What happens when you shred pinyon and juniper trees?

Bruce Roundy, Jordan Bybee, Wyatt Shakespear, Kert Young, April Hulet, Darrell Roundy, Zachary Aanderud, Debbie Rigby, Tayte Campbell

What do we have against these trees, anyway?

Courtesy Brad Jessop

Stansbury Mountains 1901

Stansbury Mountains 2004

Big Pole Fire August 2009

PHASE I

- Trees are sparse
- Shrubs and herbaceous perennials dominate
- TC: <15%

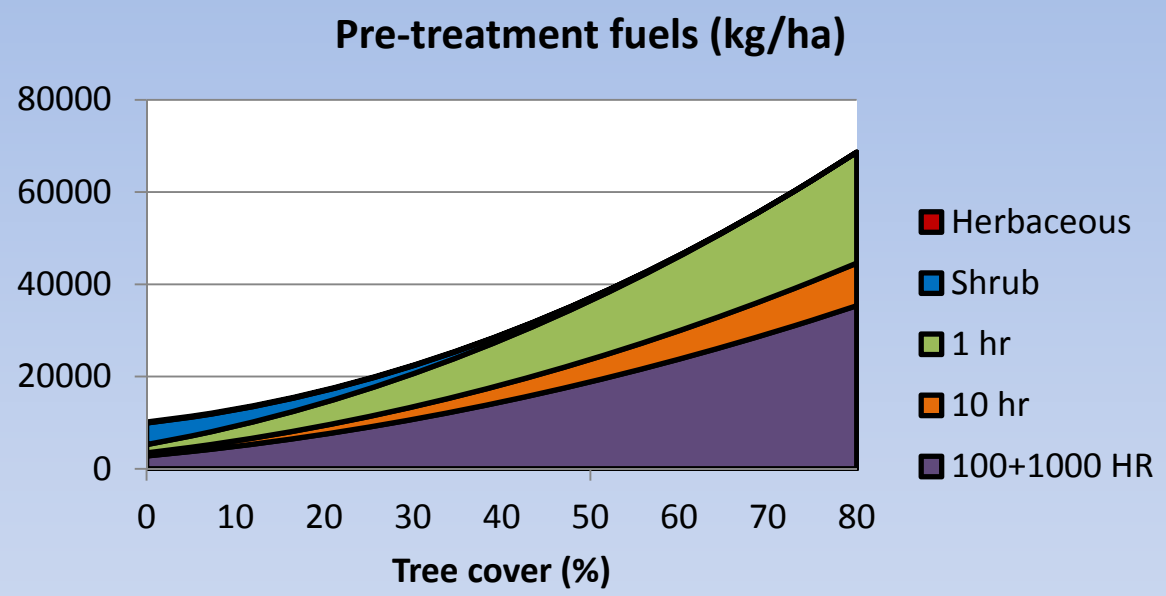
PHASE II

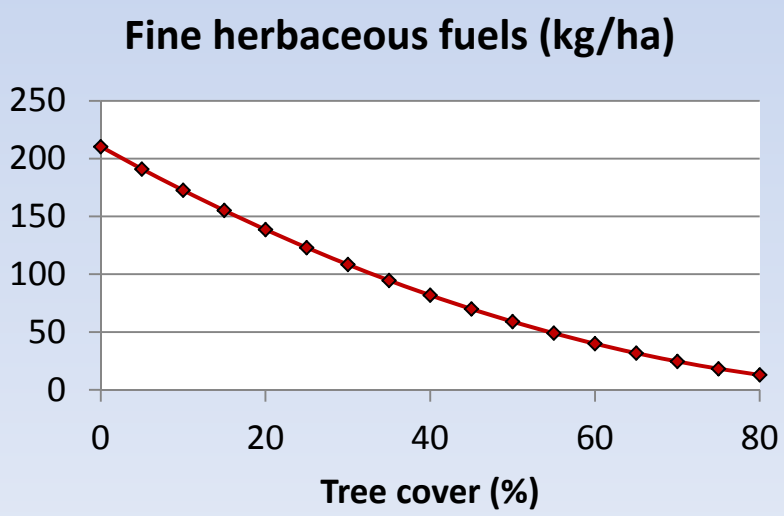
- Trees, shrubs, and perennial herbaceous are co-dominant
- TC: 15-45%

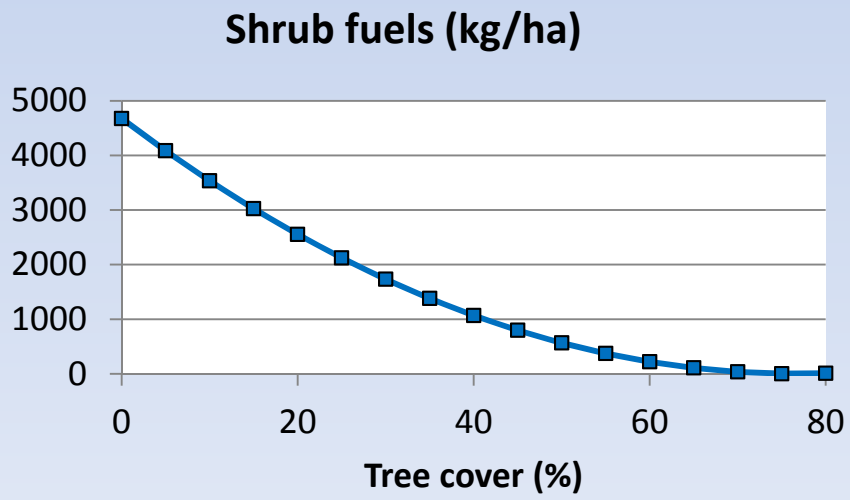
PHASE III

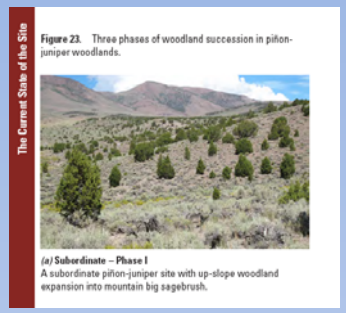
- Trees are dominant
- Perennial herbaceous and shrub cover sparse
- TC: >45%

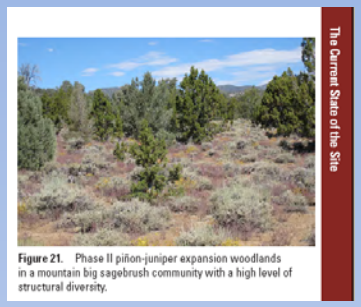
Pre-treatment fuels

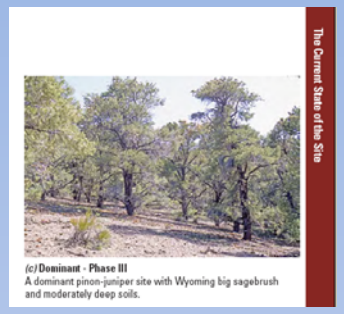


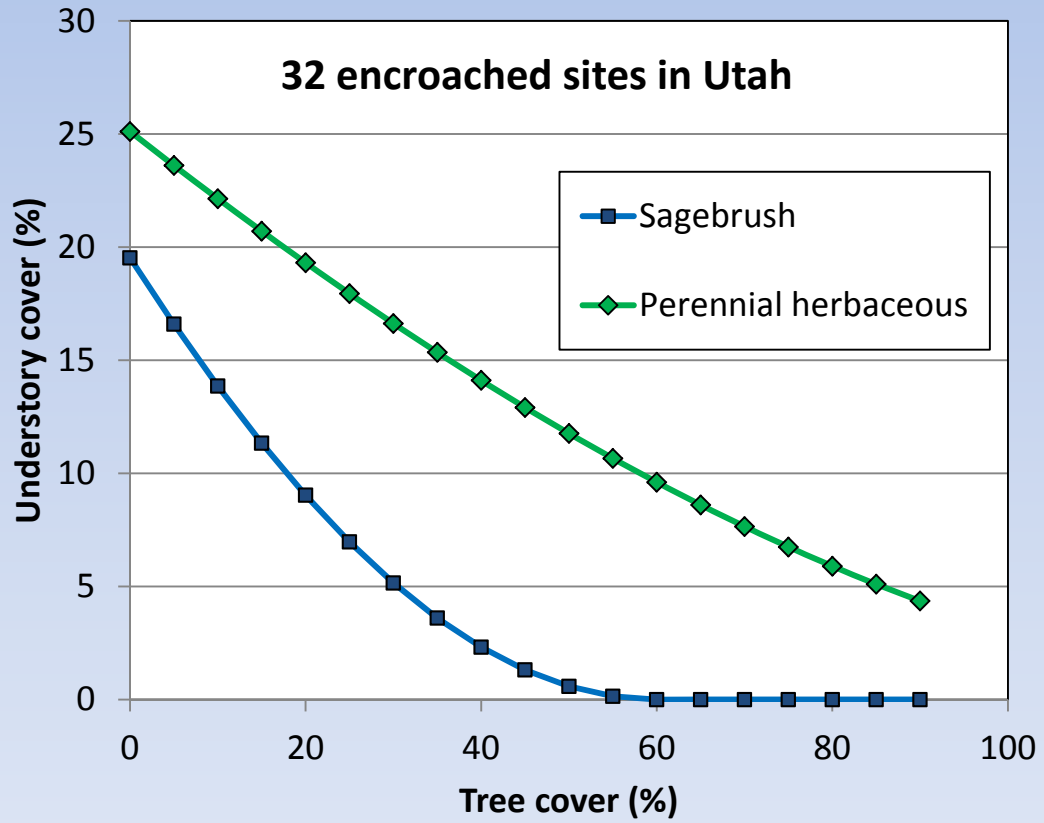





The Current State of the Site
Figure 23. Three phases of woodland succession in piñon-juniper woodlands.
(a) Subordinate – Phase I
A subordinate piñon-juniper site with up-slope woodland expansion into mountain big sagebrush.

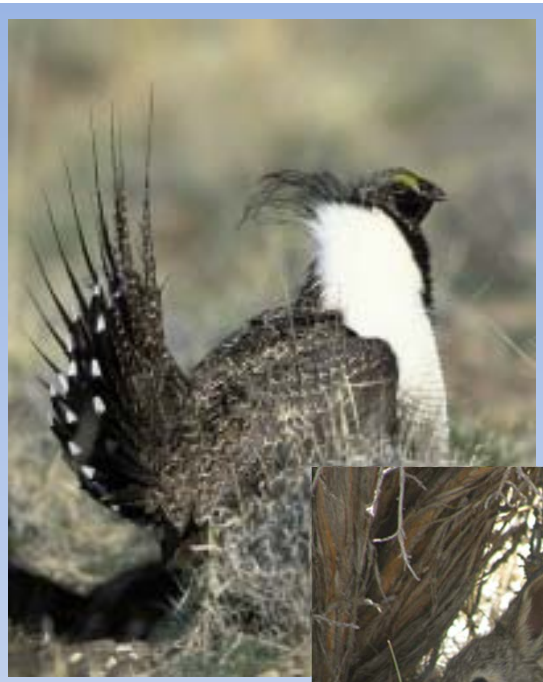

The Current State of the Site
Figure 21. Phase II piñon-juniper expansion woodlands in a mountain big sagebrush community with a high level of structural diversity.


The Current State of the Site
(c) Dominant - Phase III
A dominant pinon-juniper site with Wyoming big sagebrush and moderately deep soils.


32 encroached sites in Utah
Sagebrush
Perennial herbaceous
Understory cover (%)
Tree cover (%)
0
5
10
15
20
25
30
0
20
40
60
80
100

Decreases:

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

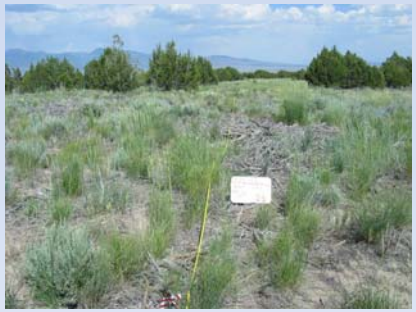


Increases:

- Canopy fuels
- Intense fire
- Weed dominance
- Erosion

Shredding changes fuels, but does shredding:

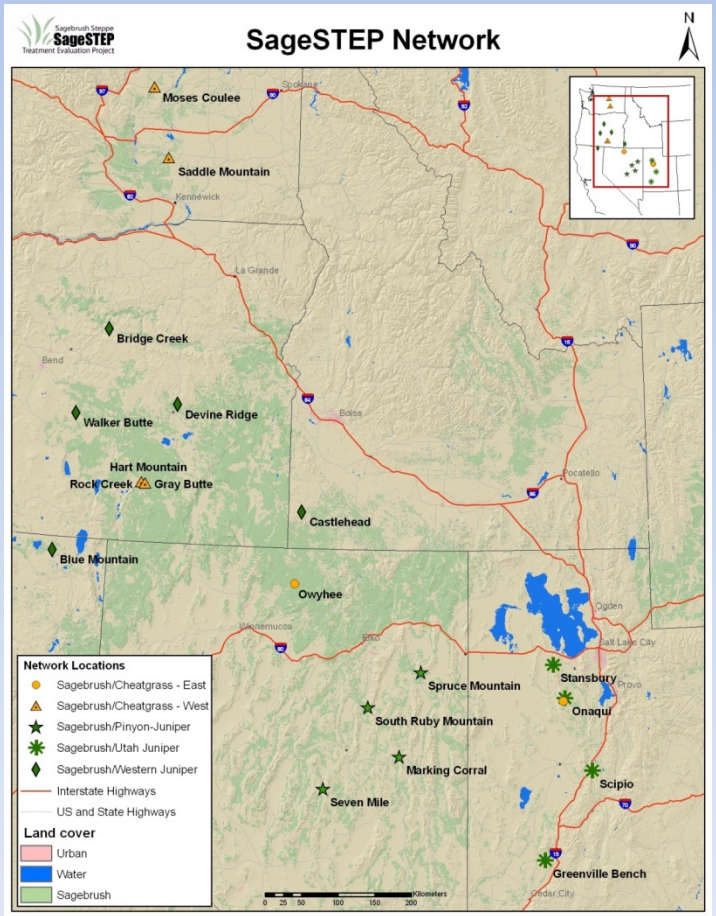
- Need to be done before tree cover gets too high?
- Increase desirable cover?
- Require seeding?
- Increase weed cover?
- Affect soil resources and fertility?
- Affect erosion?

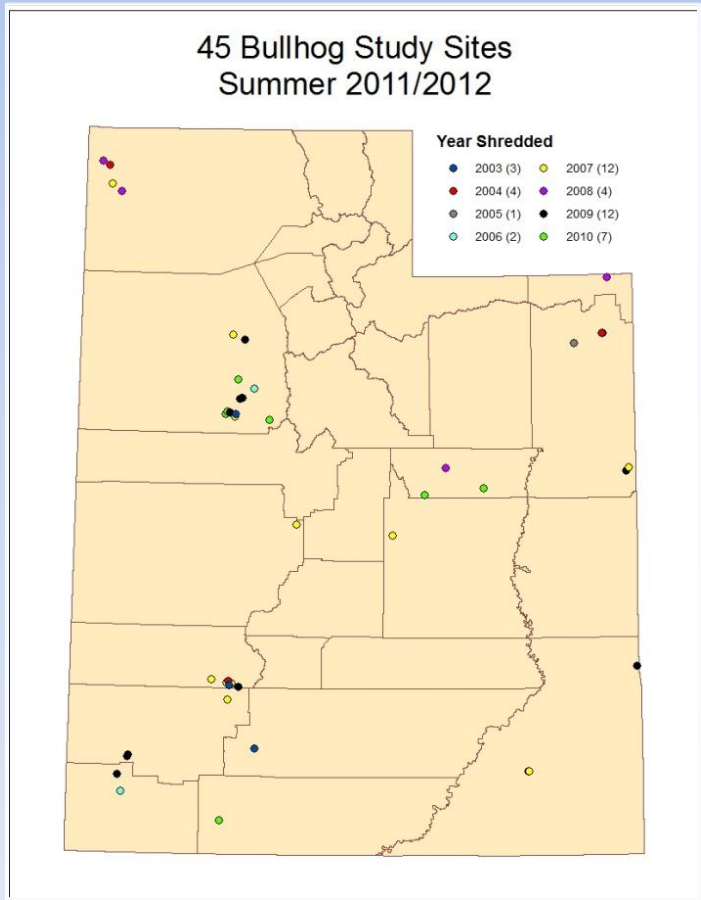


Extensive research

Tree reduction at different infilling phases on:

- Fuel response
- Vegetation response
- Soils

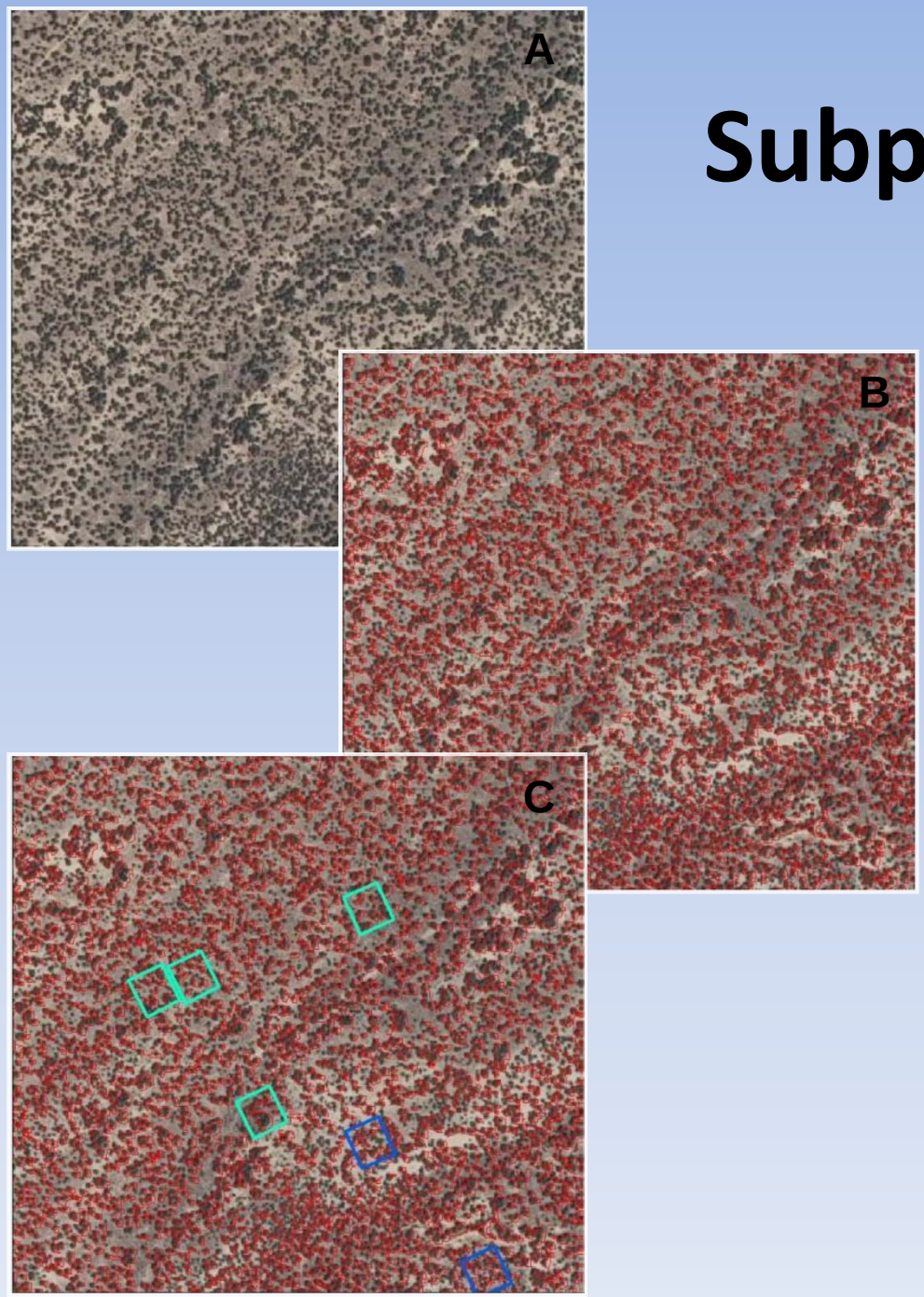




- How do responses vary for tree and encroachment ecological sites?
- What is the effect of initial tree cover (degree of infilling) on response?
- How does seeding of shredded treatments affect response?

Encroached vs Tree sites

	Encroached	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



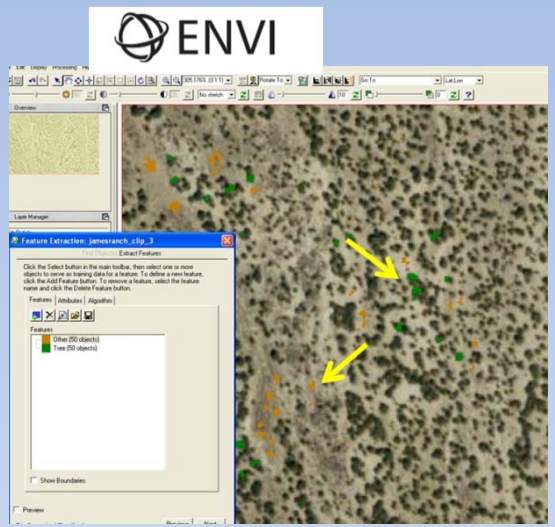
Subplot selection

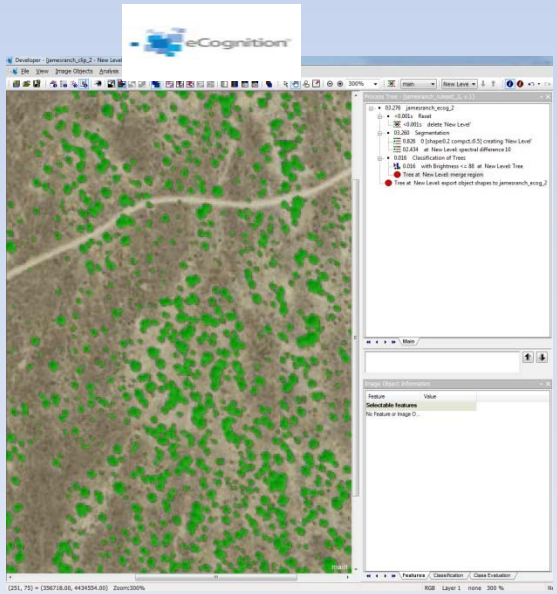
A. NAIP imagery

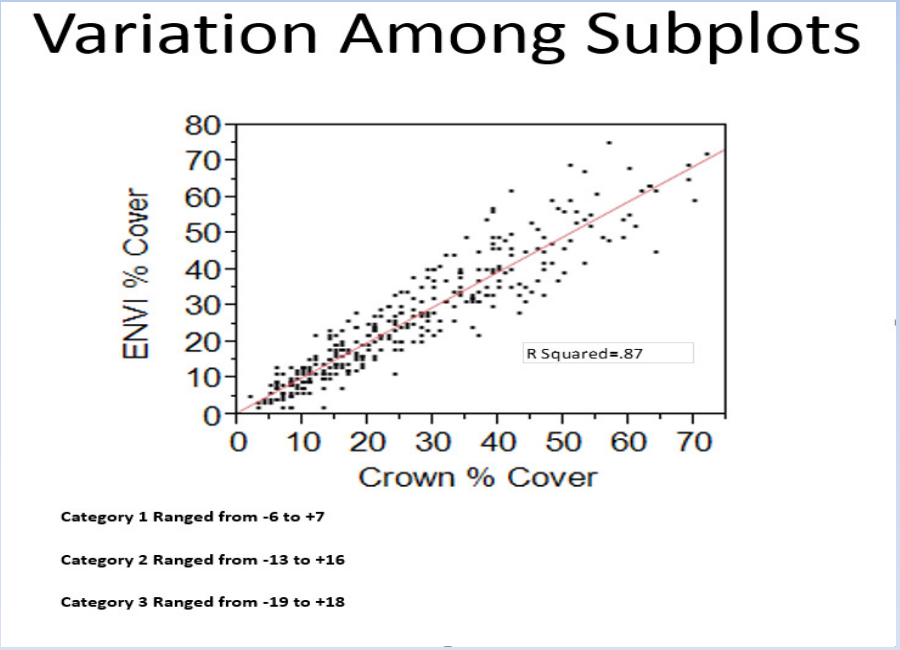
B. Classified trees using feature extraction software (ENVI 4.5)

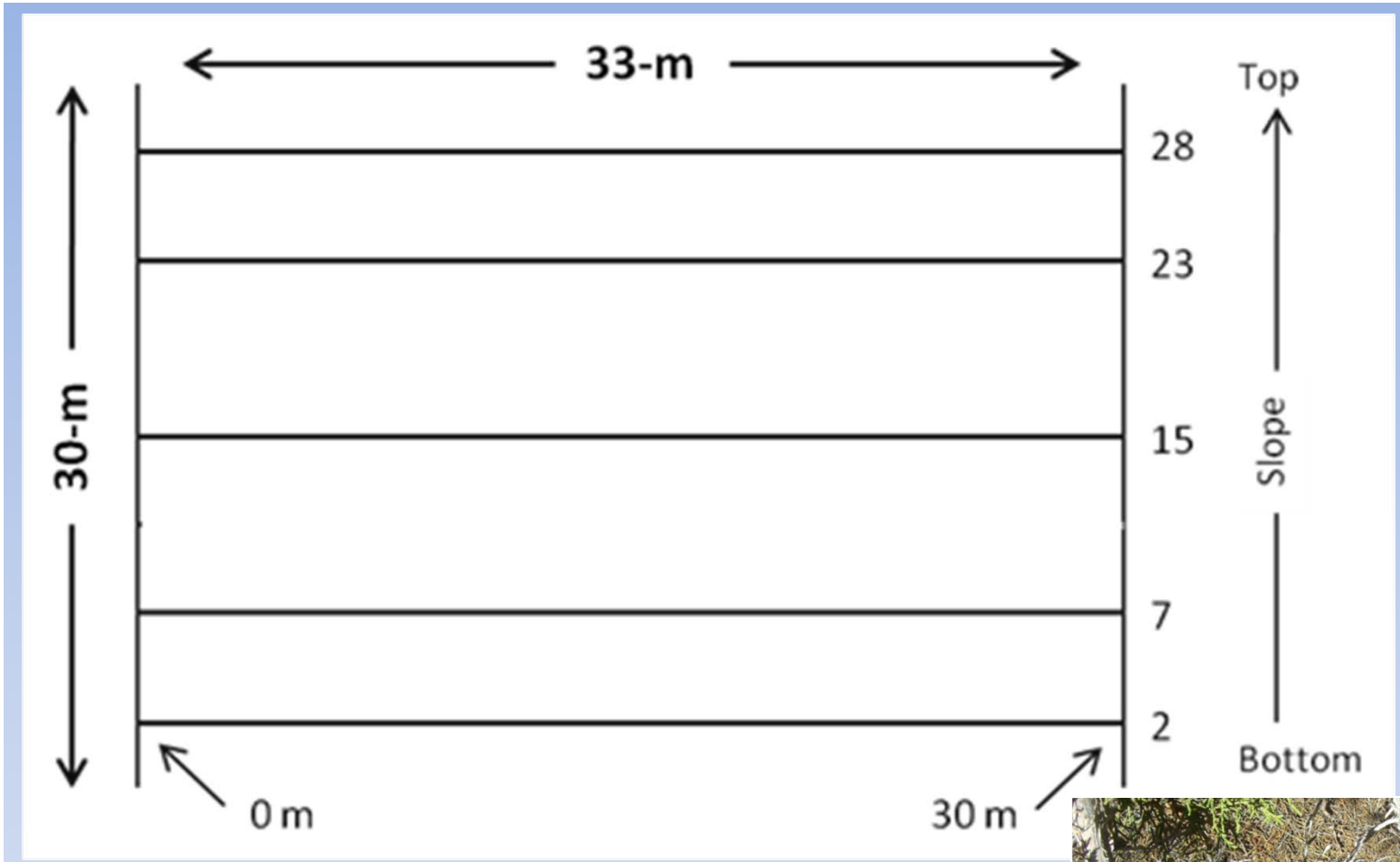
C. Paired subplots with similar tree cover calculated using ArcGIS

Side benefits- estimating tree cover from NAIP imagery







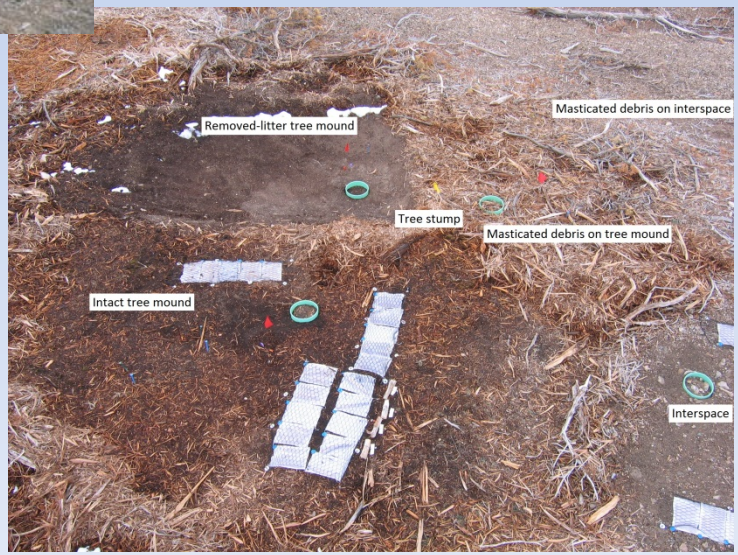


5 lines x 60 points per line =
300 points per subplot

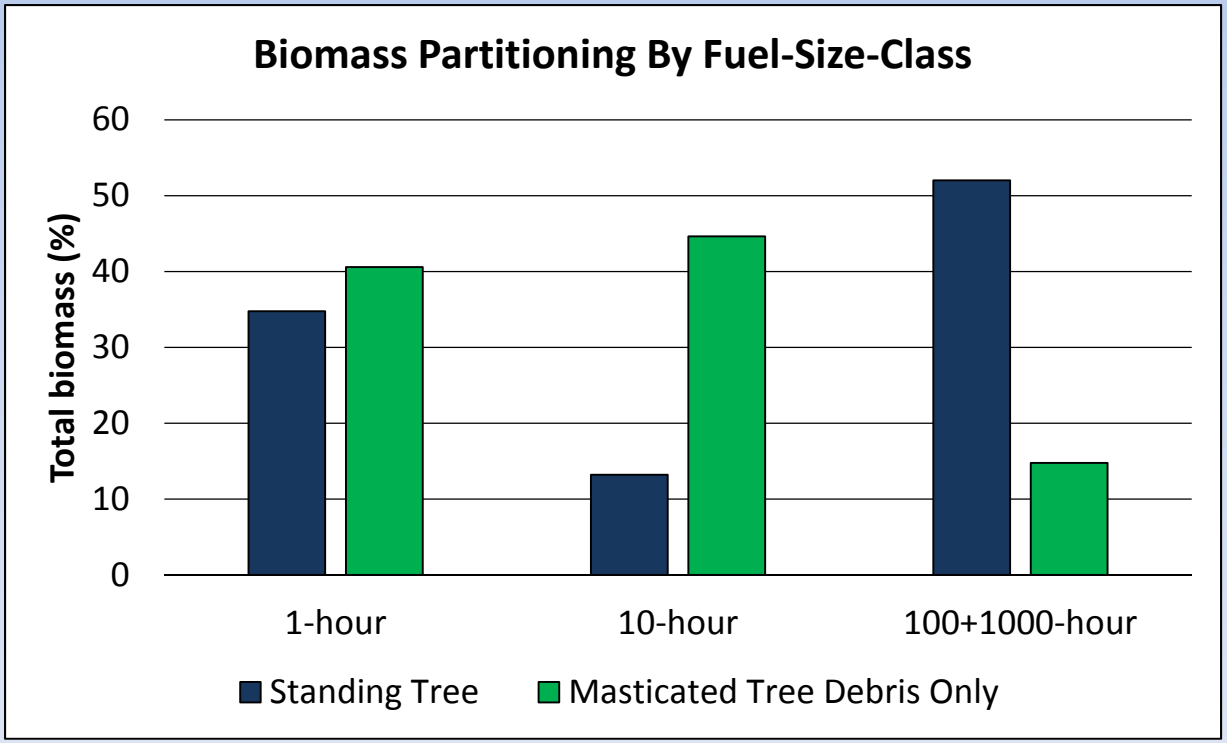
Mechanistic or microsite research

Effects of:
- Tree reduction
- Litter cover
- Shred cover

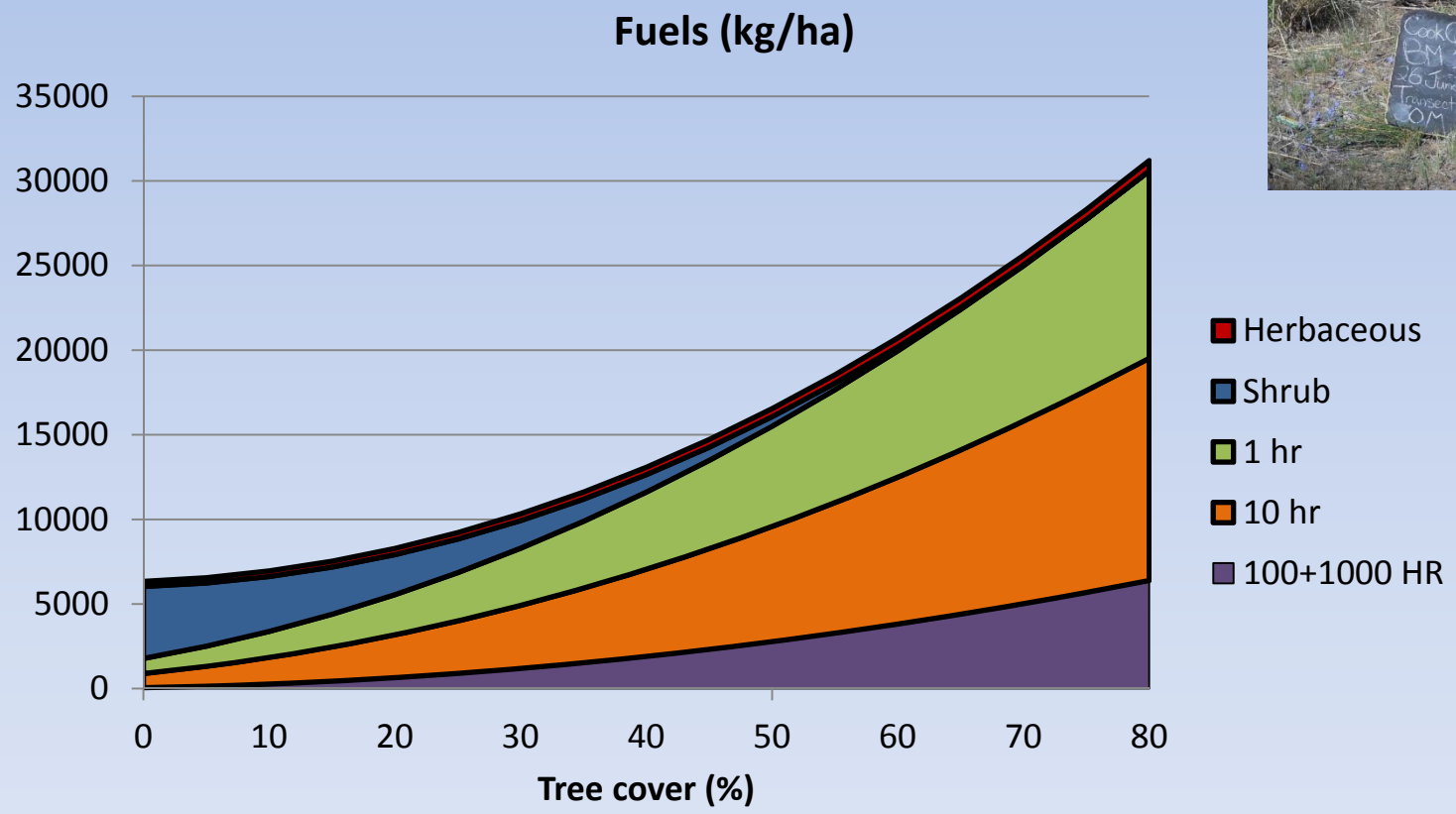
On:
- Hydrology
- Soil water/temperature
- Microbes, nutrients
- Seedling establishment



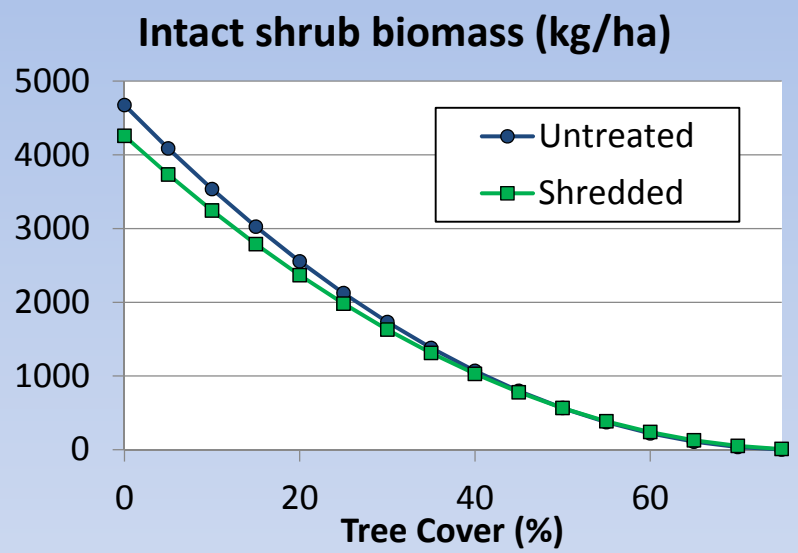
Tree fuels

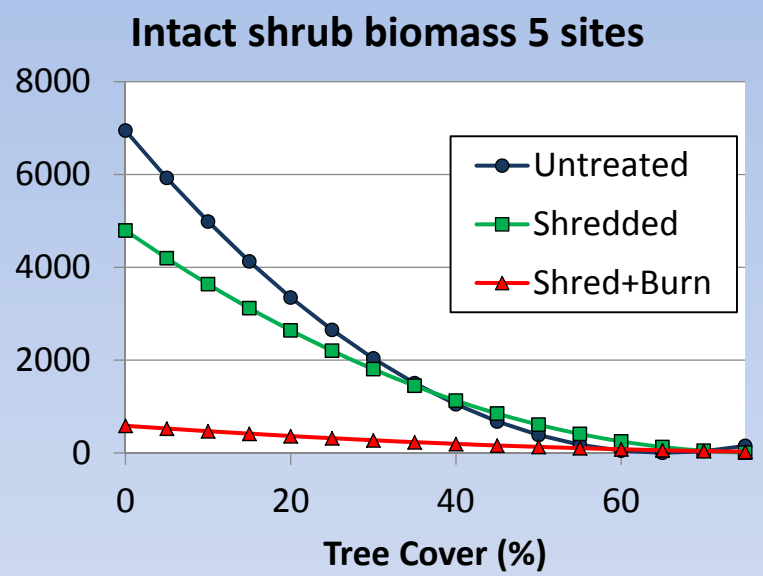

Biomass Partitioning By Fuel-Size-Class
Total biomass (%)
60
50
40
30
20
10
0
1-hour
10-hour
100+1000-hour
Standing Tree
Masticated Tree Debris Only

Shredded fuels

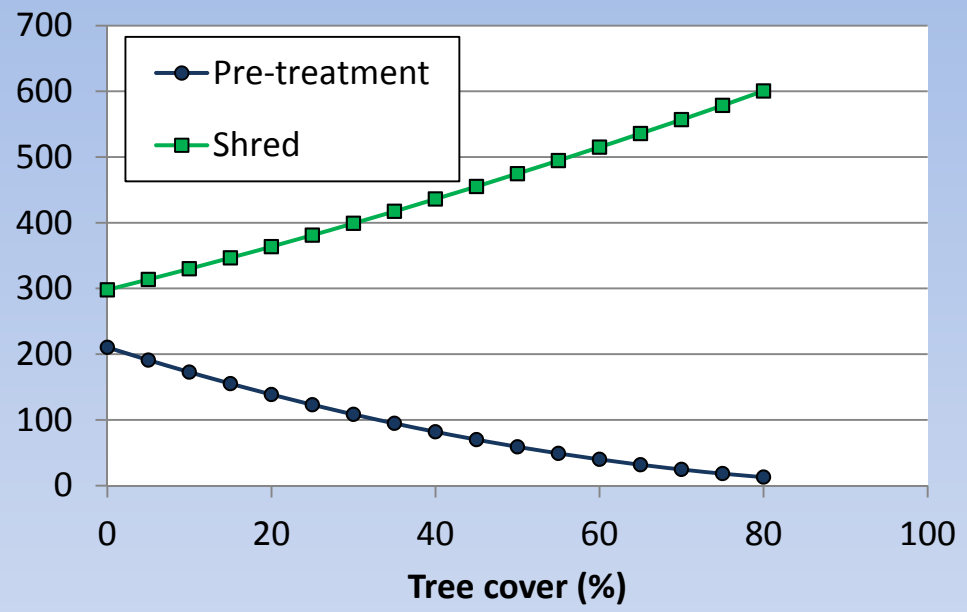


Shrub fuels

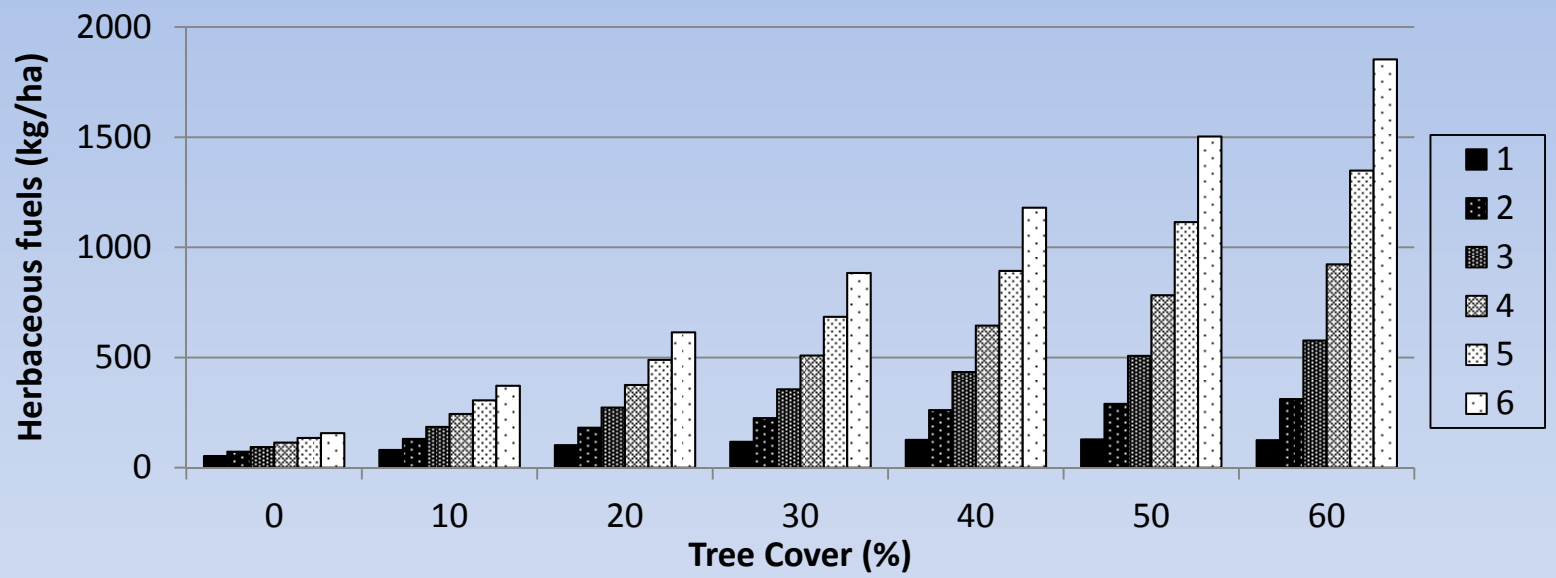

Intact shrub biomass (kg/ha)
5000
4000
3000
2000
1000
0
0
20
40
60
Tree Cover (%)
Untreated
Shredded


Intact shrub biomass 5 sites
8000
6000
4000
2000
0
0
20
40
60
Tree Cover (%)
Untreated
Shredded
Shred+Burn

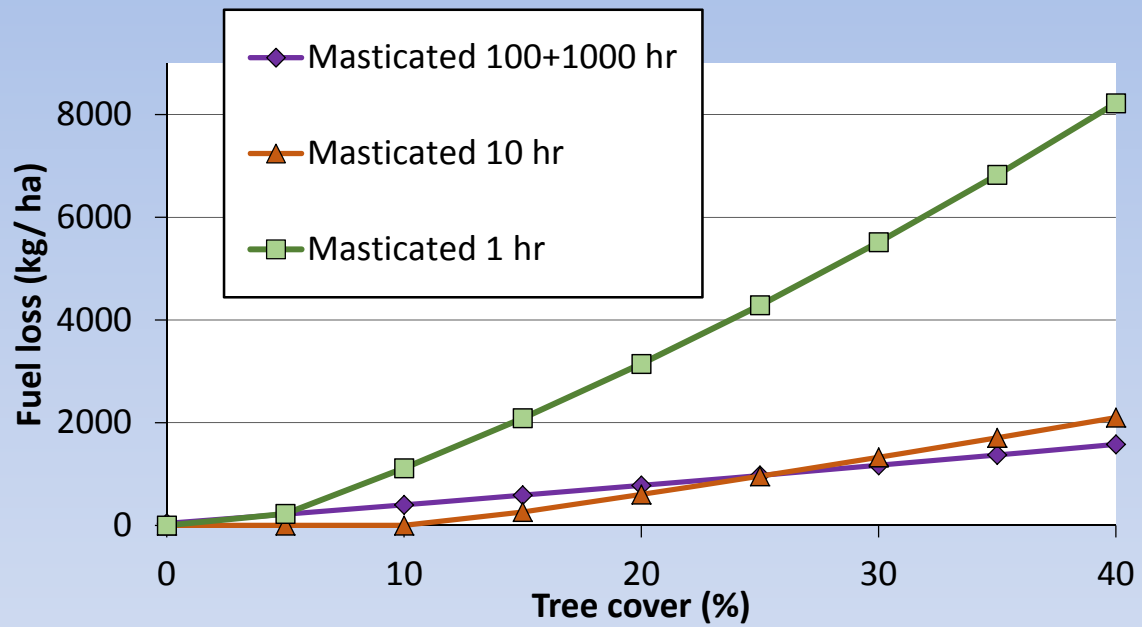
Herbaceous fuels (kg/ha)



Herbaceous fuels increase with time since shredding



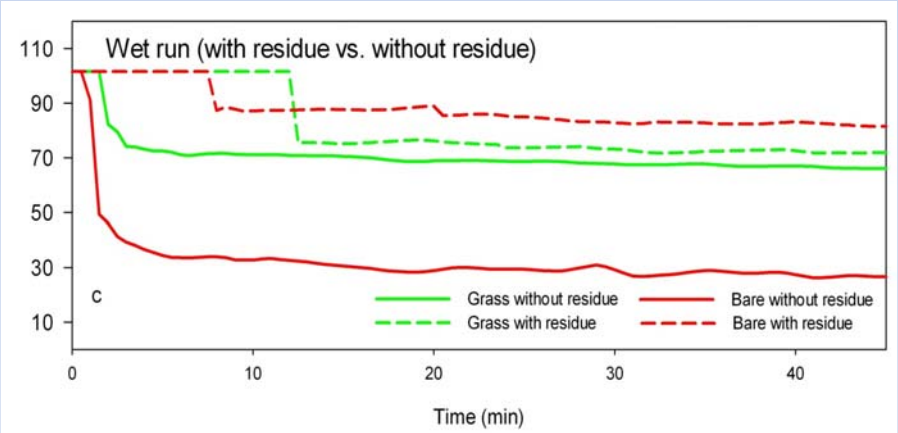
Shredded woody fuels decrease with time since shredding



Flame lengths much shorter in shredded than canopy fuels

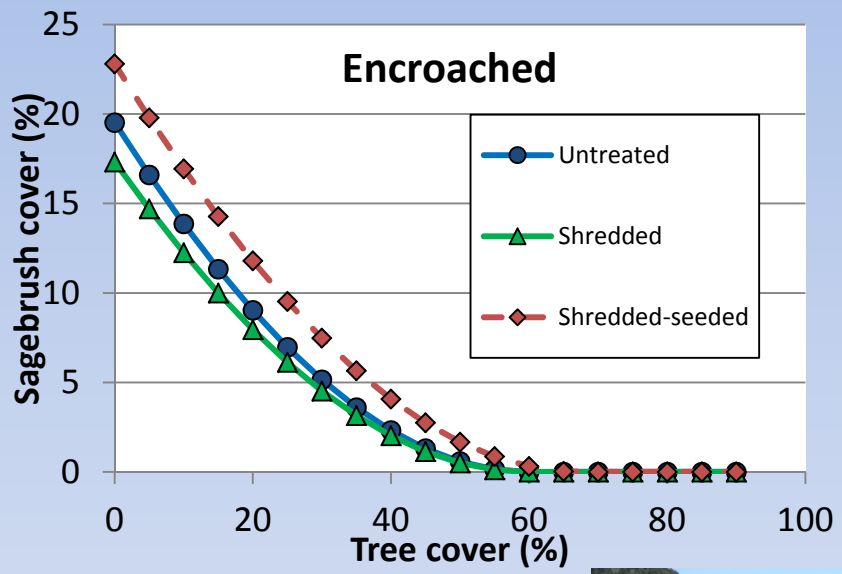
Courtesy Brad Jessop

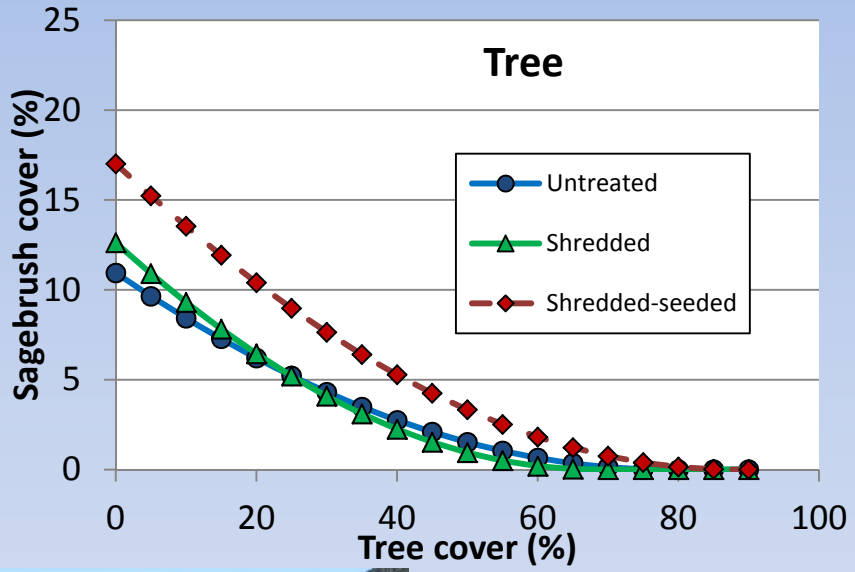
Shredding increases plant and litter soil cover, and….infiltration



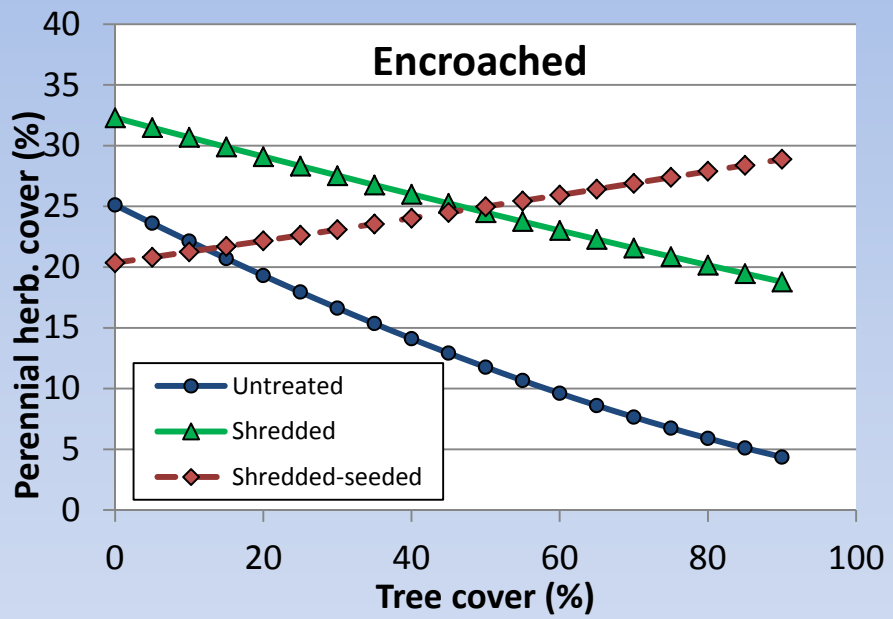
Cline et al. 2010

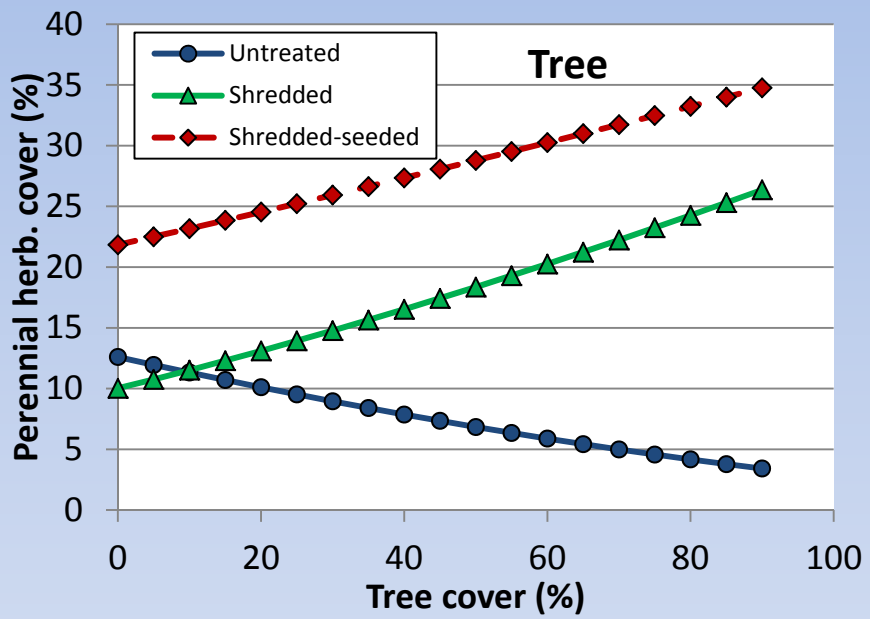
Shredding maintains shrub cover if you don't wait too long



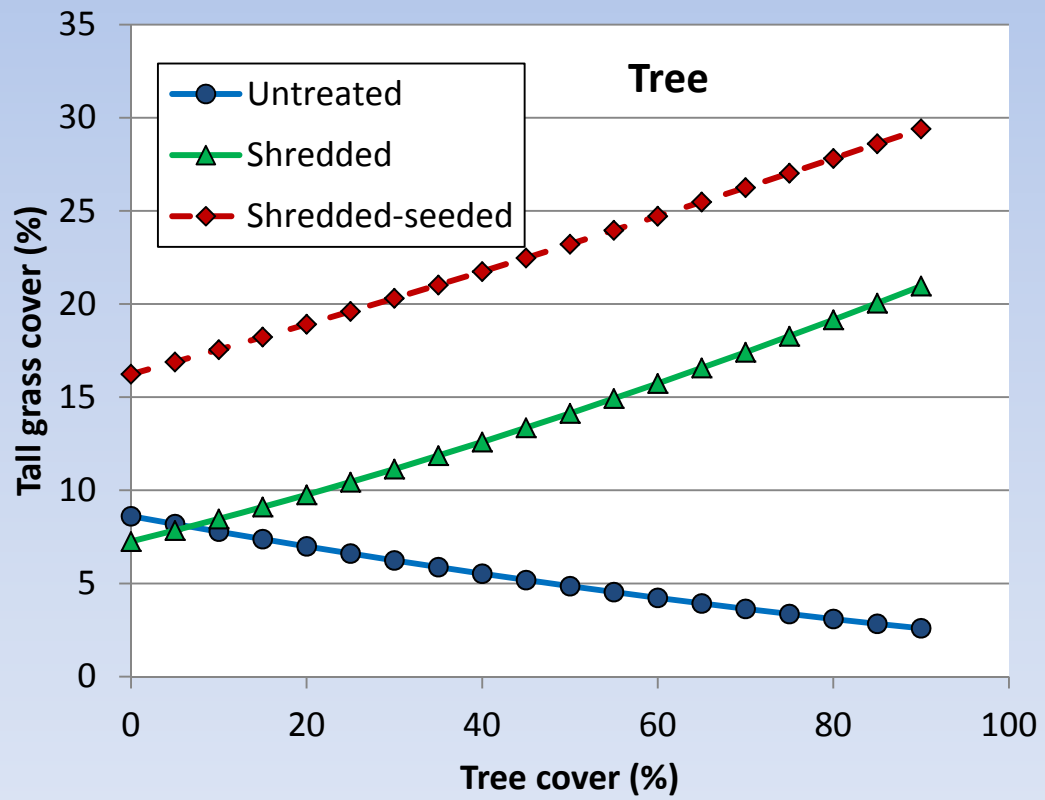


Shredding increases perennial herbaceous cover

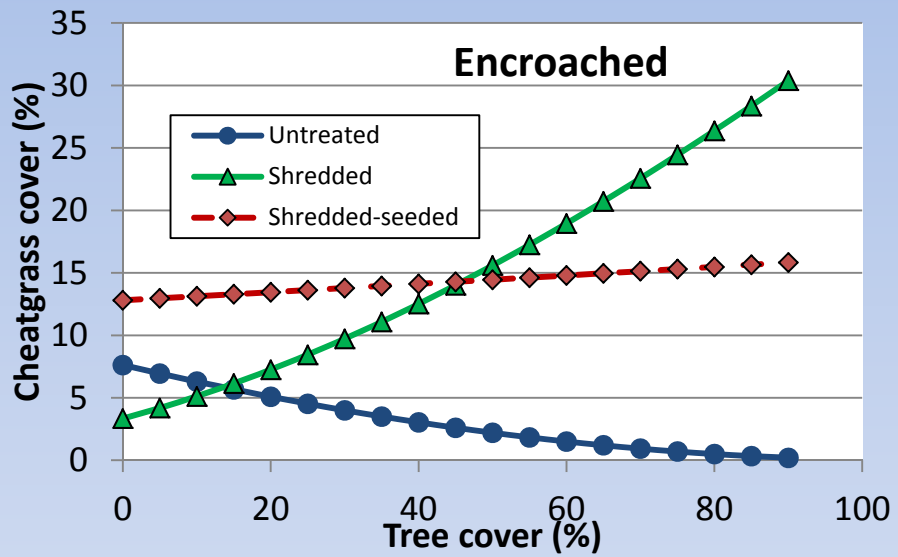


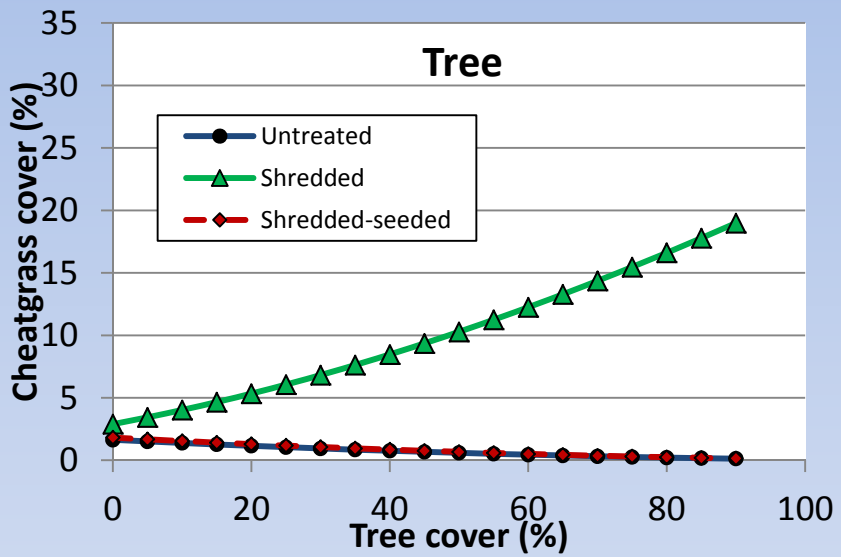


Shredding-seeding increases tall perennial grass cover, especially on tree sites

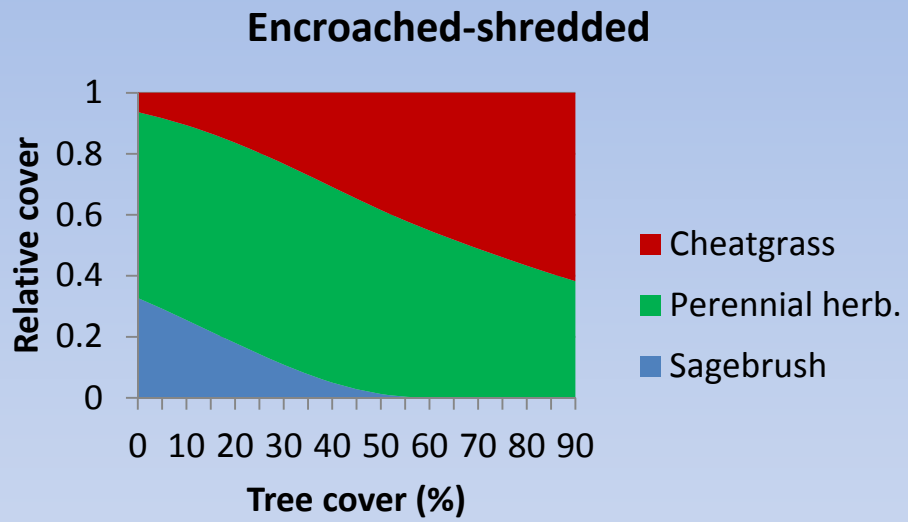


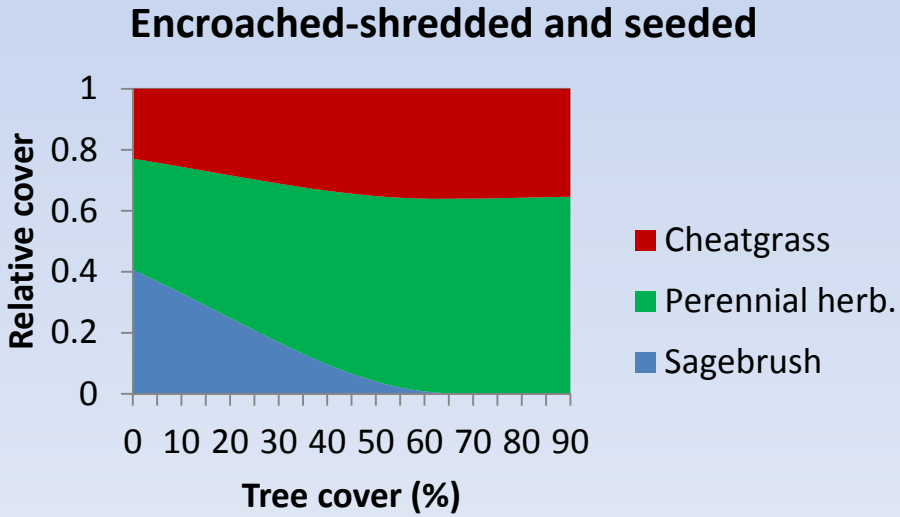
Shredding increases cheatgrass cover; seeding suppresses it



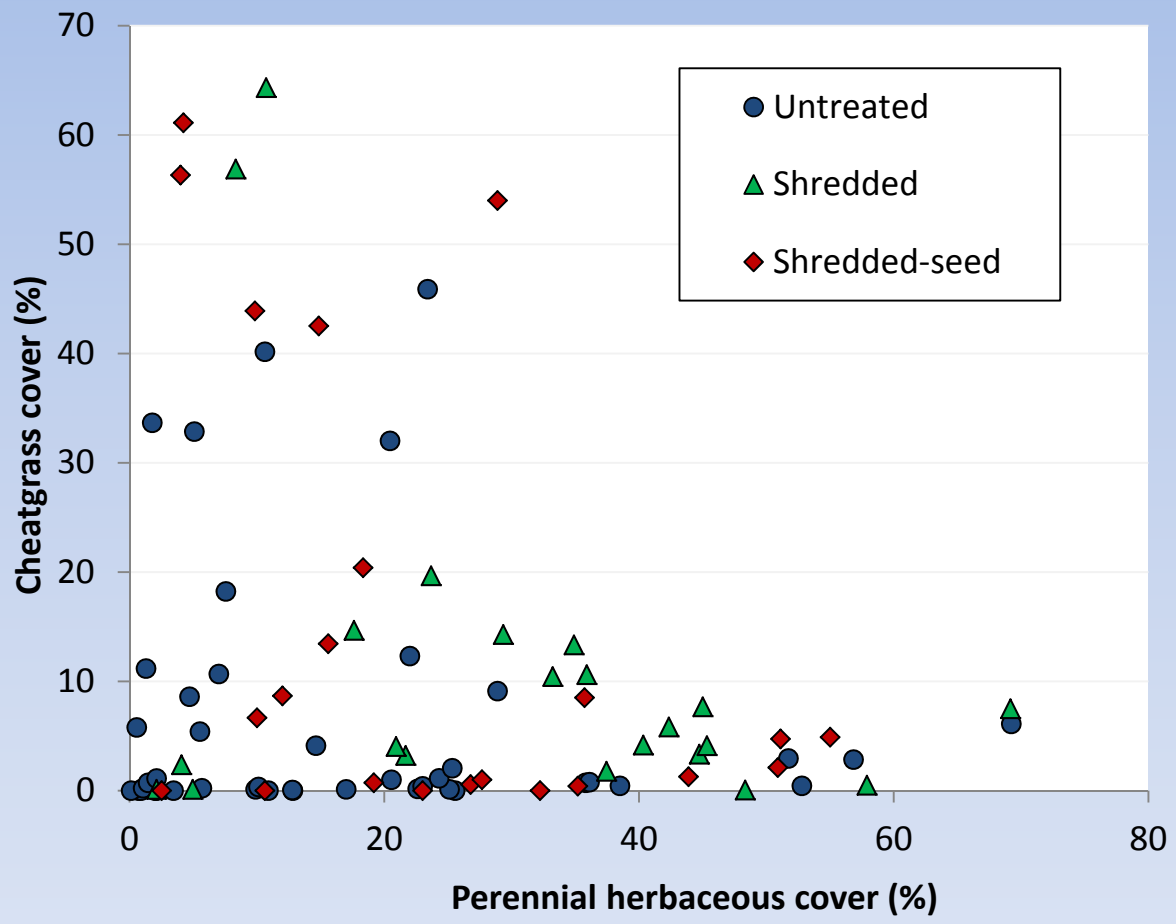


Community response





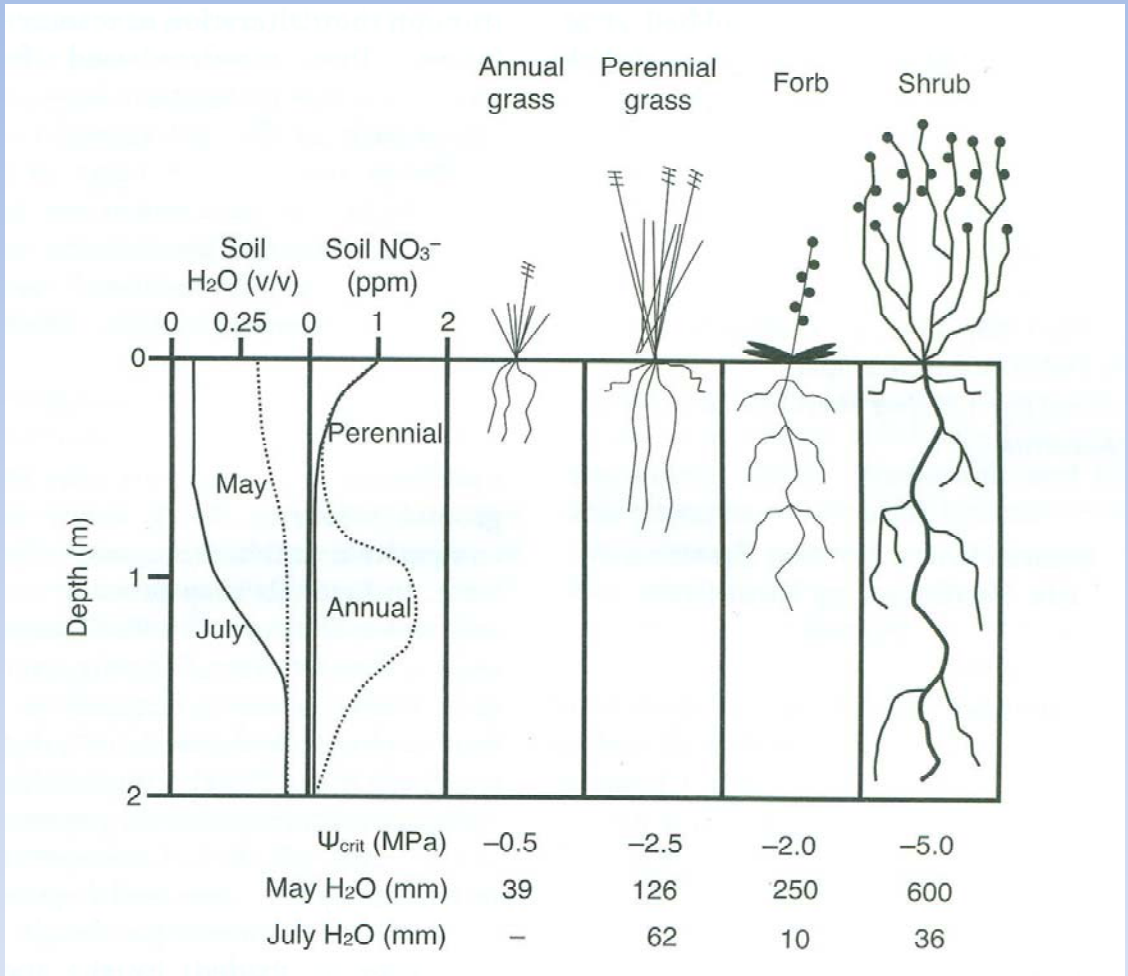
More perennial herbaceous cover=less cheatgrass cover



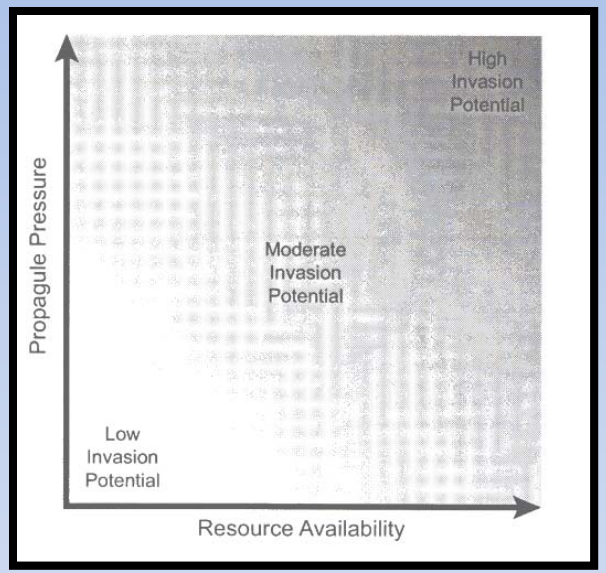
Why these responses?

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

Resource growth pool



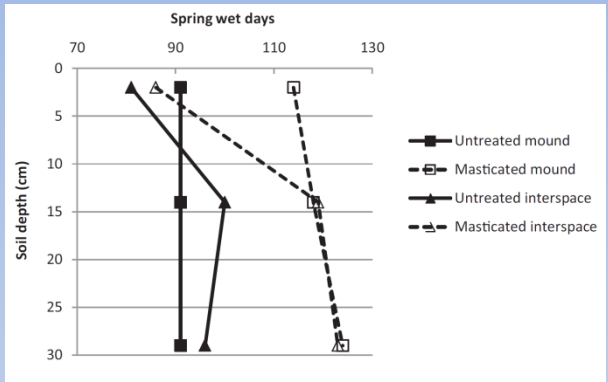
Ryel et al. 2008; Leffler and Ryel 2012



Brooks 2008

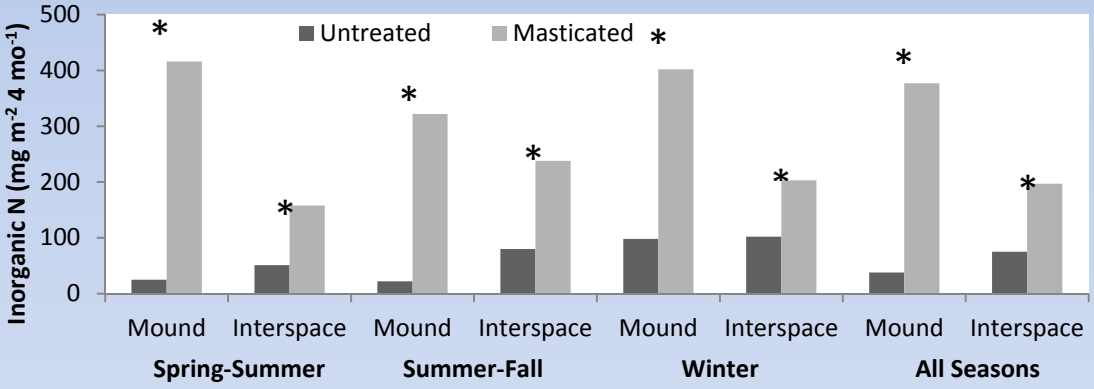
Shredding increased:

- Time of soil water availability and temperatures

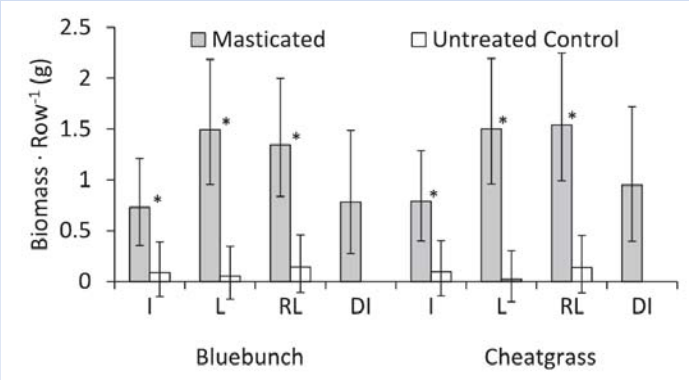


Young et al 2013 FEM

- Inorganic N

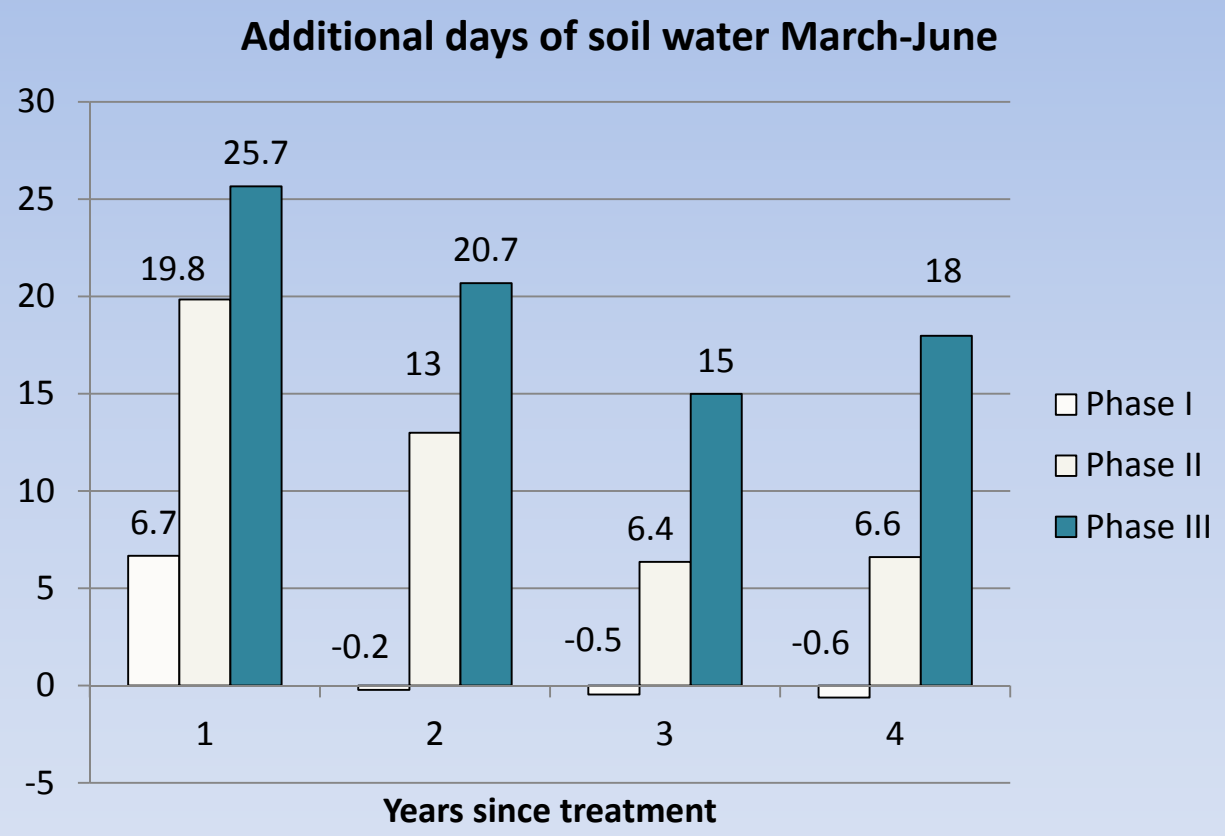


- Seedling biomass



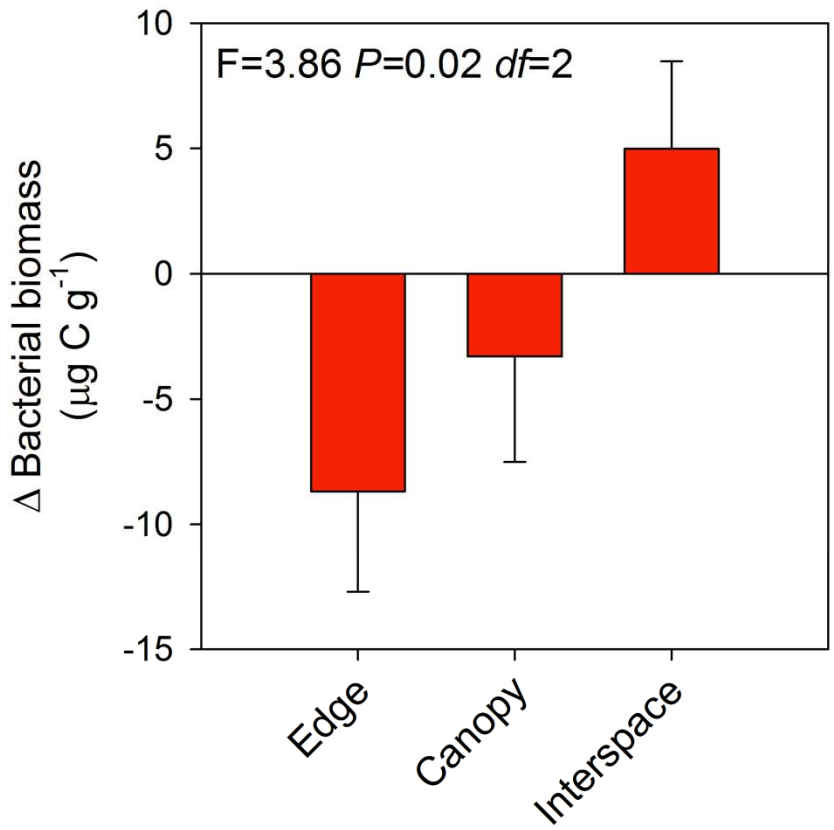
Young et al 2013 REM

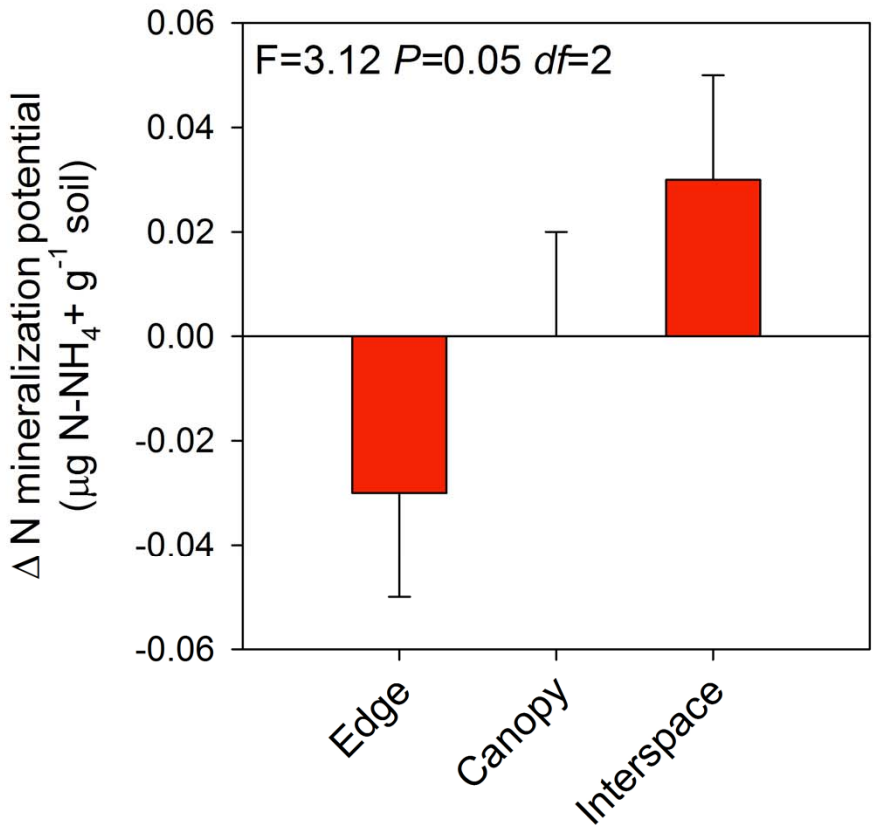
Killing trees increases available soil water most where more initial tree cover



Bacteria in microsites responded differently to shredding

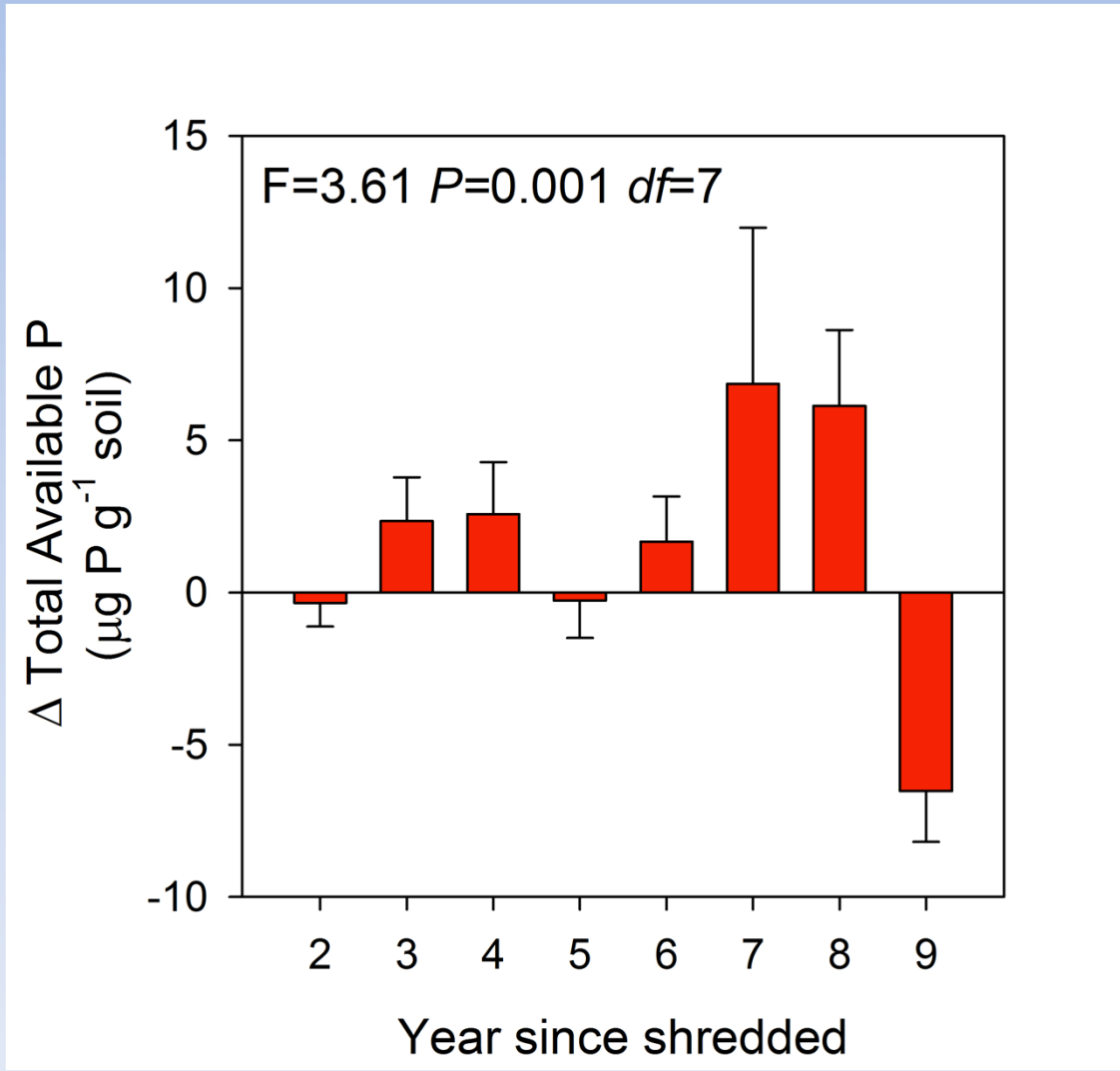
- Bacterial activity and N mineralization stimulated in Interspaces but depressed in Edges
- Activity in canopy buffered against changes possibly due to layer of duff between soil and shredded material



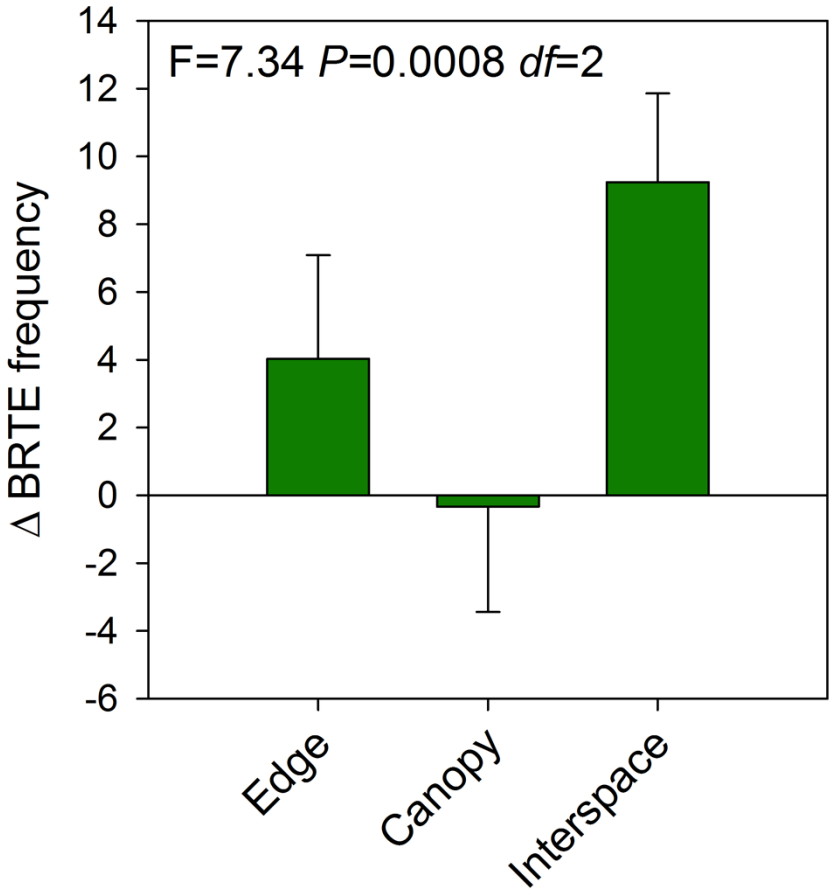


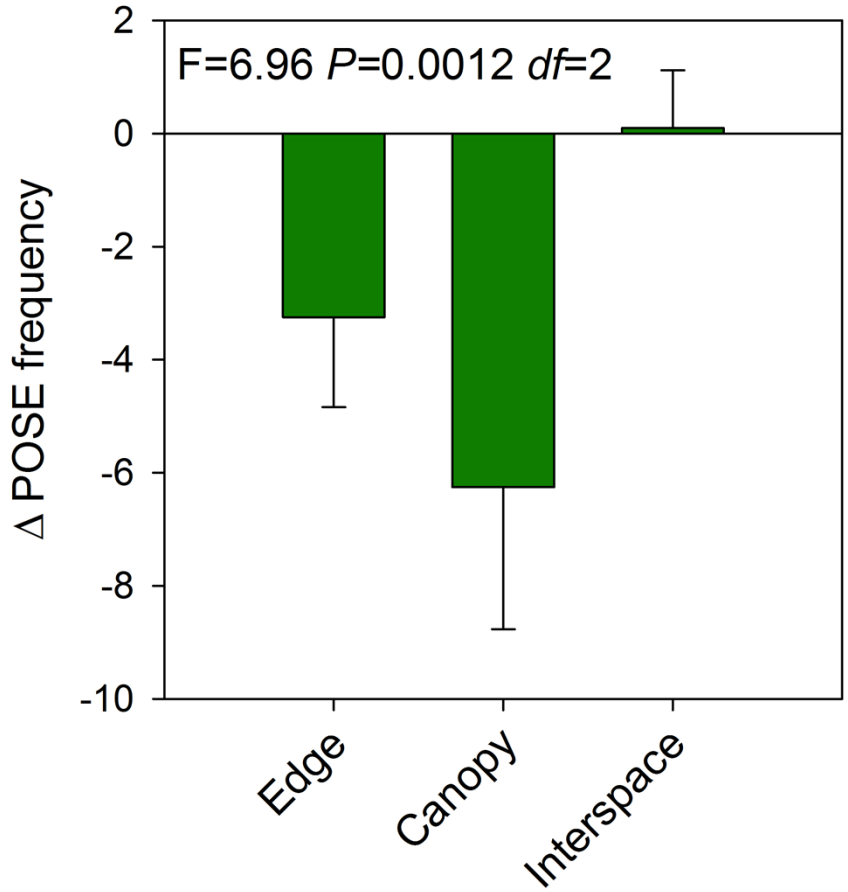
Shredding enhanced P availability in all microsites

- P increased as shredded and duff material decomposed in edge, canopy, and interspace

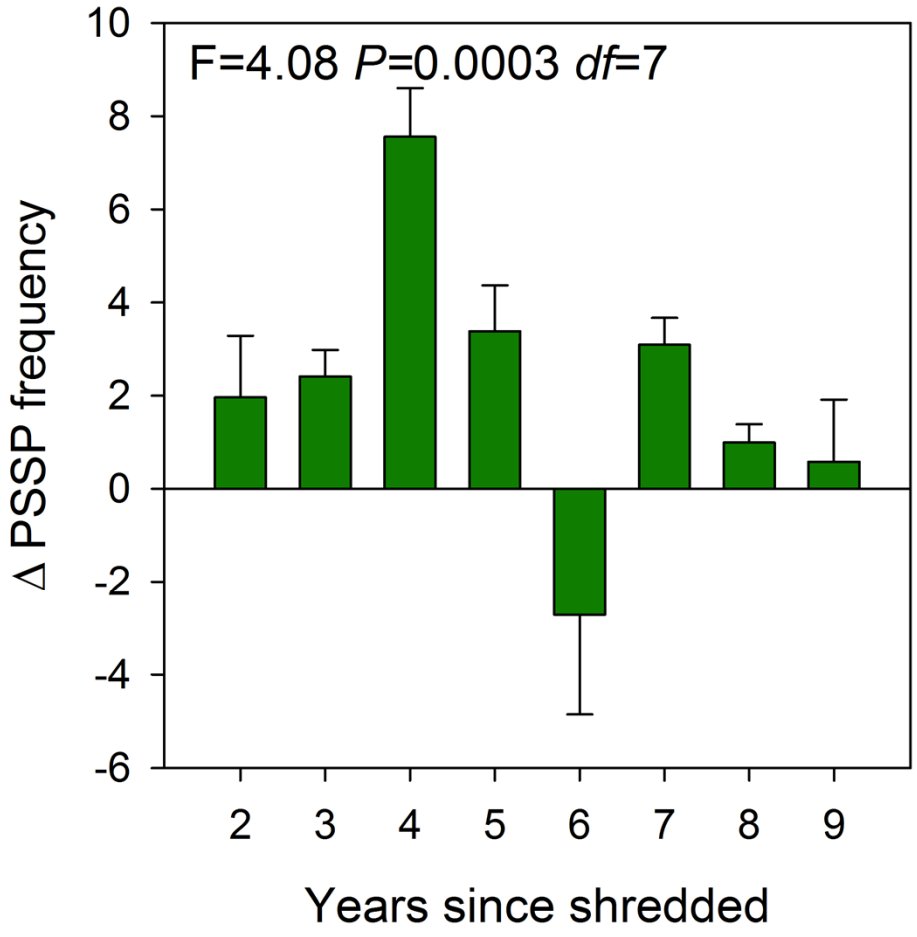


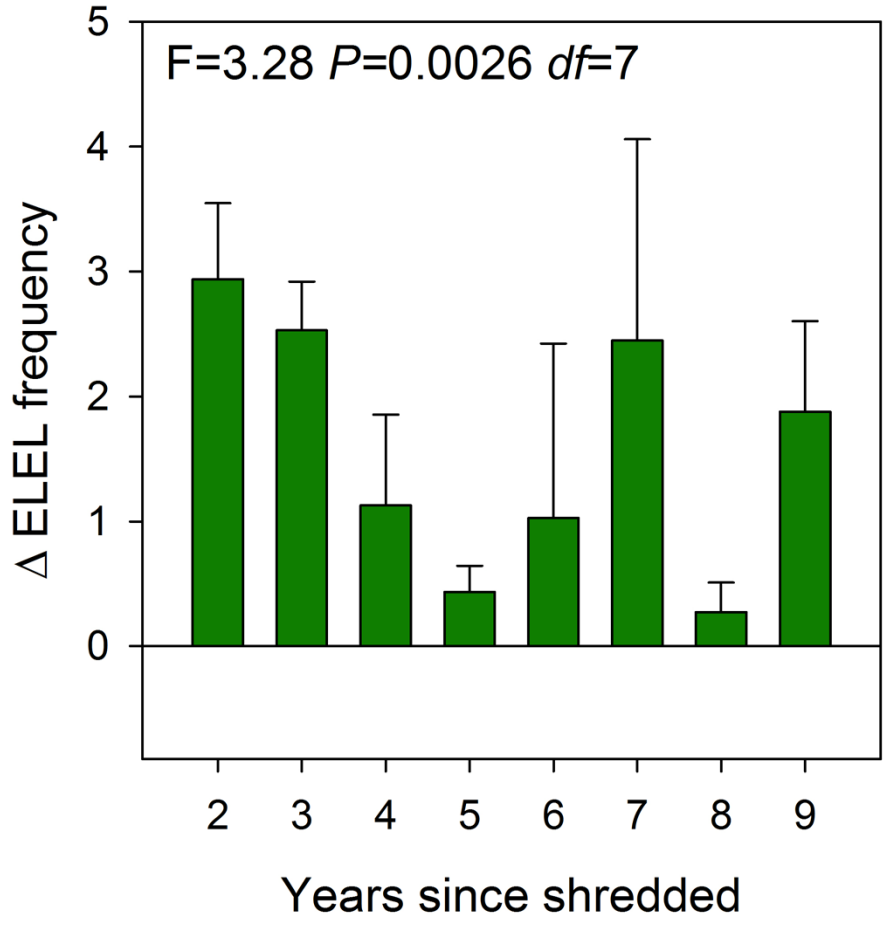
Grasses demonstrated species-specific responses to shredding





Other grasses, *Pseudoroegneria spicata* and *Elymus elymoides*, increased following shredding





Conclusions

- Shredding reduces fuel size, facilitates fire suppression
- Shredding modifies environment and increases resources
- Shred at low –mid tree cover to maintain shrub/herbaceous community
- Shredding at high tree cover= herbaceous dominance
- Weedy sites should be seeded

Additional Information

http://sagestep.org/pdfs/newsletter/SageSTEP_News_Issue_22.pdf

SageSTEP Newsletter Issue 22, Fall 2013