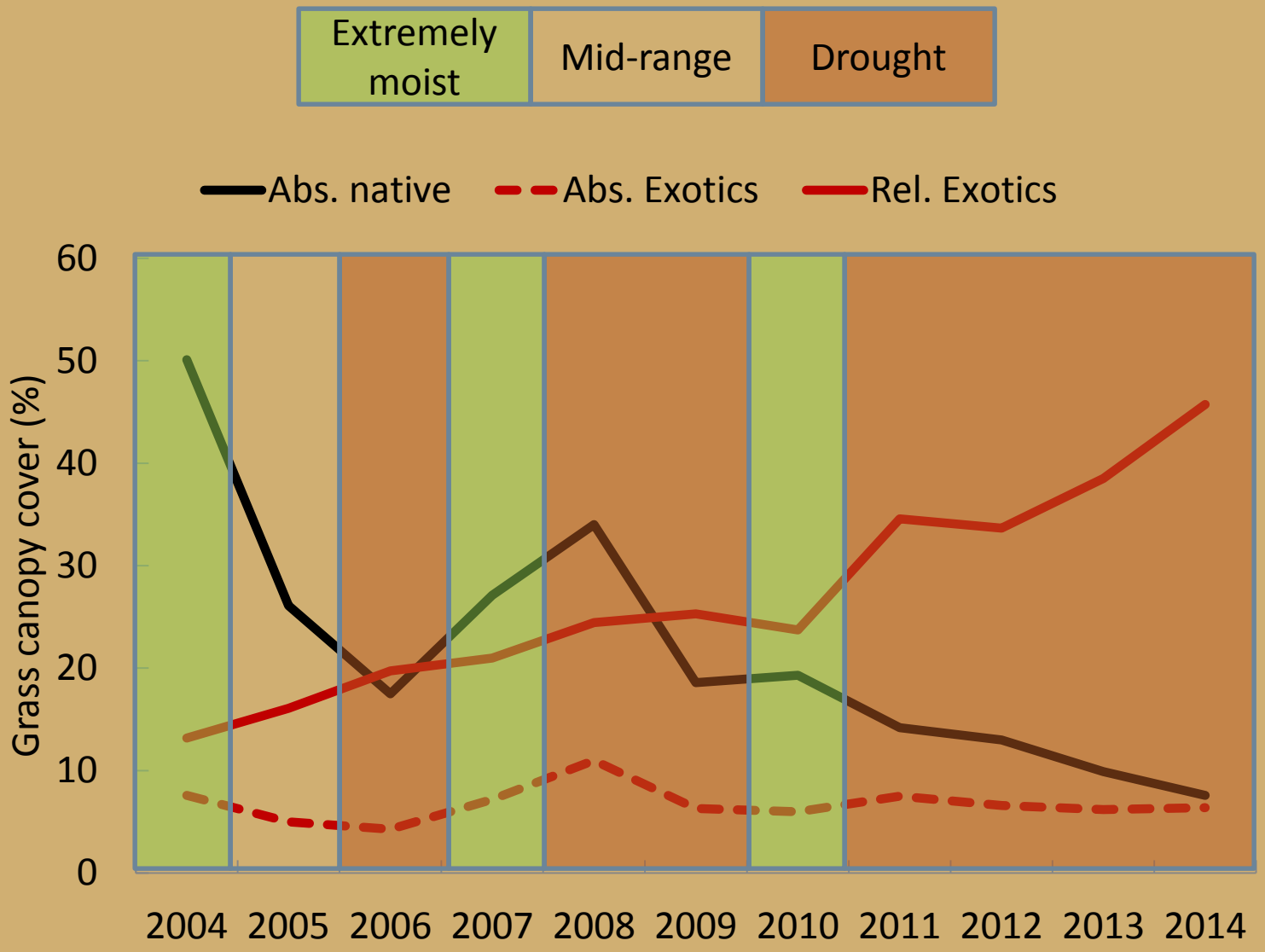


Years since initial sampling in 1976

Warming

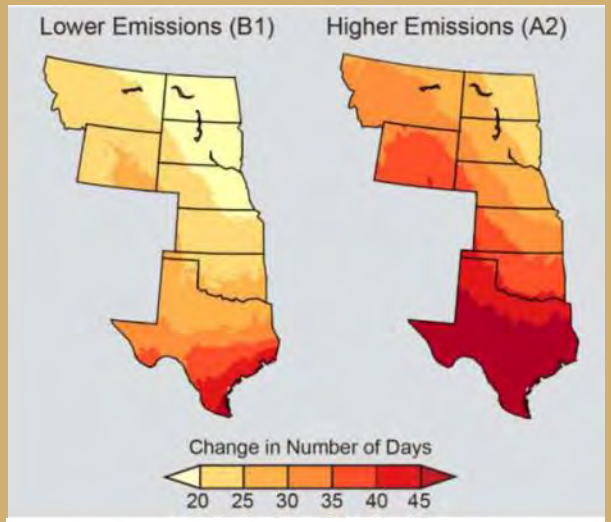
- Subtropical grasses limited by temperature
- Guineagrass not established in 1975
- Spread north in past decade
- Killed at -7°C
  - Last temperatures <-7°C were 22-24 December 1989
  - May be a factor in rapid increase

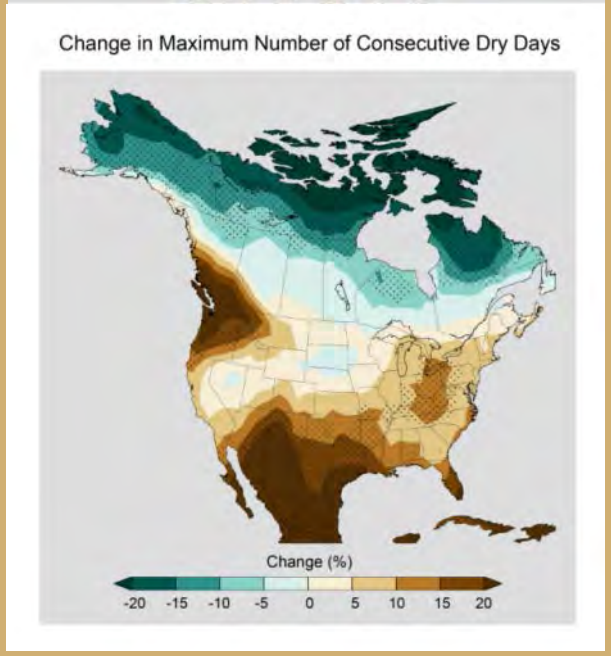
Grass, Comanche Ranch



Predictions

- Warmer temperatures favor subtropical grasses
  - Extend northward
  - Increase abundance
- Drought may increase exotic composition





Cascading effects of exotic grasses

- Replace native plant communities
- Form monotypic exotic grass communities
  - Reduced biodiversity
  - Altered soil microbial community
  - Simplified insect community
- Beneficial (pollinators and predators) insects reduced
- Reduced agricultural productivity

Conclusions

- Climate change
  - May have been part of brush increase
  - Indirectly influences brush management decisions
- Exotic grasses
  - Planted in response to drought
  - Replacement of native plant communities driven in part by climate change
- Native herbaceous communities increasingly rare