

Seeds of change: A comparison of seeding vs. natural recovery for post-fire rehabilitation in a ponderosa pine forest



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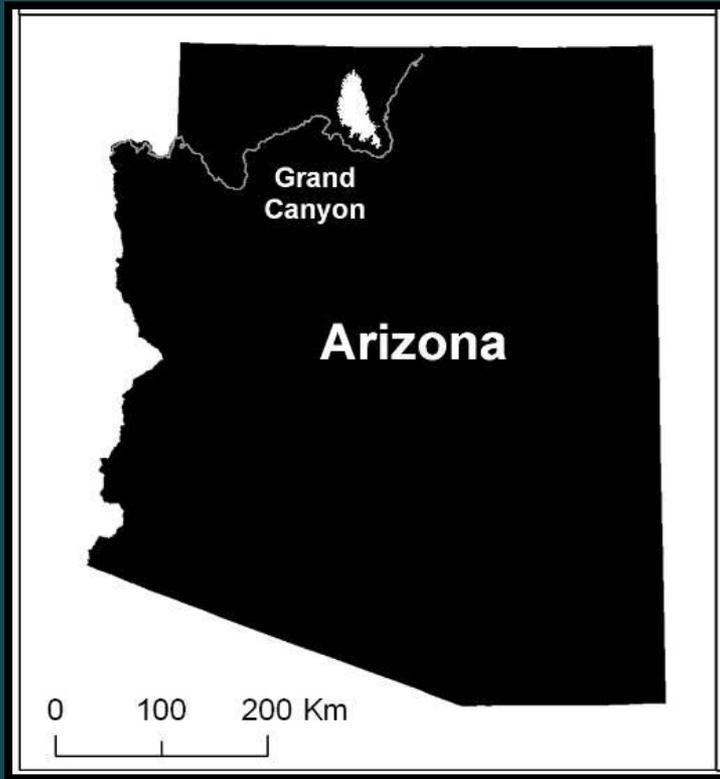
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Warm Fire- June 2006

Wildland Fire Use (13,000 ha)

Wildland Fire (11,000 ha)

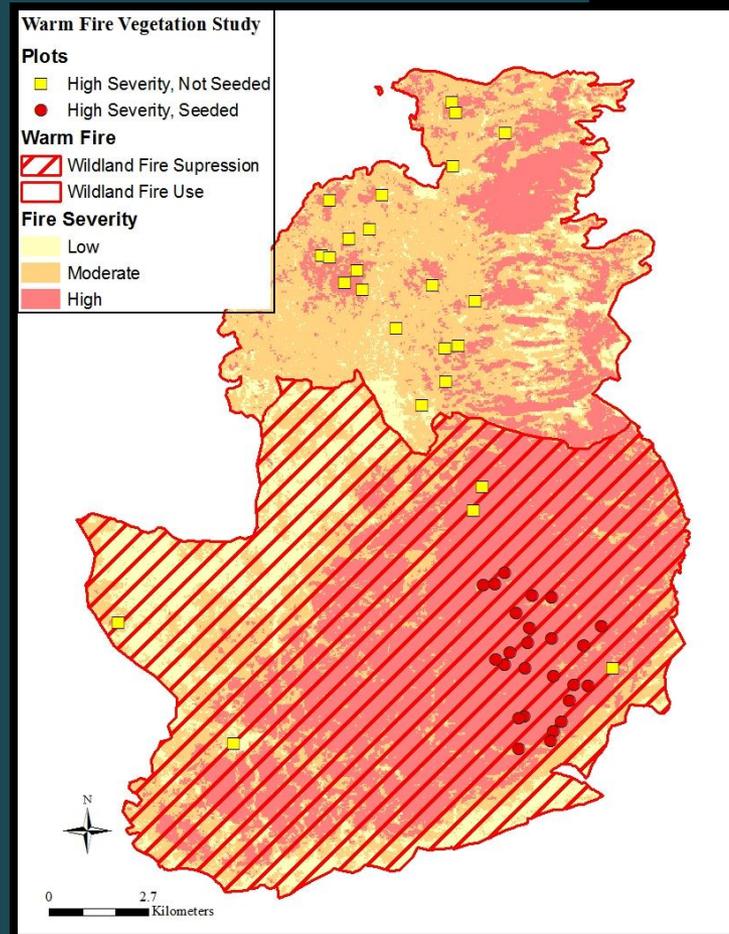
Mixed severity

Vegetation types

- Pinyon-Juniper: 1,500 ha
- Ponderosa: 18,000 ha
- Mixed conifer: 4,000 ha

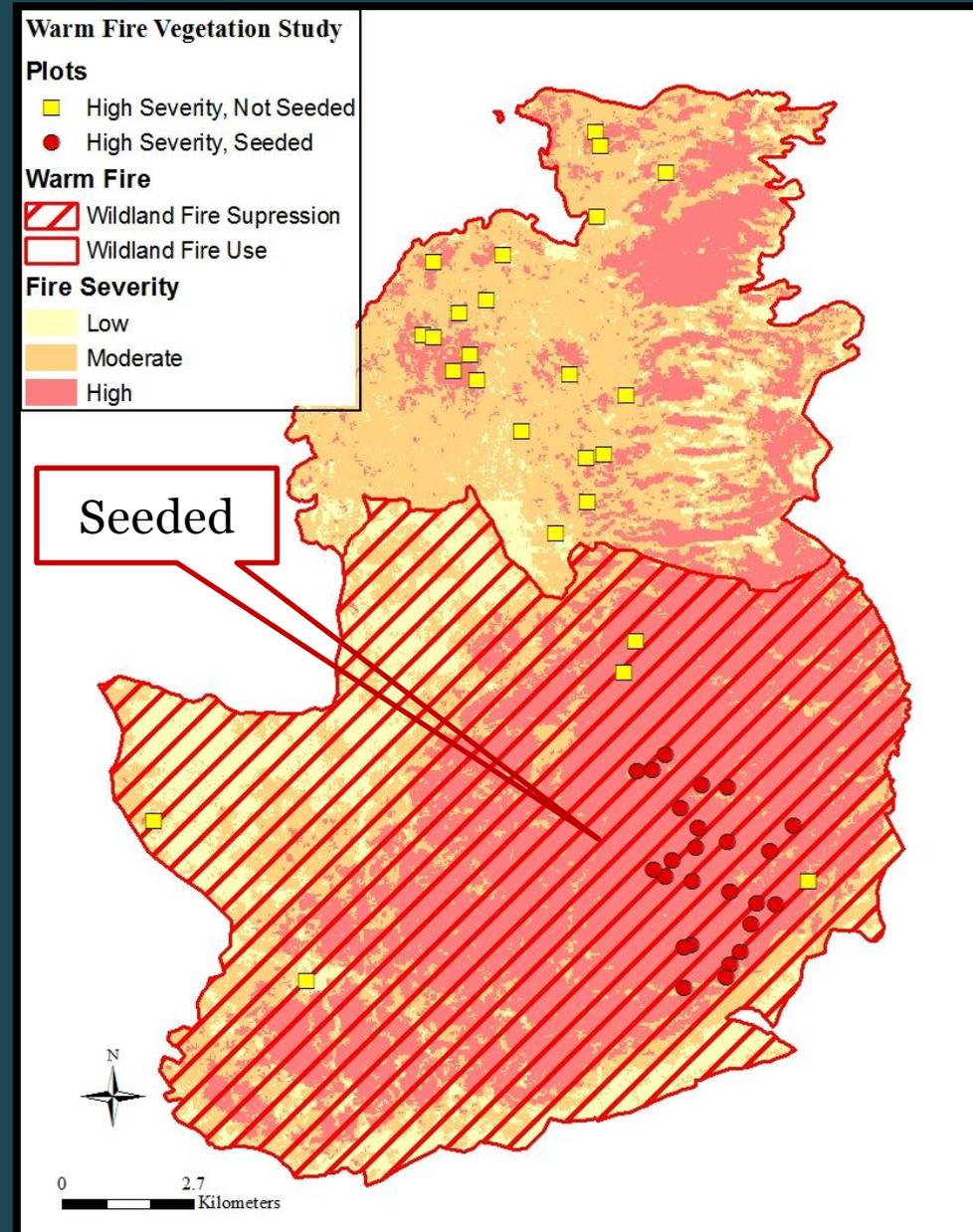
Controversy

- Fire management policies
- 2x's the acreage
- Loss of resources
 - Recreational, timber, wildlife



Burned Area Emergency Response Team

- Wildfire section only
- High/moderate severity
- Goals
 - Soil erosion/stabilization
 - Decrease exotic invasion
 - *Bromus tectorum*
cheatgrass
 - *Carduus nutans*
musk thistle
- Post-fire seeding
 - *Lolium perenne ssp. multiflorum*
 - Aerial seeding- 4800 ha
 - July - monsoons



Lolium perenne ssp. multiflorum

Ryegrass

Advantages

- Germinates quickly
- Exits the system in 2-3 years

Disadvantages

- Readily hybridizes with perennial taxa
- Outcompetes native vegetation
 - Utilization of nitrogen and light
 - Allelopathic properties
 - Disrupt root establishment
- Decreases native cover, richness and diversity



Research questions



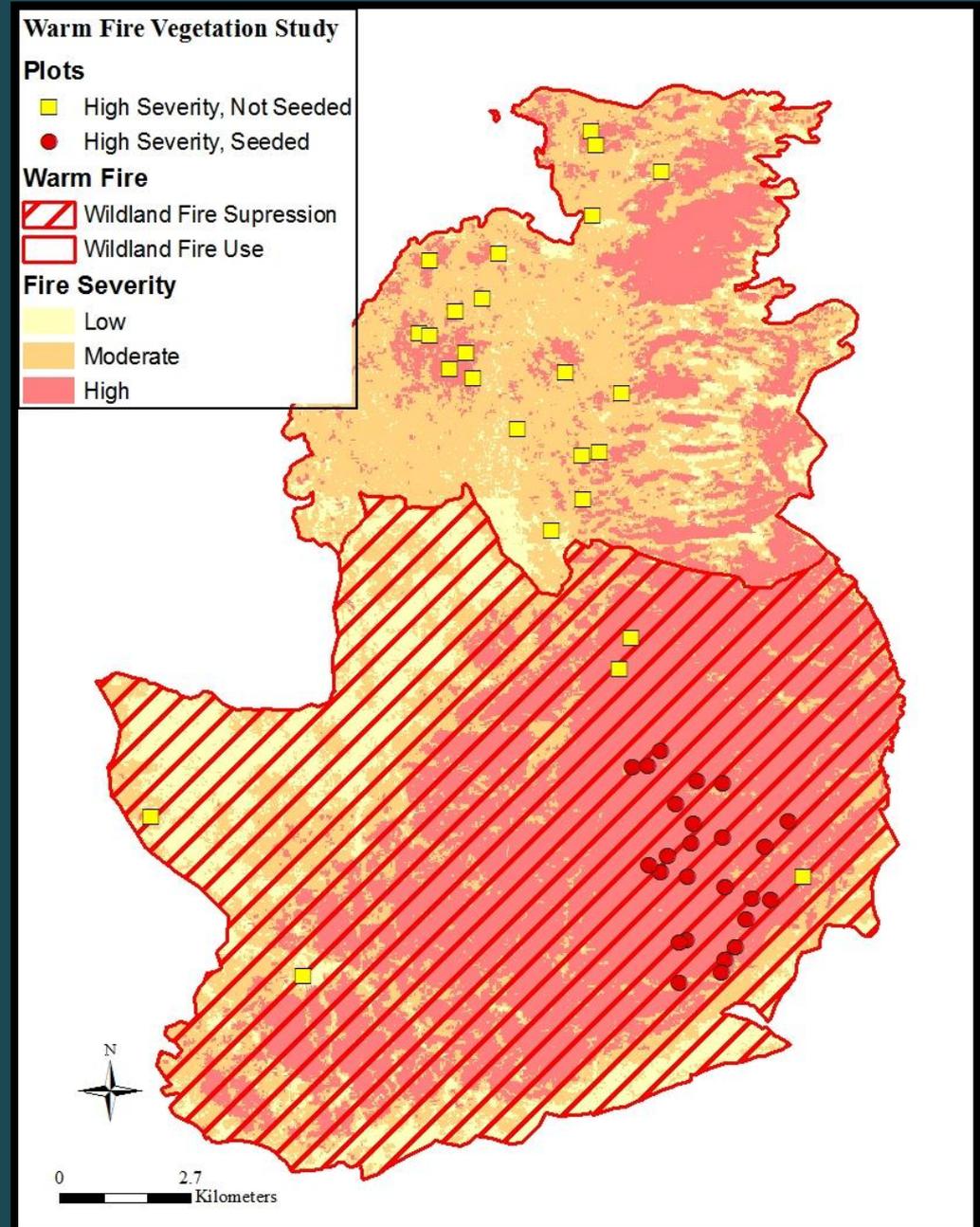
1. Did seeding provide adequate ground cover to decrease soil erosion?
2. Was seeding more successful at preventing exotic invasions than natural regeneration?
3. What effects did ryegrass have on the native plant community?

Methods

44 plots

July & August, 2007-2009

- 7.32 m radius
1/20 of an acre
- 9 1x1 m frames
 - Foliar plant cover
 - Species
 - Total cover
 - Graminoids
 - Forbs
 - Ground cover
- Species richness



Statistical analyses

PERMANOVA

- community composition
- foliar cover
- functional groups
- rate of change
- $p < 0.05$

Indicator species analysis

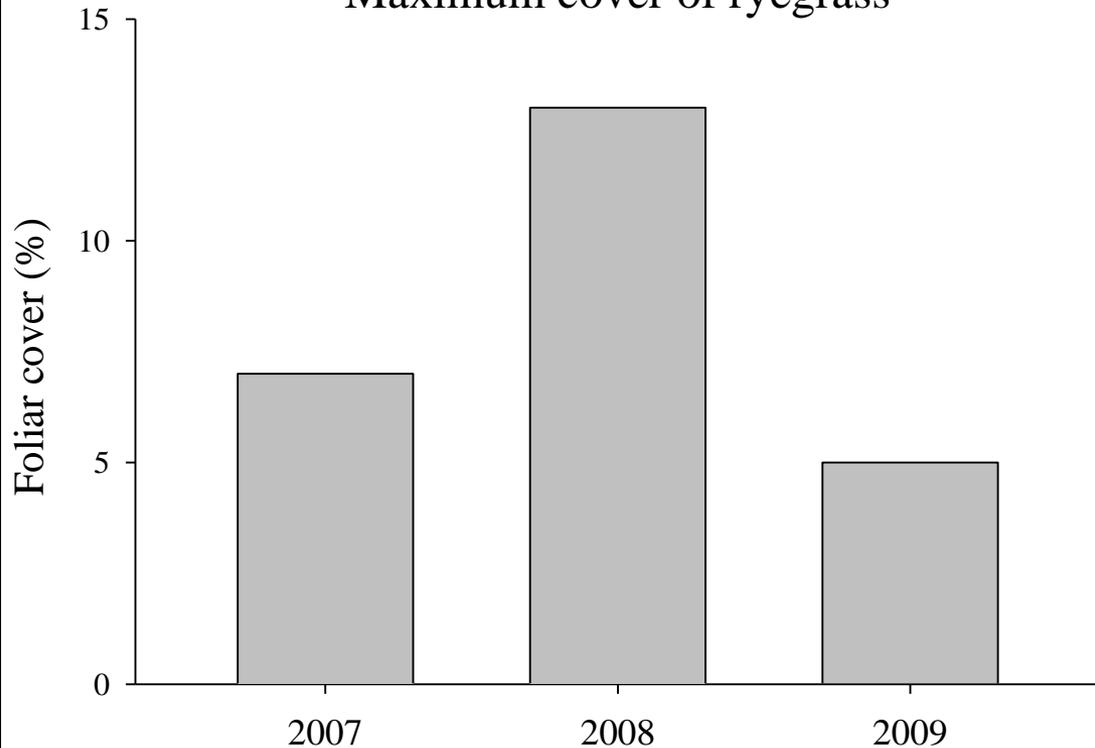
- $p < 0.05$ $IV > 30$

Non-metric multidimensional scaling

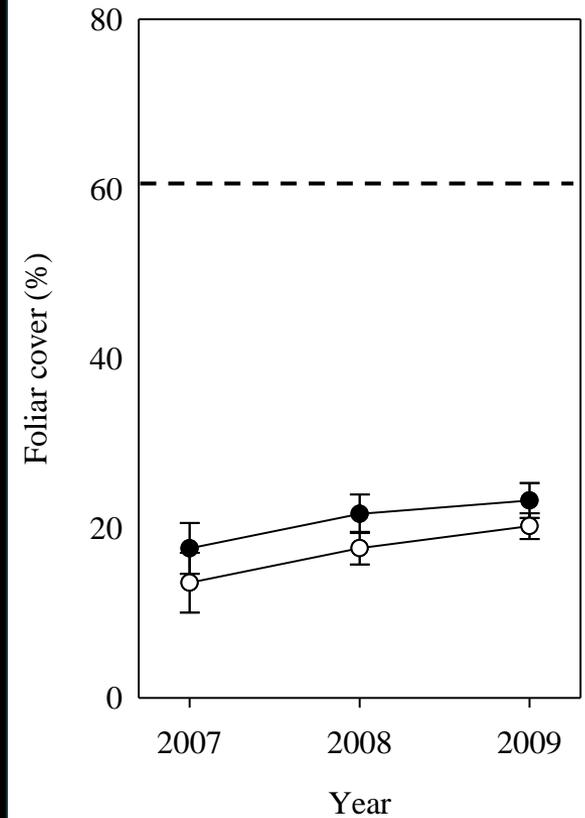
NMDS ordinations

Did seeding provide adequate ground cover to decrease soil erosion?

Maximum cover of ryegrass

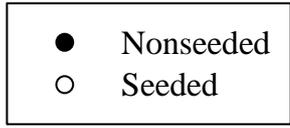
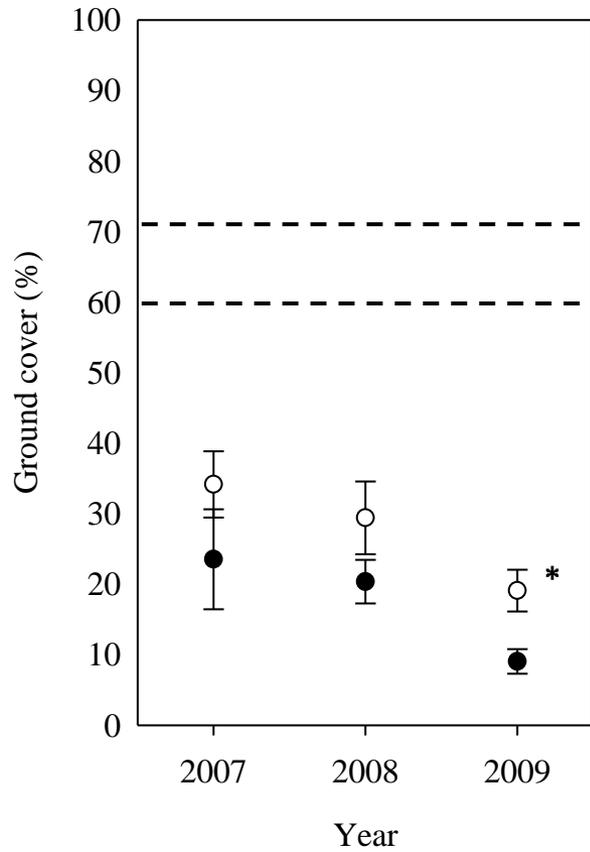


Total vegetation cover

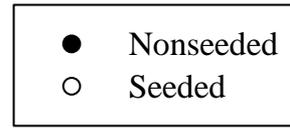
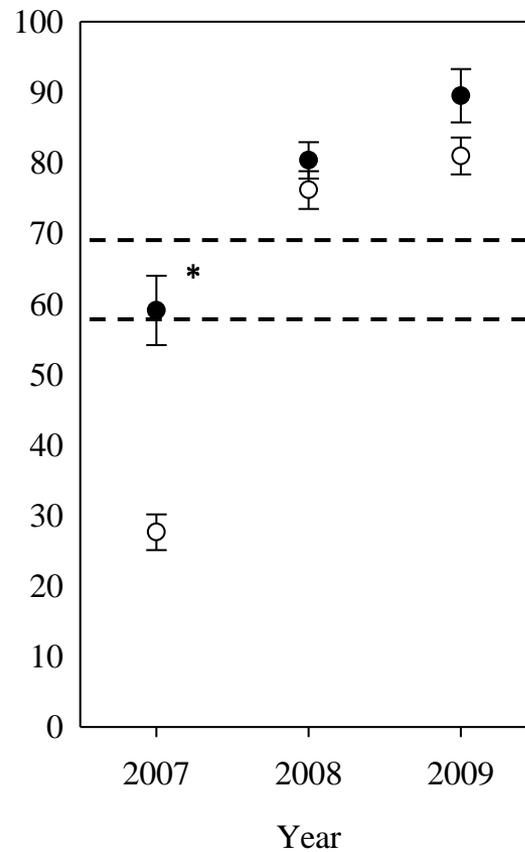


- Nonseeded
- Seeded

Bare soil



Total ground cover



Was seeding more successful at preventing exotic invasions?

No significant difference in cover of exotics between seeded and non-seeded

$$p = 0.3226$$

- 21 species of exotics (10%)
- Non-seeded: 1.6%
- Seeded: 0.6%
- < 10% for individual plots

Bromus tectorum

2008: 43% of plots

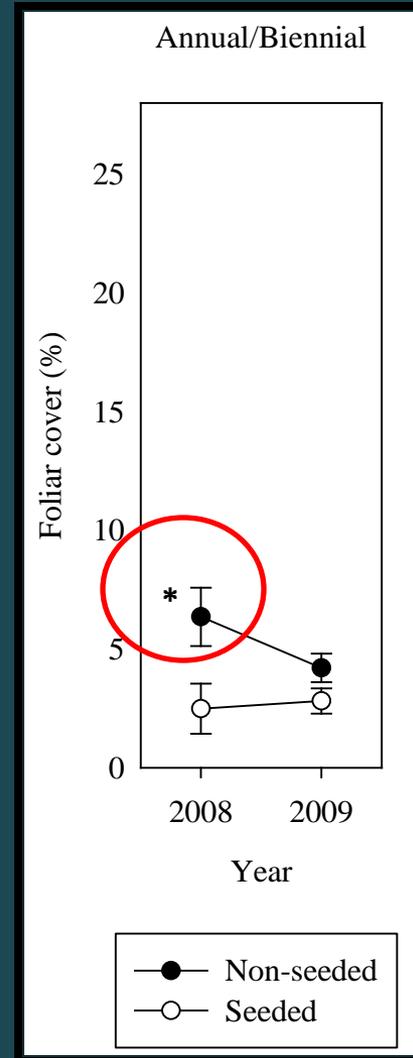
2009: 50% of plots

Carduus nutans



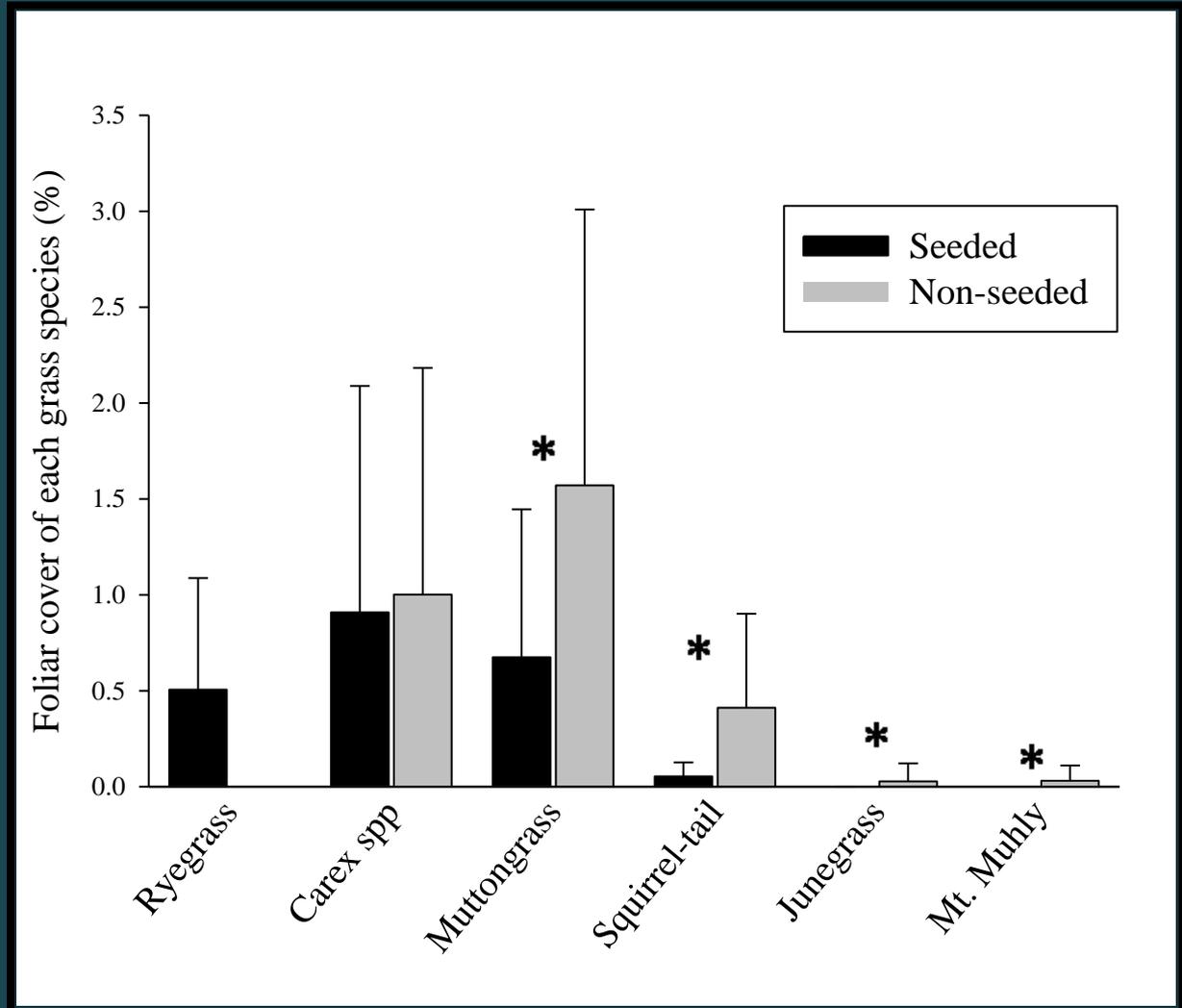
What effects did ryegrass have on the native plant community?

- Annual and biennial forbs



Graminoids

- Significantly less cover in seeded plots 3 years post-fire

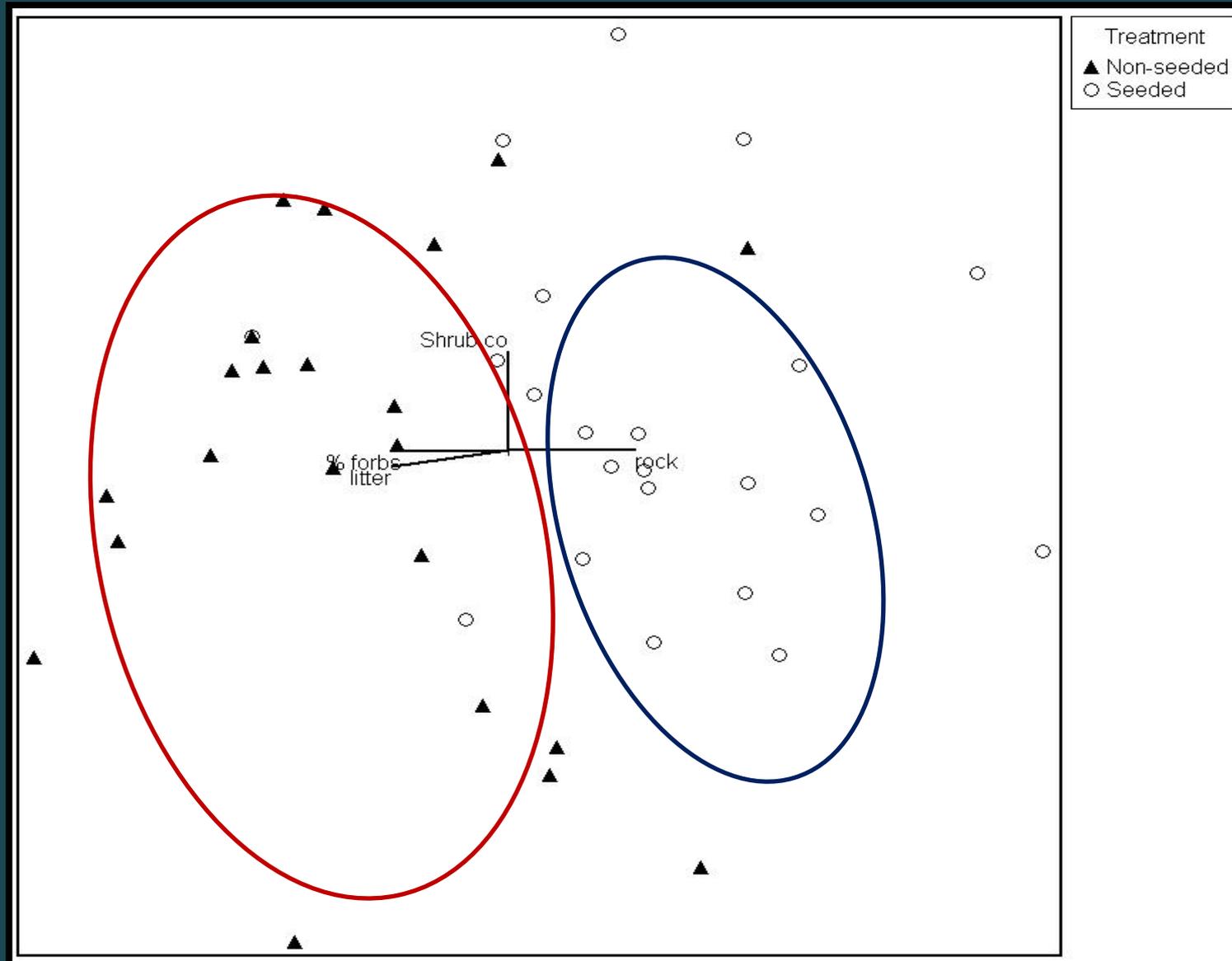


Community composition 2009

PERMANOVA
 $p = 0.0002$

- Rate of change of community composition from 2008 - 2009: not significantly different

$p = 0.4132$



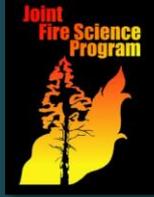
Indicator Species Analysis

Treatment	Species	IV 2008	IV 2009	Life history	Life form
Non-seeded	<i>Antennaria parvifolia</i>	45.4	66.1	P	F
	<i>Androsace septentrionalis</i>	41.4	-	A	F
	<i>Arenaria lanuginosa ssp. saxosa</i>	40.8	48.5	P	F
	<i>Bromus tectorum*</i>	56.9	61.4	A	G
	<i>Chenopodium fremontii</i>	79.1	67.6	A	F
	<i>Elymus elymoides</i>	-	76.5	P	G
	<i>Hieracium fendleri</i>	33.7	38.9	B	F
	<i>Lupinus argenteus</i>	-	57.0	P	F
	<i>Muhlenbergia montana</i>	-	31.8	P	G
	<i>Packera multilobata</i>	63.8	71.7	A/P	F
	<i>Poa fendleriana</i>	-	66.8	P	G
	<i>Pinus ponderosa</i>	56.0	53.5	P	T
	<i>Populus tremuloides</i>	52.6	72.0	P	T
	<i>Pseudognaphalium macounii</i>	59.9	-	B	F
	<i>Taraxacum officinale*</i>	61.6	70.9	A/B	F
<i>Verbascum thapsus*</i>	36.4	40.9	B	F	
Seeded	<i>Astragalus amphioxys</i>	61.3	-	P	F
	<i>Conyza canadensis</i>	-	58.7	A	F
	<i>Erigeron divergens</i>	-	86.0	B	F
	<i>Hymenopappus filifolius</i>	-	39.9	P	F
	<i>Lolium perenne ssp. multiflorum*</i>	98.5	99.5	A/B/P	G
	<i>Lotus wrightii</i>	75.0	58.0	P	F
	<i>Robinia neomexicana</i>	57.0	59.1	P	S
	<i>Tragopogon dubius*</i>	-	46.9	A/B	F

* = exotic; P= Perennial, A= Annual, B= Biennial, G= Grass, F= Forb, S= Shrub, T= Tree

Conclusions

- Seeding did not provide adequate vegetative cover to mitigate soil erosion
- Seeding was not effective at reducing the spread of exotics
- Ryegrass may inhibit annual and biennial forbs establishment and native bunchgrass regeneration
- Seeding is often unsuccessful and may have unintended ecological consequences



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Thank you.
Questions?

