

# Fuel control treatments: Dealing with differences among sites

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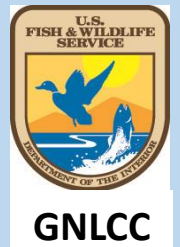


# SageSTEP Associates

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- Rick Miller
- Robin Tausch
- Eugene Schupp
- Paul Doescher
- Ben Rau
- Trevor Gruell
- Jim McIver



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**GNLCC**



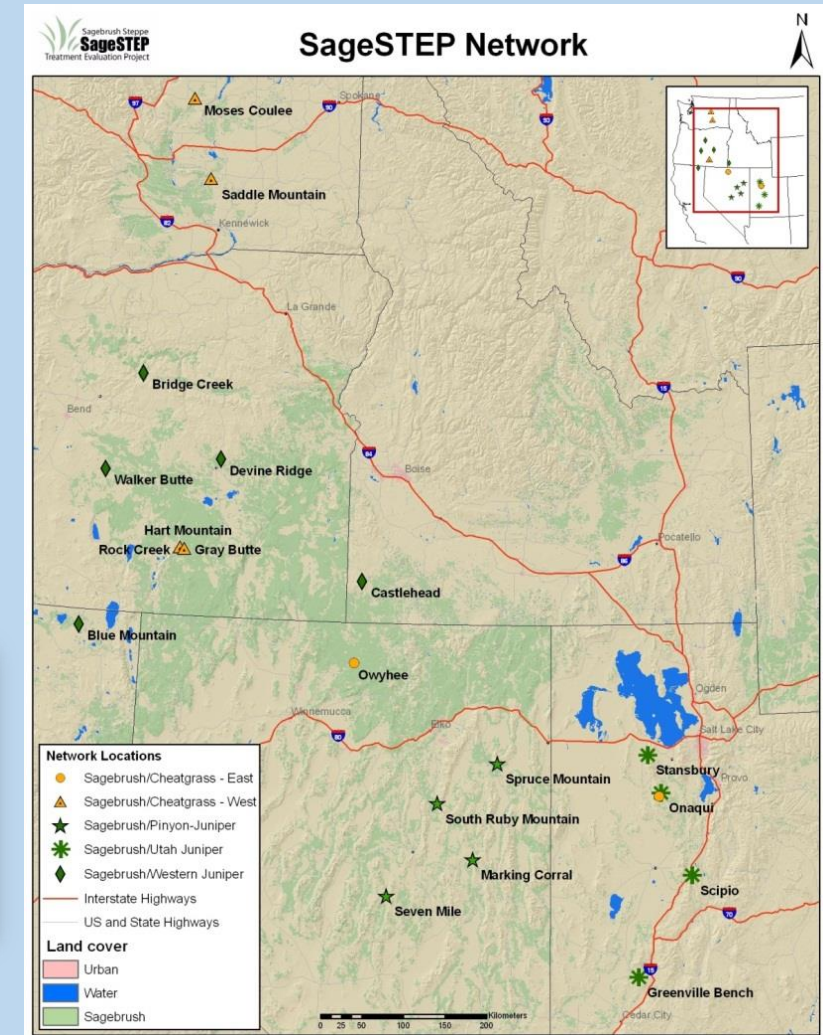
# The Problem:

*Fuels are controlled to suppress high-severity fire, but fuel control may result in weed dominance*



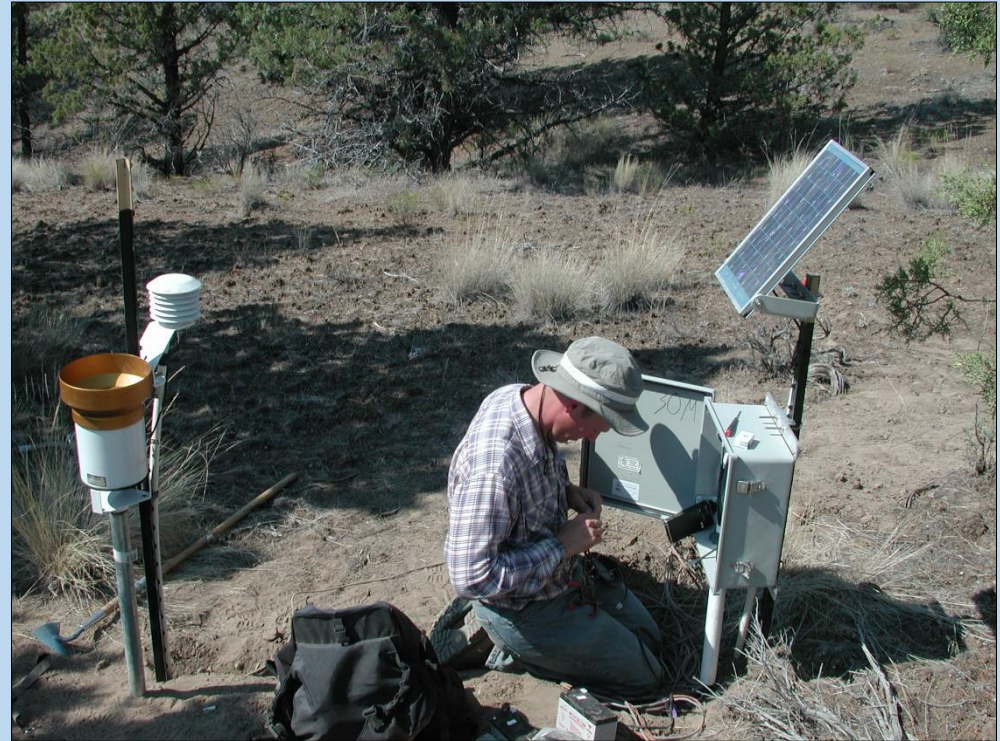
# The Regional SageSTEP Experiment

- Wyoming big sagebrush
  - 6 sites
  - 4 woody fuel treatments
    - Untreated
    - Fire
    - Mow
    - Tebuthiuron
  - 2 herbaceous treatments
    - No imazapic
    - Imazapic
- Woodland expansion
  - 11 sites
  - 3-4 fuel treatments
    - Untreated
    - Fire
    - Mechanical (cut; masticate Utah only)



# Soil temperature and available water stations

- 17 sites; 178 stations
- 4-5 treatments
- Sagebrush: Low and high p. grass
- Woodland: 3 expansion phases
- 4 microsites
- 6 depths: 4 upper 30 cm; 50, 65 cm
- Hourly averages
- 29 derived seasonal variables



# SageSTEP Results



- Sagebrush
  - Pyke et al. 2014: 1-3 years
  - Chambers et al. 2014: 3-4 years
  - Rau et al. 2014: 3 years
- Woodland
  - Miller et al. 2014: 1-3 years
  - Roundy et al. 2014 a, b: 2-3 years
  - Chambers et al. 2014: 3-4 years
  - Young et al. 2013, 2014, 2015: 1-3 years
  - Bybee et al. 2016: 5-6 years
  - Williams et al. 2017: 3, 6 years

Sagebrush	Woody fuels	P. grass	Cheatgrass
<b>Fire</b>	-	- then =	Variable
<b>Mow</b>	-	Same	Variable
<b>Tebuthiuron</b>	Same	Same	Same
<b>Imazapic</b>		-	-

- Treatments increased available nutrients
- Drier and sandier sites had more cheatgrass

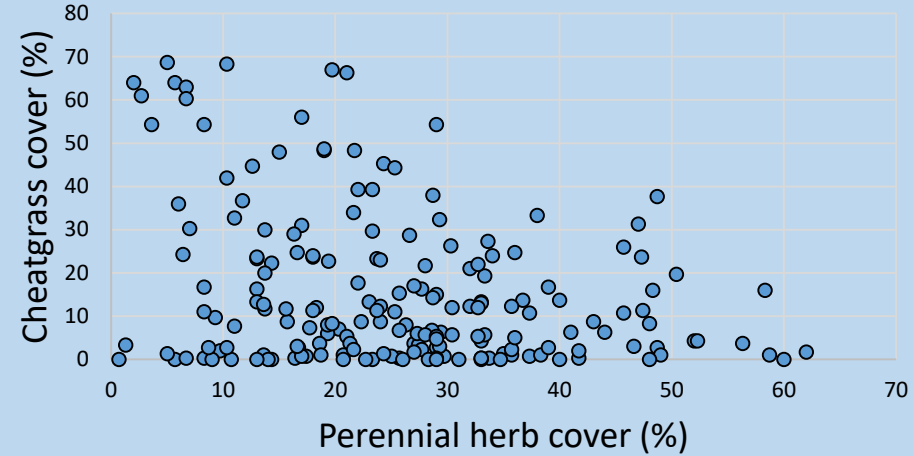
Woodland	Woody fuels	P. grass	Cheatgrass
<b>Fire</b>	-	- then +	+
<b>Cut/Shred</b>	Location, size	+	Variable

Higher pretreatment tree dominance:

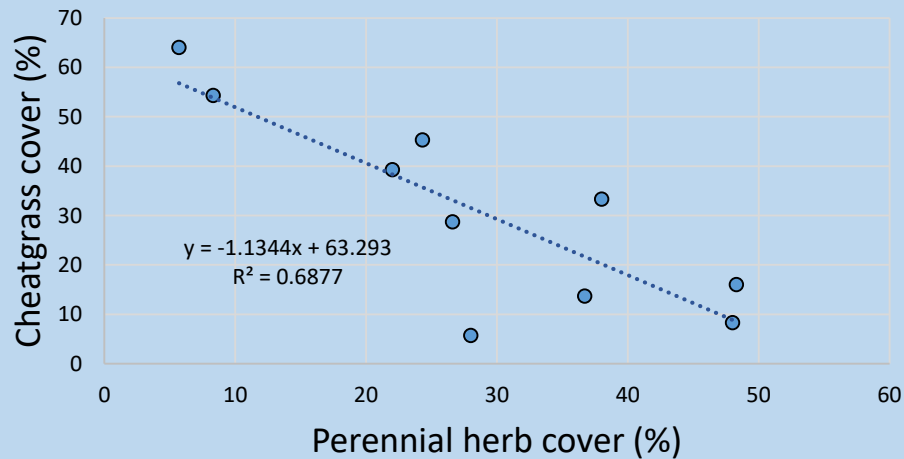
- Increased woody fuels
- Decreased understory
- Increased post-treatment available nutrients, soil water
- Increased post treatment cheatgrass

# Perennial grasses resist cheatgrass, but varies

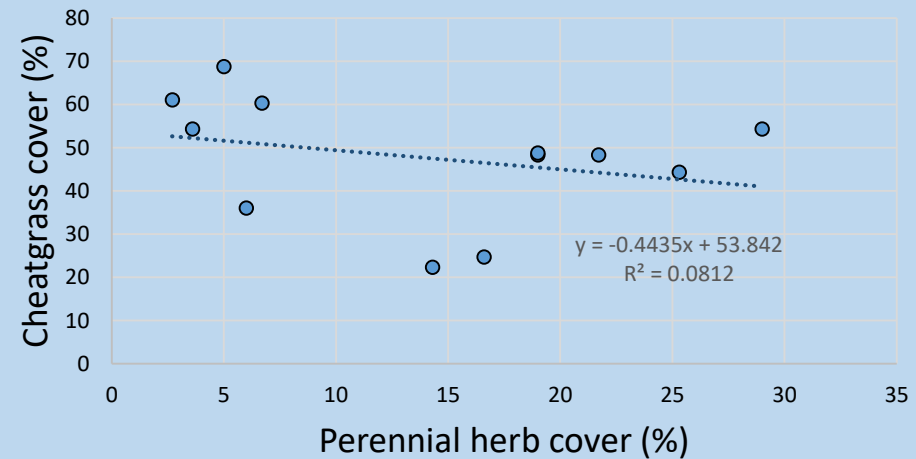
Sagebrush burn, mow, herbicide



Roberts sagebrush burn



Roberts sagebrush mow

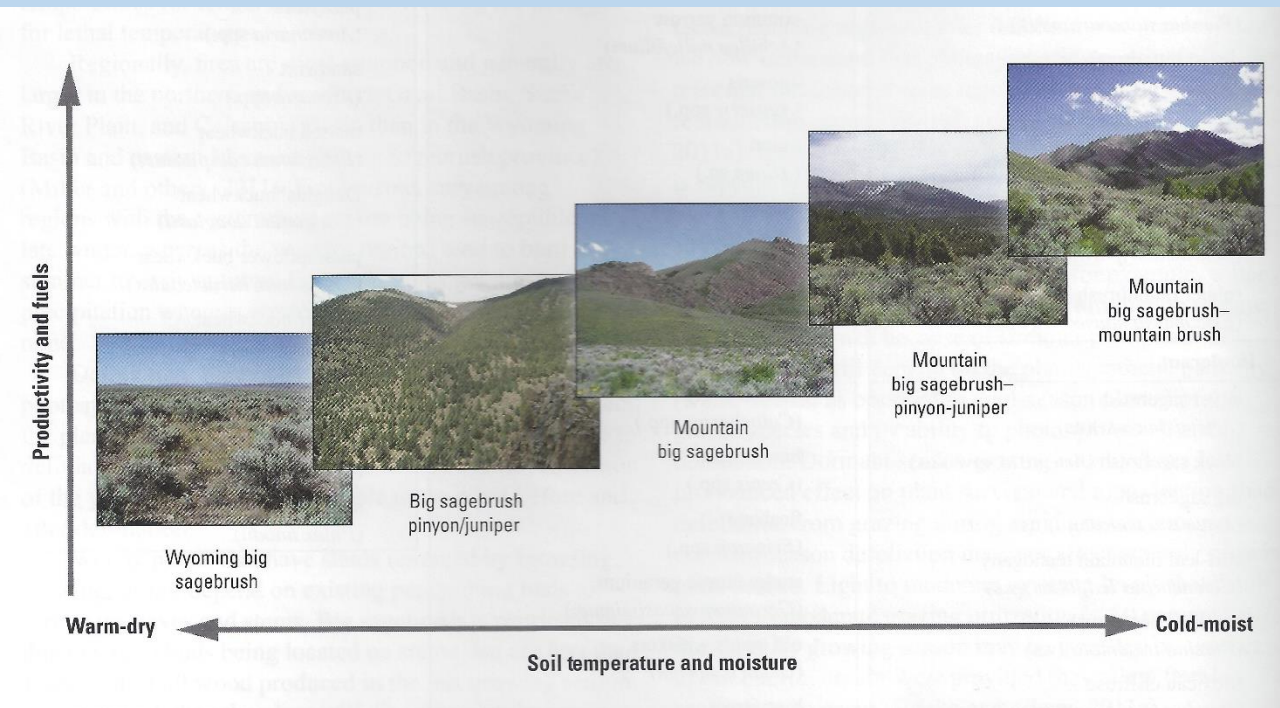


# Cheatgrass-perennial herbs vary with site, scale

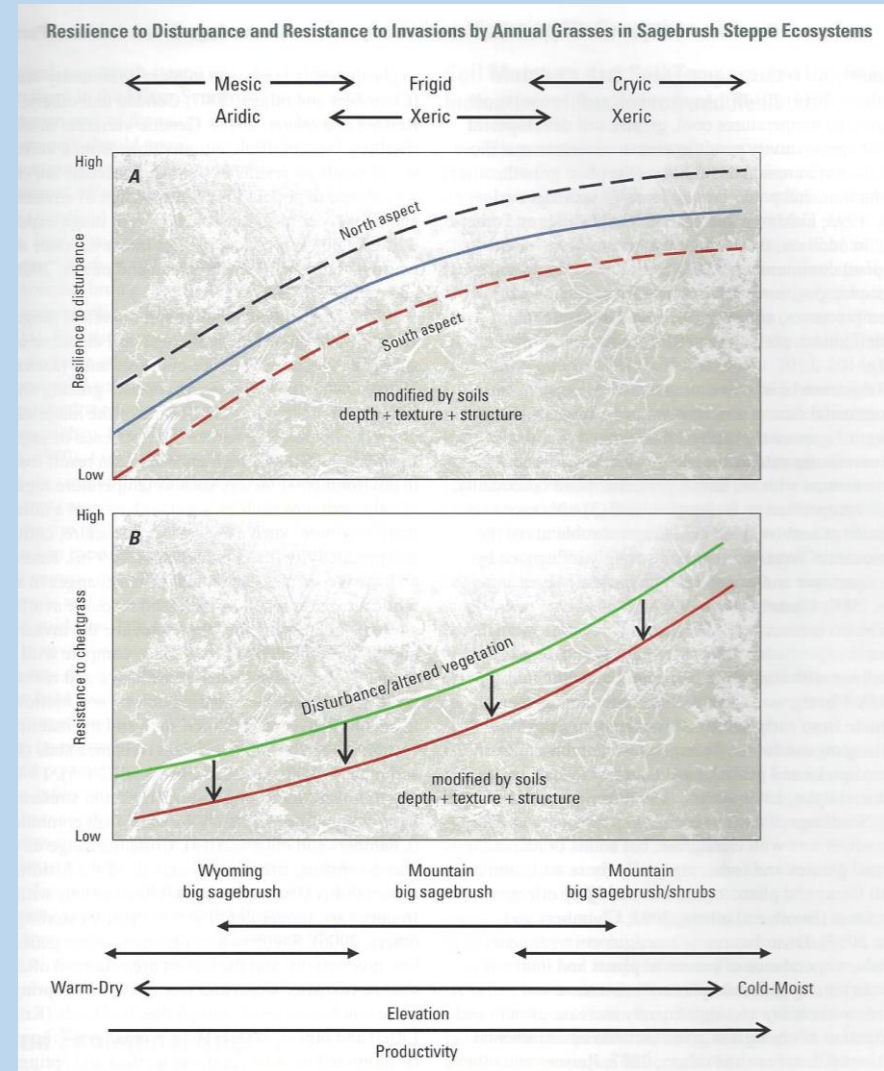




# Resilience and Resistance

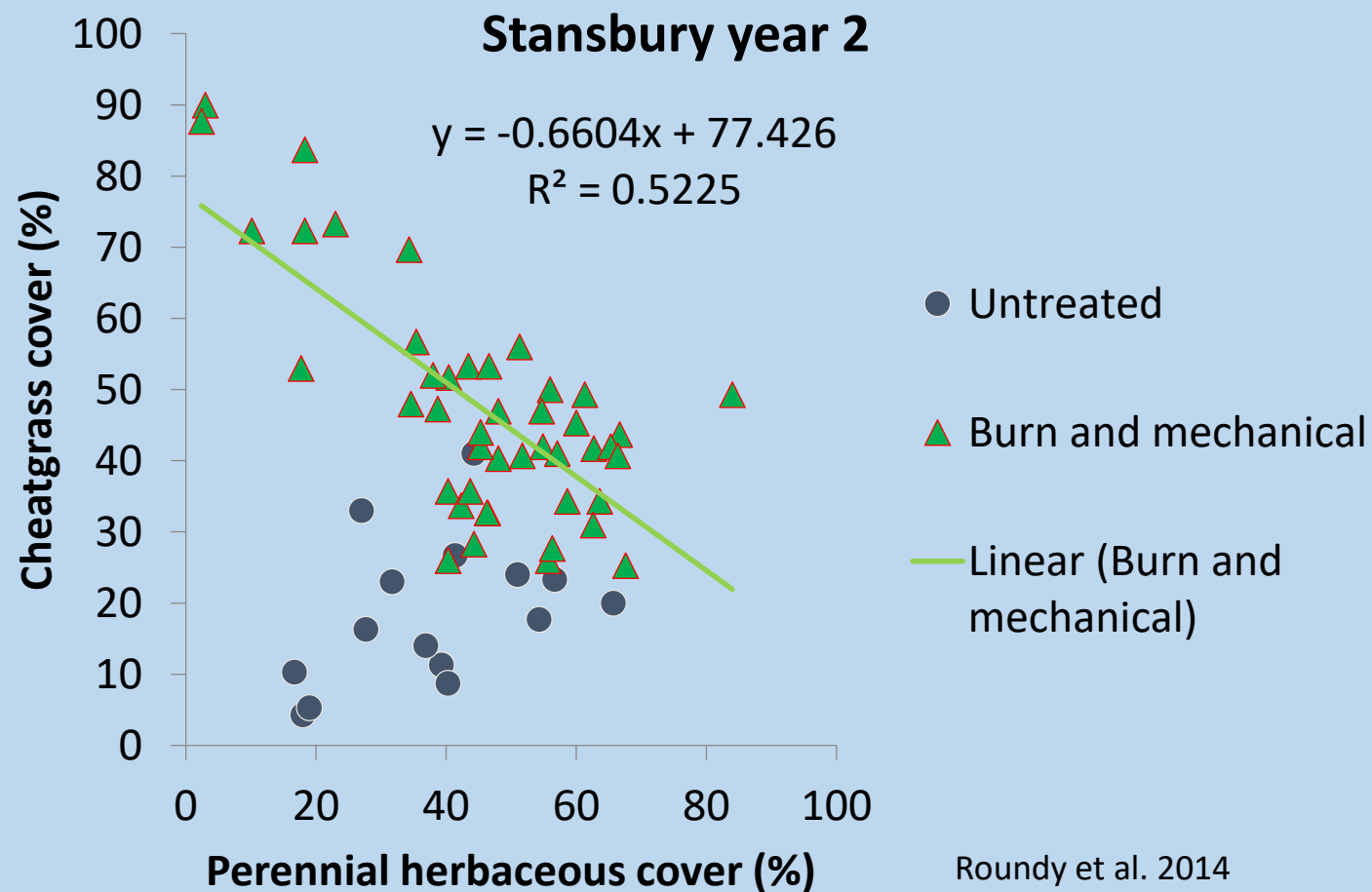


Pyke et al. 2015 after Chambers et al. 2013, 2014

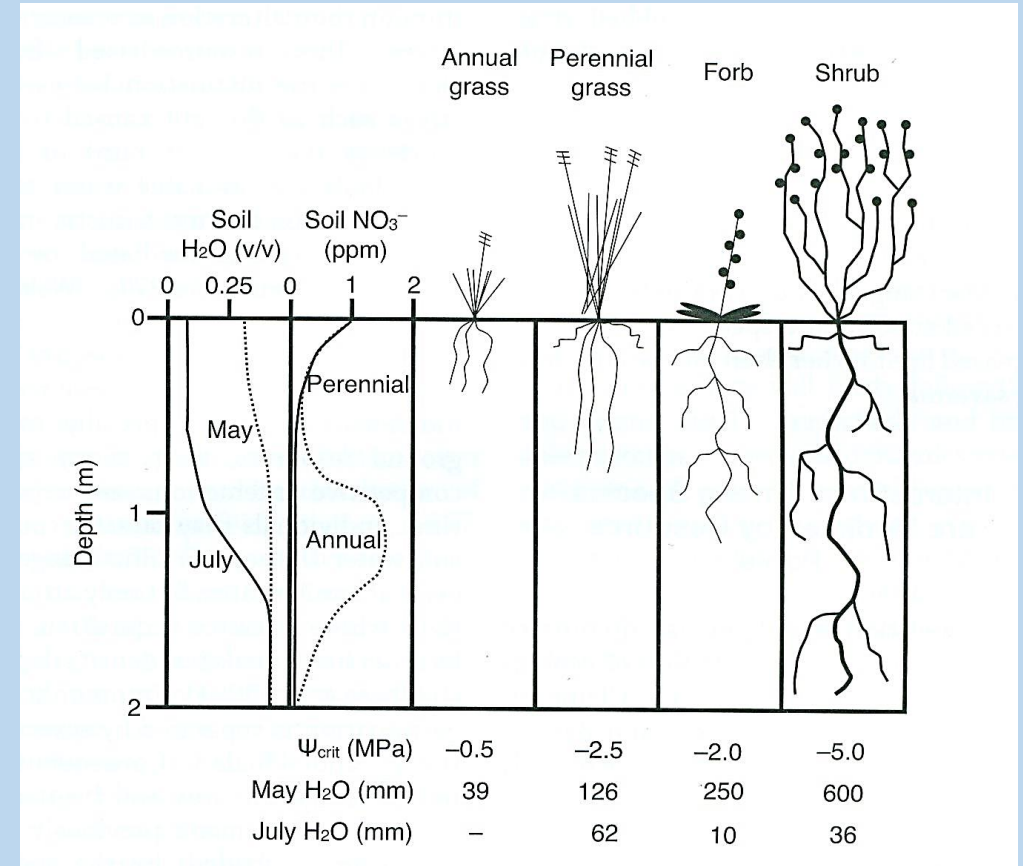
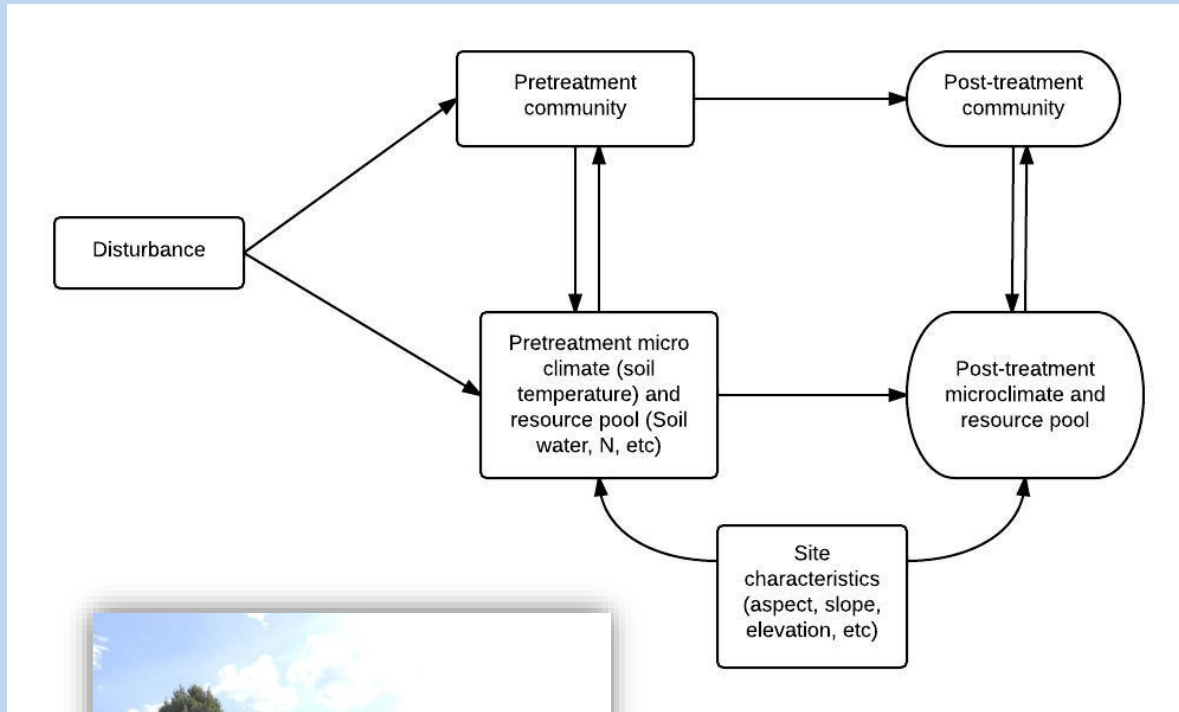


**Warmer sites with more cheatgrass  
before treatment had more cheatgrass  
after treatment**

- Fundamental niche
  - Adaptation to environment
- Realized niche
  - Distribution, abundance as affected by competition for resources



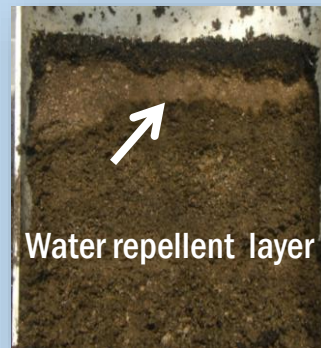
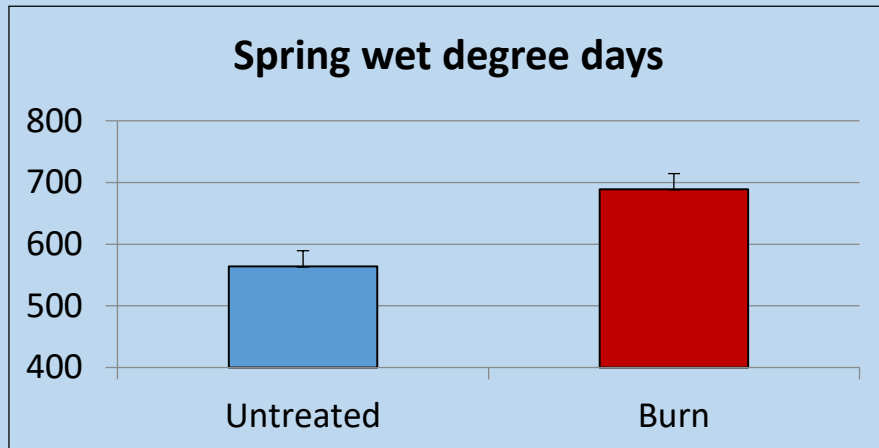
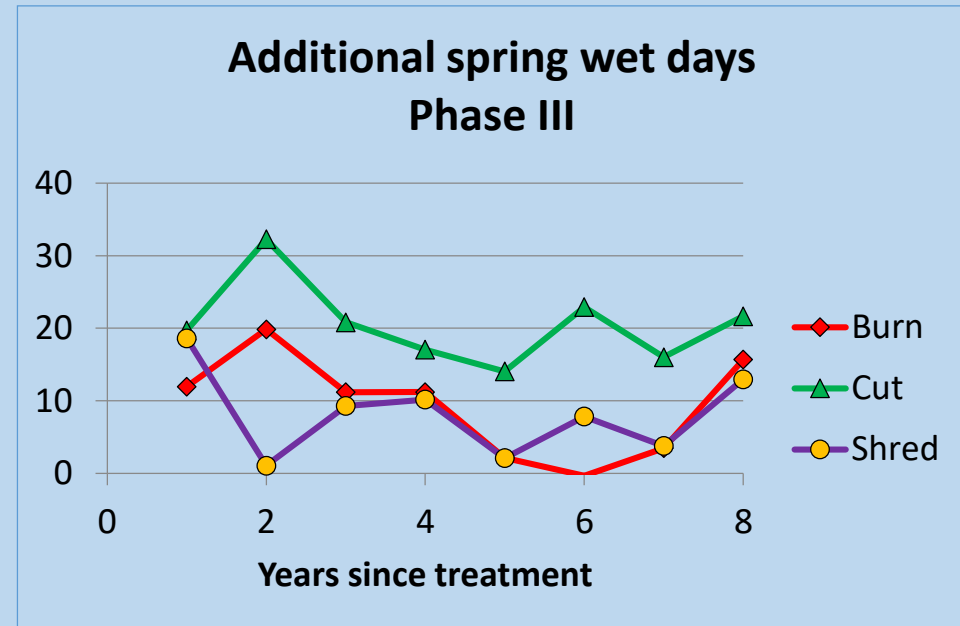
# Treatments affect plants and environment



Ryel et al. 2008; Leffler and Ryel 2012

# Treatment effects on environment

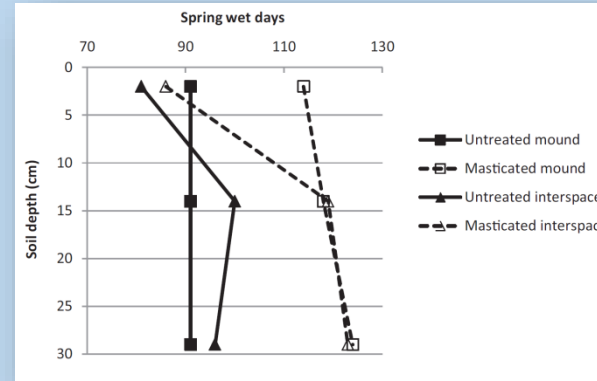
- Increased soil water availability
- Increased soil temperature
- Soil water repellency
- Nutrient availability



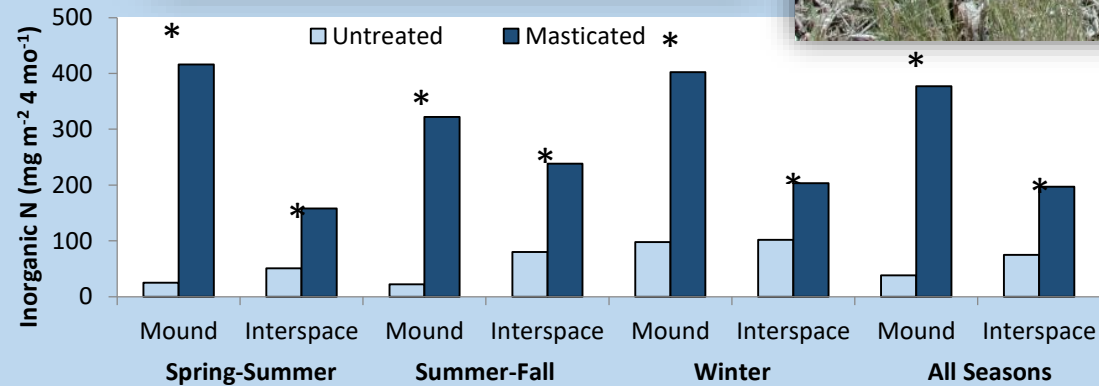
# Shredding increased:

Young et al. 2013, 2014

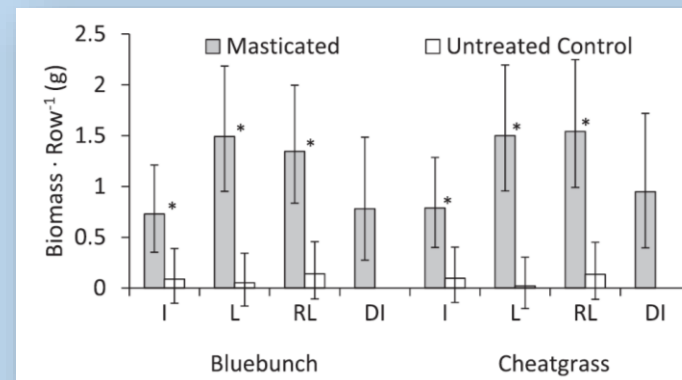
- Time of soil water availability and temperatures



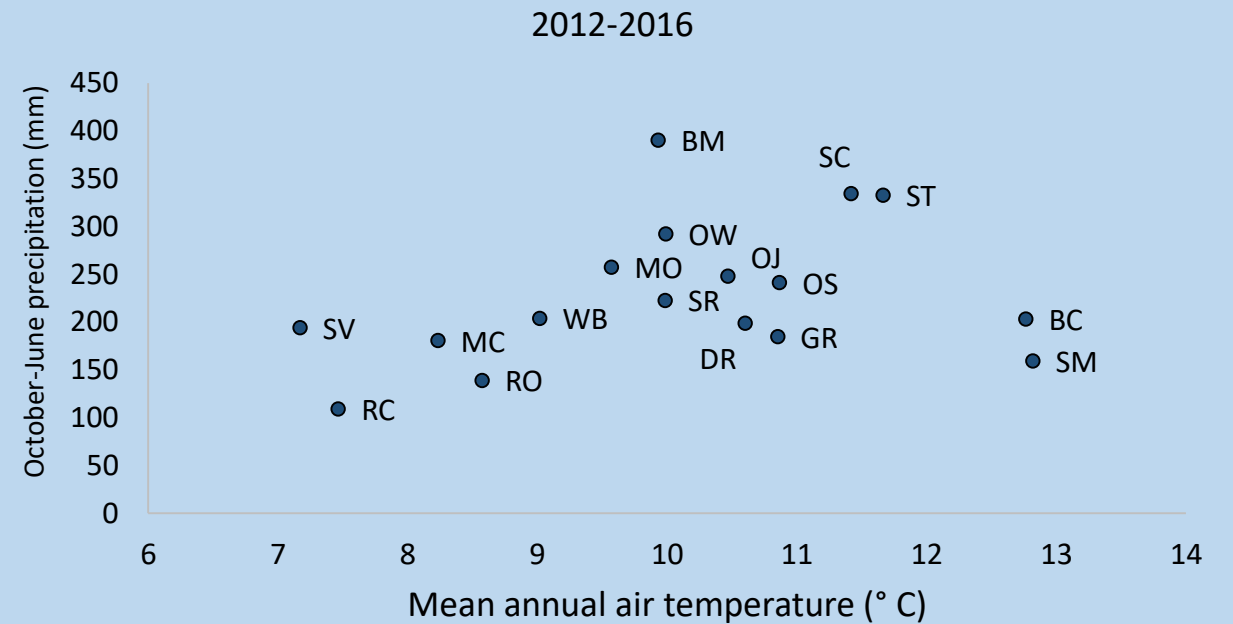
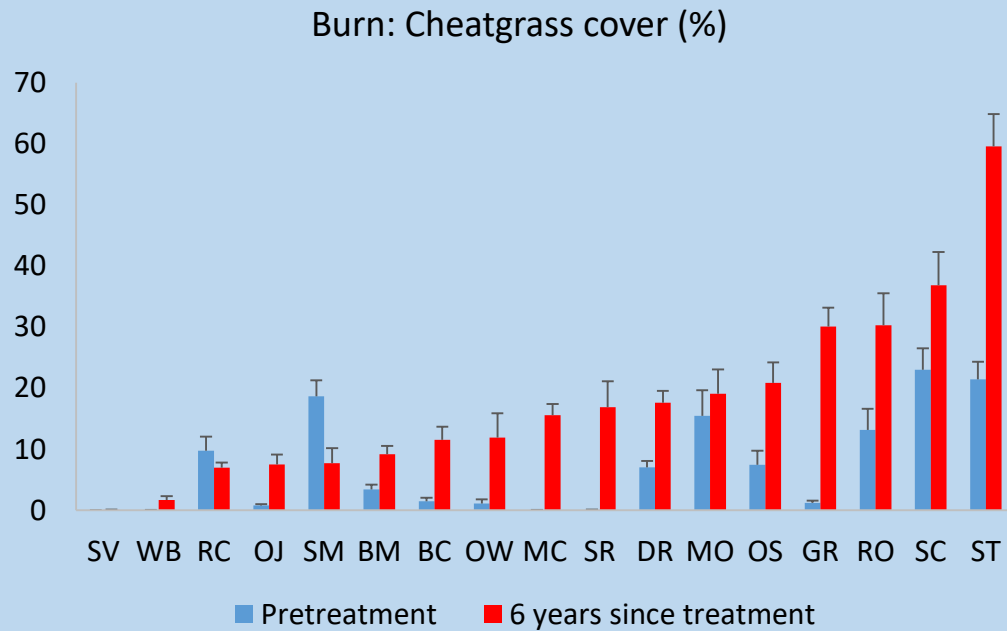
- Inorganic N



- Seedling biomass



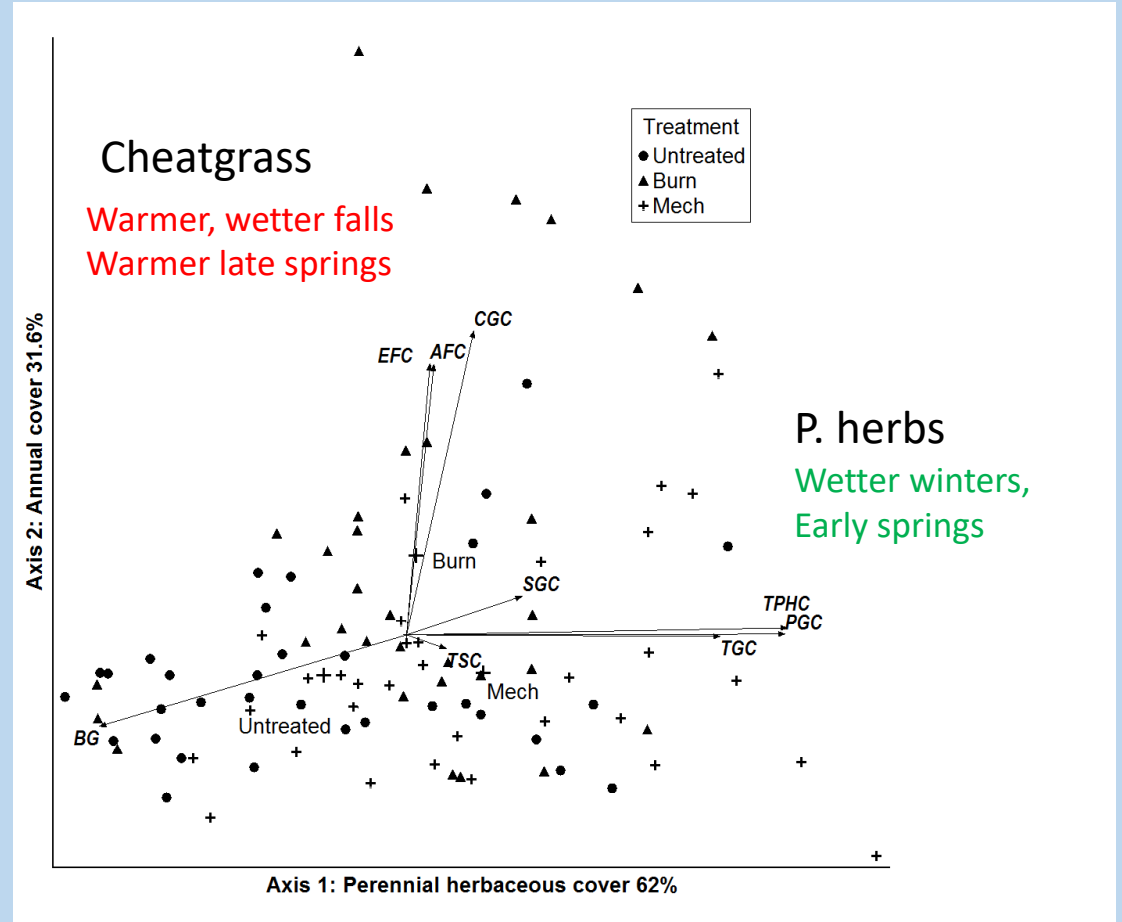
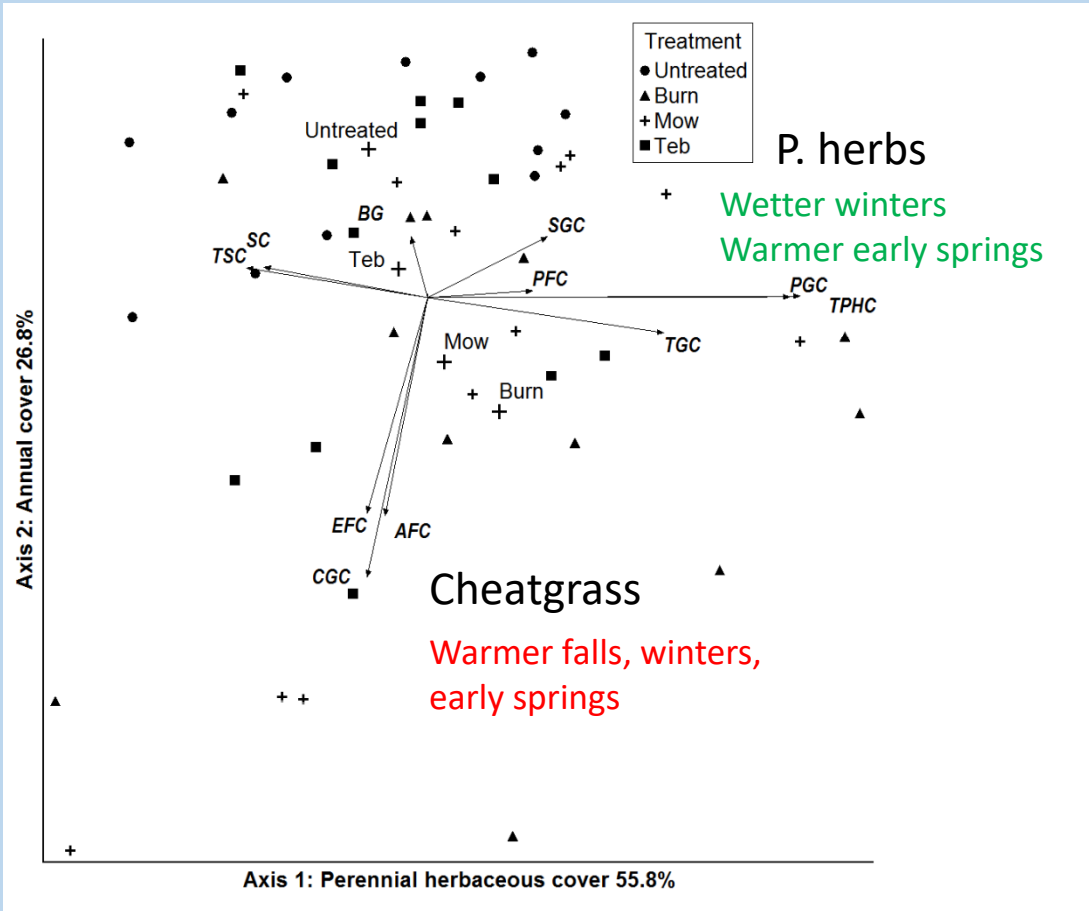
# What explains site differences?



# Gradients in cheatgrass and perennial herb cover associated with soil temperature and moisture

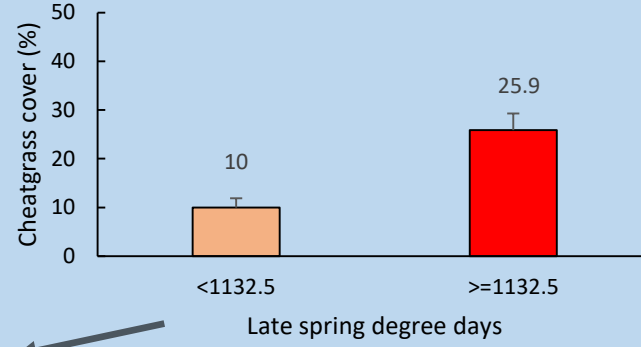
Sagebrush sites

Woodland sites

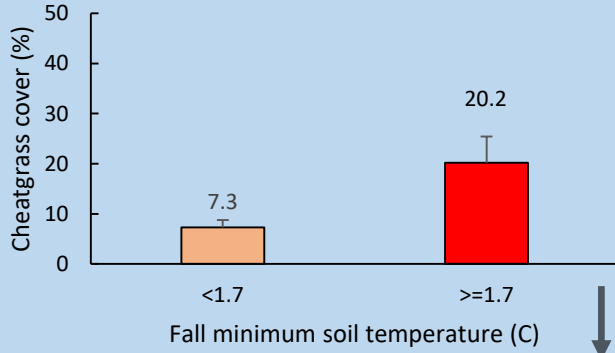


# More cheatgrass cover if:

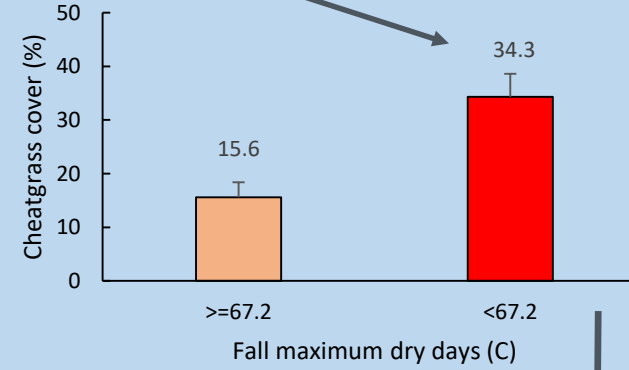
## Partition Decision Tree Analysis



If late spring cooler  
But Fall warmer

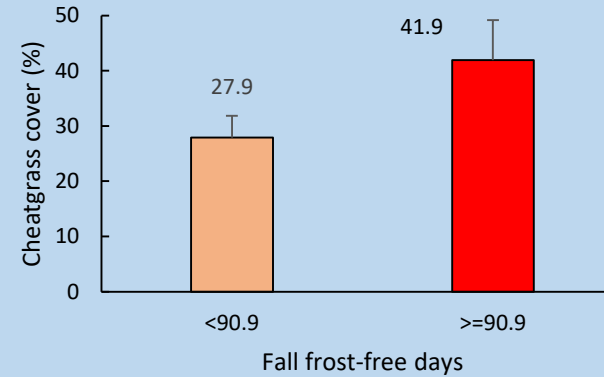
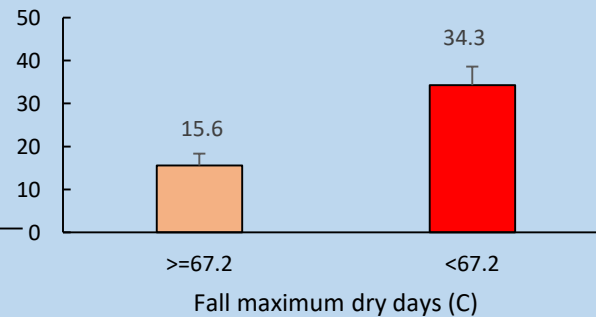
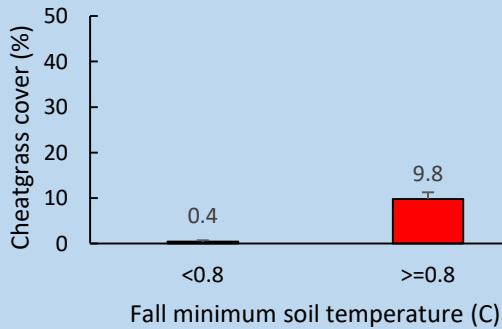


Fall wetter



Fall less freezing

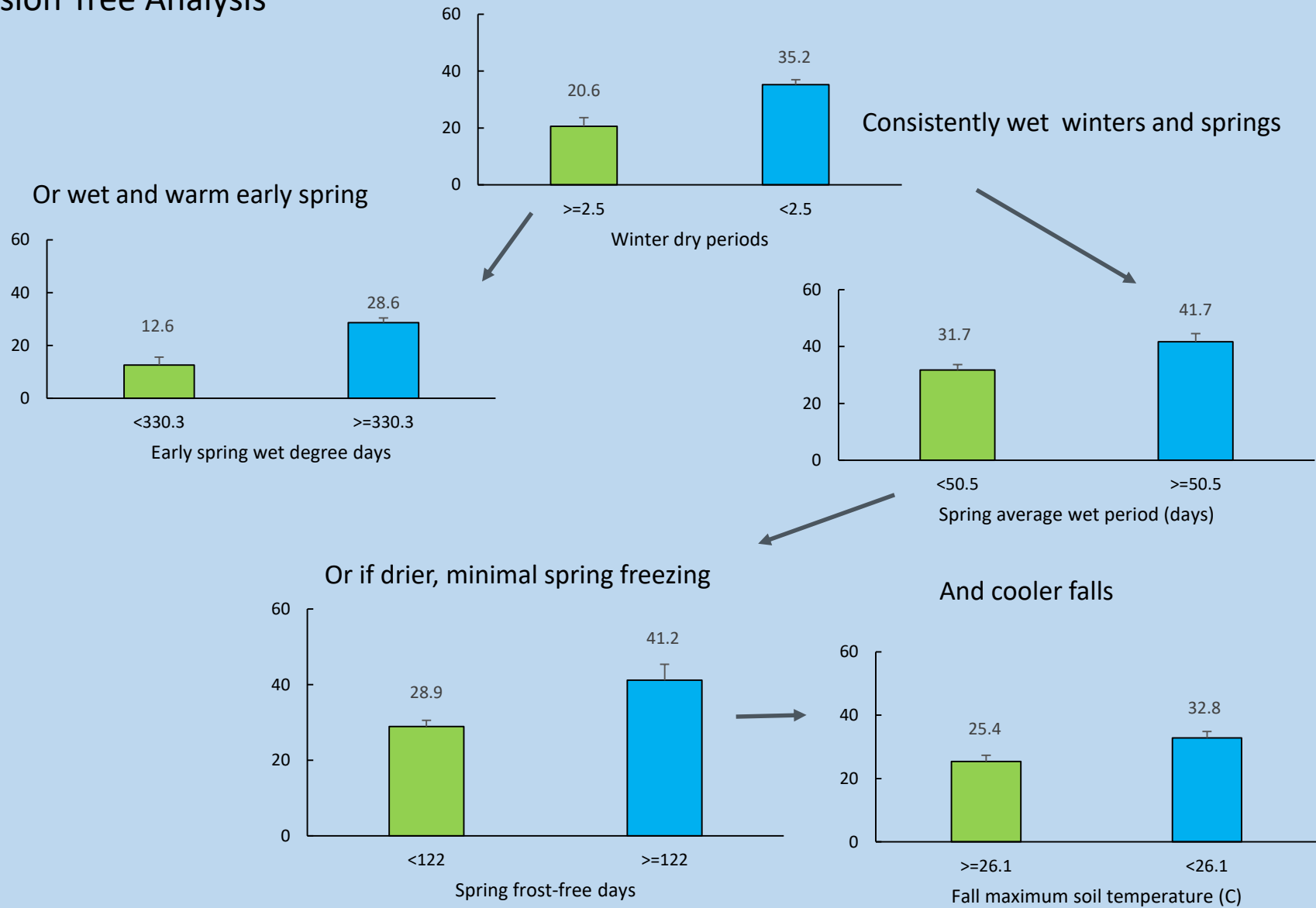
If Fall cooler but wet and not too cool





# More perennial herbaceous cover if:

## Partition Decision Tree Analysis



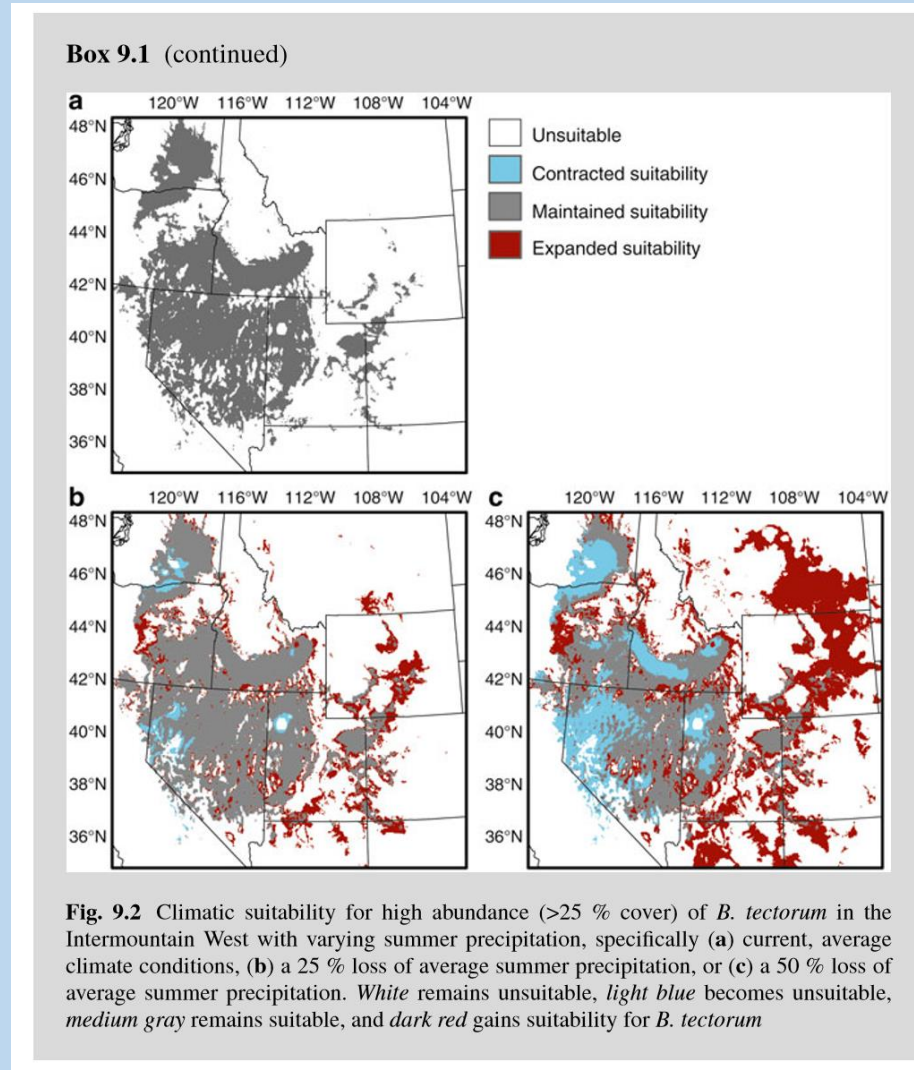
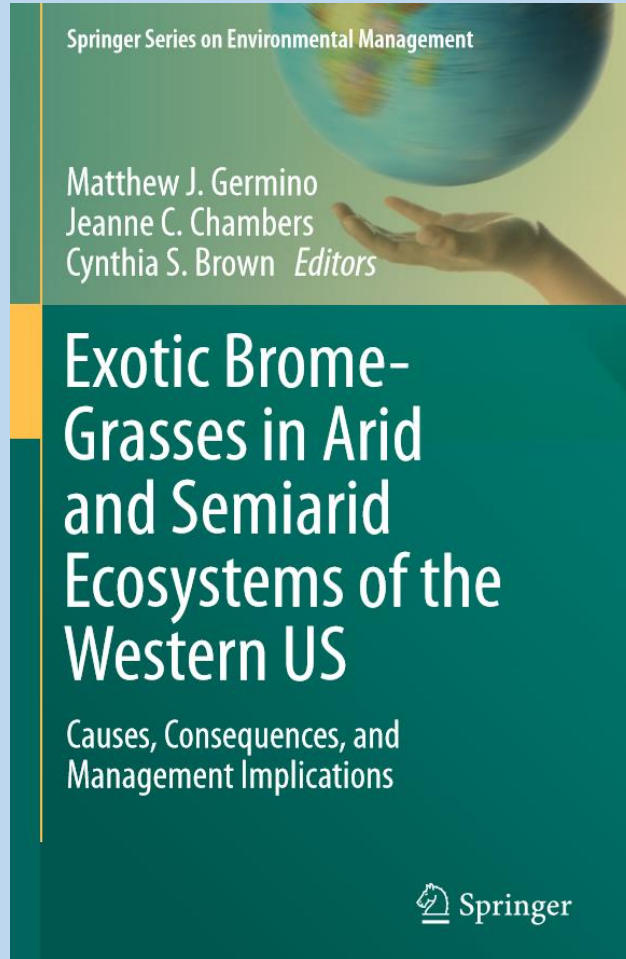
# Seasonal soil temperature/water effects

Seasonal climatic conditions	Effects on Perennial herbs	Cheatgrass	Resistance to cheatgrass
Wetter winters and early springs	+		
Cooler springs, cool, dry falls		-	Highest
Warm late springs, warm, wet falls		+	Intermediate
Drier winters and early springs	-		
Cooler springs, cool, dry falls		-	Intermediate
Warm late springs, warm, wet falls		+	Lowest

# Climate and ecology of cheatgrass

- Warmer = more cheatgrass if soil water is available
- More summer rain = less cheatgrass as p. grass favored
- Cheatgrass best adapted to fall, winter, spring precipitation, with dry summers
- Spring, summer, annual precip and winter temperature best predictors
- Best adapted to Wyoming big sagebrush ecosystem
- Germinates with fall rains, most springs
- High seed production limited by cooler temperatures
- Highly variable germination, growth on climatically-marginal areas
- Dominance highly dependent on disturbance: Fire cycles
- Flexible response to nutrients/water/temperature

# What are the predictions with global climate change?



- Cheatgrass expands where summer soil moisture decreases
- Cheatgrass dominance will increase within its range of adaptation
- With warming, cheatgrass may dominate more at higher elevations
- Drier/warmer = more cheatgrass/fire prone

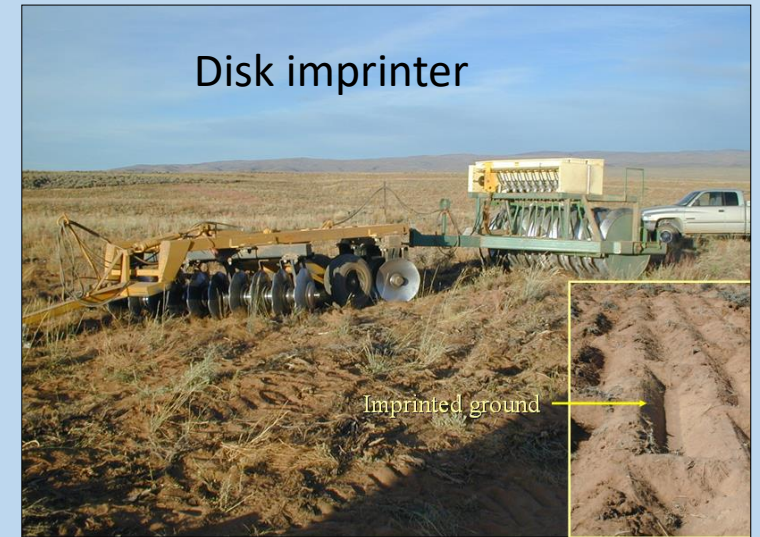
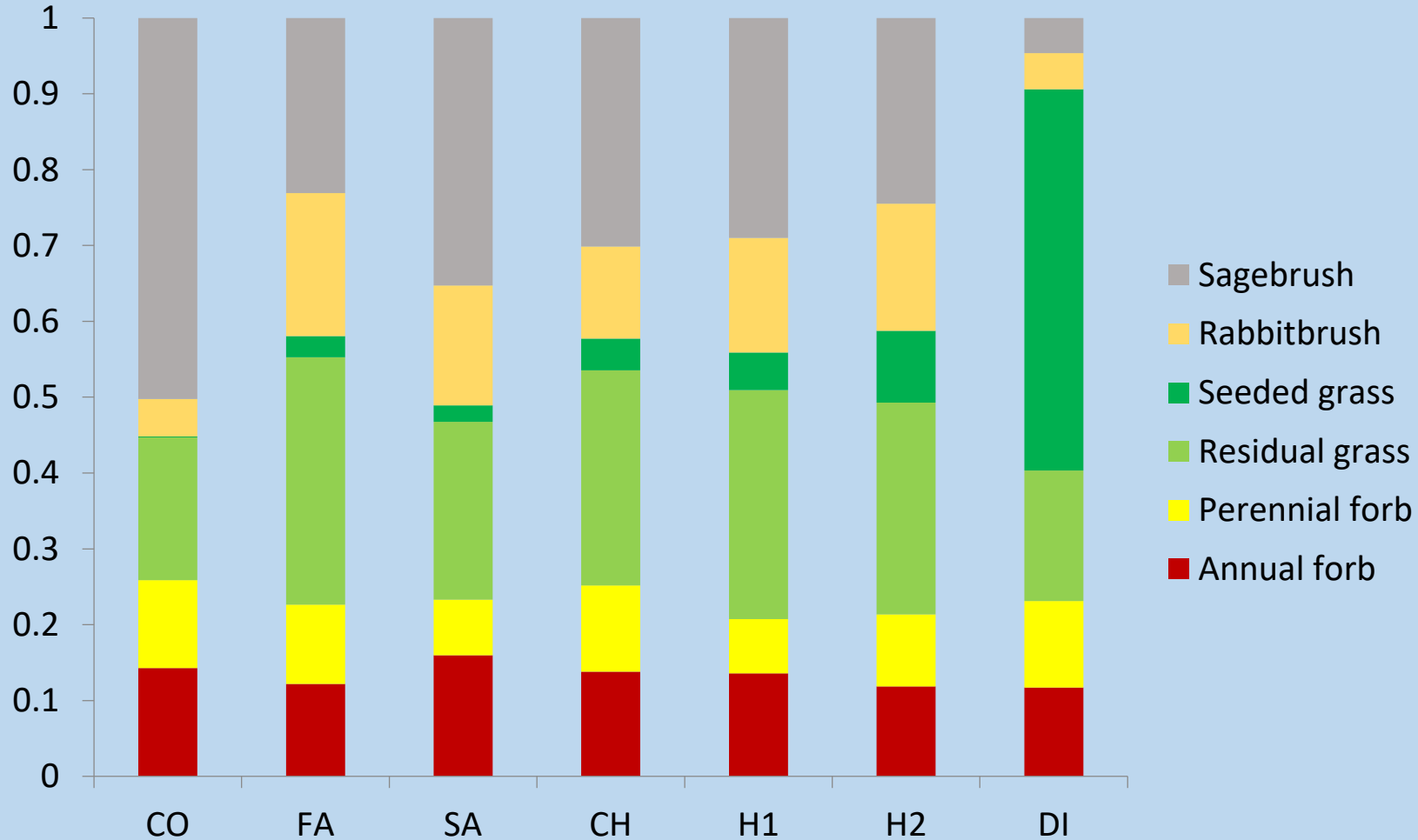
# How to increase resistance and resilience of sagebrush steppe systems?

*Maximize perennial grass cover by:*

- Manage grazing for rest or light-moderate use in growing season
- Wyoming sagebrush
  - Herbicide or mechanical/seed
  - Fire rehab seedings: cover seed
- Expansion woodlands
  - Cut/shred to reduce woodland fuels at Phase I and II
  - Seed/shred woodlands if reducing fuels at Phase III or with high potential cheatgrass
  - Fire rehab seedings: cover seed



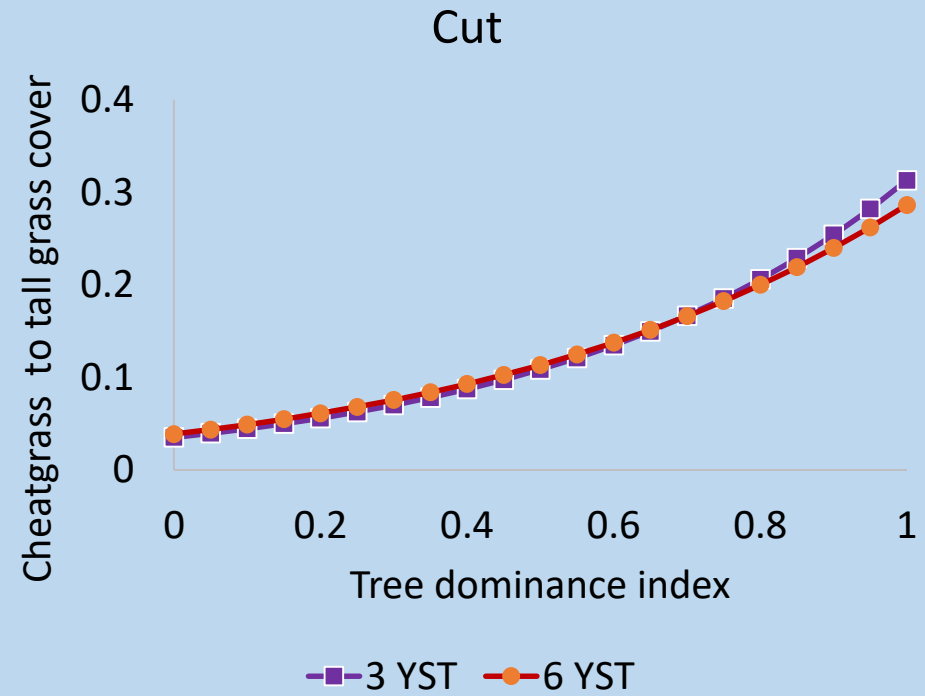
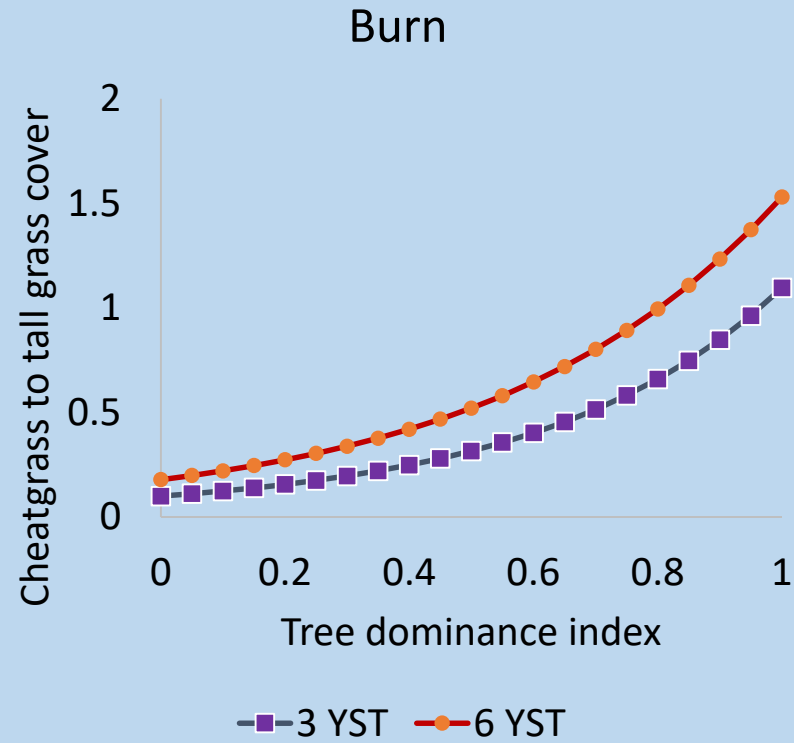
# Sagebrush renovation



Masticate at early expansion to best grow perennial grasses and retain shrubs

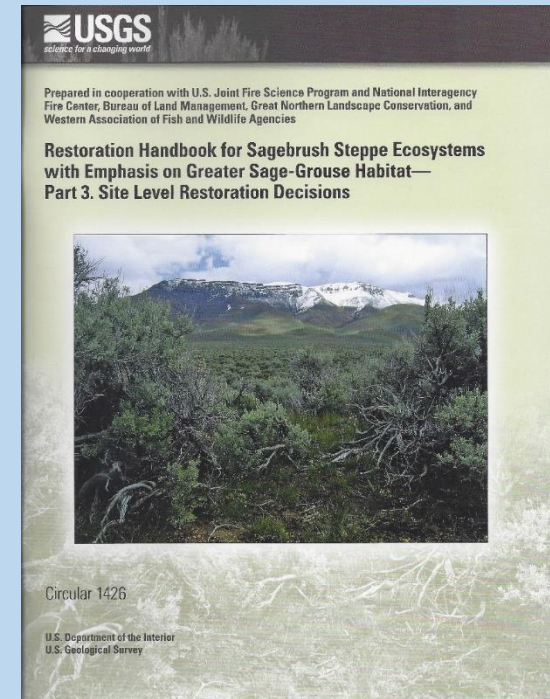
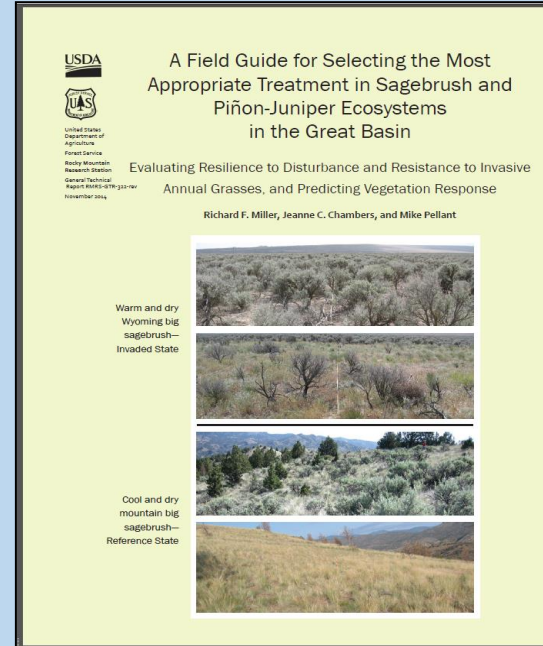
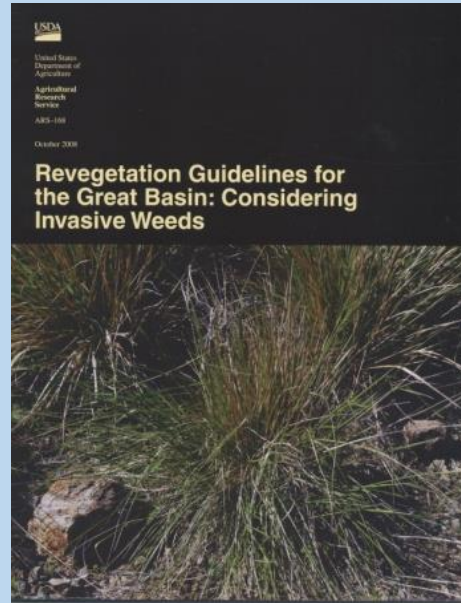
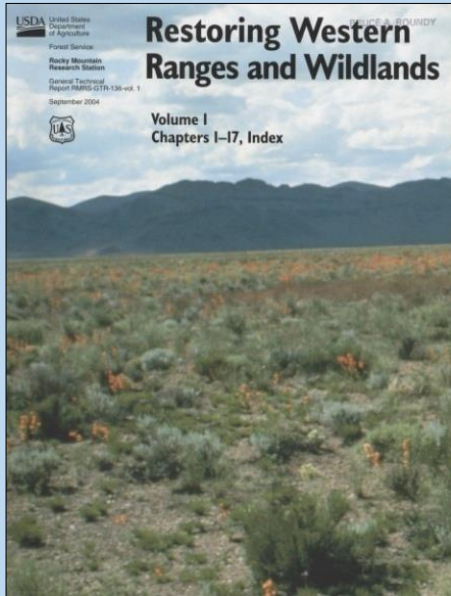


# Winning the understory battle



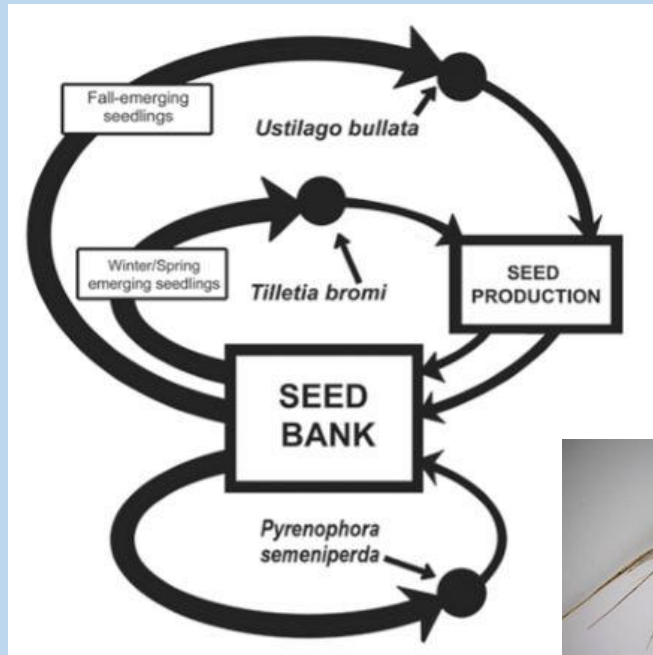


# Management and restoration guidebooks



# Promising technologies

## Biocontrol



Meyer et al. 2008



## Seed coating- Madsen et al.

- Deactivate herbicides
- Reduce water repellency
- Deter seed predation
- Delay or speed up germination to increase seedling survival



# Conclusions

- Sites vary in potential for perennial herbaceous and cheatgrass cover
- Cheatgrass most adapted to Wyoming big sagebrush and many tree-expanded sites
- Maintain resistance and resilience by maximizing desirable perennial herbaceous cover
- Grazing management
- Restoration
  - Traditional fire/ herbicide/mechanical/revegetation
  - Properly timed mechanical tree control or include revegetation
  - Follow principles of revegetation in fire rehab

