What is the effect of fire disturbance on soil microbiomes and plant community structure in a ponderosa pine forest in the southwest?

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NEW MEXICO HIGHLANDS UNIVERSITY

FORT-CREST

Fire and Climate Change

- Studies suggest fire severity and frequency will **increase** (Westerling et al., 2006)
- Climate change and land management practices has had impacts on **frequency** and severity of wildfires all over the globe (Parks & Abatzoglou, 2020)
- To mitigate, thinning and **prescribed burns** are practiced (Parks et al 2016)

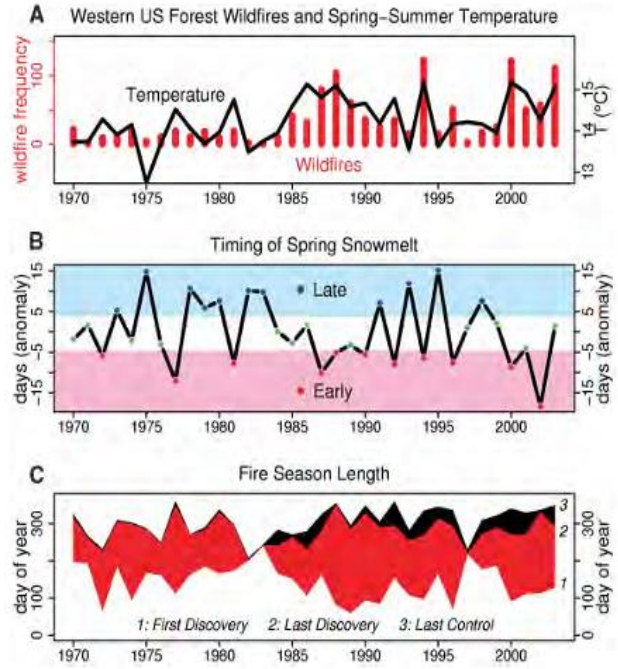
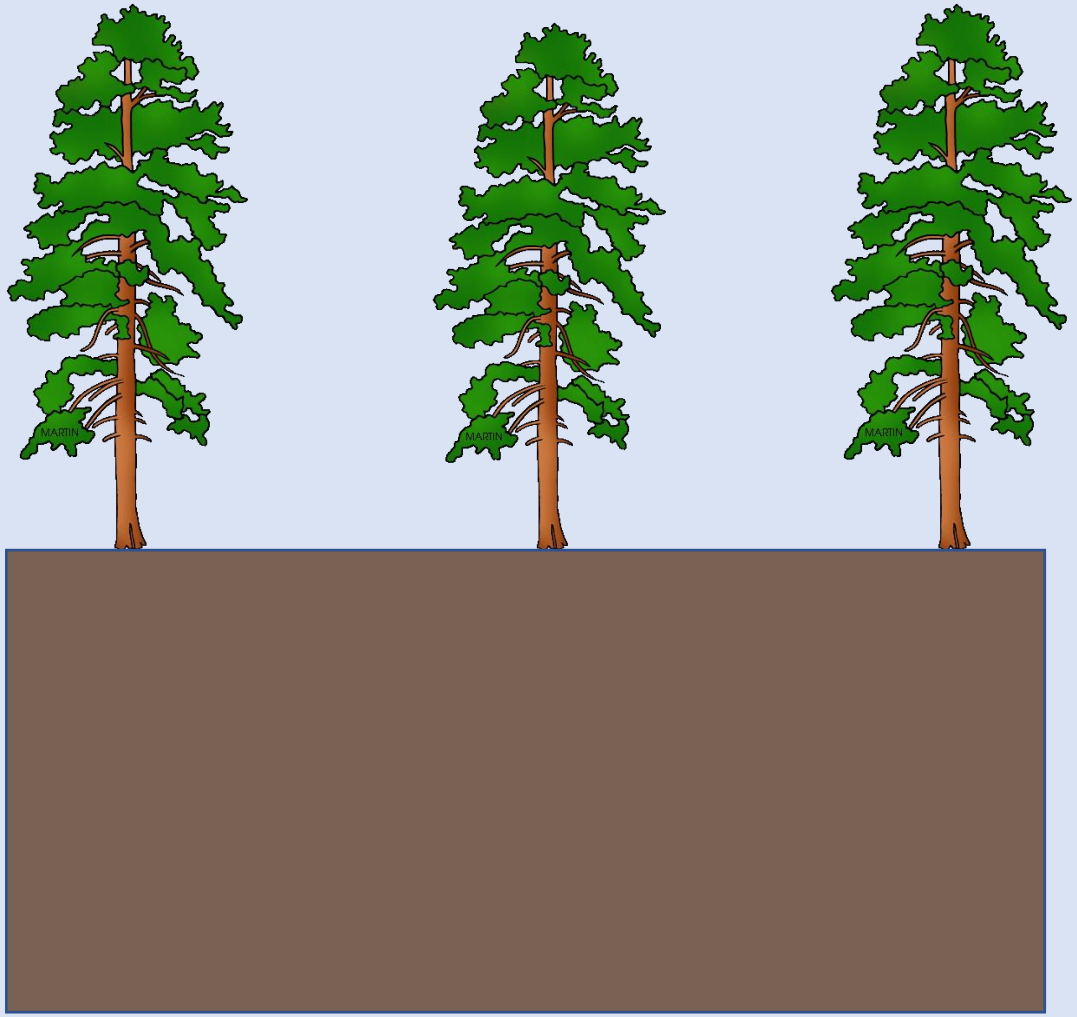


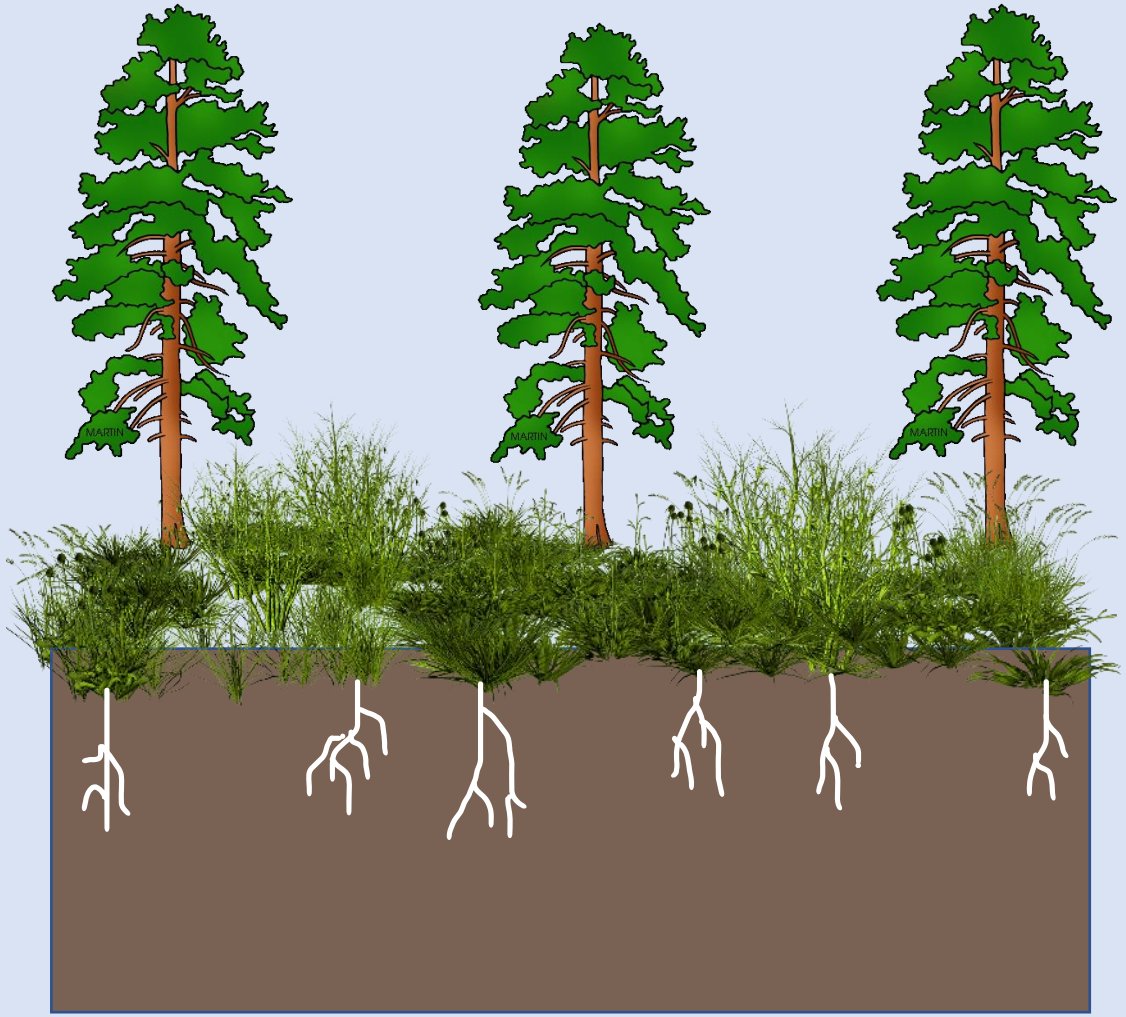
Figure 1. Westerling, 2006, Science

Ponderosa pine forest in the southwest

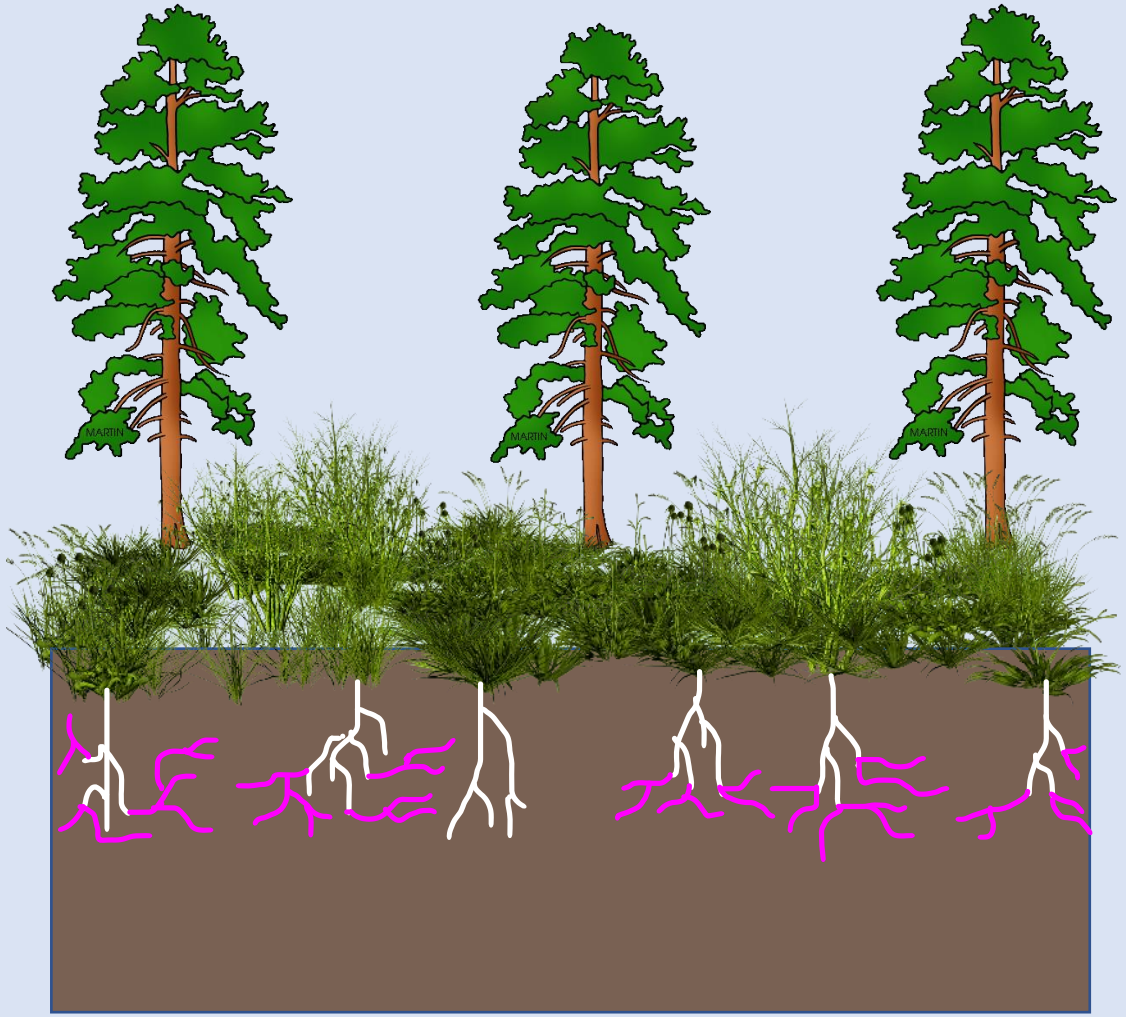


Ponderosa pine forest fire regime

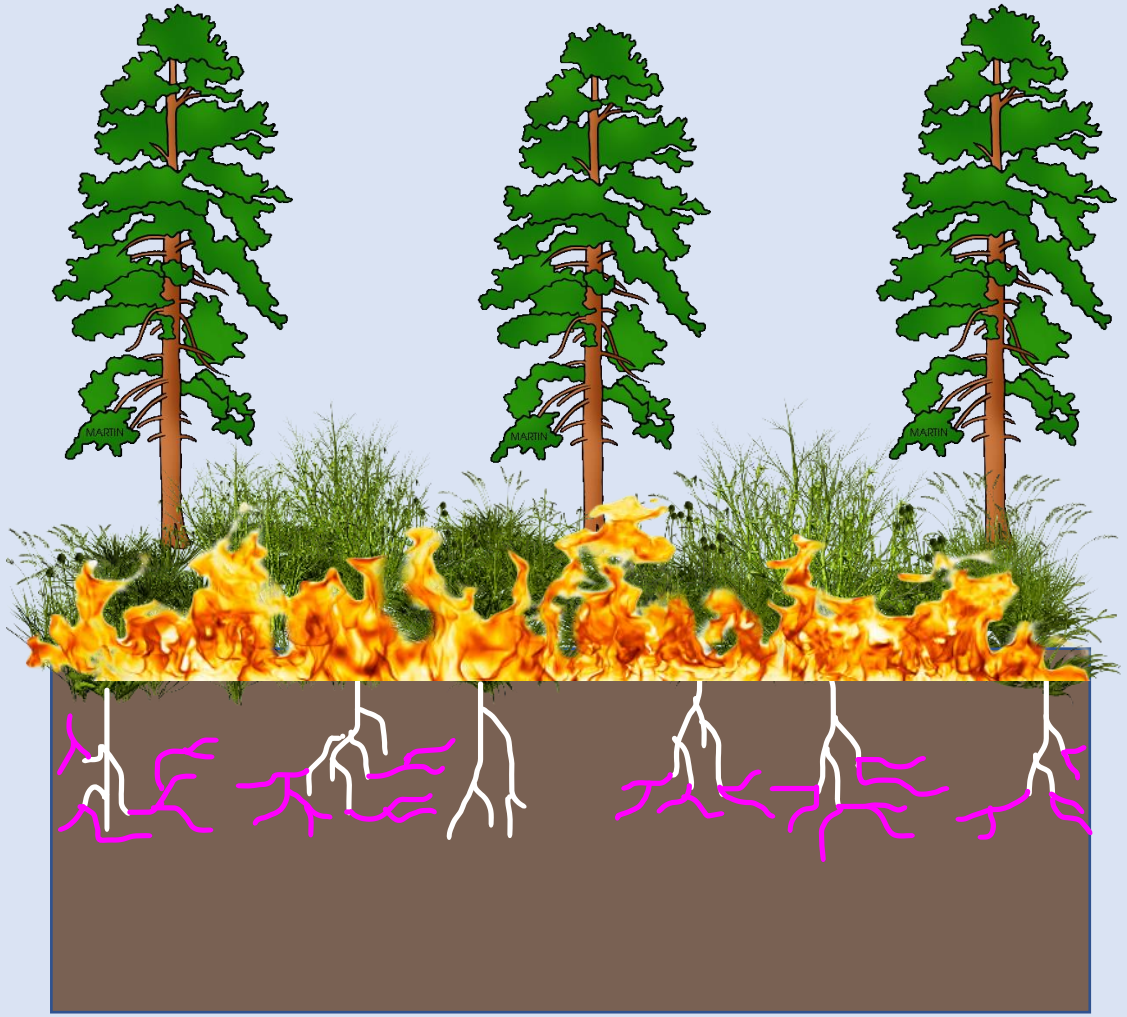
Ponderosa pine forest understory



Ponderosa pine forest microbiome

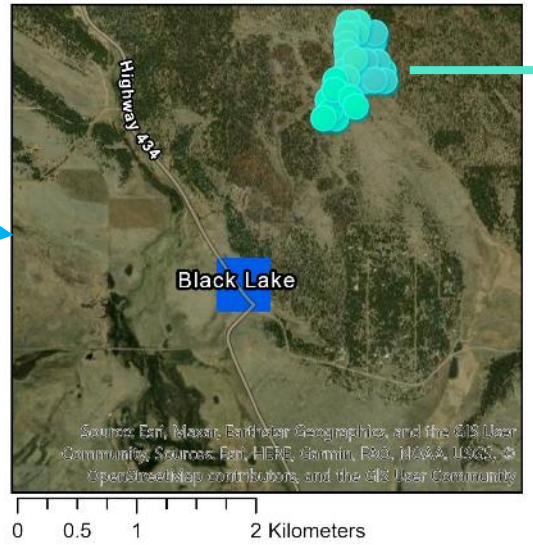


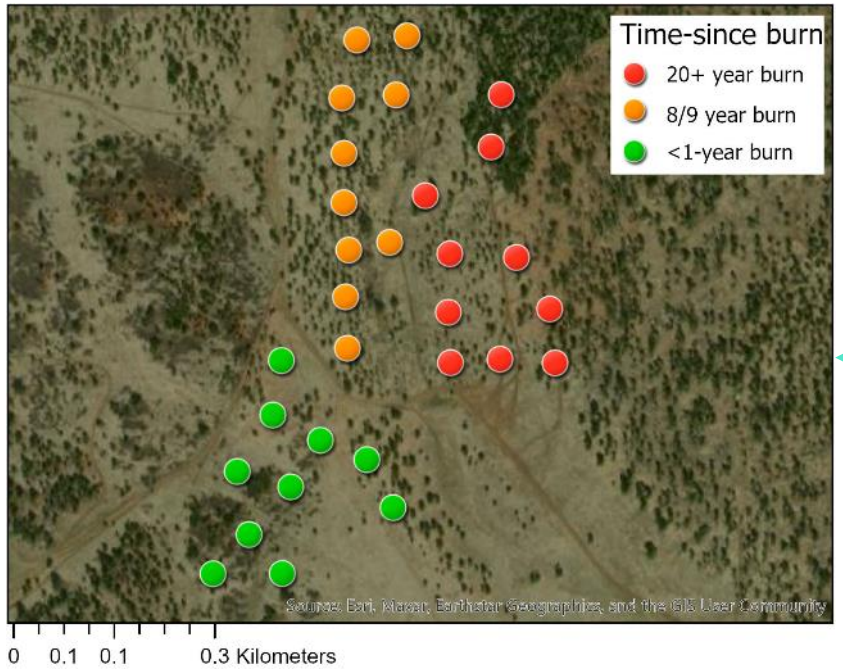
Ponderosa pine forest and prescribed fire



What is the effect of fire disturbance on soil microbiomes and plant community structure?

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





Site selection:

- Black Lake, NM
- Ponderosa pine forest
- 3 post Rx fire locations:
  - 10-month (<1-year) burn
  - 8/9-year burn
  - 20+ year burn
- 10 sampling points in each area

Ponderosa pine stand characteristics

- Average elevation is 8926 ft
- 23 trees per acre
  - SE ±3 trees/acre
- 13% canopy cover
  - SE ±5.35%
- Average tree height 43.7 ft
  - SE ±5.35 ft
- Average DBH is 13.74 in
  - ±2.87 in

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Little Coyote Prescribed Fire Burn Unit Plan

New Mexico State Land Office
Field Operations Division, District: Roy
Black Lake Forest Restoration

Project Name: **Little Coyote Prescribed Fire** (2,286 Acres)
Legal: T24N, R16E, Sections: 8, 9, 10, 15, 16, 17, 21 and 22
Latitude/Longitude: 36.31 N, -105.24 W (Approximate Center of Unit)

Moderate Complexity: RXB2 Required

Prescribed Fire Project Description: The Little Coyote Prescribed Fire Project is to improve watershed function, wildlife habitat, productive sustainable forests and livestock forage along with providing protection to the Wildland Urban Interface from intense and damaging wildfires. This project will promote fire resiliency and maintain a more natural range of variability in native vegetation successional stages by allowing fire to act as a natural disturbance process reducing activity and naturally accumulated fuels and the risk of catastrophic wildfire that would negatively affect overall ecosystem health. The unit is on State of New Mexico Trust Lands and approximate center of the unit is located 6 miles SSE of Angel Fire, NM (Images 1 & 2; Appendix A: Map 1 - Vicinity). Lower elevations in the unit are dominated by ponderosa pine and upper reaches of the unit become more mixed conifer. Mechanical thinning began in 2008 and continues at the time of this plan creation (Appendix A: Map 4 – Silvicultural Treatment Units). Sub-units identified in this plan will be burned when the harvest status and fuel conditions are appropriate to meet objectives defined in this plan. There have been 5 previous prescribed burn entries in 2013 and 2014 within this unit totaling 355 acres as depicted on Map 2 – Project Overview/Zones/Sub-units.

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NM STATE

FORT Center

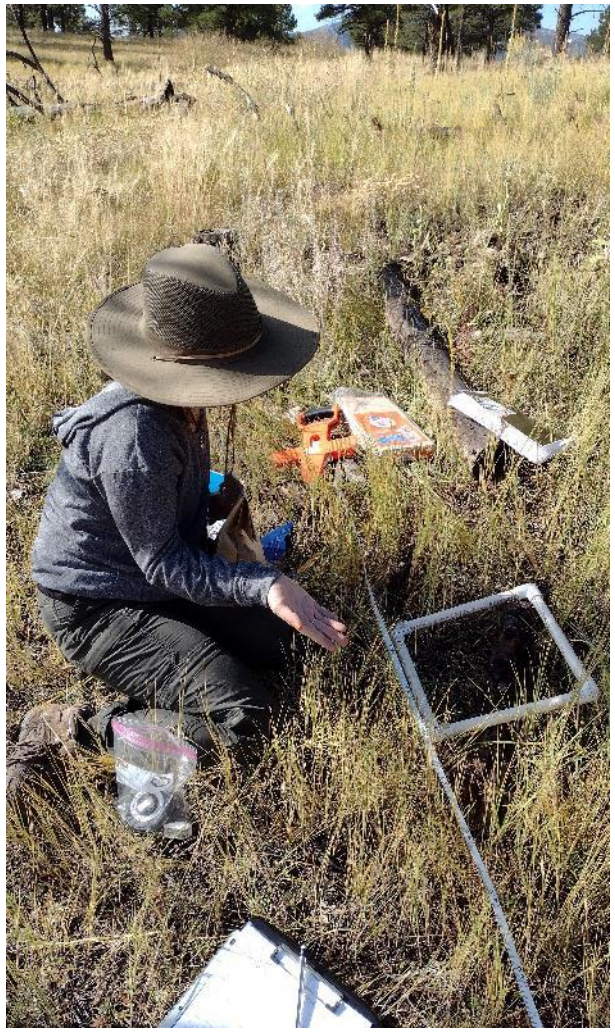
NMFWRI

Little Coyote Creek Prescribed Burn Unit

2019 Plan Update

New Mexico State Land Office
Black Lake Forest Restoration

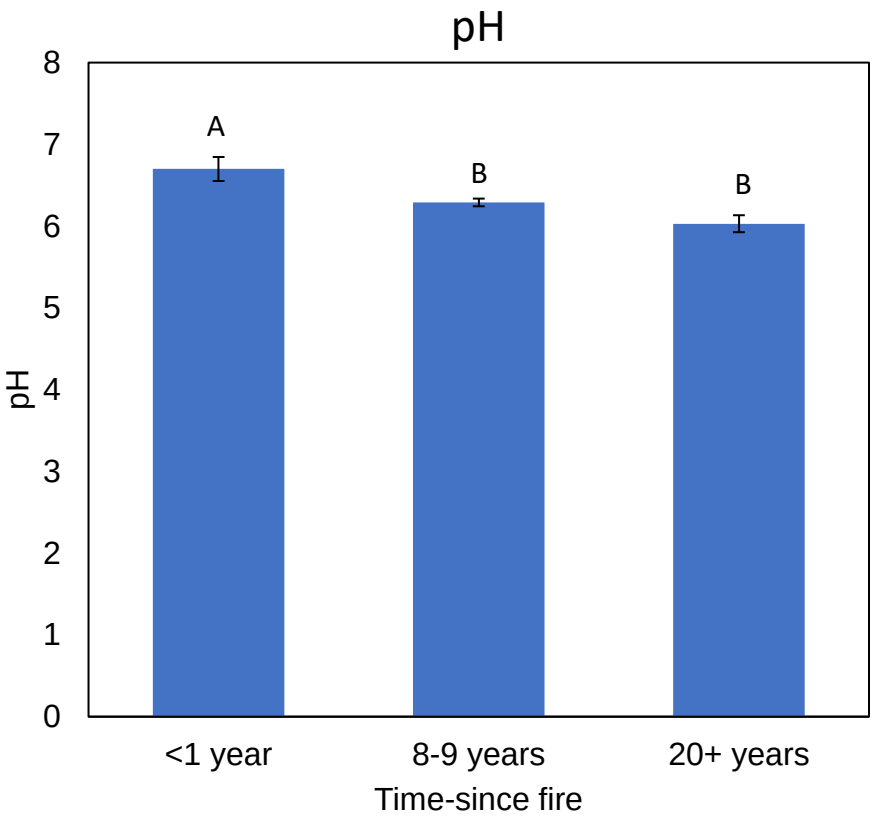
...n is intended as an update to the 2016 Prescribed Fire Burn Unit Plan prepared by Raymond Gasc, Smoked Goose Consu...C. The original plan remains representative of the site, however, this update will include current fuel conditions, updated ...otification lists, and revised unit designs. The previous 2016 plan will hereby be referred to as "the Programmatic Plan".



Data collection 2022:

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

Soil characteristics:



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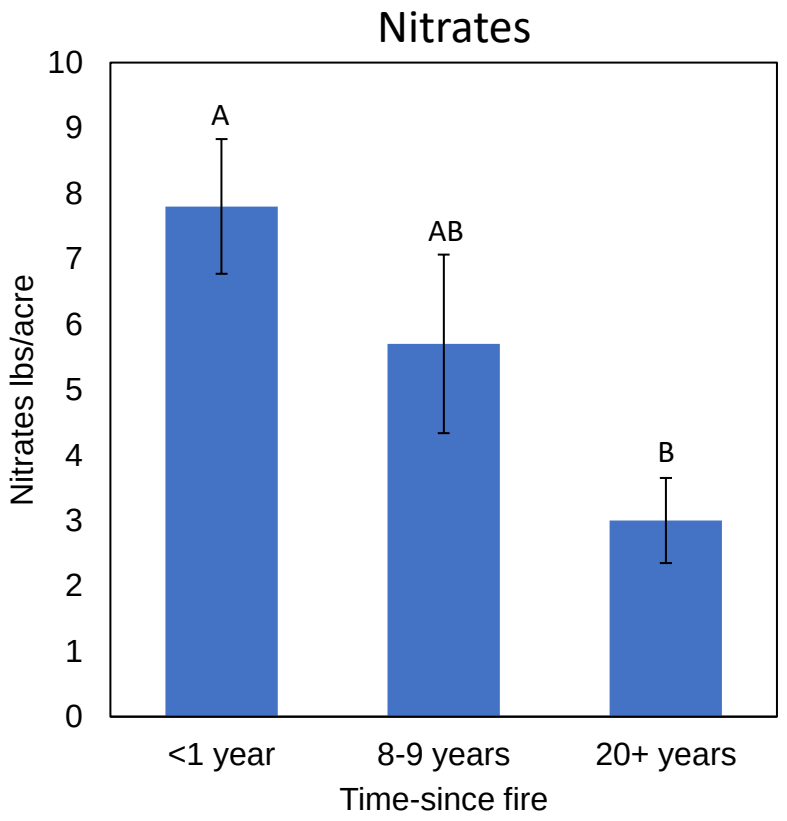

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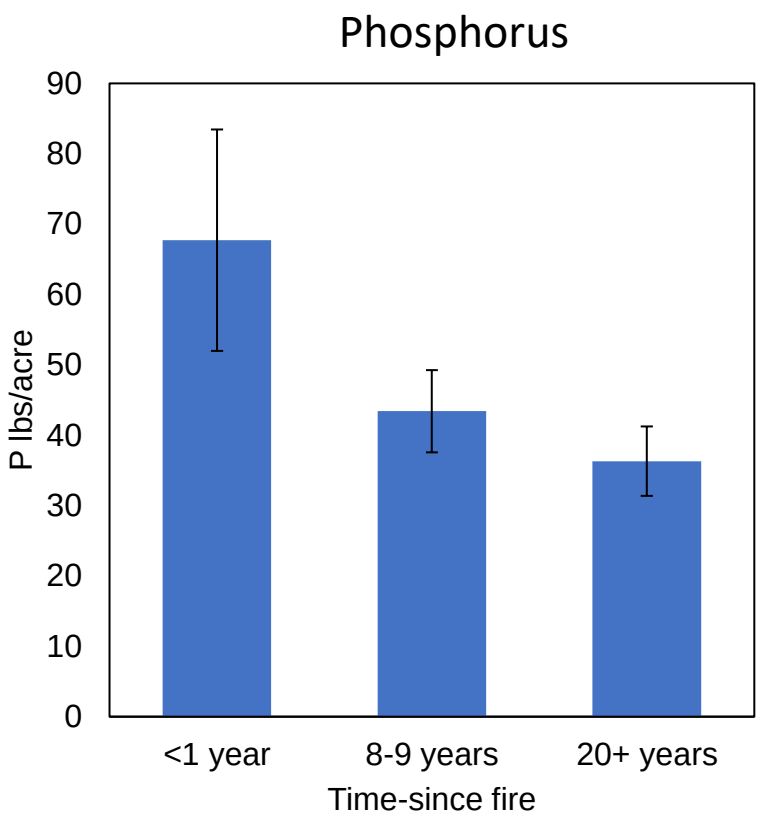

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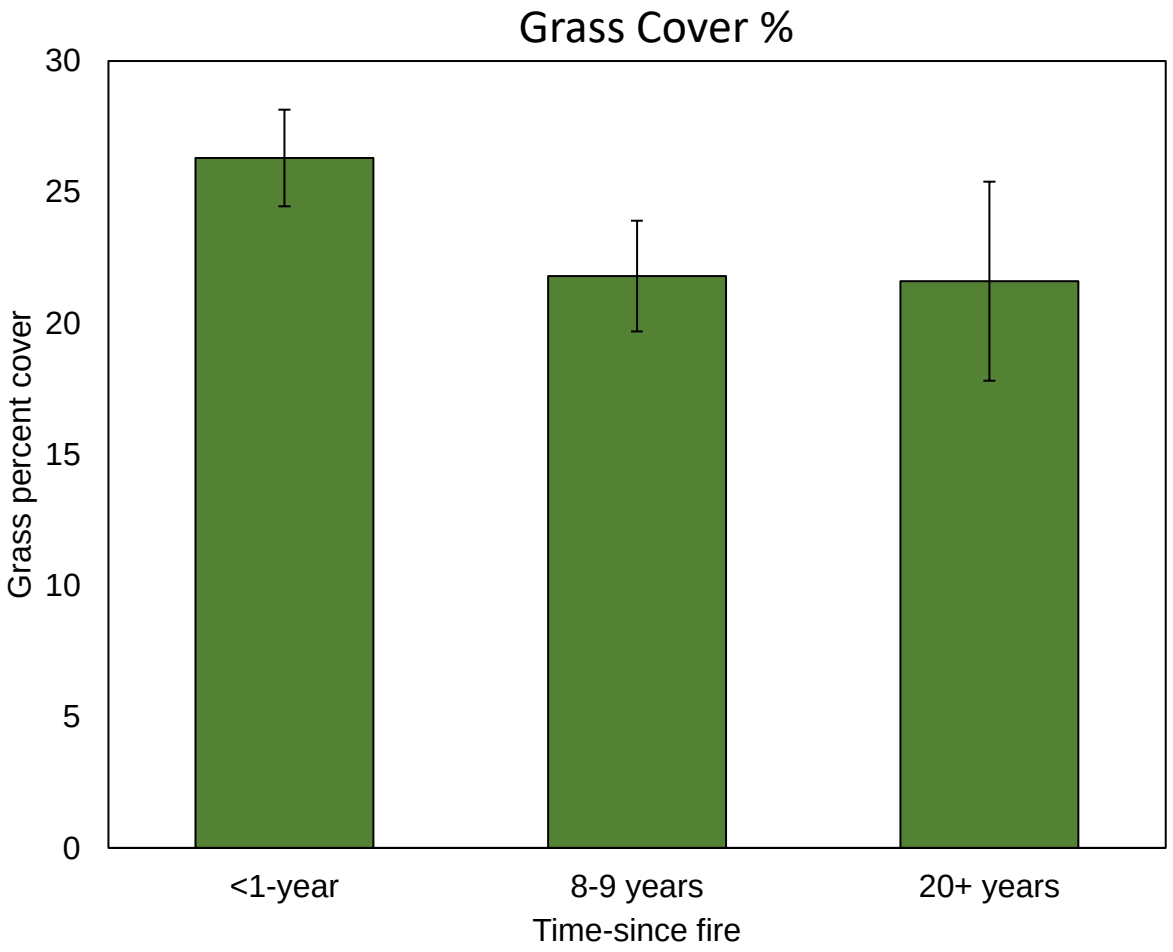
Grass cover & grass biomass



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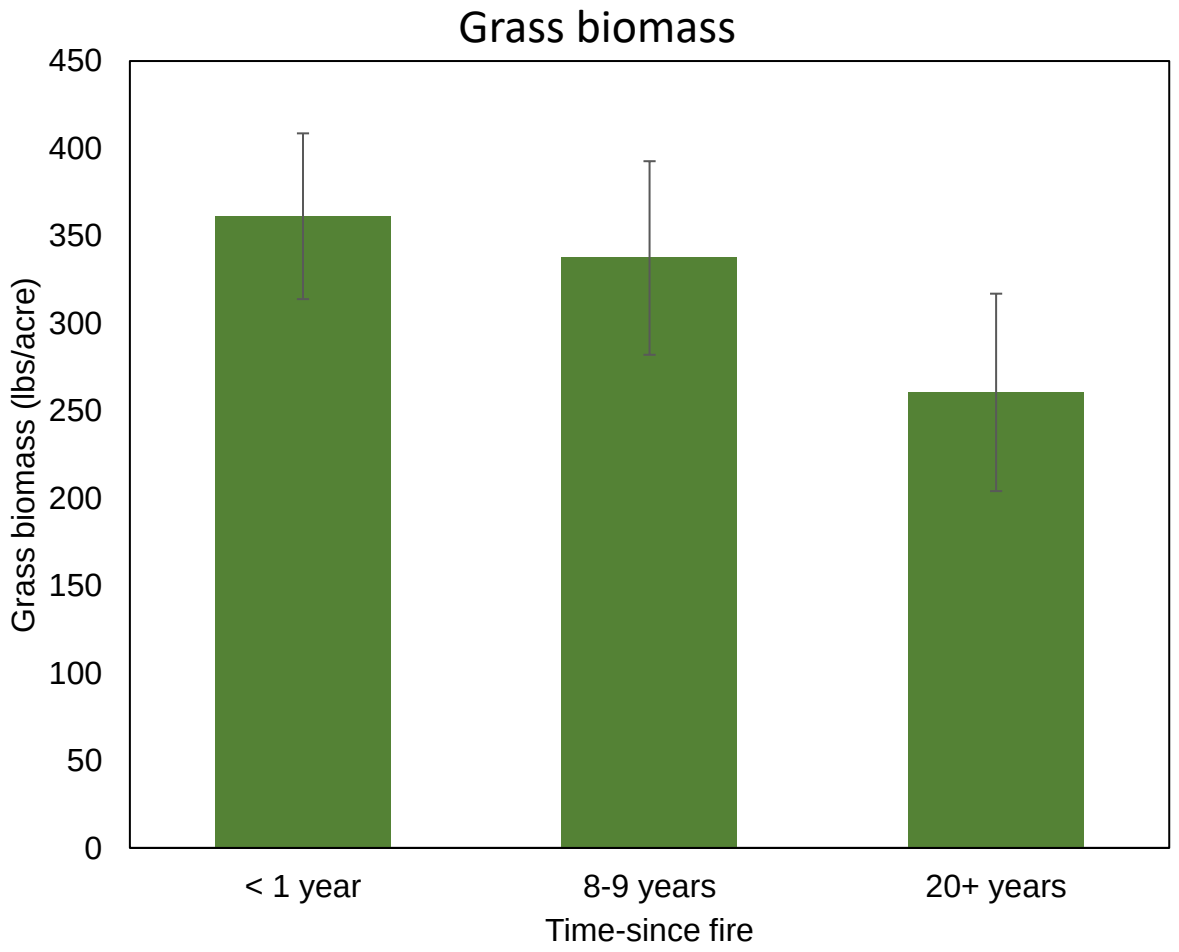
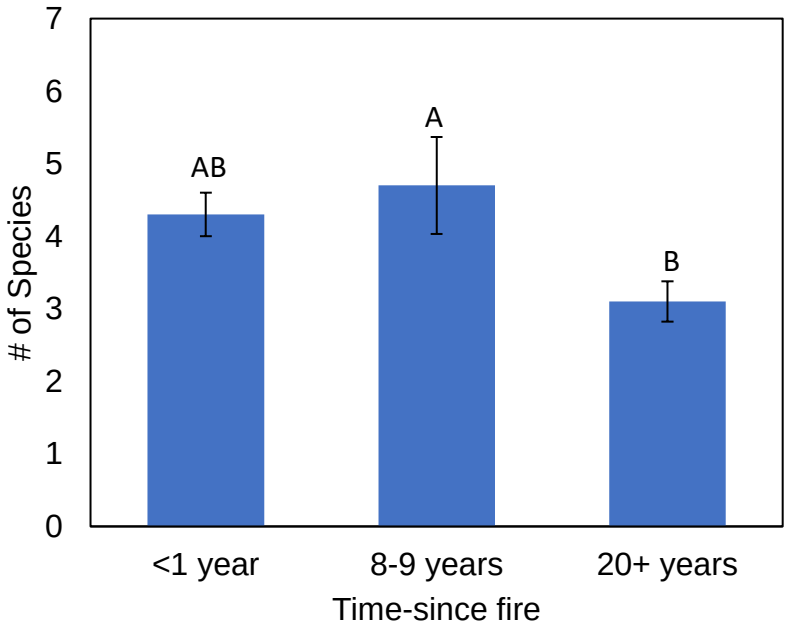


P-value = 0.389

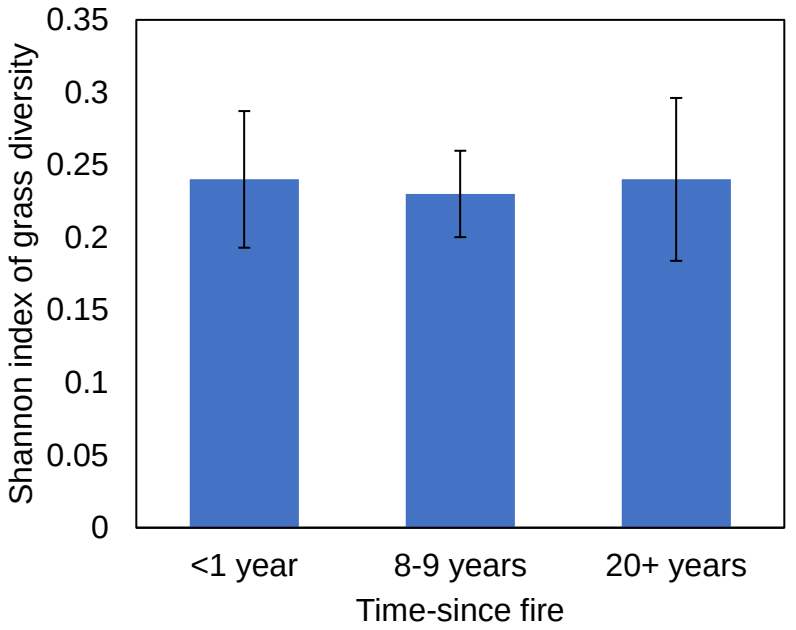
Grass species richness, diversity and evenness:

Species richness of Grass



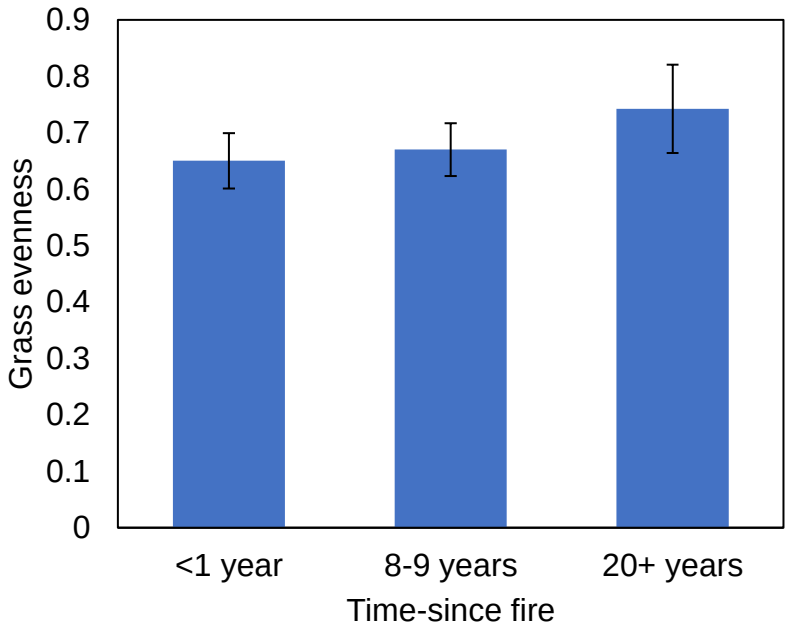
P-value= <0.05

Shannon diversity index of grass



P-value= 0.96

Shannon evenness index of grass



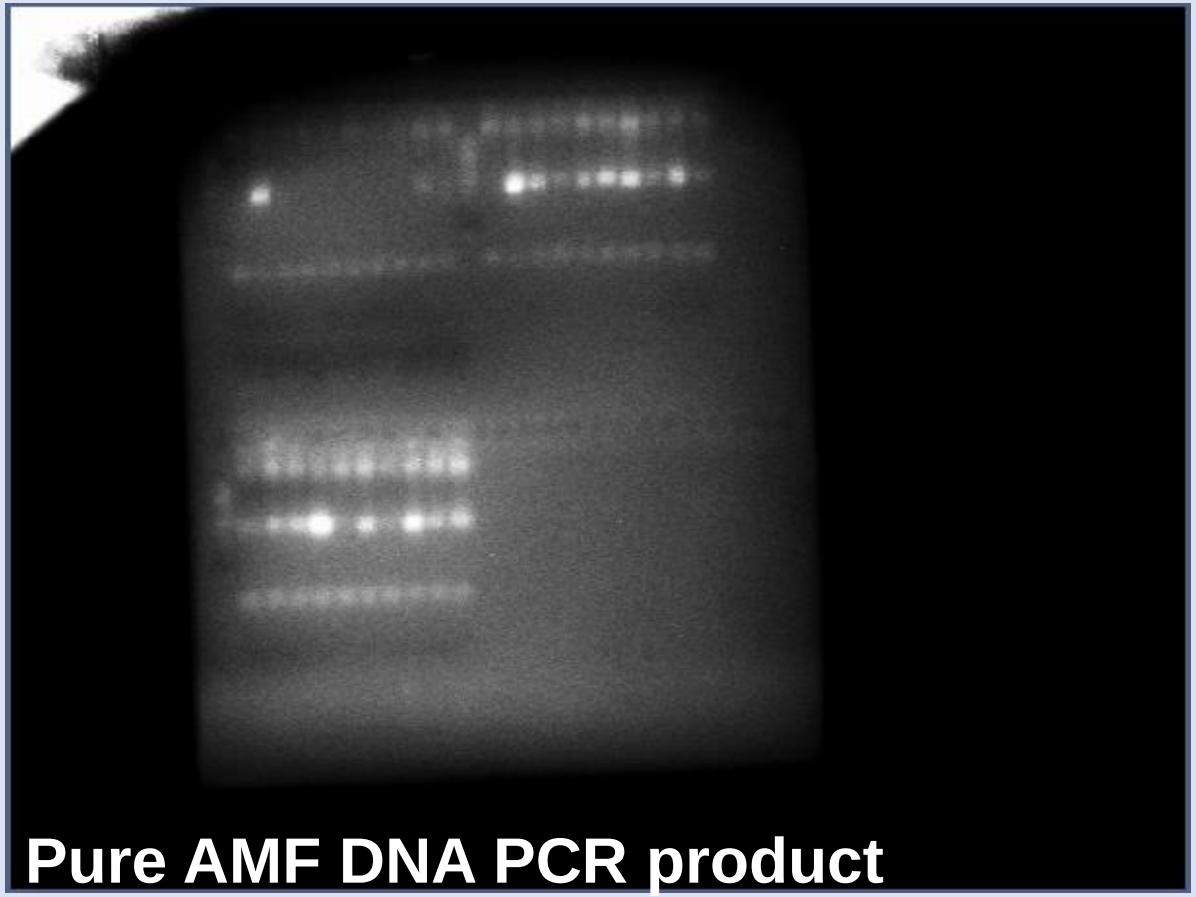
P-value= 0.53

AMF soil samples

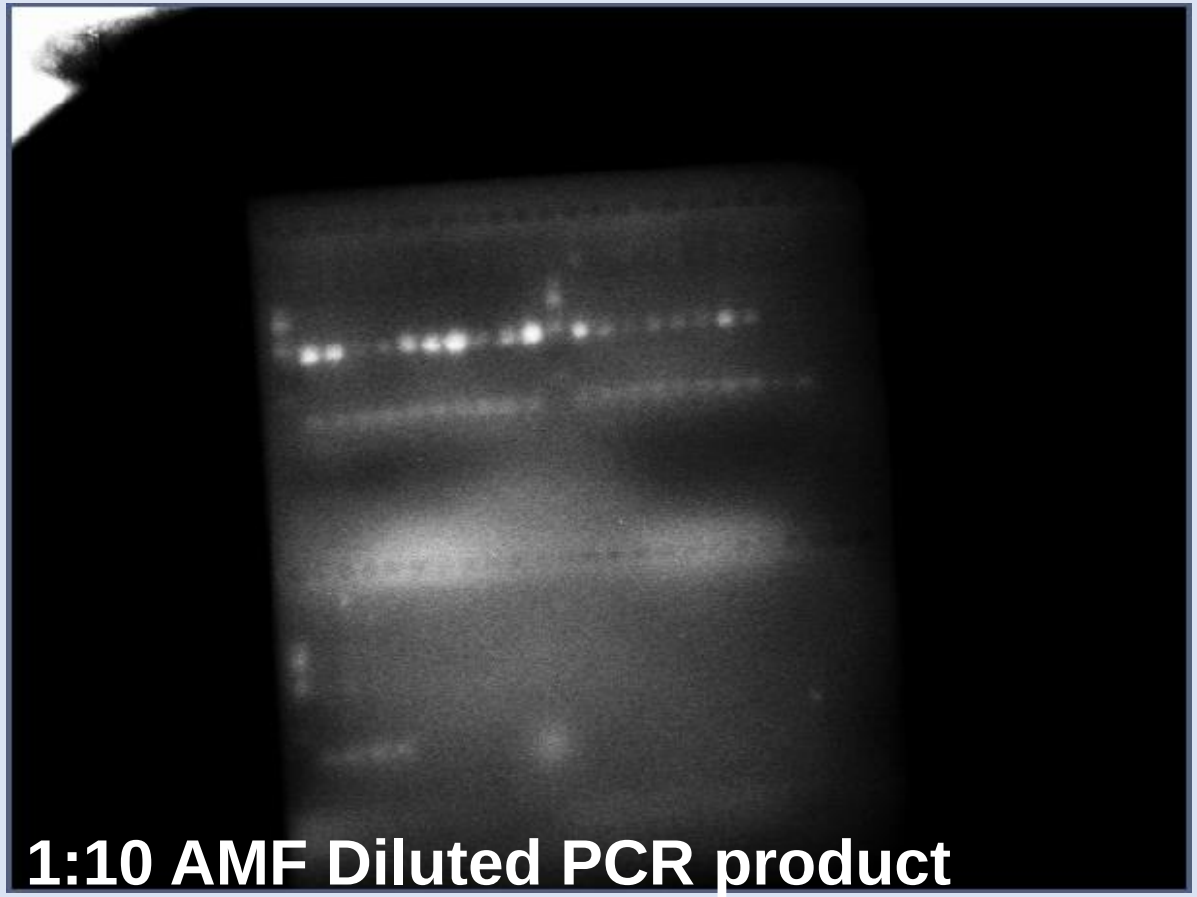
AMF species:

- DNA extraction
  - Powersoil Pro kit
- Fungi specific primers & PCR
  - (Taylor et al., 2016)
- Gel electrophoresis

Fungi gel electrophoresis



Pure AMF DNA PCR product



1:10 AMF Diluted PCR product

Rx fire in ponderosa pine understory summary:

- Nutrients in soil
- Effects on plants
- Effects on AMF
- Grass-AMF-fire interactions

Rx fire in ponderosa pine understory summary:

- Preliminary analysis and more results
- Attend community workshops to share findings with ranchers of the understory relationships

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