



# Vegetation restoration from piñon-juniper control treatments

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# What do we have against these trees, anyway?





Courtesy Brad Jessop



Stansbury Mountains 1901

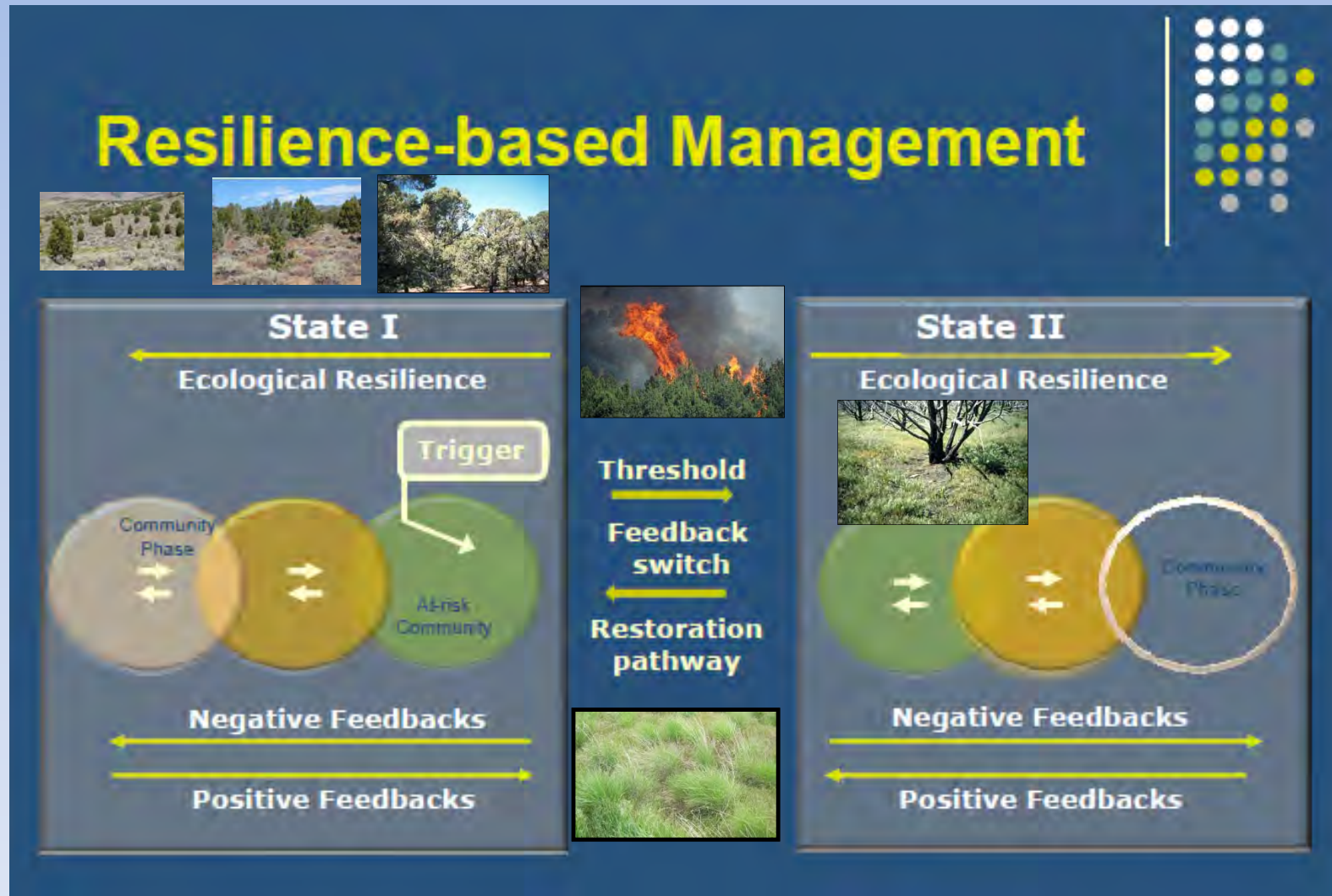


Stansbury Mountains 2004



Big Pole Fire August 2009

# Resilience theory and practice



From Briske et al. 2008.

<http://jornada.nmsu.edu/sites/default/files/briskeSRM08.pdf>





$$TDI = \text{Tree} / (\text{Tree} + \text{Shrub} + \text{Tall Grass cover})$$

## PHASE I

- Trees are sparse
- Shrubs and herbaceous perennials dominate
- Tree cover: <15%
- TDI: 0-0.34

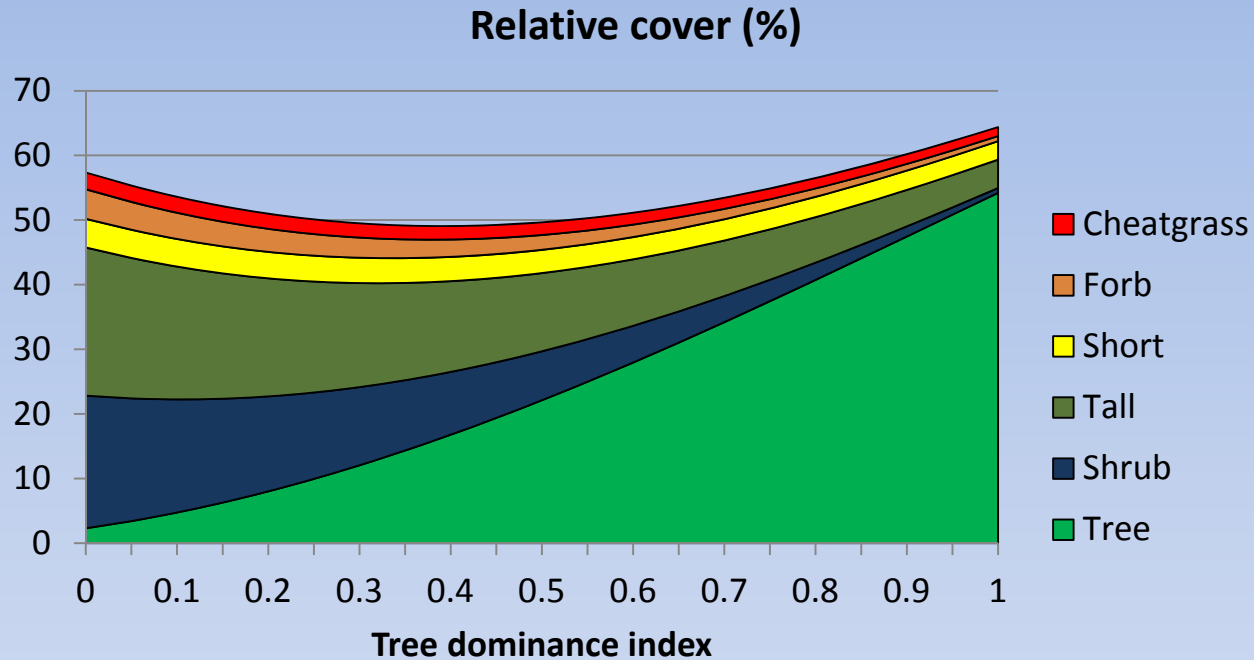
## PHASE II

- Trees, shrubs, and perennial herbaceous are co-dominant
- Tree cover: 15-45%
- TDI: >0.34-0.67

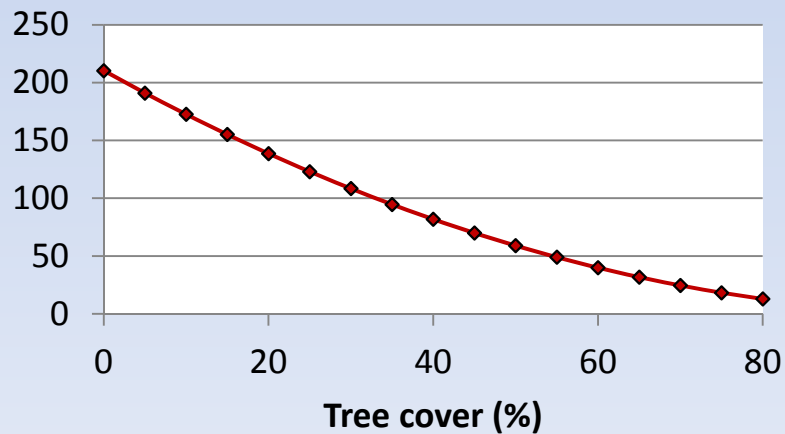
## PHASE III

- Trees are dominant
- Perennial herbaceous and shrub cover sparse
- Tree cover: >45%
- TDI: >0.67

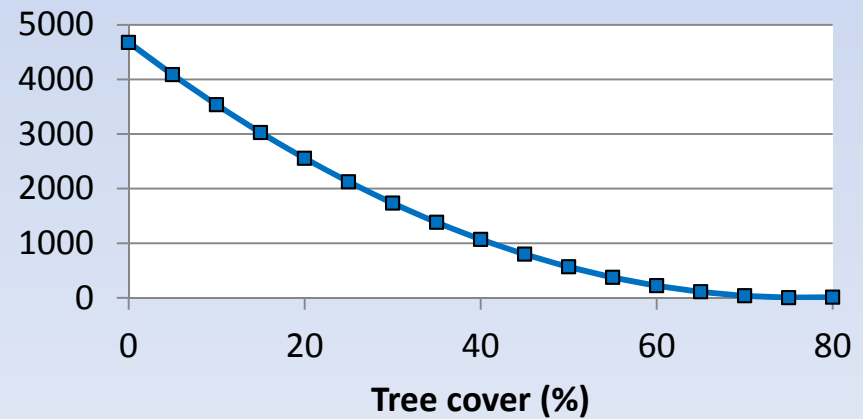
# Pre-treatment vegetation



Herbaceous biomass (kg/ha)

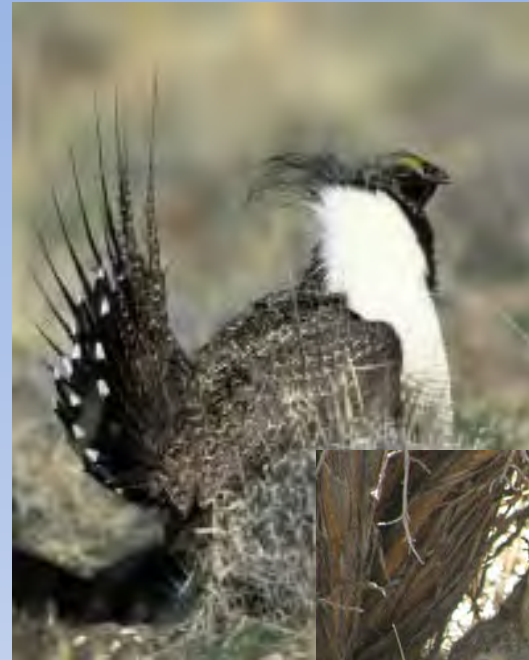


Shrub biomass (kg/ha)



## Decreases:

- Shrub and perennial herbaceous biomass
- Cover
- Diversity
- Carbon sequestration
- Wildlife habitat
- Watershed function



## Increases:

- Canopy fuels
- Intense fire
- Weed dominance
- Erosion



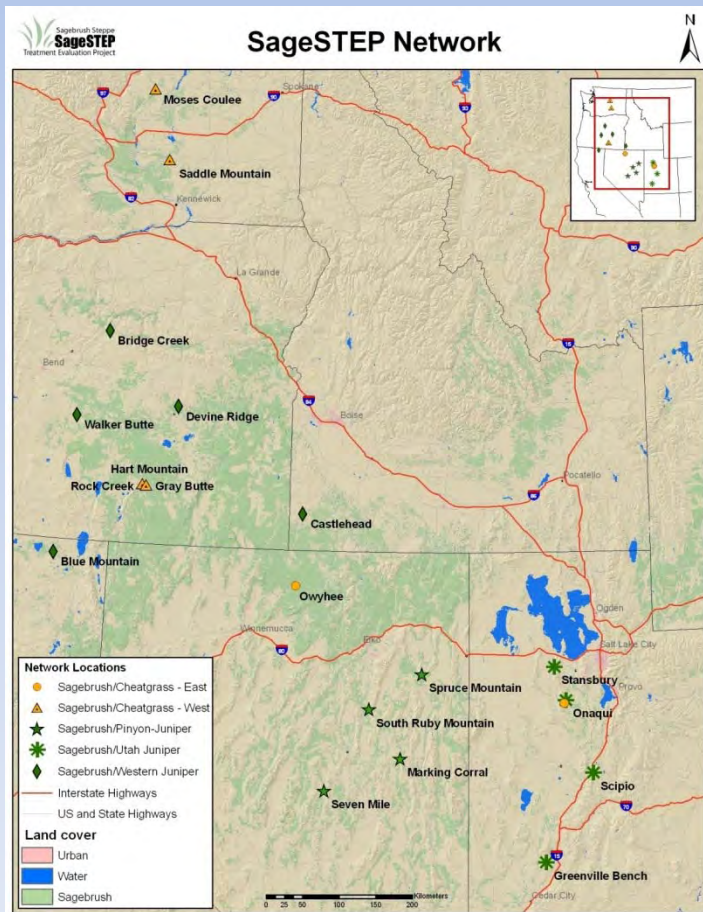
# Extensive research

Tree reduction at *different infilling phases* on:

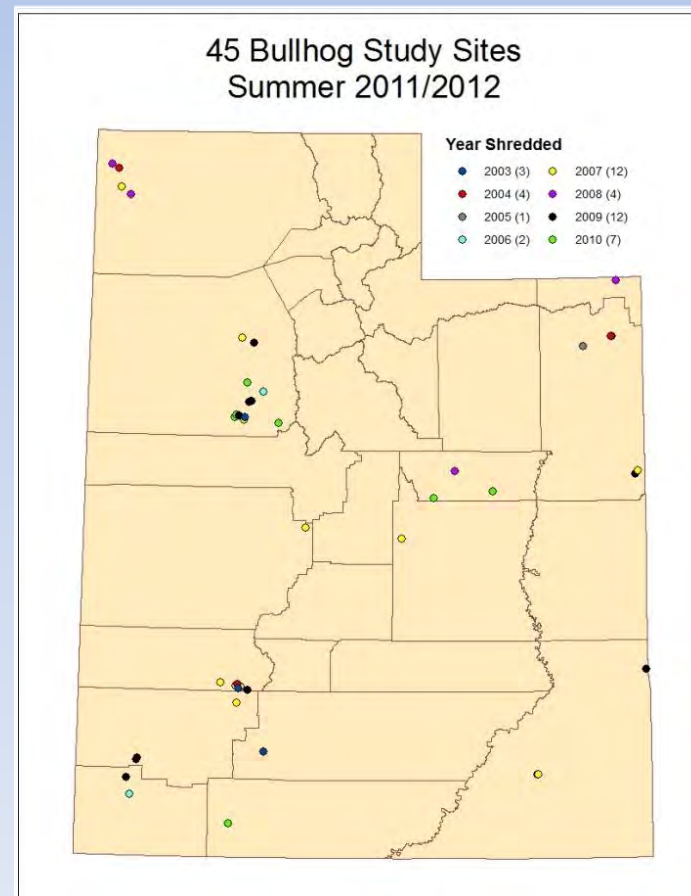
- Fuel, vegetation, soils



## SageSTEP study



## Shred study





# Shred study: Expansion vs Tree sites

	Expansion	Tree climax
Soil depth	> 0.5 m	< 0.5 m
Coarse fragments	Lower	Higher
Tree age	< 150 years	> 150 years
Romme et al 2009	Wooded shrublands	Persistent woodlands





# Mechanistic or microsite research

Effects of:

- Tree reduction
- Litter cover
- Shred cover

On:

- Hydrology
- Soil water/temperature
- Microbes, nutrients
- Seedling establishment





# Fuels

## Mechanical

## Shred

### Prescribed fire



### Wildfire



### Cut and drop



### Wildfire



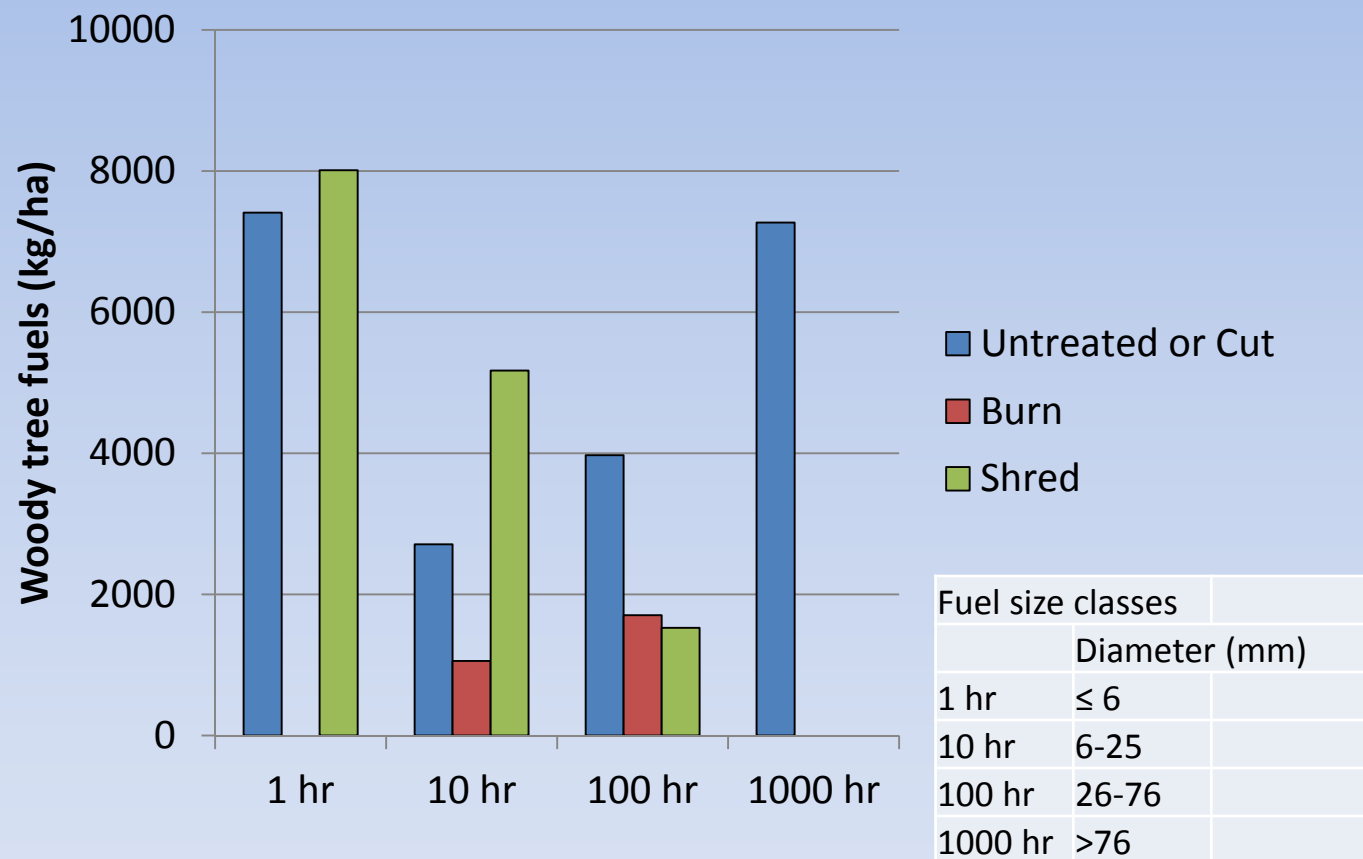
### Wildfire



Courtesy Brad Jessop

# Treatment fuel effects

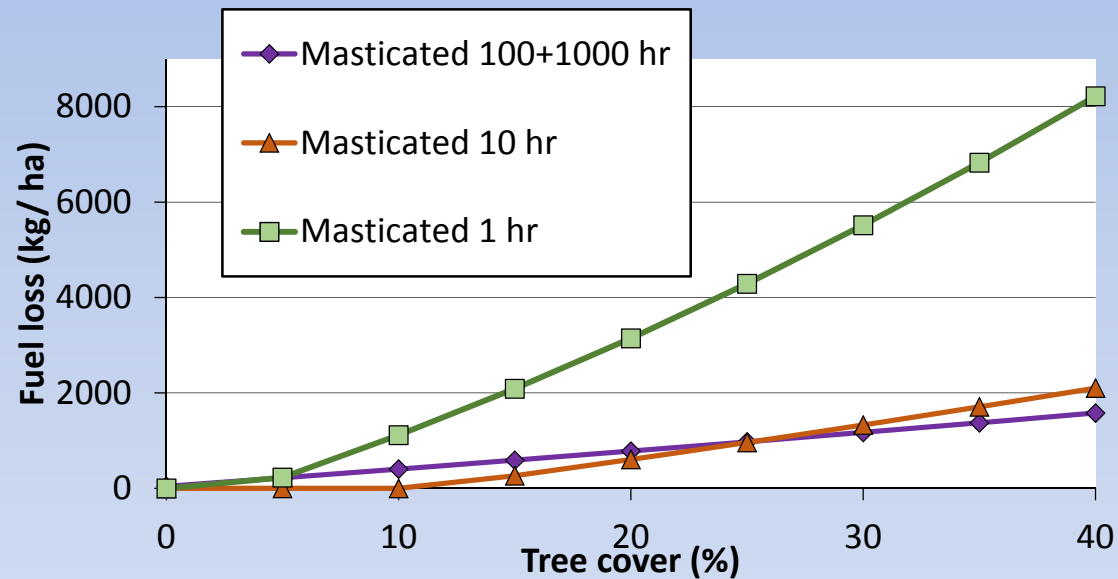
## 30% Pretreatment Tree Cover



Young et al 2014 IJWLF



# Shredded woody fuels decrease with time since shredding

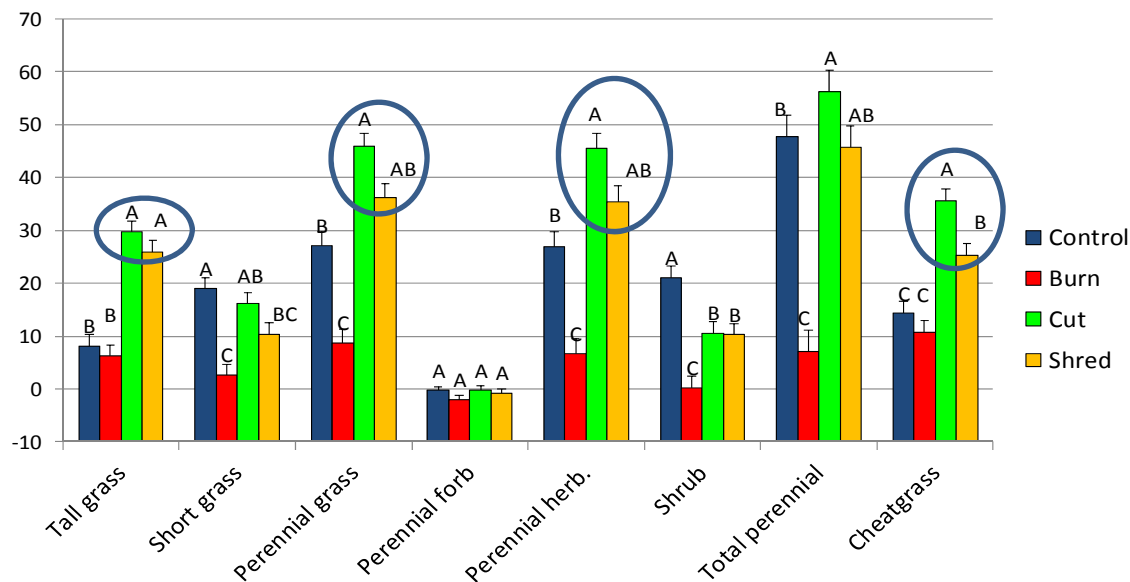


Shakespear 2014



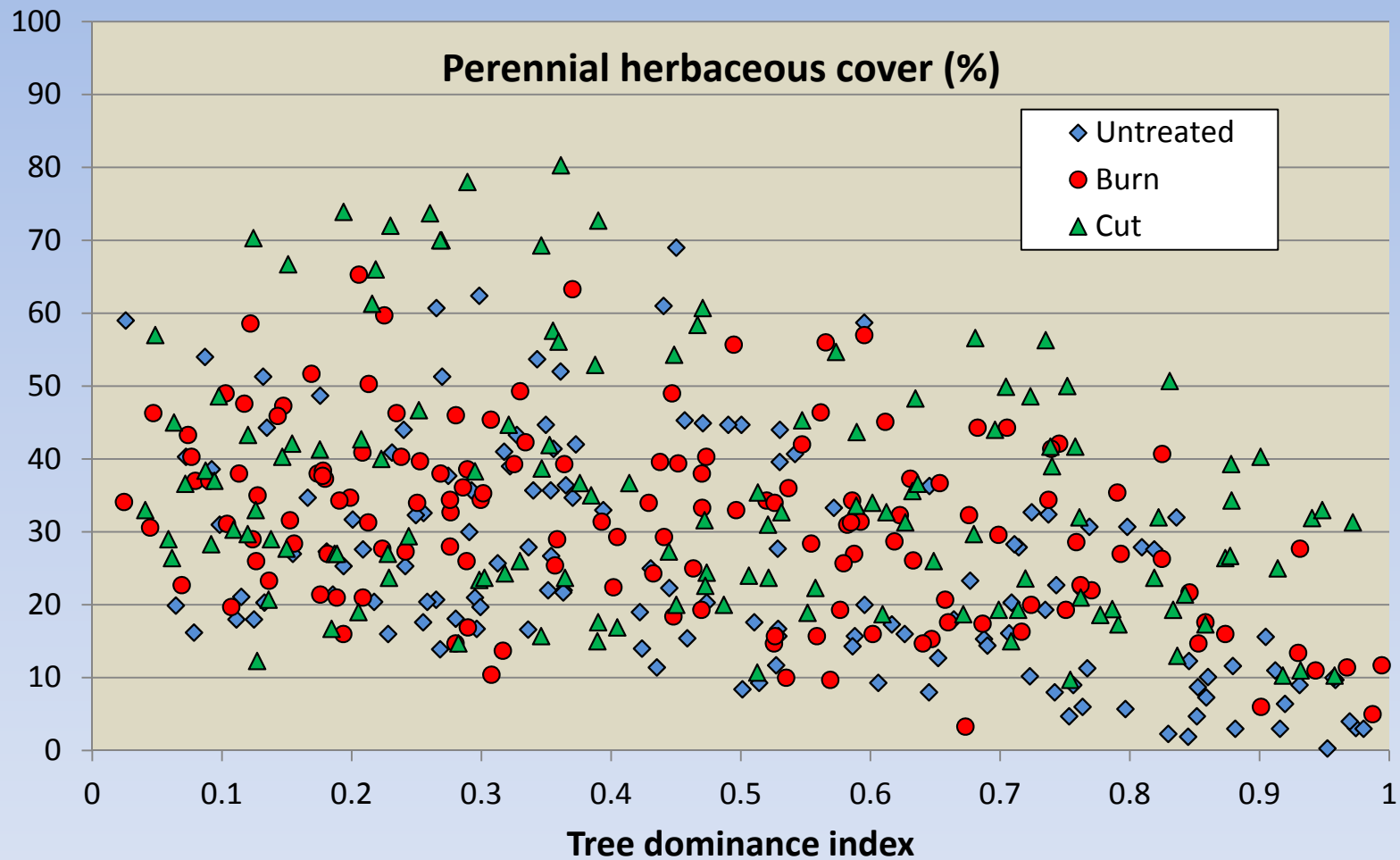
# Avoiding wildfire damage after mechanical treatments may require prescribed fire

Stansbury cover loss (%) 1 year after Big Pole fire

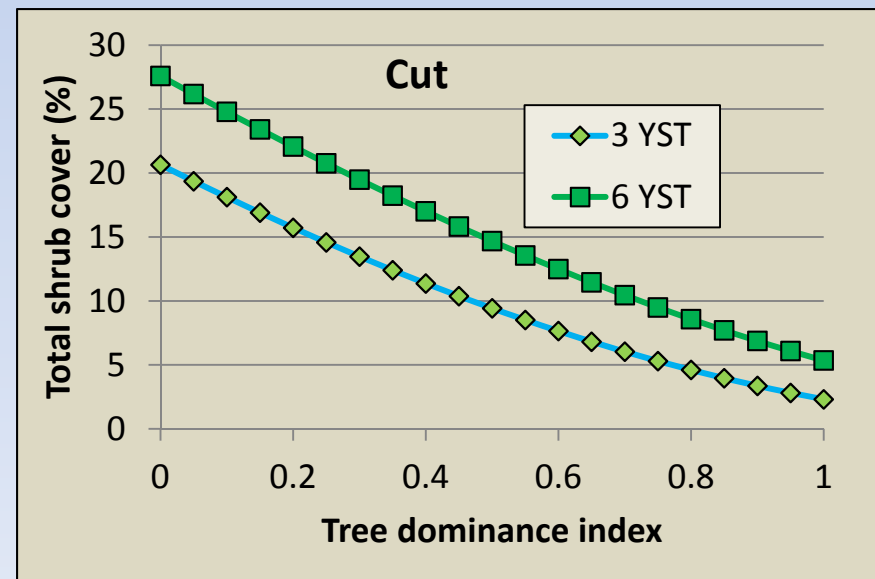
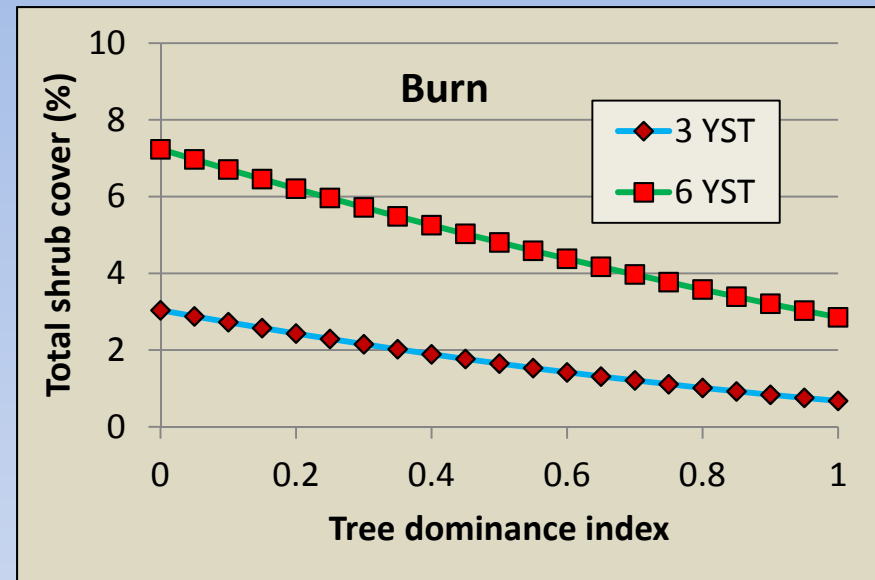
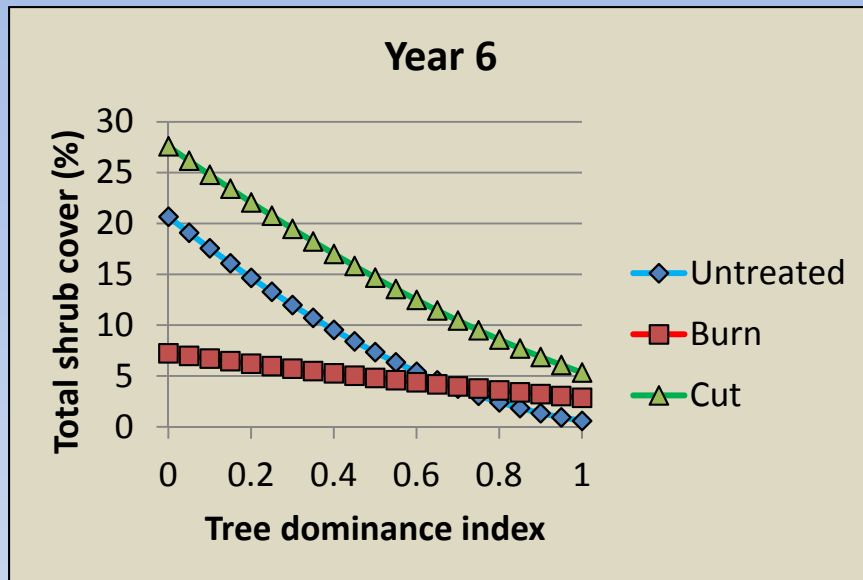




# Regional responses

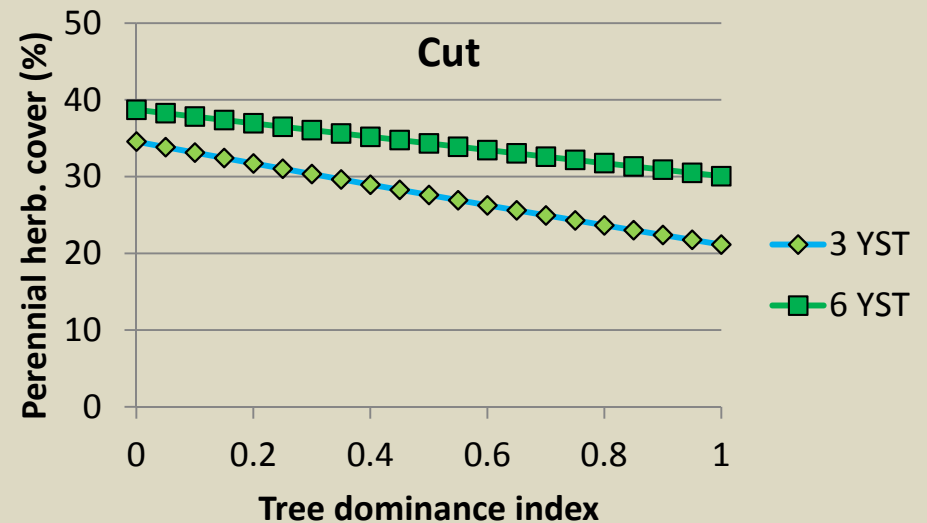
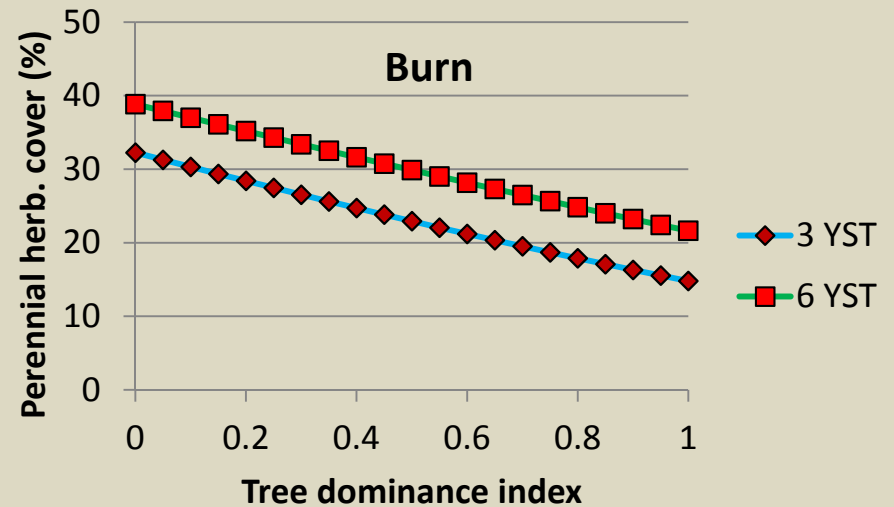
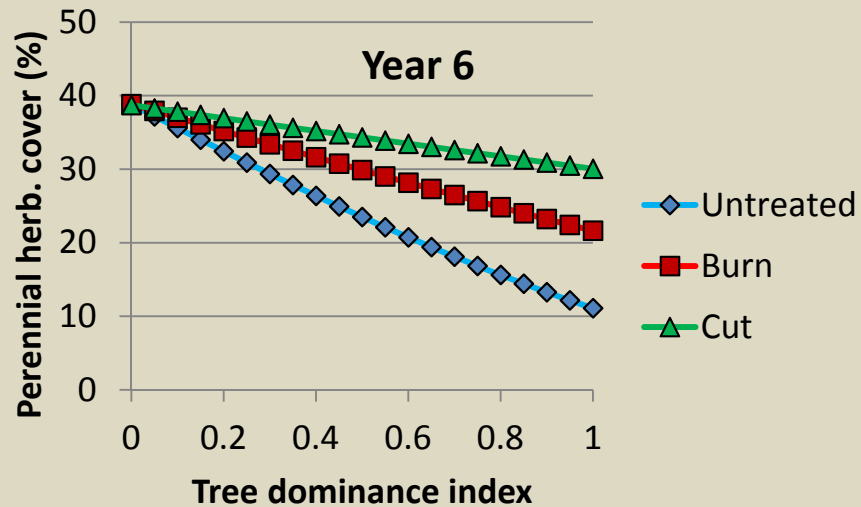


# Shrub cover

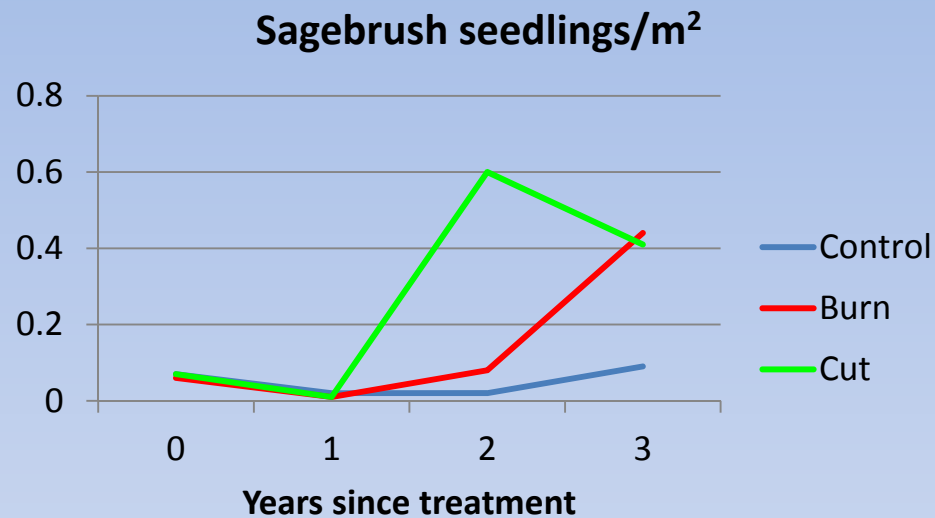




# Perennial herbaceous cover



# Residual trees and sagebrush seedlings

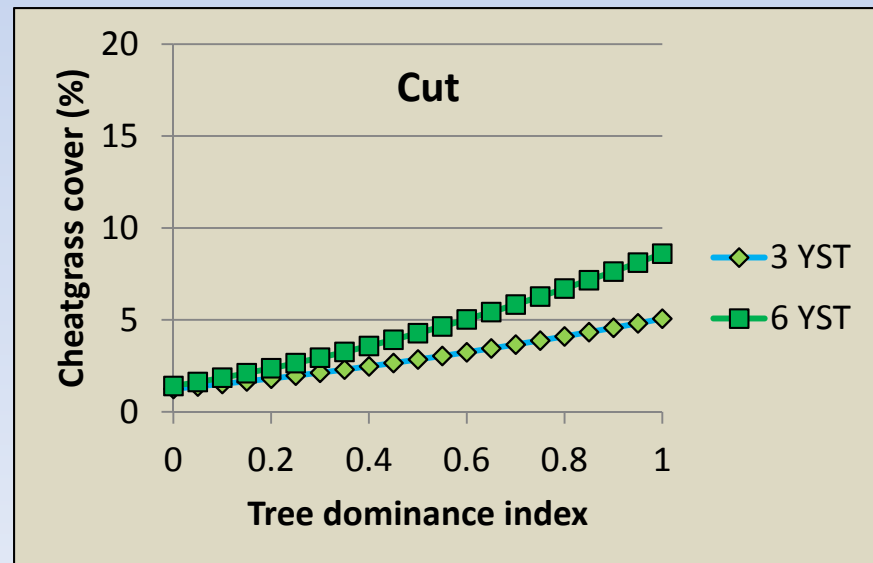
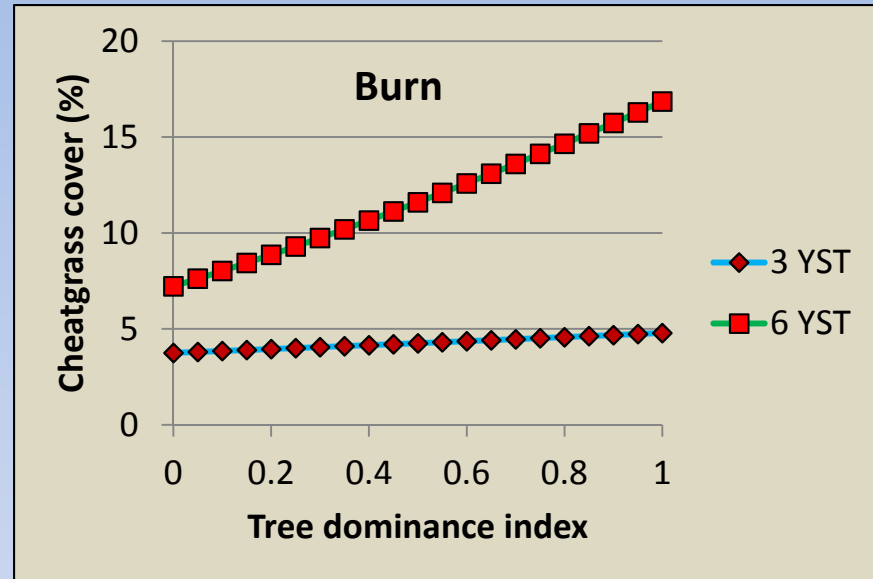
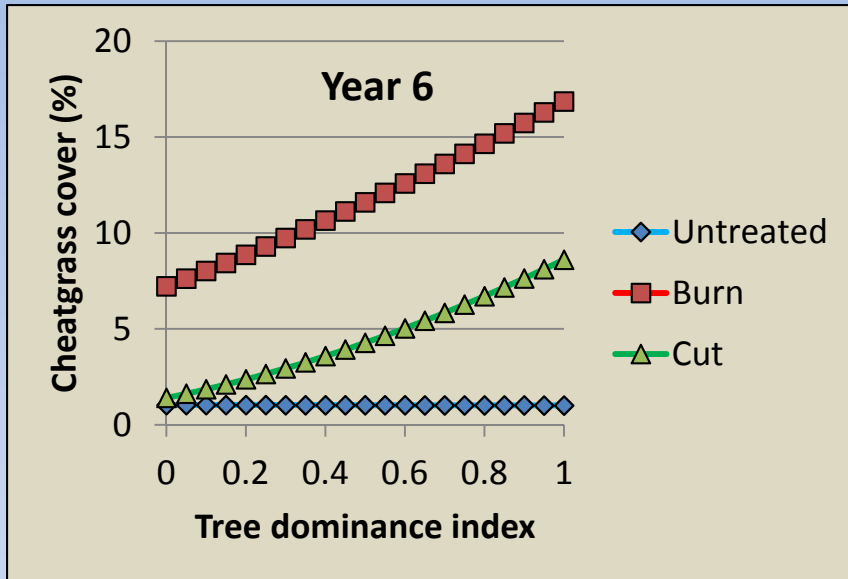


Miller et al 2014 REM



Sagebrush  
seedlings

# Cheatgrass cover





# How much cheatgrass cover makes an at-risk phase?

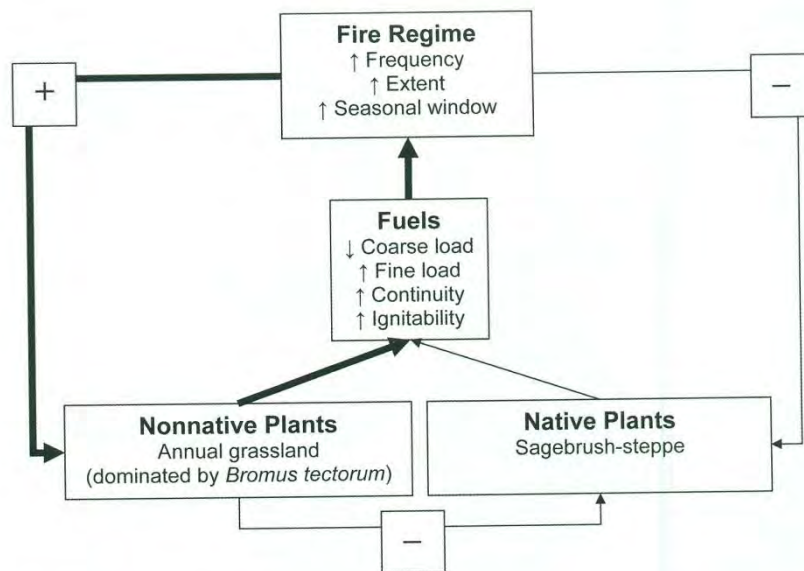
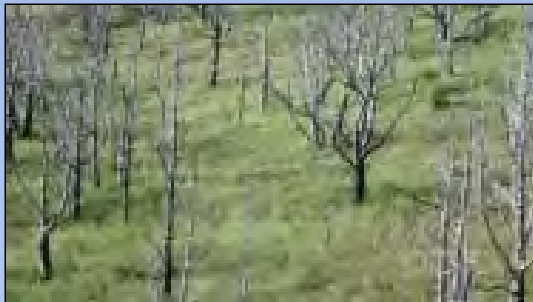
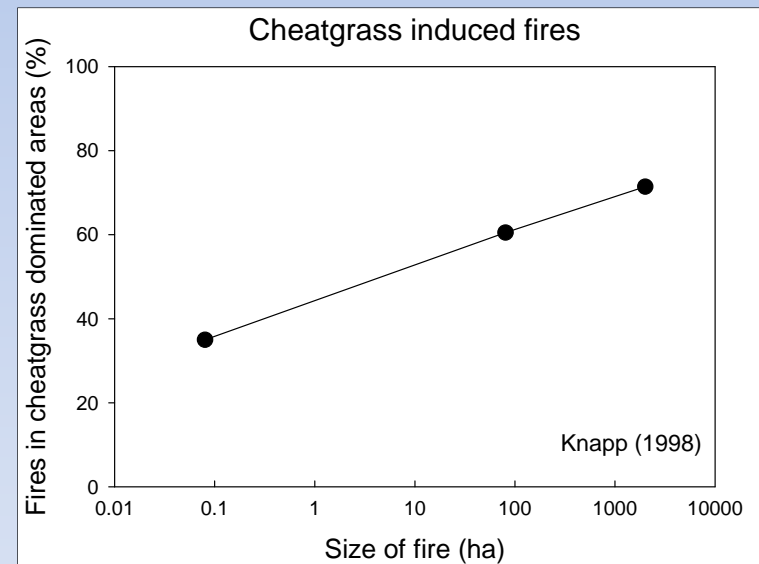
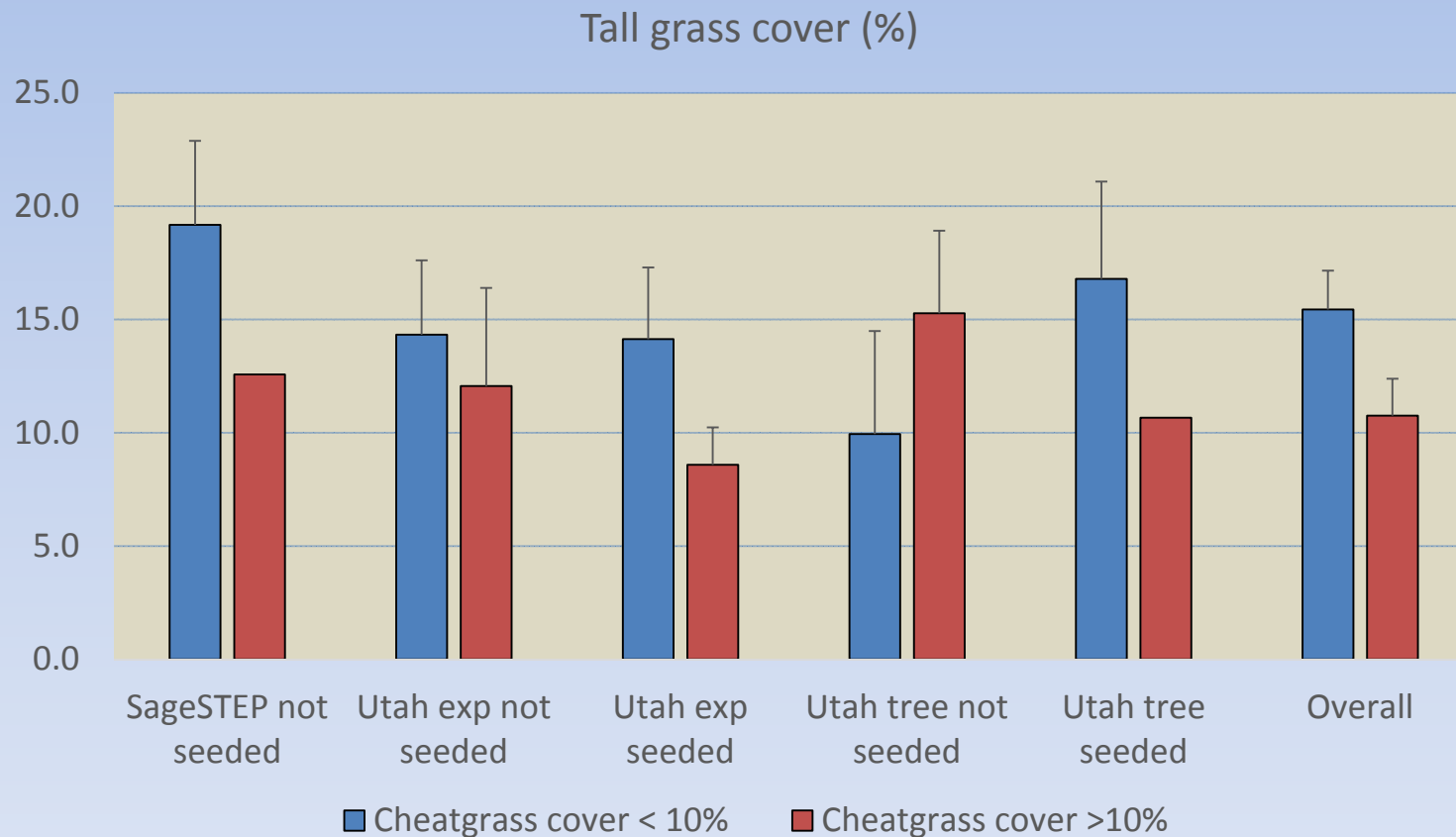


Figure 3-7—Changes in fuelbed and fire regime properties caused by the invasion of nonnative annual grasses into native sagebrush-steppe in the Intermountain West of North America.



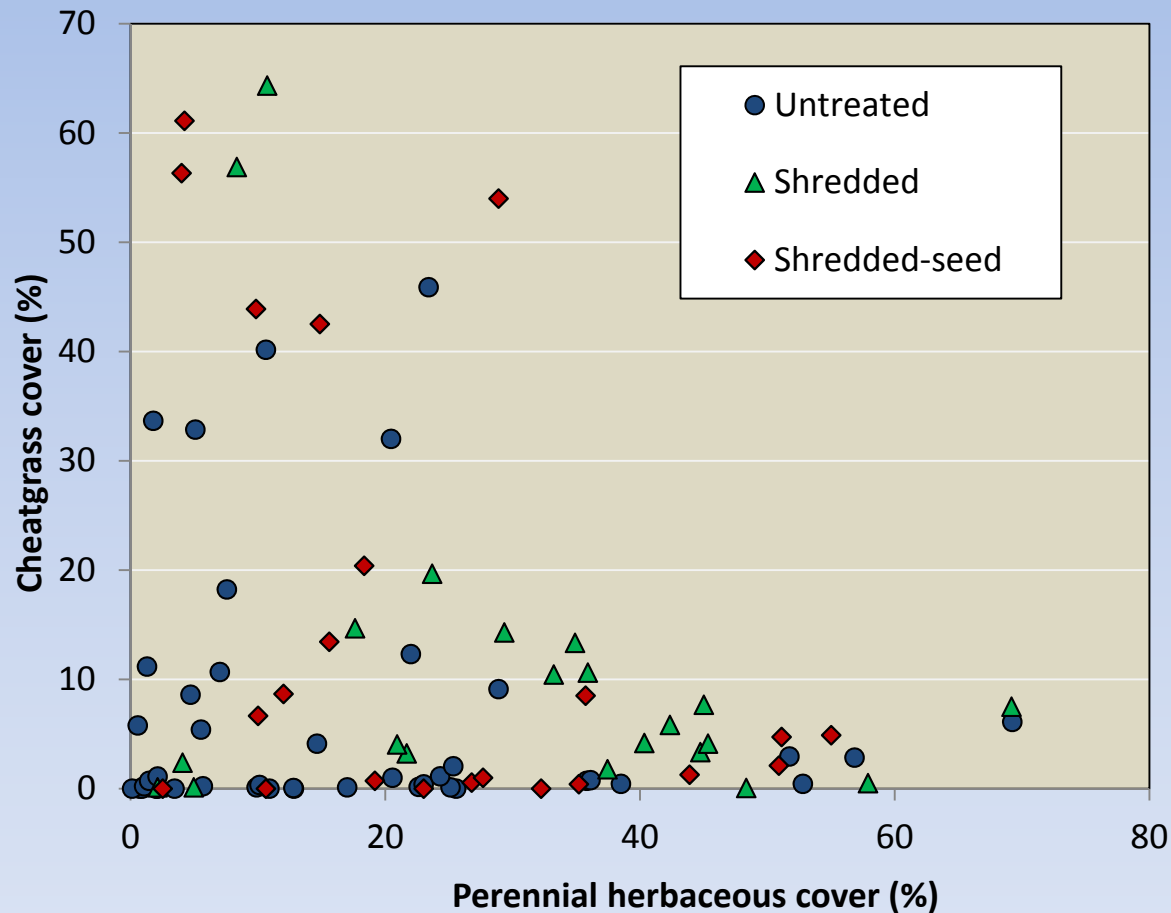
Brooks 2008

# Tall grass suppresses cheatgrass





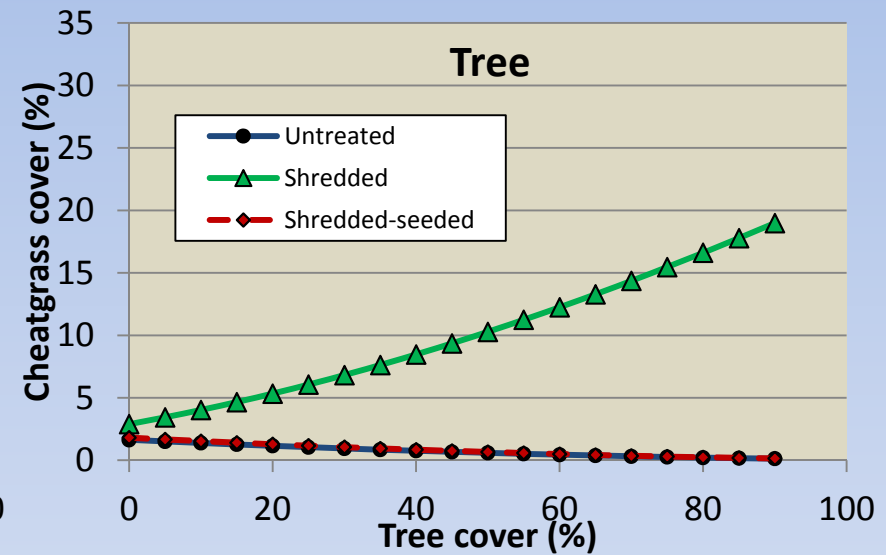
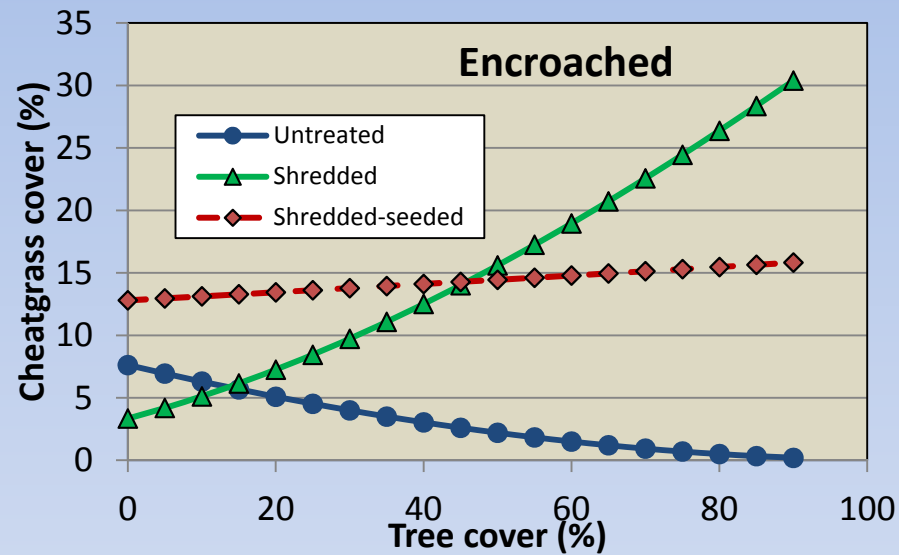
# More perennial herbaceous cover=less cheatgrass cover



Bybee 2013

# Shredding increases cheatgrass cover; seeding suppresses it

Bybee 2013

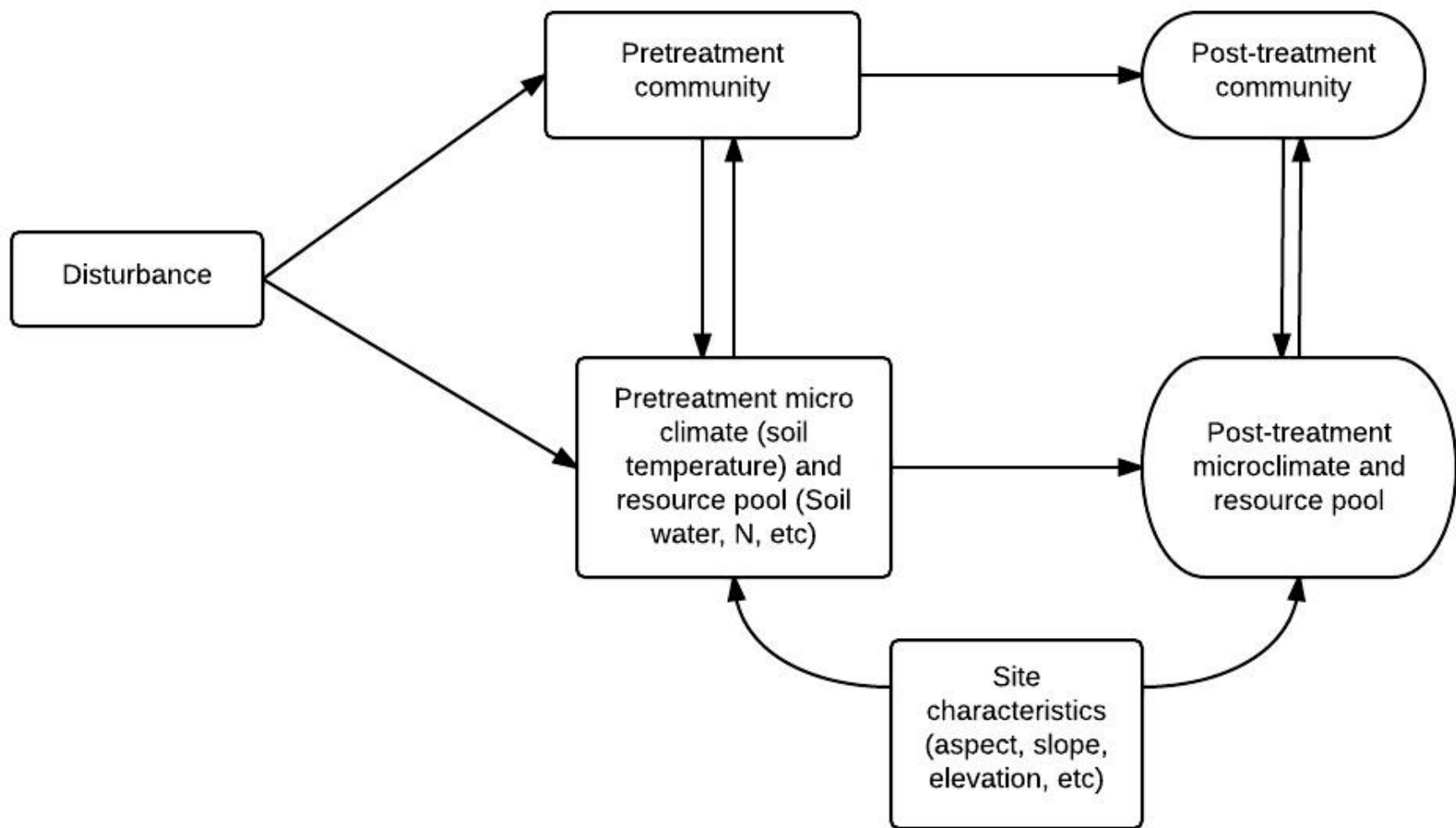




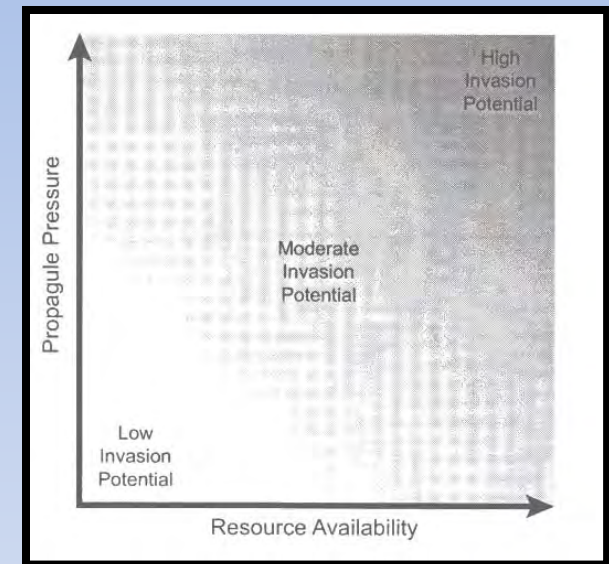
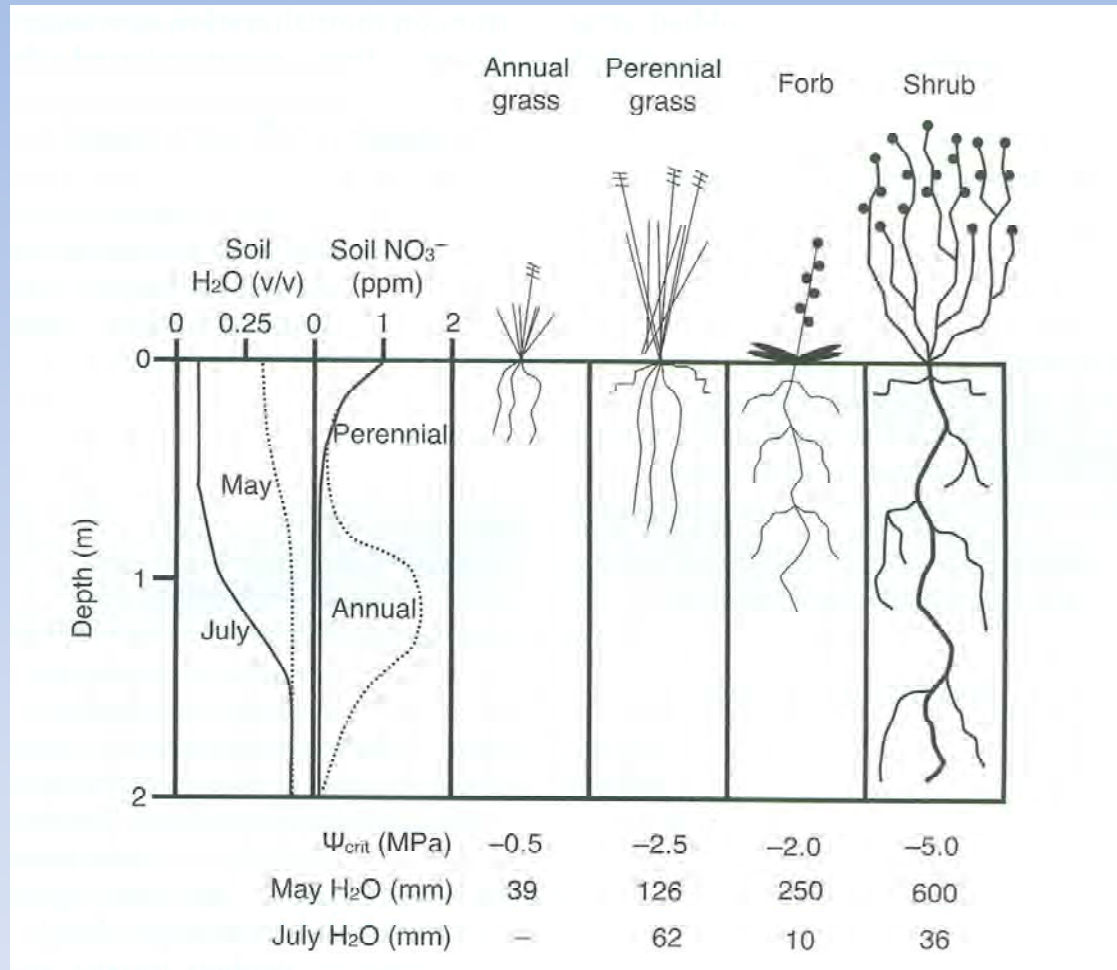
# Why these responses?

- Nutrients?
- Microbes?
- Soil water?
- Soil temperature?





# Resource growth pool

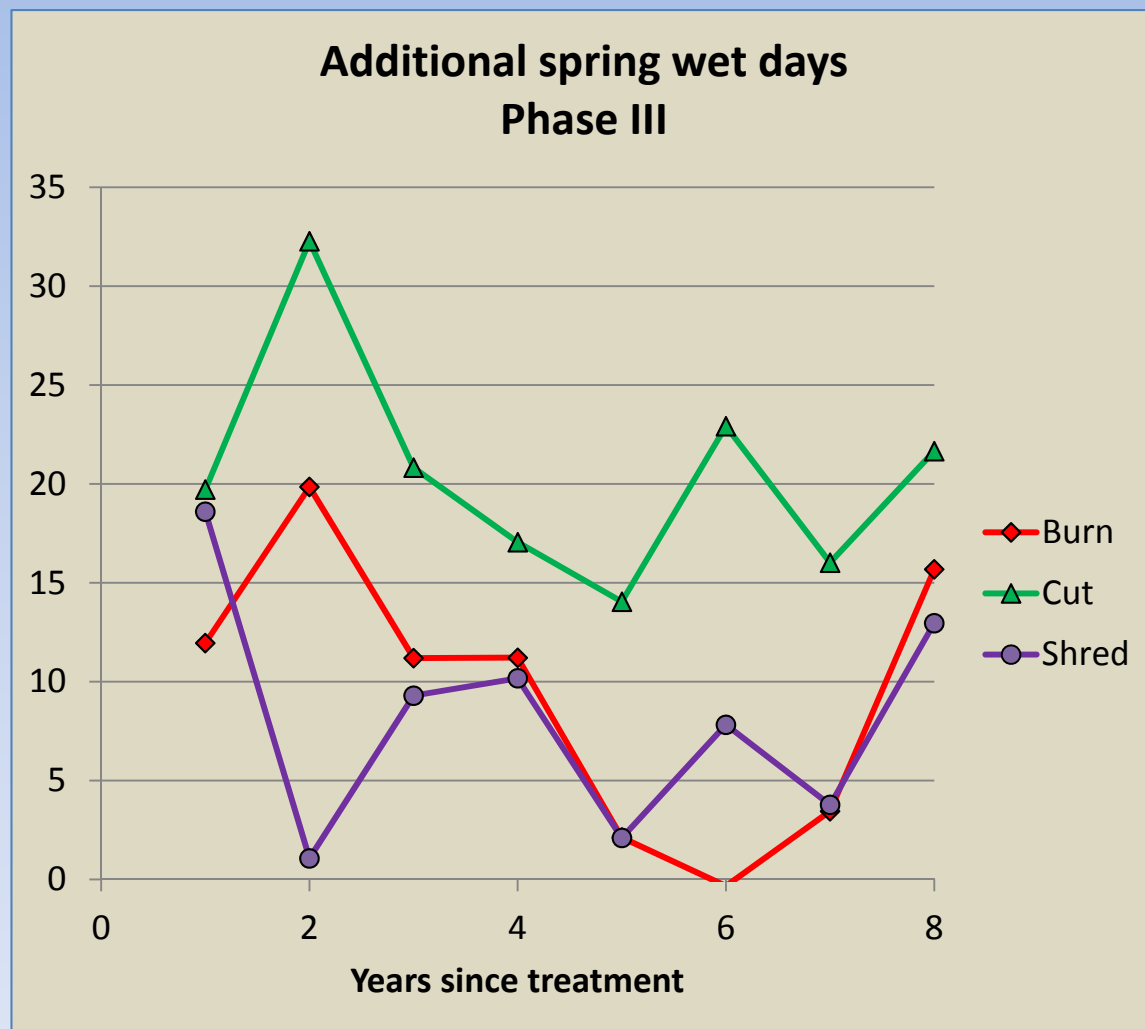


Brooks 2008

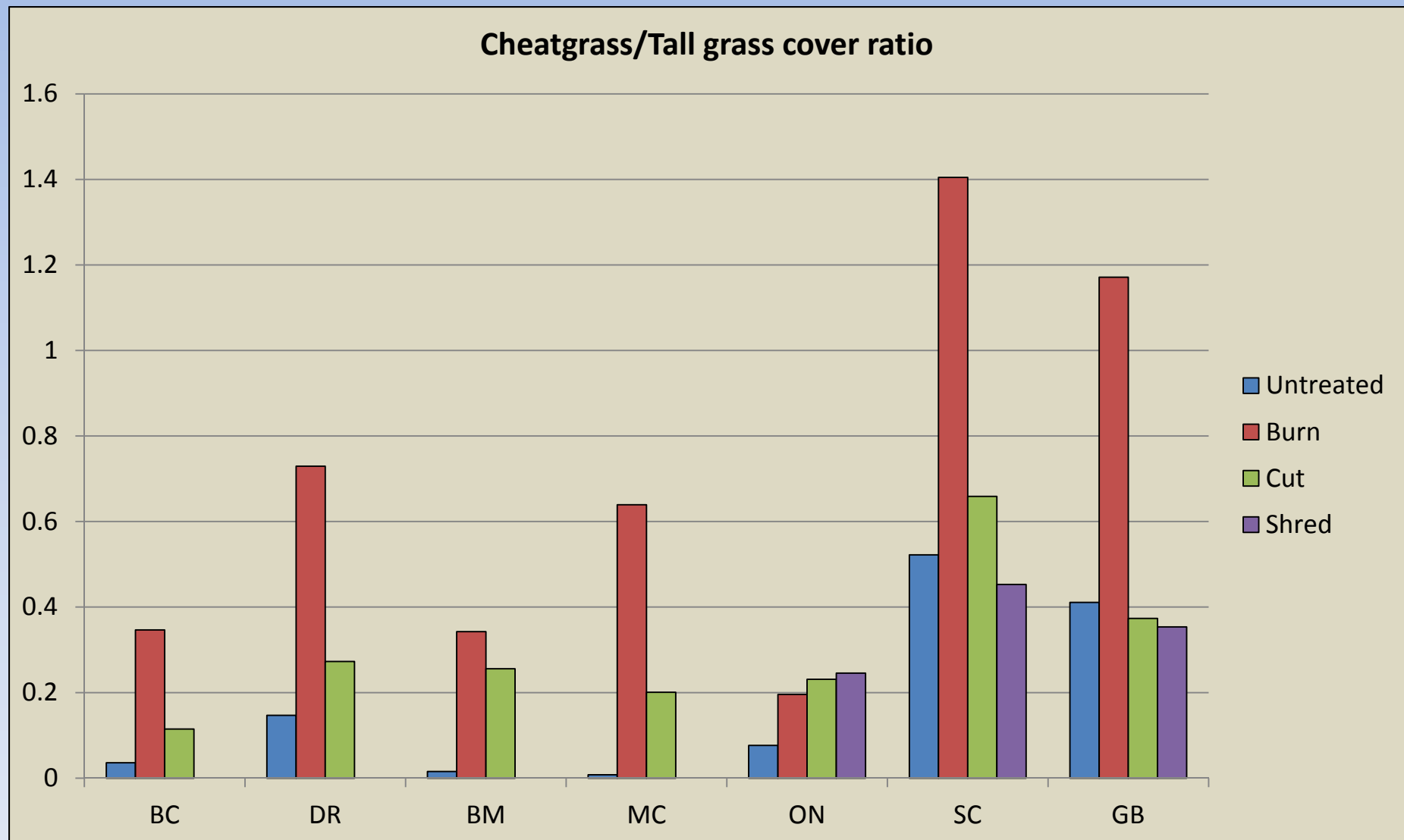
Ryel et al. 2008; Leffler and Ryel 2012



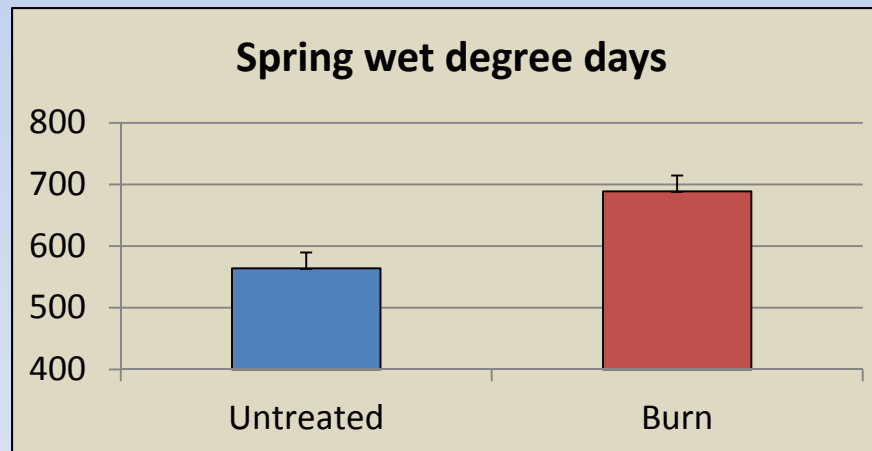
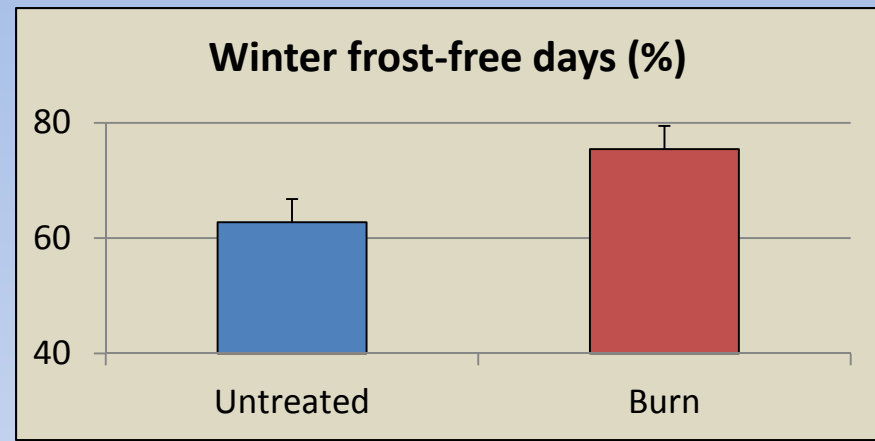
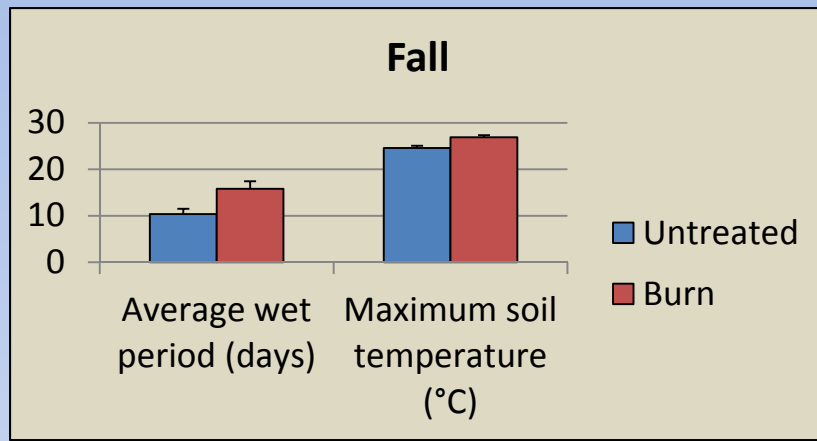
# Increased soil water availability



# Site and treatment effects

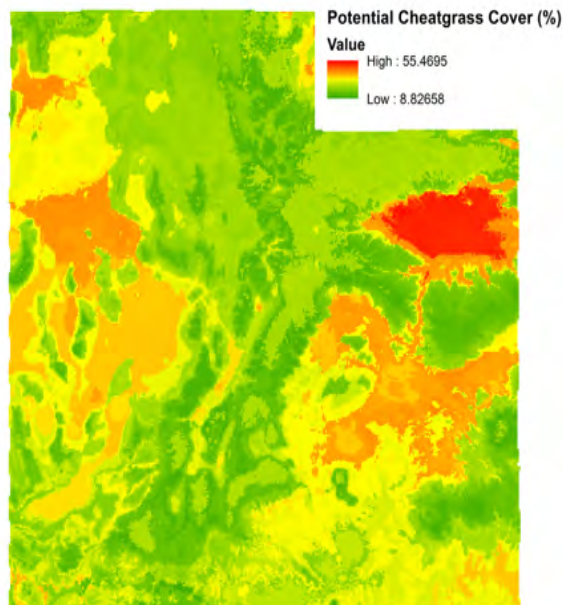
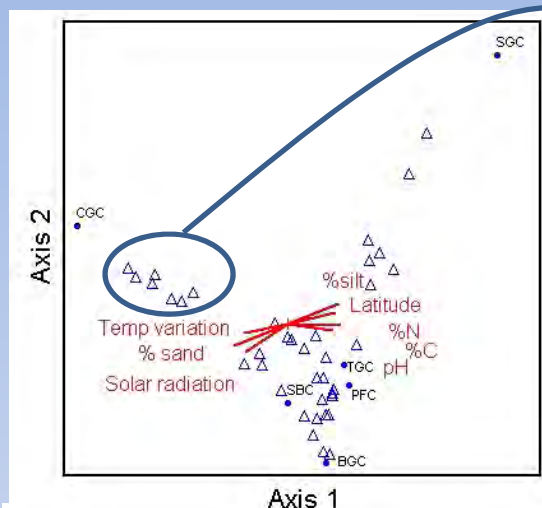


# Burn treatments had warmer soils





## How do Site environmental characteristics influence cheatgrass and perennial cover?

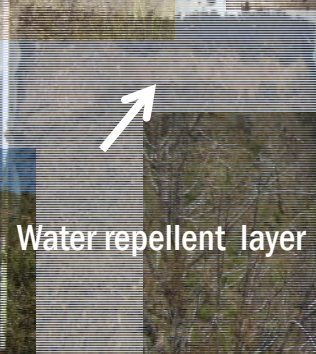


Sites with > 14% cheatgrass cover over sites with less cover

- Temperature variation indicators increase slightly
- 23 kWh/m<sup>2</sup> increase in solar radiation
- 10% increase in % sand
- 6% decrease in % silt
- 5% decrease in % N
- 2% decrease in % C

- We are developing regression and niche based classification models to help determine the site potential following shredding.

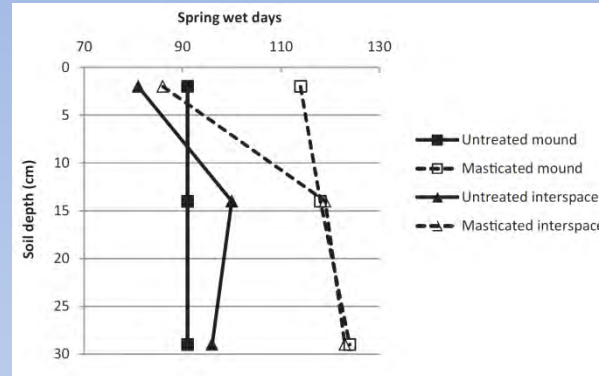
# Soil water repellency affects N and soil water availability to seedlings



Fernelius et al submitted

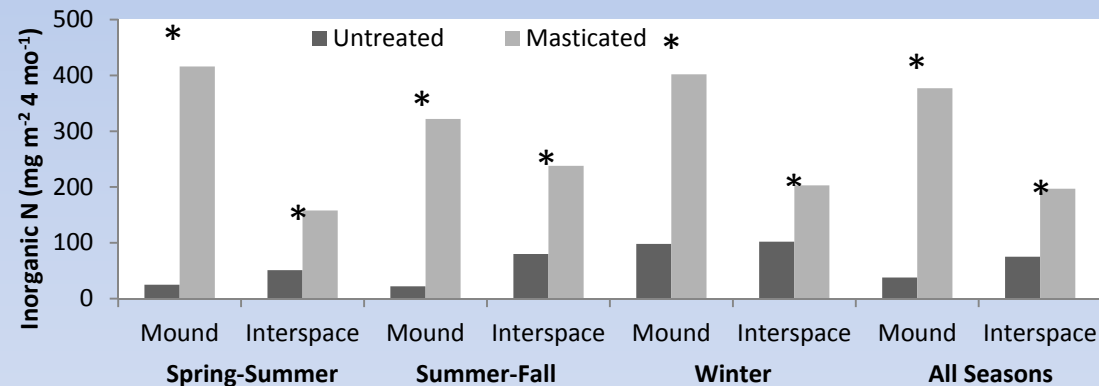
# Shredding increased:

- Time of soil water availability and temperatures

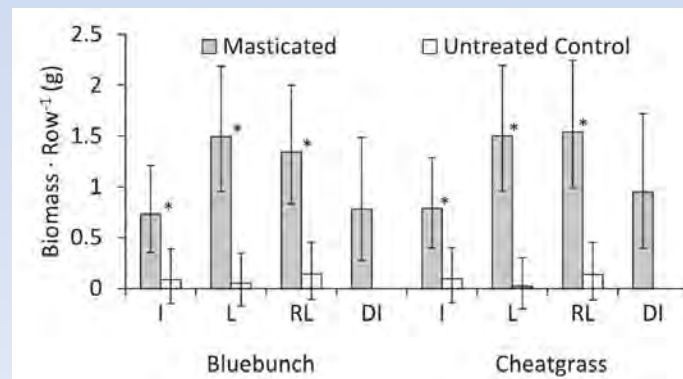


Young et al 2013  
FEM

- Inorganic N



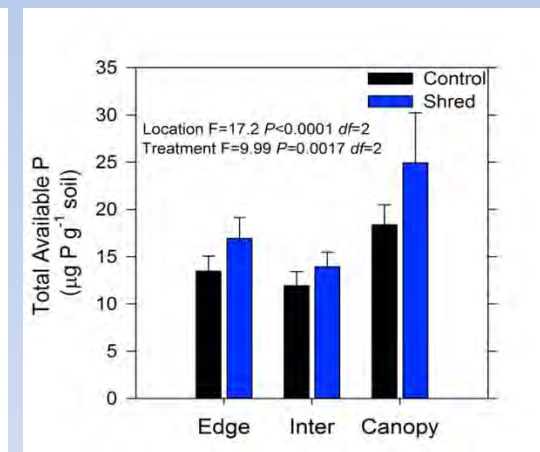
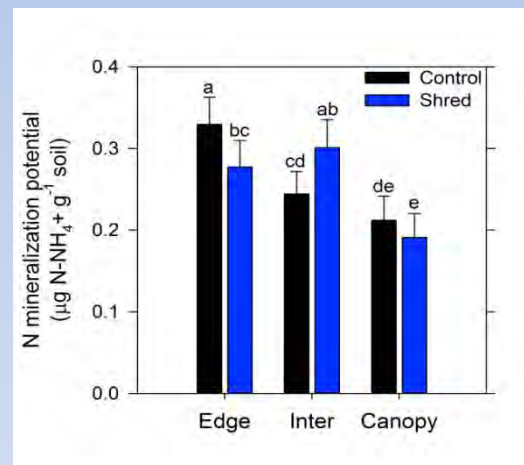
- Seedling biomass



Young et al 2013  
REM

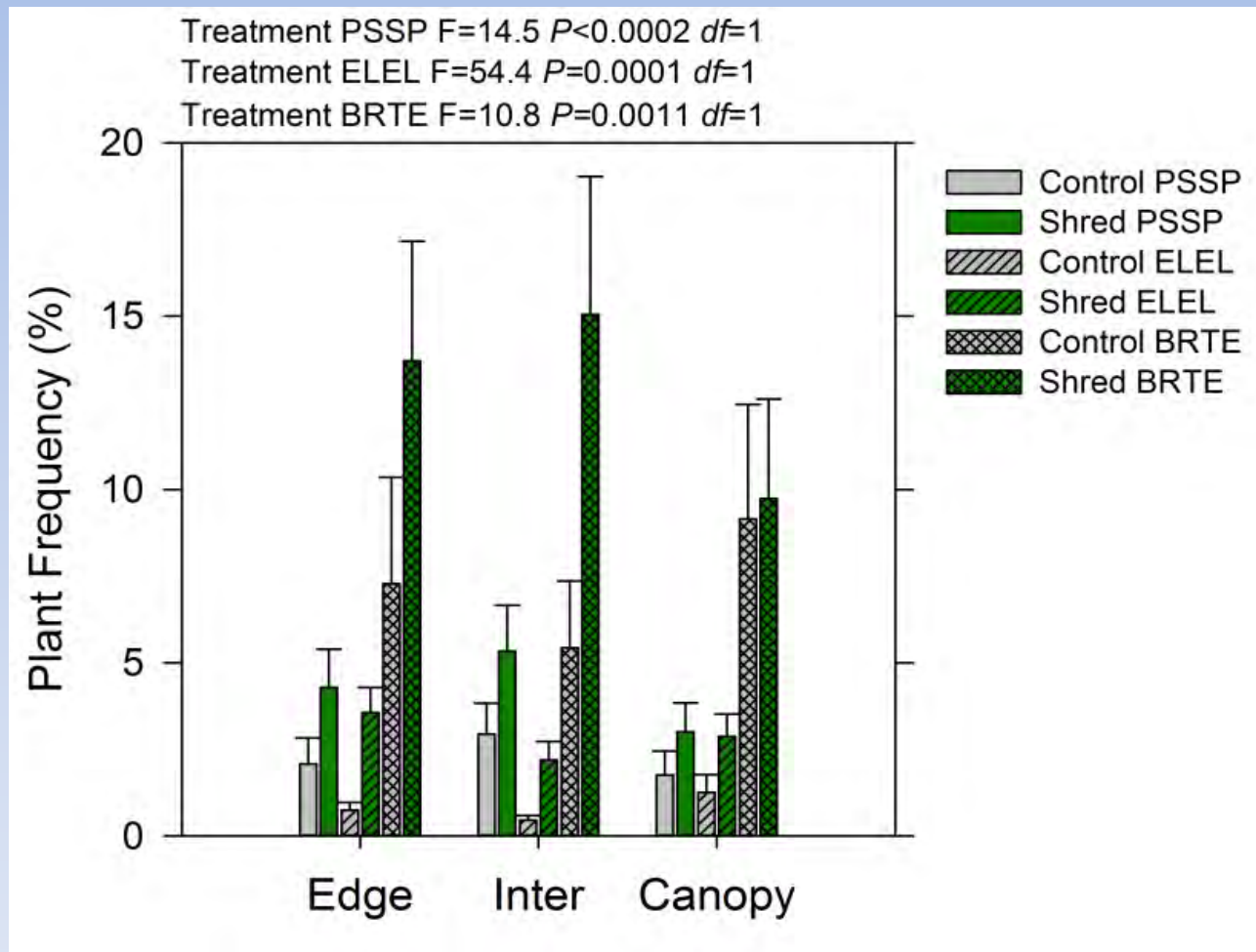


# Shredding increased N mineralization in interspaces and available P in canopies and canopy edges



Aanderud et al submitted

# Shredding increased frequency of cheatgrass and perennial grasses



# Conclusions

<b><u>Objective</u></b>	<b><u>Action</u></b>	<b><u>Guidelines</u></b>
<b>Maintain shrubs</b>	Mechanical	< 20% tree cover
<b>Reduce fuels</b>	Prescribed fire	Phase I to minimize cheatgrass
<b>Minimize cheatgrass</b>	Mechanical	< 40% tree cover
	Seed	When cheatgrass >10%

Follow-up may be necessary for mechanical





# Conclusions

- Mechanically reduce trees at < 20% tree cover to maintain shrubs
- Tall perennial grasses respond well to mechanical treatments, even at Phase II-III
- Tree reduction and especially fire can increase cheatgrass on warmer sites
- Fire reduces woody fuels best, but mechanical treatments encourage more resilience
- Post-mechanical treatment fuels control may be necessary



# Conclusions

- Tree reduction increases resource availability , modifies microclimate
- What you have before affects what you get after
- Fire reduces fuels but also sagebrush
- Mechanical treatments change fuels, keep shrubs, increase herbaceous
- Waiting to treat increases tree fuels and loses shrub cover
- Some sites more susceptible to weeds than others
- Weedy sites should be seeded