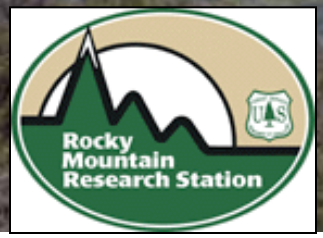
Above- and Belowground Response to Tree Thinning Depends on Treatment of Tree Debris

Suzanne Neal, Carolyn Sieg, Catherine Gehring, Matthew Bowker







In review: ***Ecological Applications***

Study Site: San Juan National Forest Near Dolores, CO



Site History:

Livestock grazing (before 1985), Fire suppression & Drought

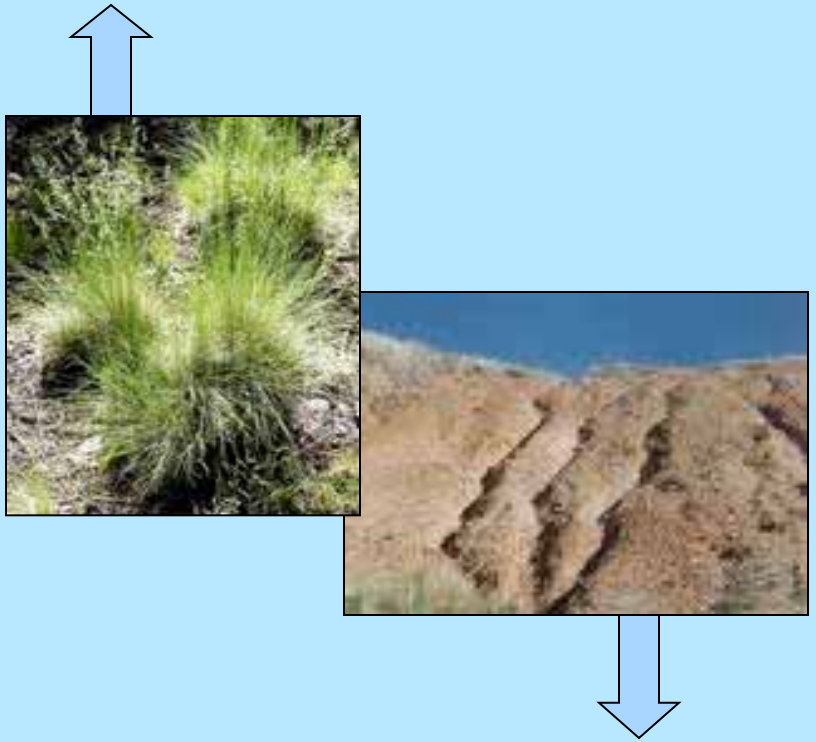


Main Goal



Reduce wildfire risk around <u>homes</u> and Archaeological sites

Secondary Goals



Increase native understory and decrease soil erosion

Two Thinning Methods:

1) **Slash pile burning**





2) **Mechanical mastication**





Thin ~ 40-60% of overstory

Questions:

Will thinning treatments affect:

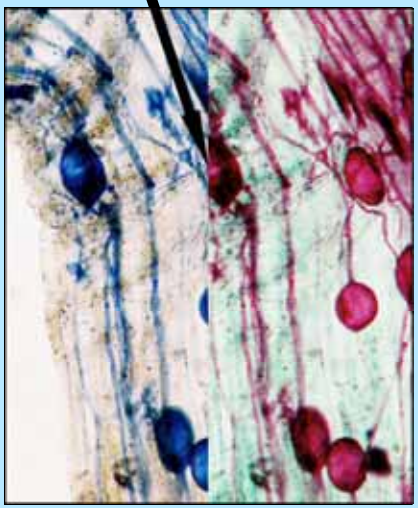
1) Soil Properties: physical or chemical?

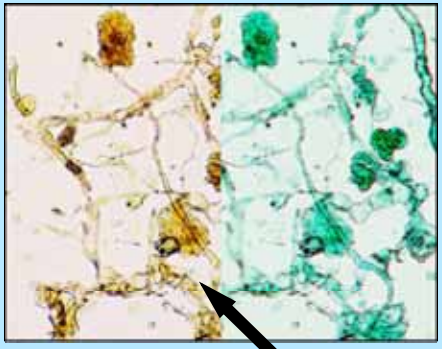
2) Arbuscular Mycorrhizal Fungi (AMF): propagule abundance, species richness or community?

3) Plant Composition: Native or Exotic richness?

Arbuscular Mycorrhizal Fungi (AMF)

Vesicles



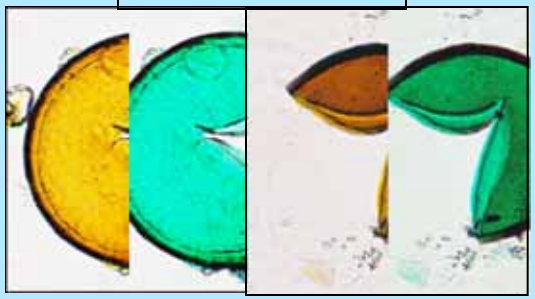


Hyphae



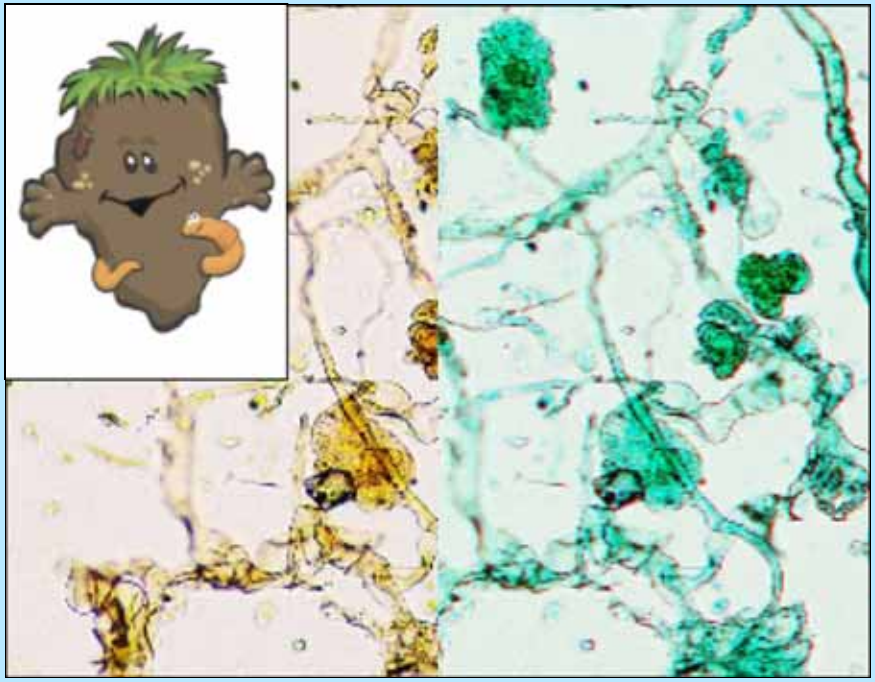
Arbuscules – nutrient exchange

Spores

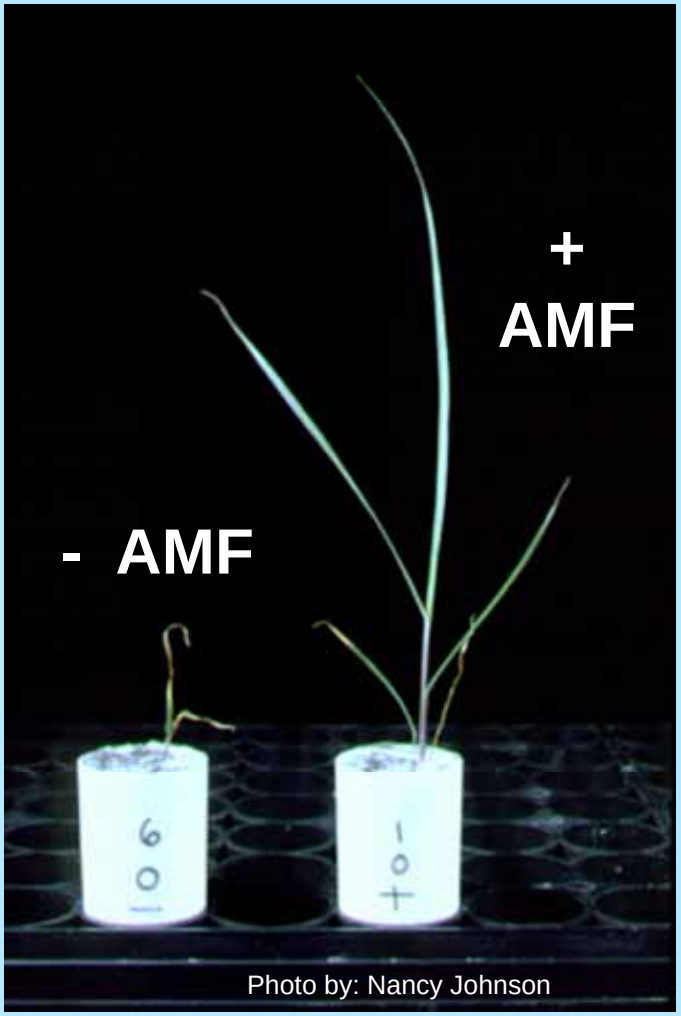


Over 90% of plants rely on AMF

AMF Promote Plant Growth and Increase Soil Stability



Soil hyphae and stability (Tisdall 1991)



Treatments







25 Mastication 25 Untreated 25 Pile Burns

Elevation: 7,136ft (2,175 m)

Soil: Alfisols **Texture: Sandy loam**

6-months and 2.5-years post treatment

Hypotheses

Pile Burn



↑ [Available Nutrients]
pH
Soil temp

↓ % Soil moisture
Soil stability
AMF & Plant abundance & richness

△ AMF & Plant community

Mastication

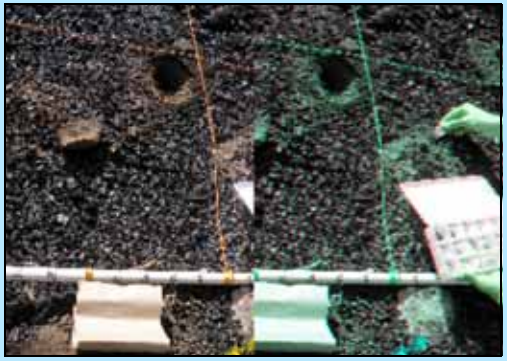


↑ % Soil moisture
Soil compaction

↓ Soil temp
Available N

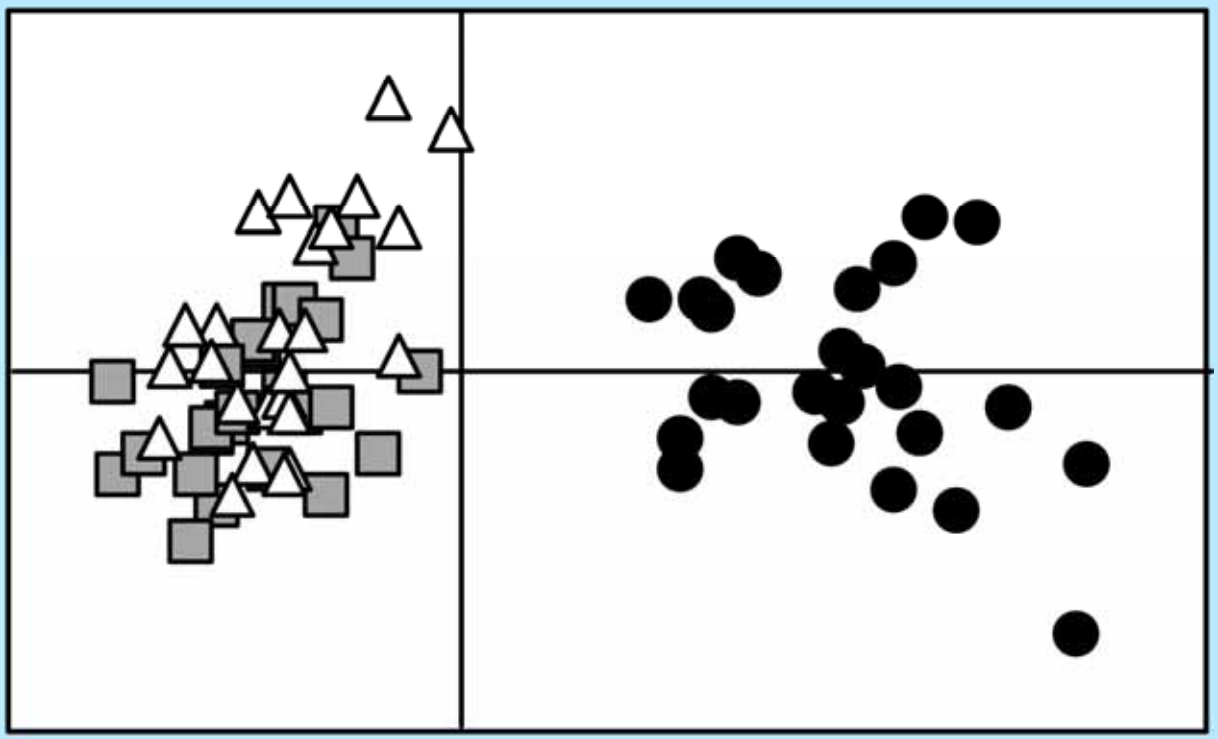
△ AMF & Plant community

Methods



- **Soil (0-15 cm)**
  - **Soil moisture, Temperature, pH, Total N and C, NO_3^-, NH_4^+ (KCL extraction), PO_4^{3-}, Bulk density, Soil stability (Slake test kit)**
- **AMF**
  - **Soil hyphae and spore abundance, richness**
- **Plants**
  - **Cover (Daubenmire), richness and native/exotic status**

Results: PCA on Soil Properties



Axis 1: 41%

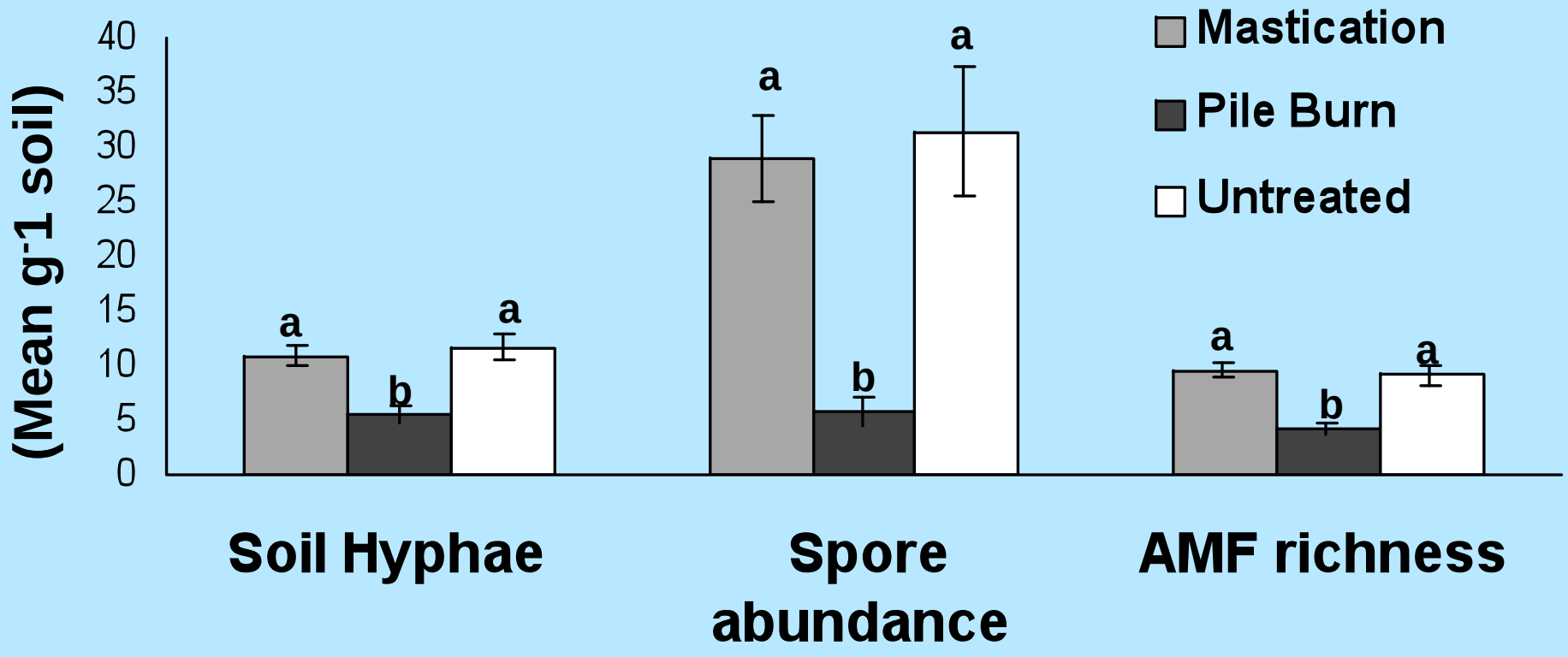
Axis 2: 15%

Mastication
Pile burns
Untreated

Driven by:
Moisture (.35)
Temp. (.34)

Driven by:
Temp. (.47)
NO_3^- (.37) and NH_4^+ (.36)
Soil stability

AMF Propagule Abundance and Richness Lower in Pile Burns

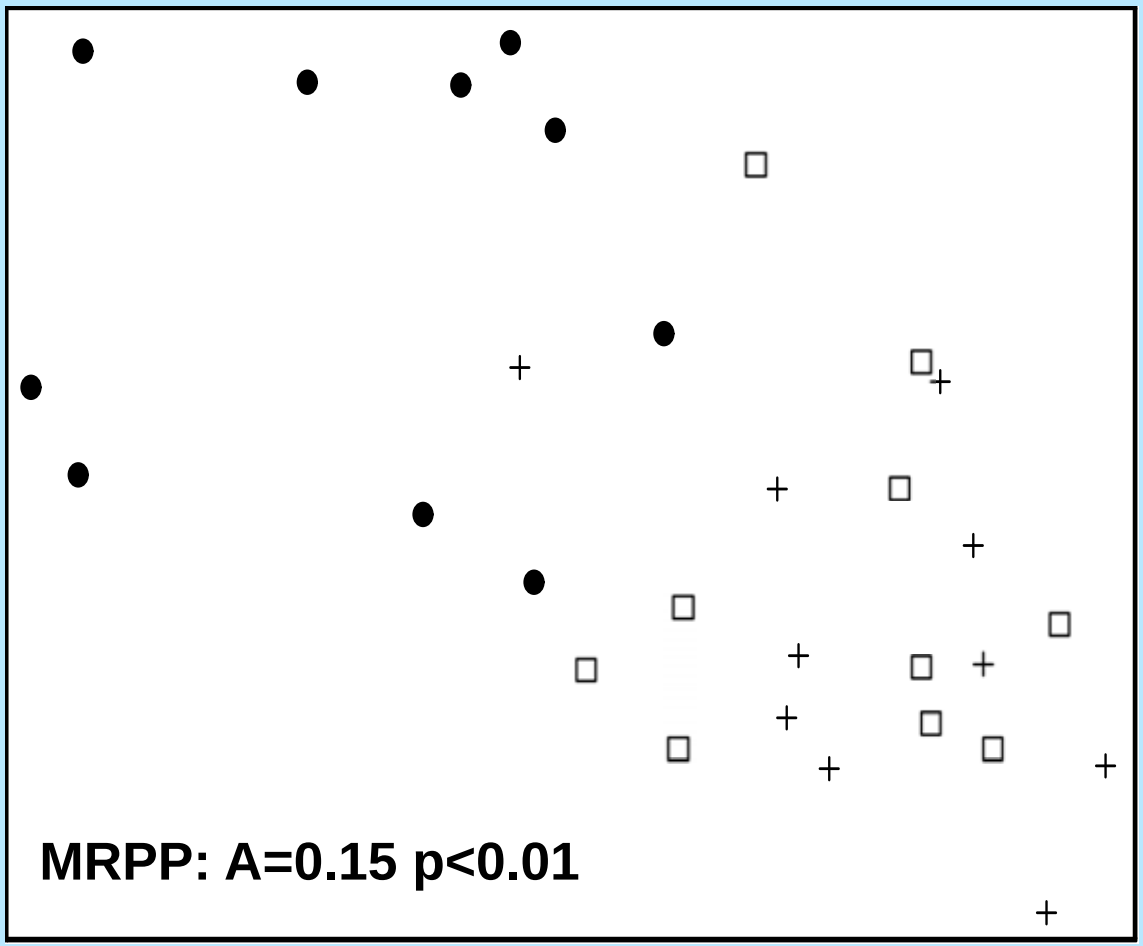


F= 13.3, p<0.01

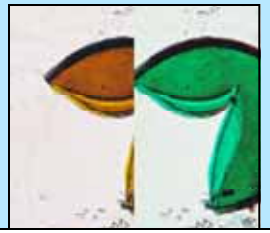
F= 13.1, p<0.01

F= 15.3, p<0.01

AMF Spore Community Different in Pile Burns



□ Mastication
● Pile Burn
+ Untreated



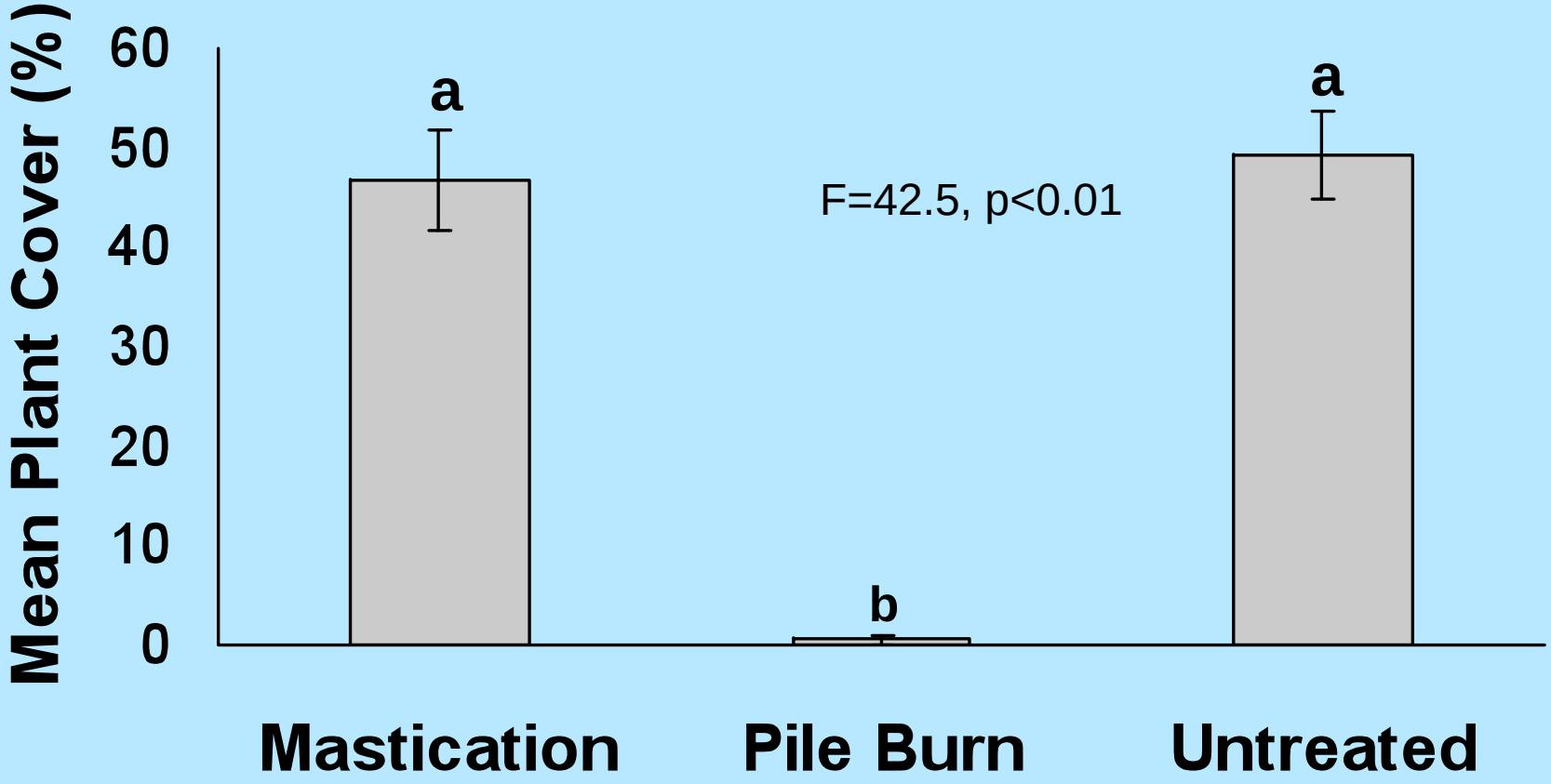
G. constrictum



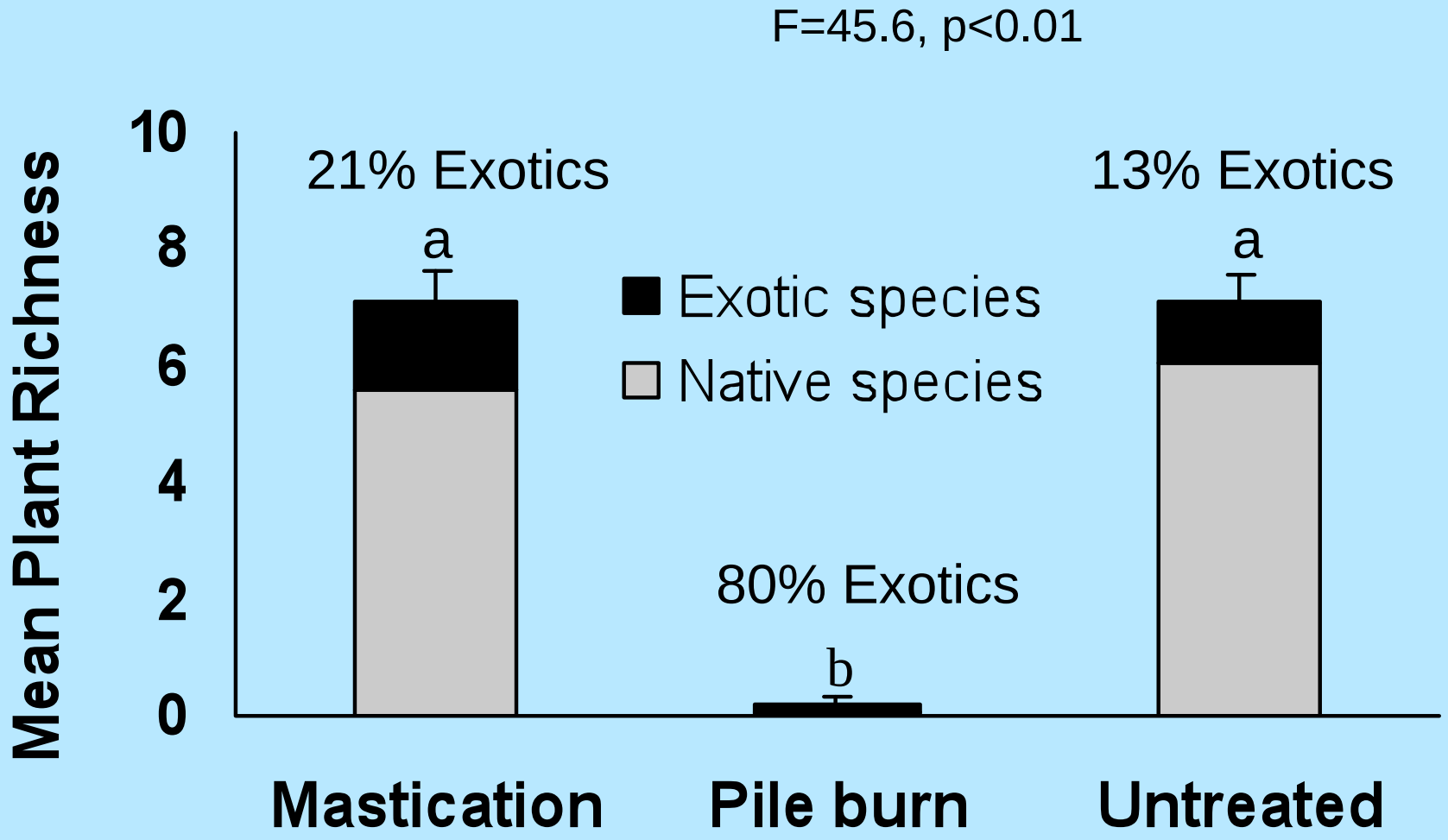
S. calospora

Plant Cover Lowest in Pile Burns





Plant Richness Lowest and % Exotics Highest in Pile Burns



Trends 2.5-years post treatment

- **<u>Pile Burns</u>: Same trends – except no difference in AMF spore abundance**

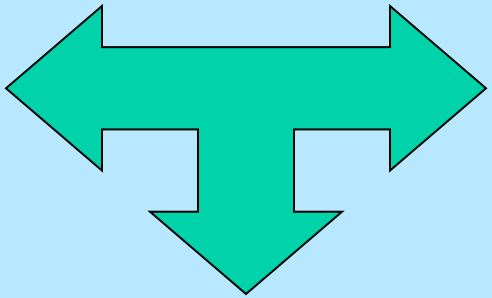
- **<u>Mastication</u>:**

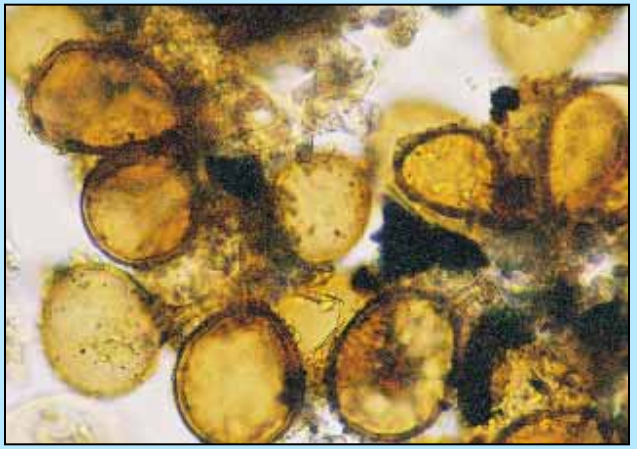
↑ **Plant cover**
Exotic plants (cheatgrass)
[NH_4^+]

↓ **Temp**
AMF Richness

How do Soil, AMF and Plants Interact?

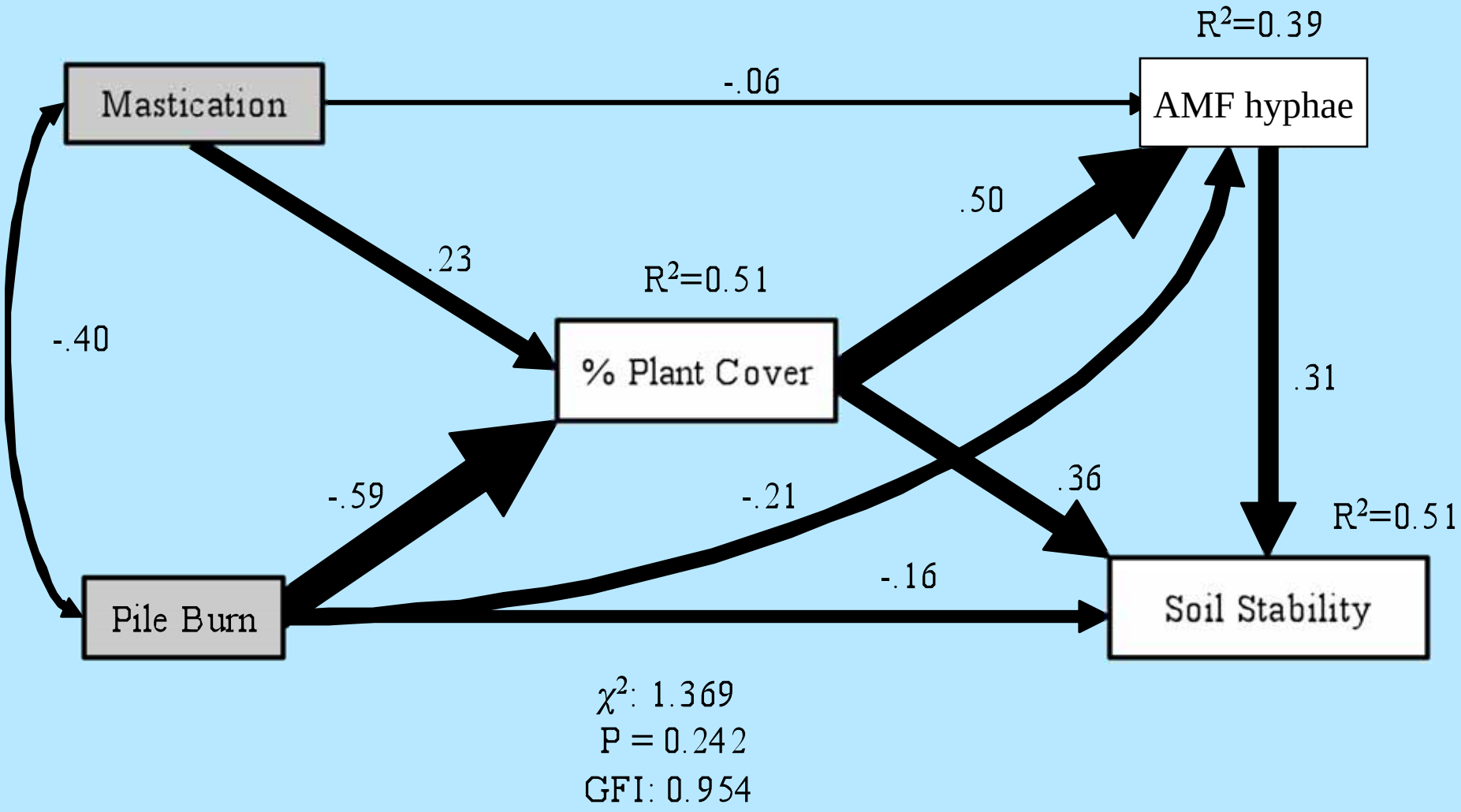








SEM: Soil-Plant-AMF relationship



SEM Results: Plant, Soil and AMF Relationship

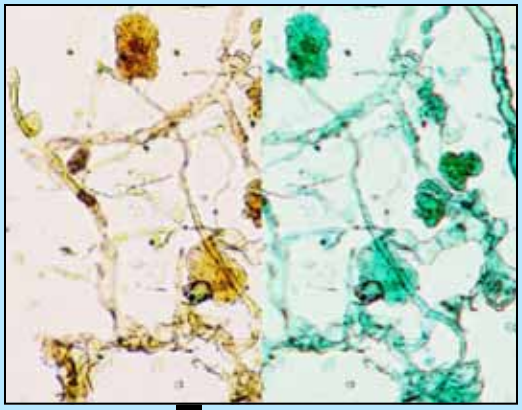
Treatments

R^2 = 51%



50%

R^2 = 39%



31%

36%



R^2 = 51%

Pile Burning Creates Long-Lasting Disturbance



- **Soil Erosion**
  - **Exposed mineral soil and low soil stability**
- **Nutrient leaching**
  - **High [available nutrients] & low plant cover and moisture**
- **Loss of Native species (both plants and AMF)**

Mechanical Mastication

- **<u>Short term:</u> Only difference - ↑soil moisture and ↓soil temp.**

- **<u>2.5 years later:</u> Main concern is loss of AMF species and more cheatgrass over time**
  - **(combination of disturbance, neighboring seed source and high soil moisture?)**

Ecological & Management Implications

Mastication creates fewer disturbances (in the short term); Long-term?



Pile burns – may reduce functionality

Treat in only high-priority areas and continue monitoring for exotic species



Nancy Johnson, Andrew Owen, Steve Overby, Noah Barstasis, Rudy King, Todd Gardiner, Jim Fowler, Tina Ayers,

Anita Antoninka, Patrick McCoy, Cara Gildar, Elaine Sherman, Bradford Blake, Dana Erickson, Lauren Hertz, Bala Chaudhary, Dan Guido, Todd Wojtowicz, John Hockersmith, Chris Olson, Nick Cortopassi, Mike Pass

NAU

Gehring & Johnson lab groups

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