



*Does Fire
Disturbance Impact
Soil Microbiomes and
Plant Communities in
the Southwestern
USA?*

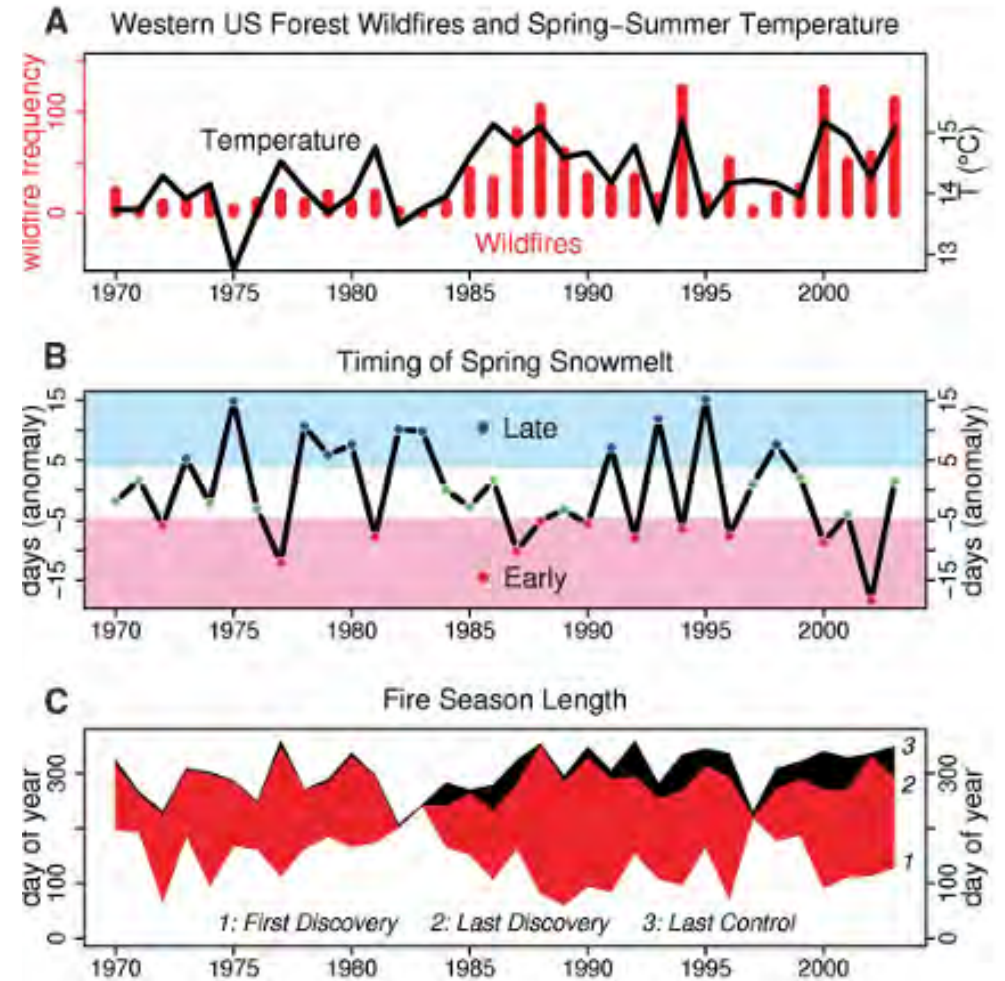
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Céspedes



Fire and climate change

- Climate change and land management practices impact **frequency** and severity of wildfires all over the globe (*Parks & Abatzoglou, 2020*)
- Western US predicted **increase** in fire severity and frequency in forested ecosystems (*Westerling et al., 2006*)
- Tree thinning and **prescribed burns** can mitigate climate change effects on wildfire (*Parks et al 2016*)



Fire and forest ecology

- Ponderosa pine forests are widely found across the western US
 - Low severity and intensity fires every 5-15 years (*Swetnam, 1999*)
 - 80% used by BLM for grazing livestock in NM (*Stade & Salvo, 2009*)
- Fire disturbance is a natural part of nutrient cycling within a forest ecosystem
 - Direct impact on the grass understory in a forest (*Kauffman et al., 1994*)
- Arbuscular mycorrhizae fungi (AMF) associates with 80% of all plant roots (*Neary, 1999*)





Burning questions

1. Does time-since fire impact grass biomass and species diversity?
2. Does time-since fire impact arbuscular mycorrhizal fungi (AMF) species diversity and abundance?
3. Does time-since fire impact grass and AMF interactions?

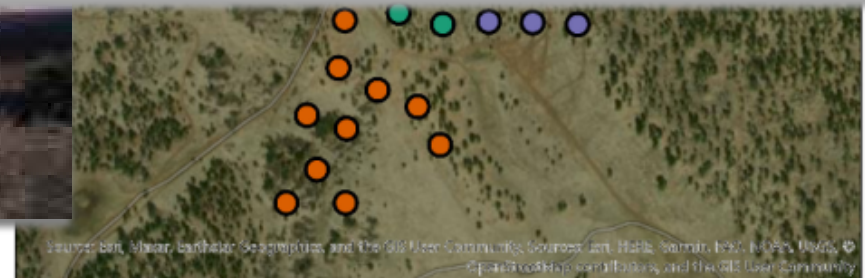
Utah	Colorado	Kansas
		Oklahoma

Site Selection

- Black Lake, NM
- Ponderosa pine forest
 - 22 trees per ha
 - 13% canopy cover
 - 14 species of grass
- 3 post prescript
 - 10-month (<1 year)
 - 8/9-year burn
 - 20+ year burn



Search Area
 New (<1 year)
 8-9 years
 20+ years



Source: Ben, Alvar, Barbara, Sebastian, and The Old West Cultural Site Sources, Inc. Public Domain, 1997, 1998, 2005, © 2010, 2011, 2012, 2013, and the Old West Community

Data collection 2022:

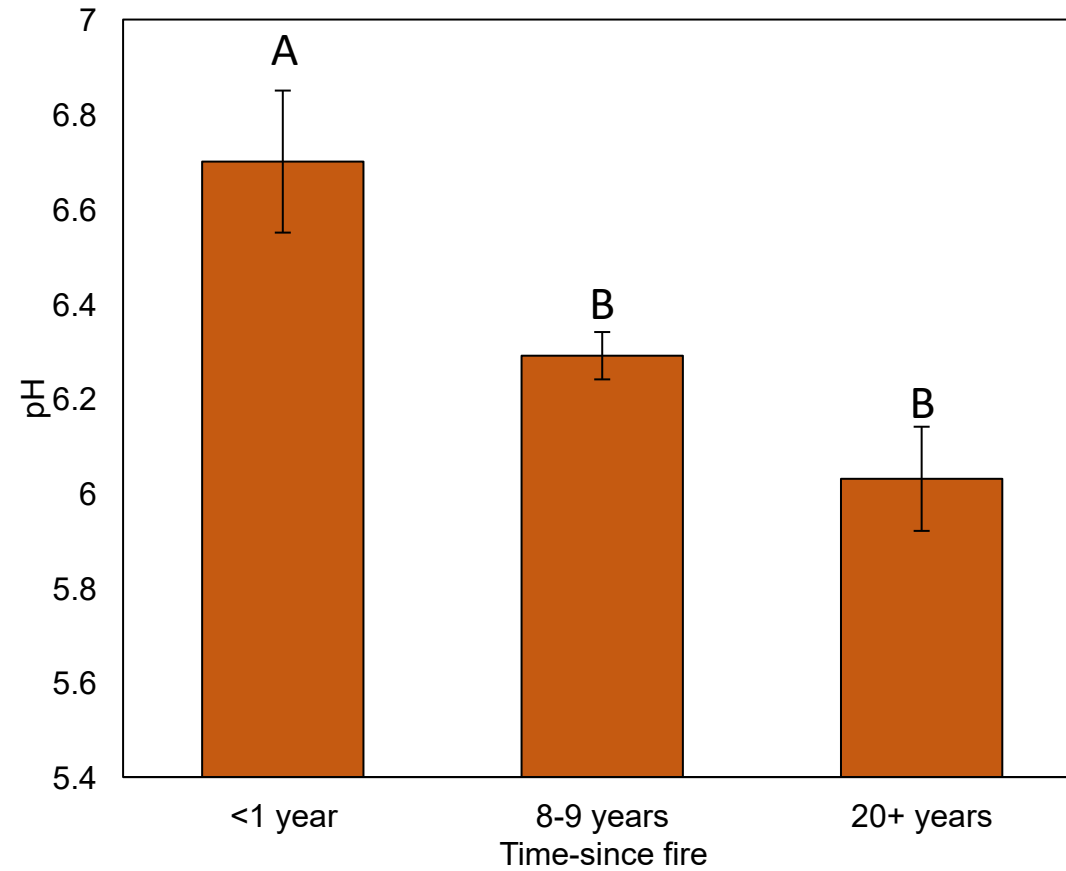


- Tree density, canopy cover %, and tree regeneration
- Ground cover surveys
- Aboveground biomass of grass
- Soil characteristics:
 - Organic matter, TopN (nitrates), P, K, & pH
 - Texture
- AMF analysis for species richness and abundance
 - Nanopore sequencing and bioinformatic analysis



Soil characteristics

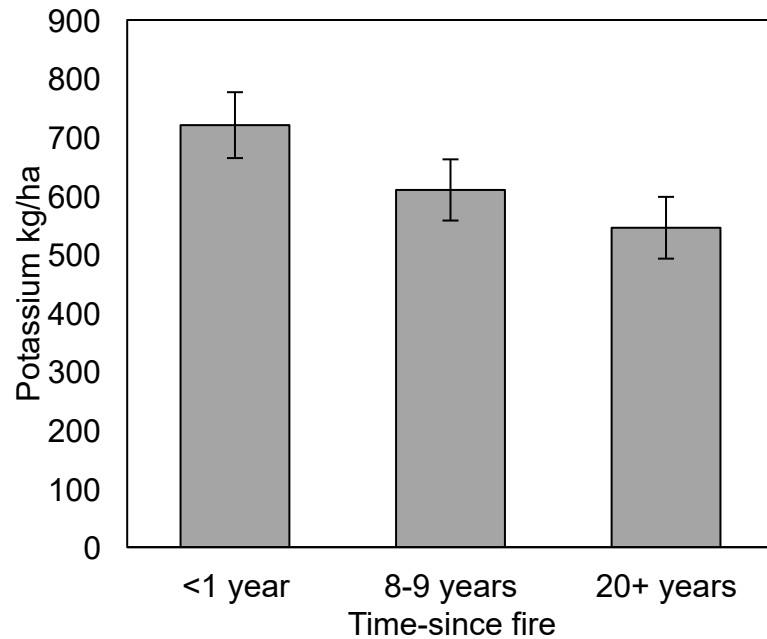
pH decreases with time-since fire



P-value = 0.0006

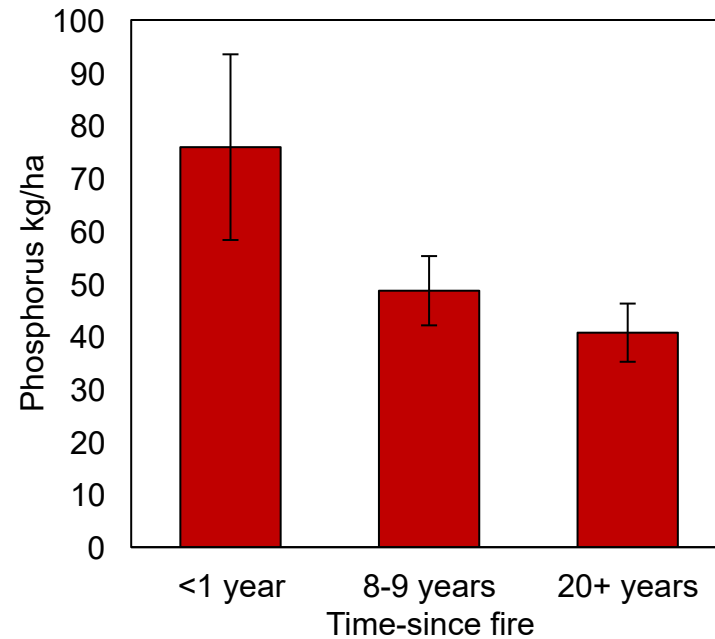
Soil nutrients

No change in potassium over time



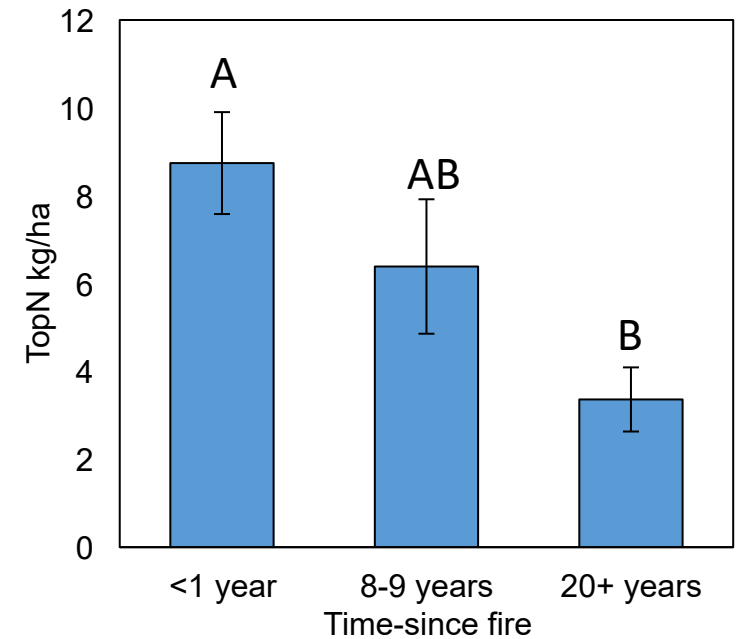
P-value = 0.08

No change in phosphorus over time



P-value = 0.11

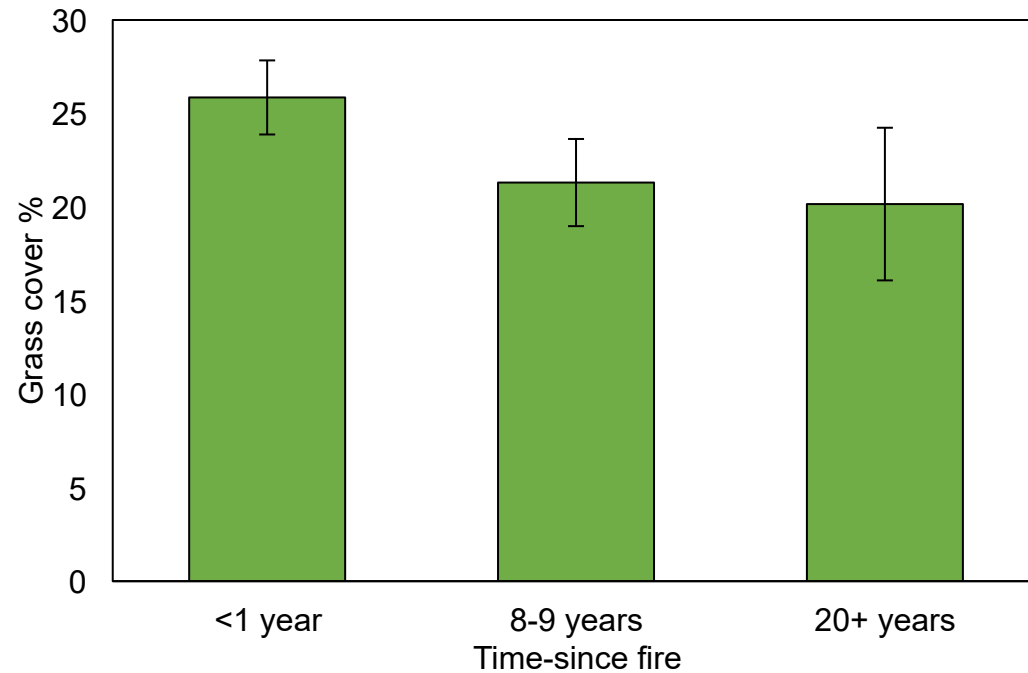
Top Nitrogen decreases as time-since fire increases



P-value = 0.008

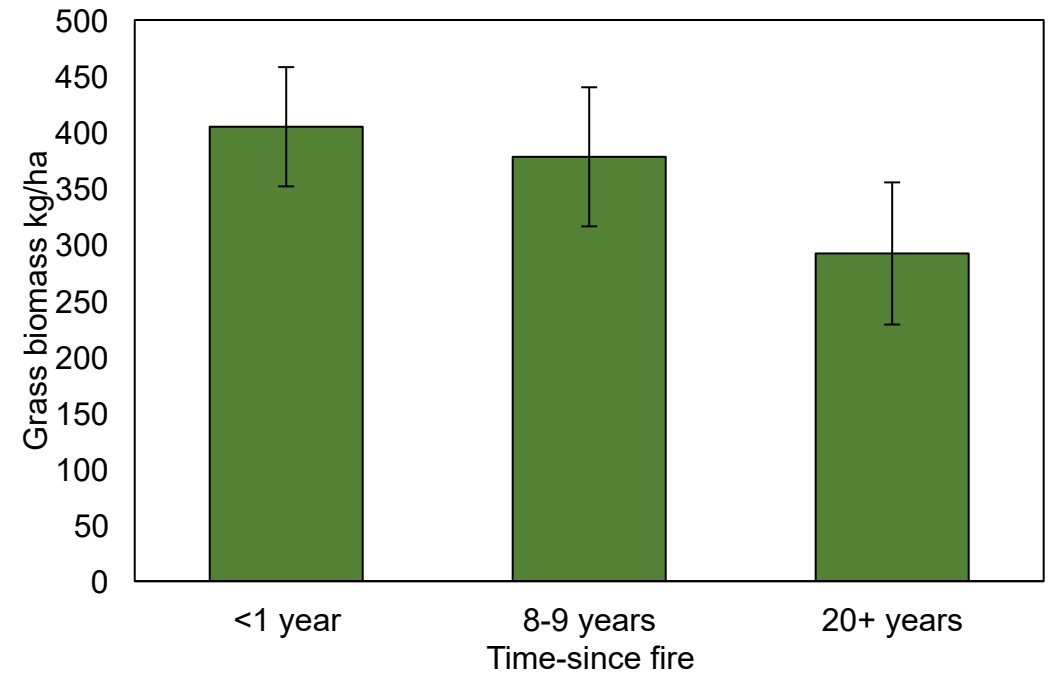
Grass cover & biomass

No change in total amount of grass over time



P-value = 0.364

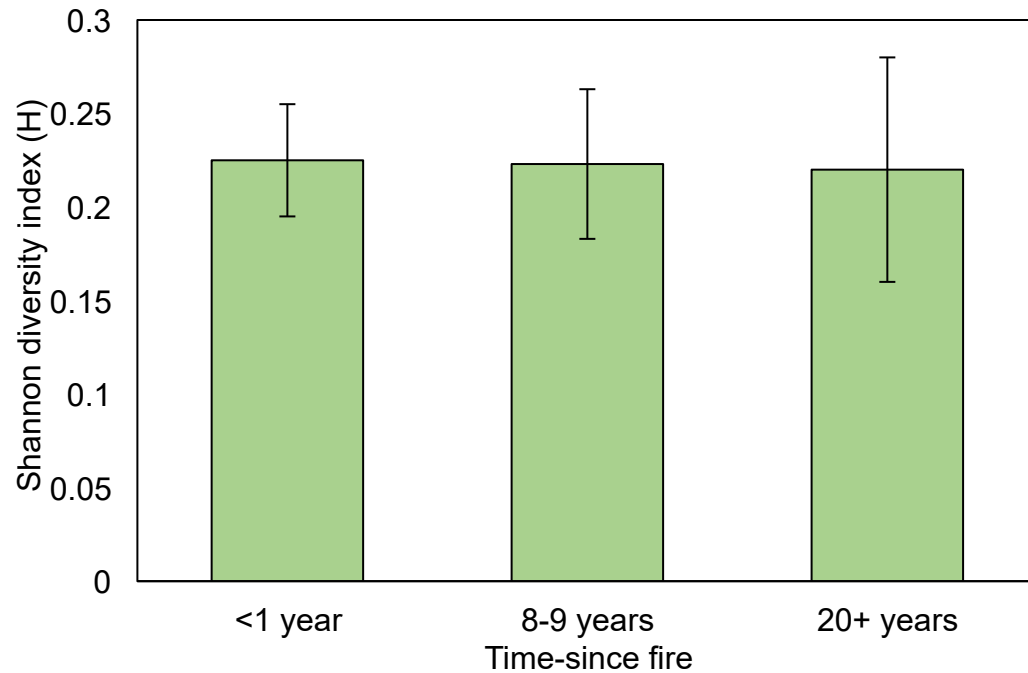
No change in grass biomass over time



P-value = 0.389

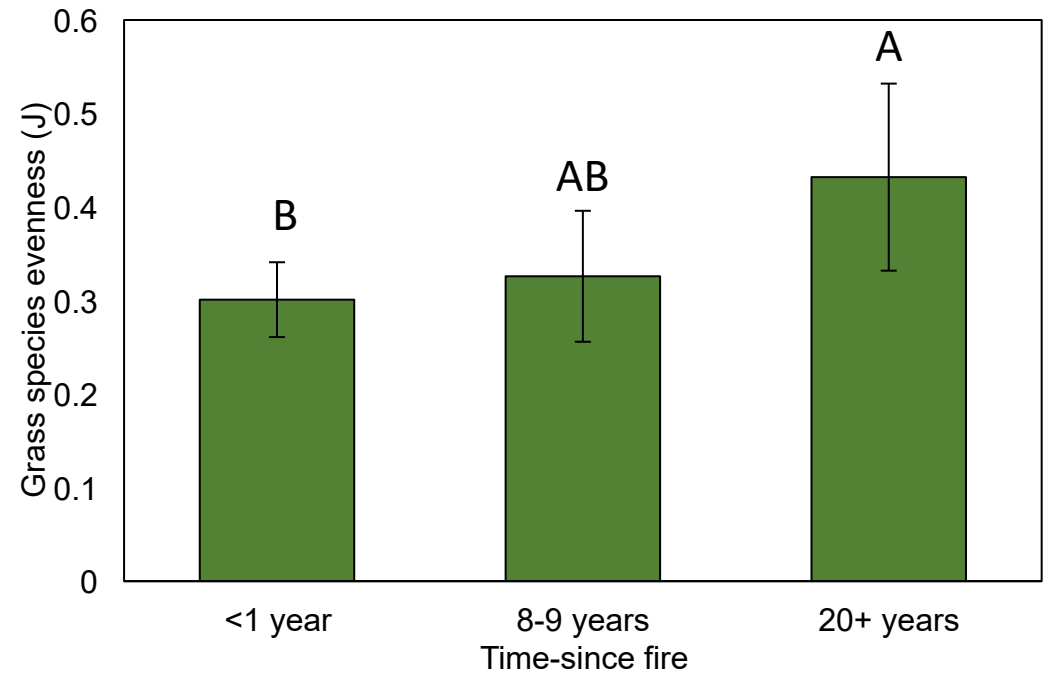
Grass species Shannon diversity index and evenness

No change in grass species diversity with time



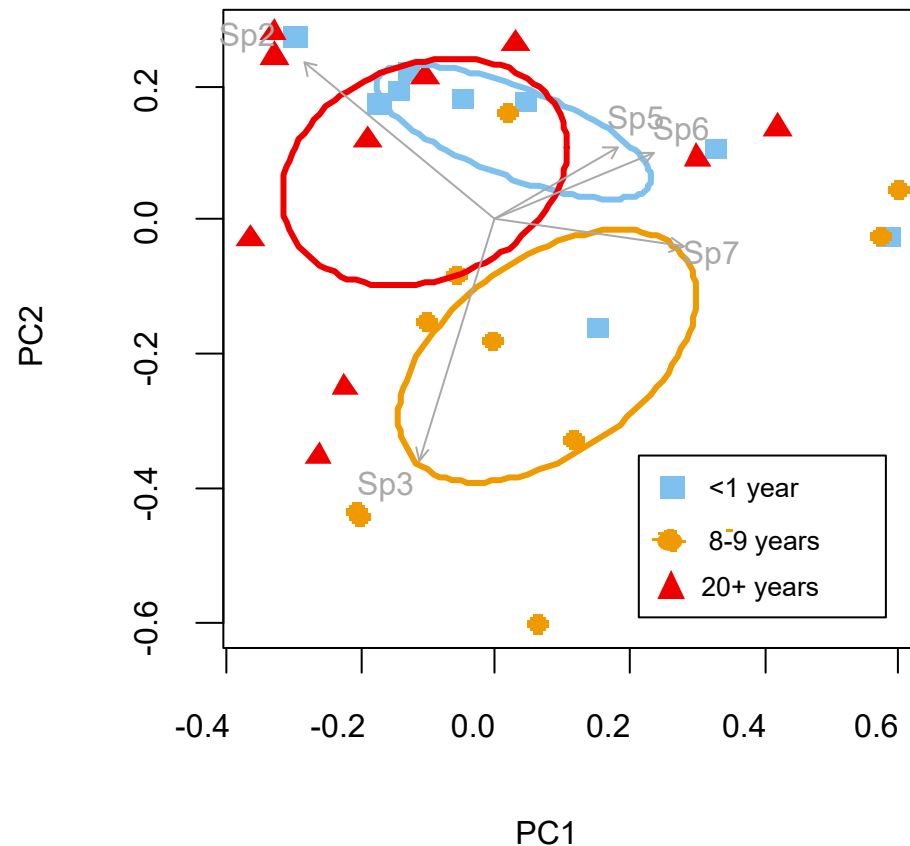
P-value = 0.997

Grass species evenness increases with time-since fire



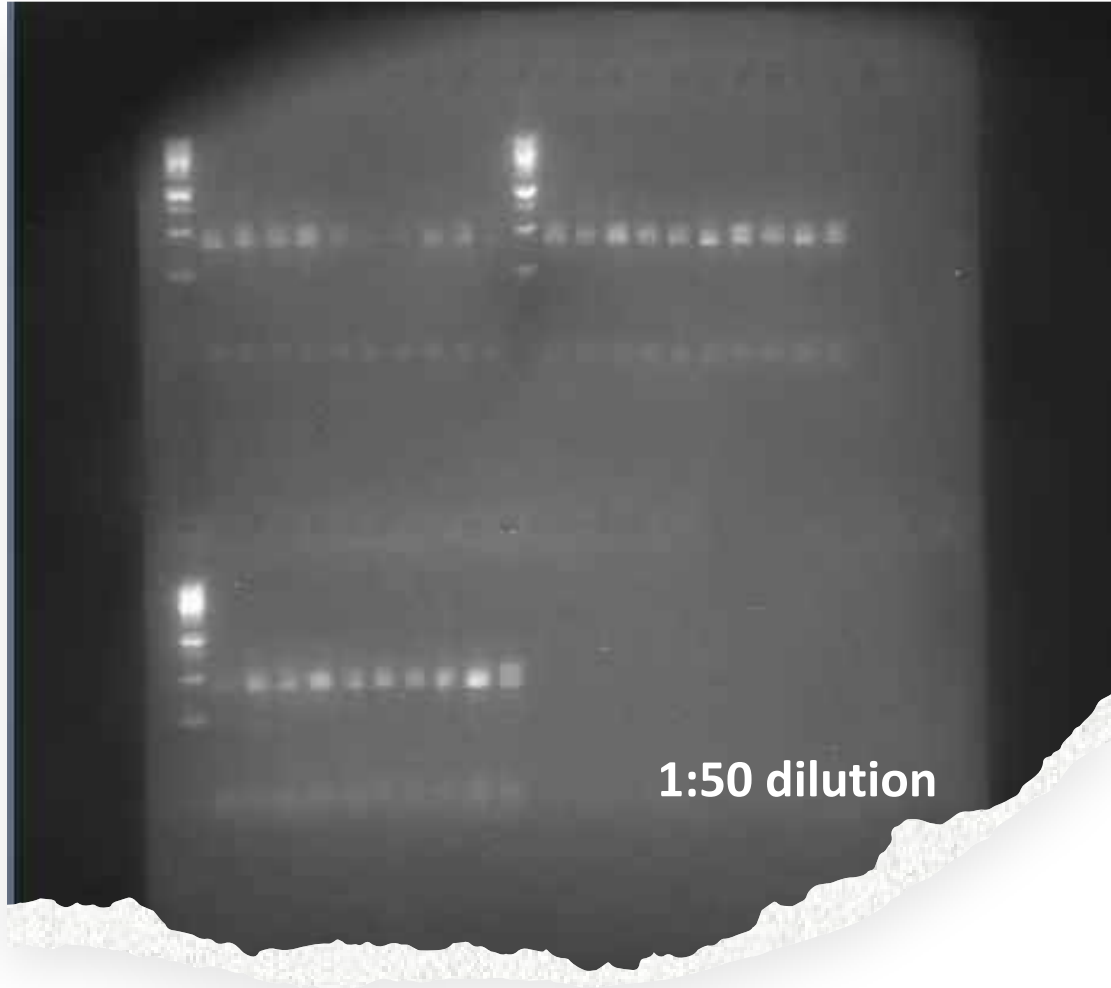
P-value = 0.041

Grass communities differ with time-since fire

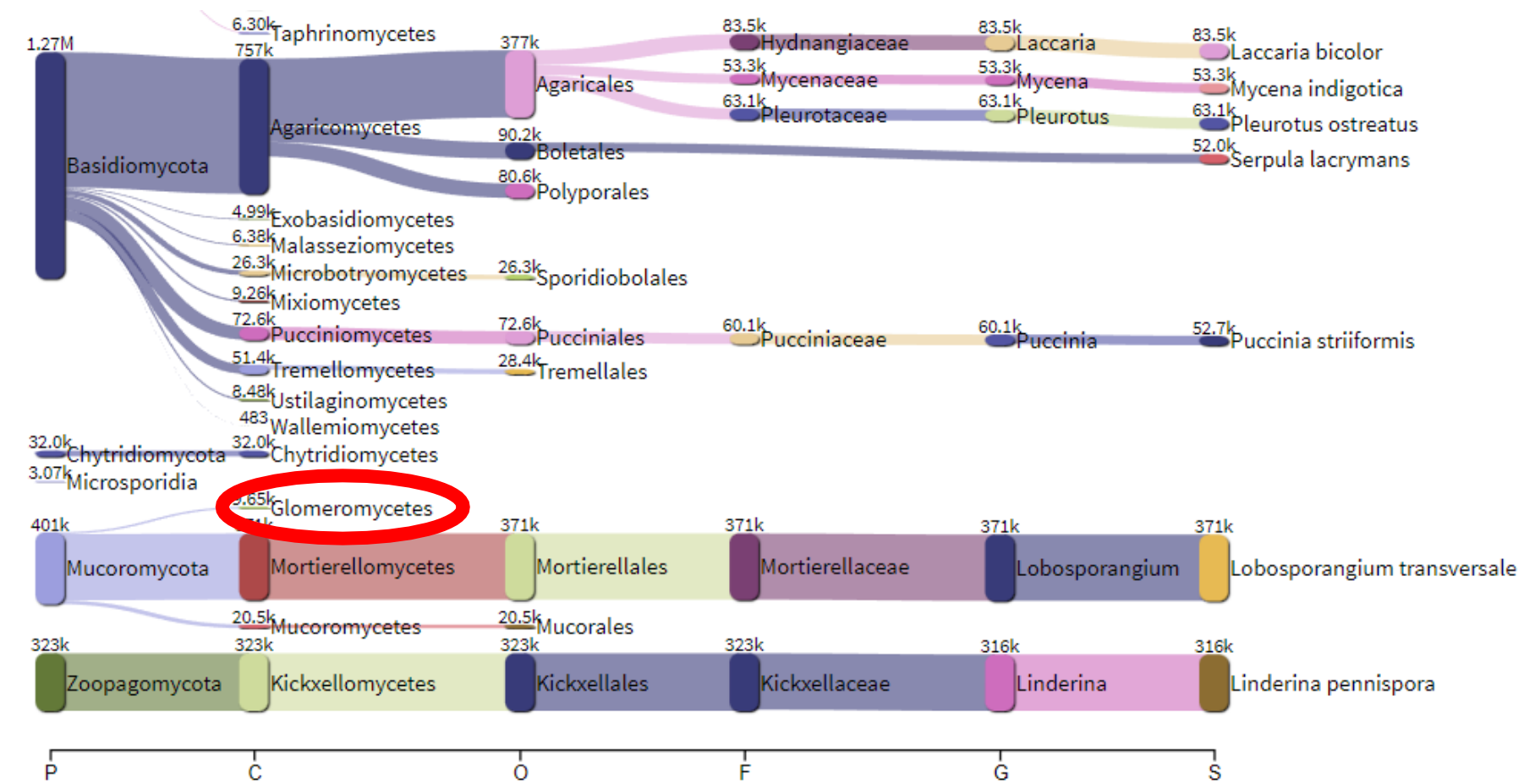


- Sp2-** Mountain muhly (*Muhlenbergia montana*)
- Sp3-** Arizona fescue (*Festuca arizonica*)
- Sp5-** Squirrel tail (*Elymus elymoides*)
- Sp6-** Fringed brome (*Bromus ciliatus*)
- Sp7-** Blue grama (*Bouteloua gracilis*)

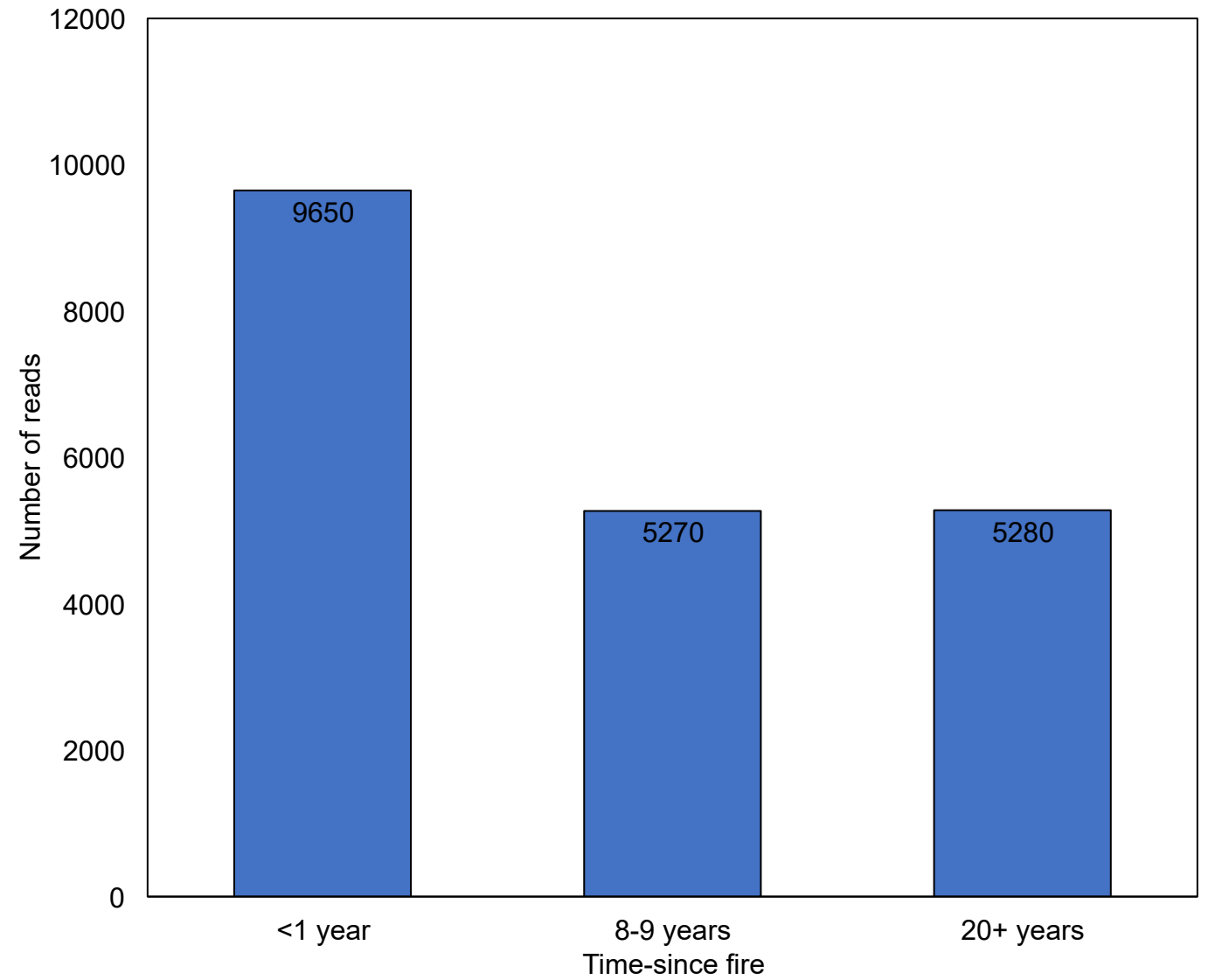
P-value = 0.009 from permutational manova



AMF



Preliminary
AMF read
results



Grass community and soil change with time-since fire

- Soil characteristics **decreased** as time-since fire **increased**
- No statistical differences due to time-since fire on biomass, grass cover, and Shannon's diversity index
- Plant communities changed with time-since fire



Separate to open

Site Plot 185

Press to close

SOIL SAMPLE BAG

Code 0615

Instructions for collecting and preparing soil samples

Samples should be taken from the "root zone" of the plants being grown in the soil. The "root zone" for grass would be 2 or 3 inches below the surface of the soil. The "root zone" for garden or farm crops would be 6 to 8 inches below the surface. When analyzing a specific area of soil (a garden, or field), take the sample from



Acknowledgements

- Undergraduate work studies Dillon Alexander, Caven Elsaessar, & others
- Funding through FORT-CREST
- New Mexico State Land Office
- NCGR and NM-INBRE funding through the National Institute of General Medical Sciences grant 8P20GM103451

