# J Bates, ARS

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*Continuing stuff*

- Juniper control
  - 10-15 years fire treatments
  - 10-30 years cutting treatments
- Fire ecology sagebrush
  - 10 - 20 years old
- Grazing
  - Post fire

# New stuff

- **Low sagebrush**
  - **Habitat potentials, environmental controls**
  - **Fire effects**

- **Grazing use, fire ignition and spread**

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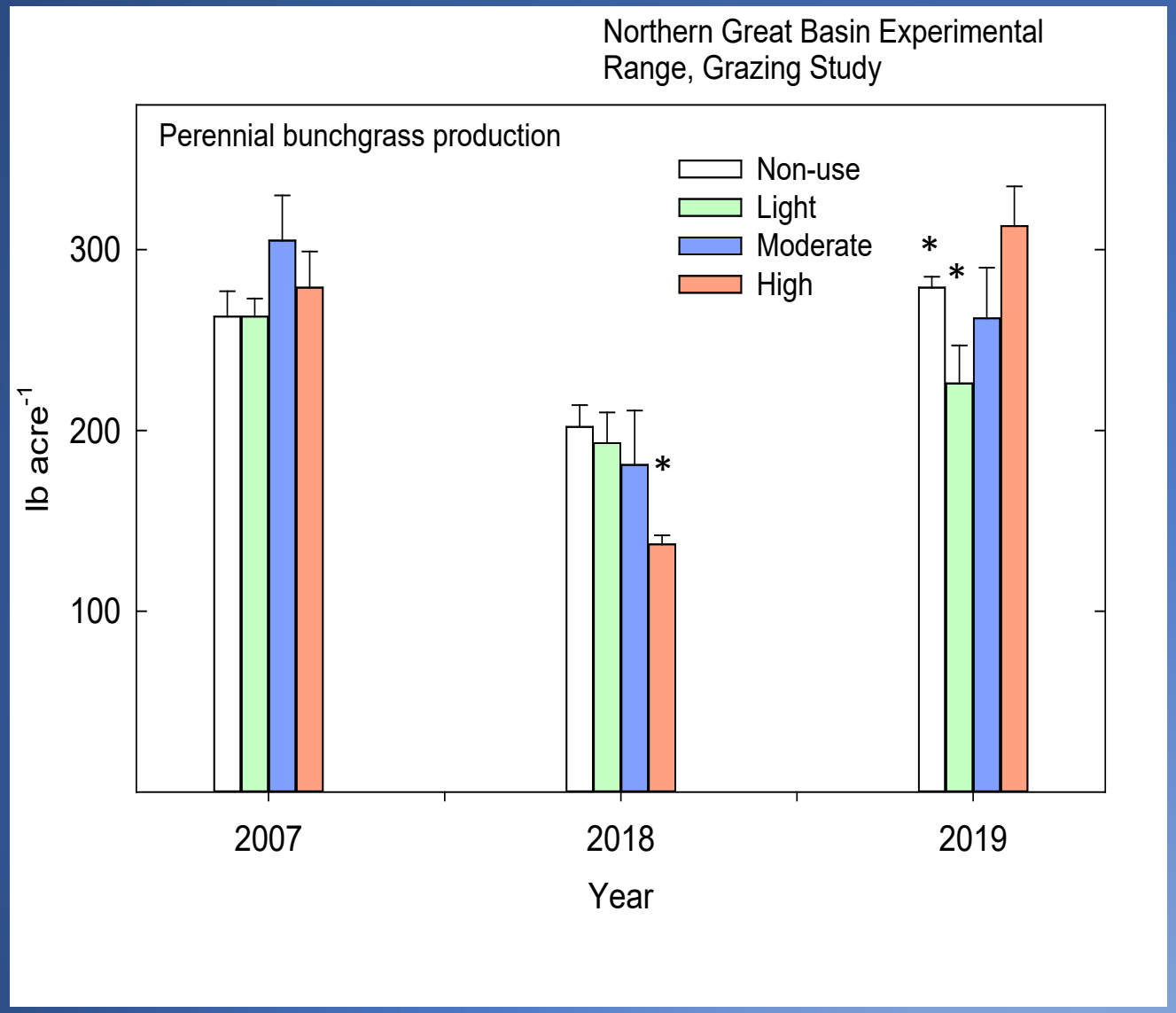
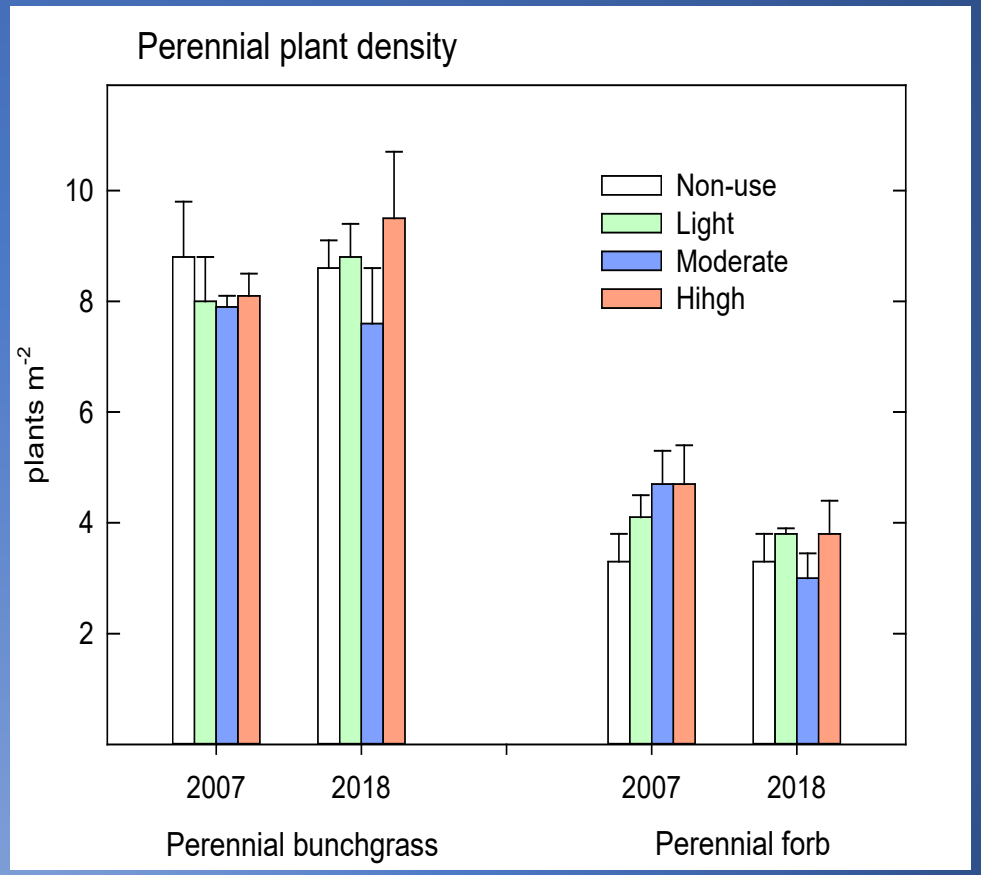
Maybe

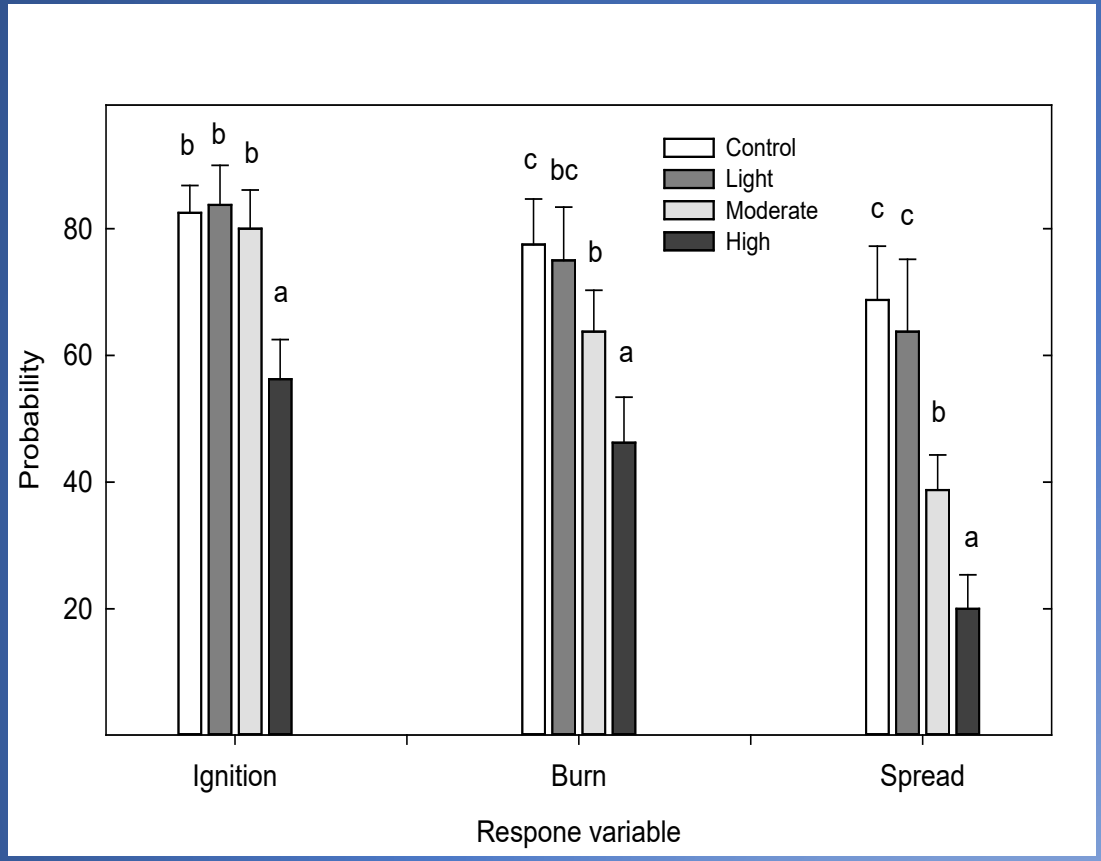
- Herbicide/Juniper
  - Monument SWCD

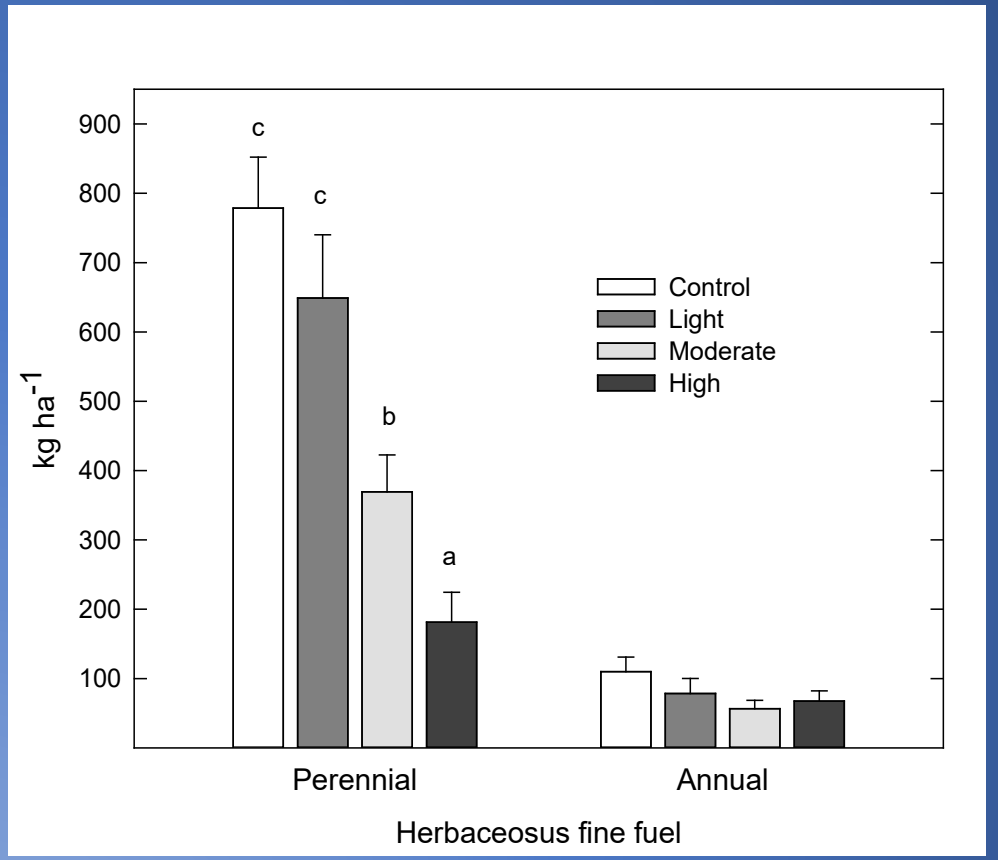
# Grazing Use Study
# 2007 - present



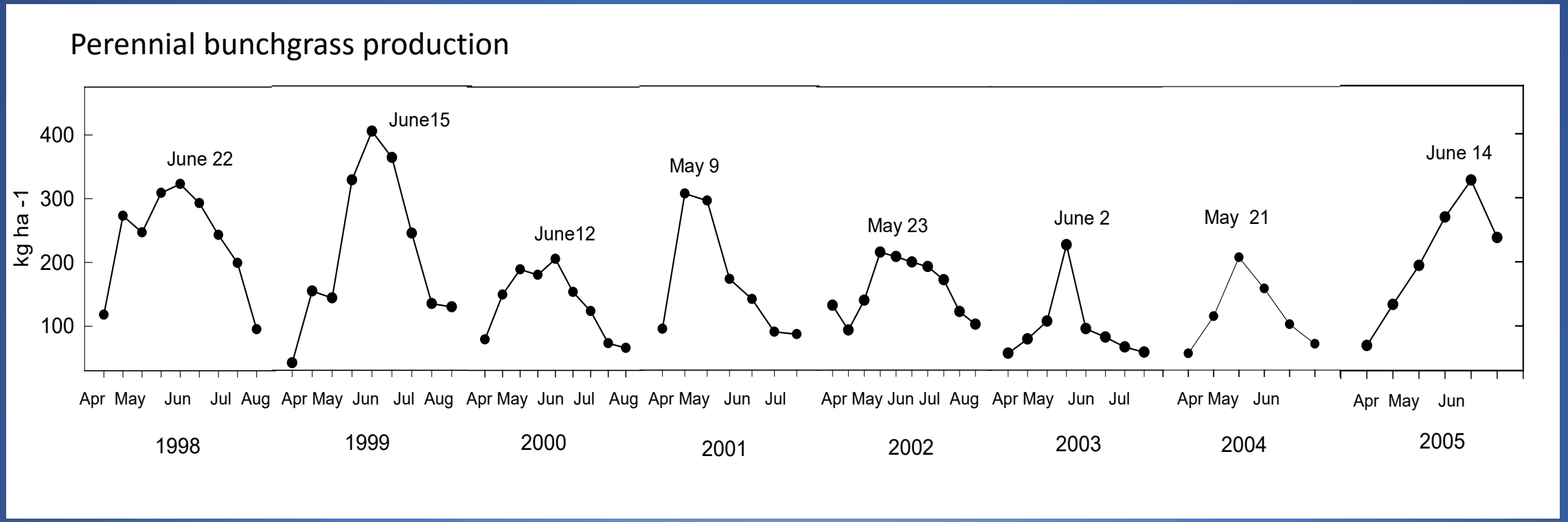



# Fire Ignition and spread 2018



# Climate controls; production and timing

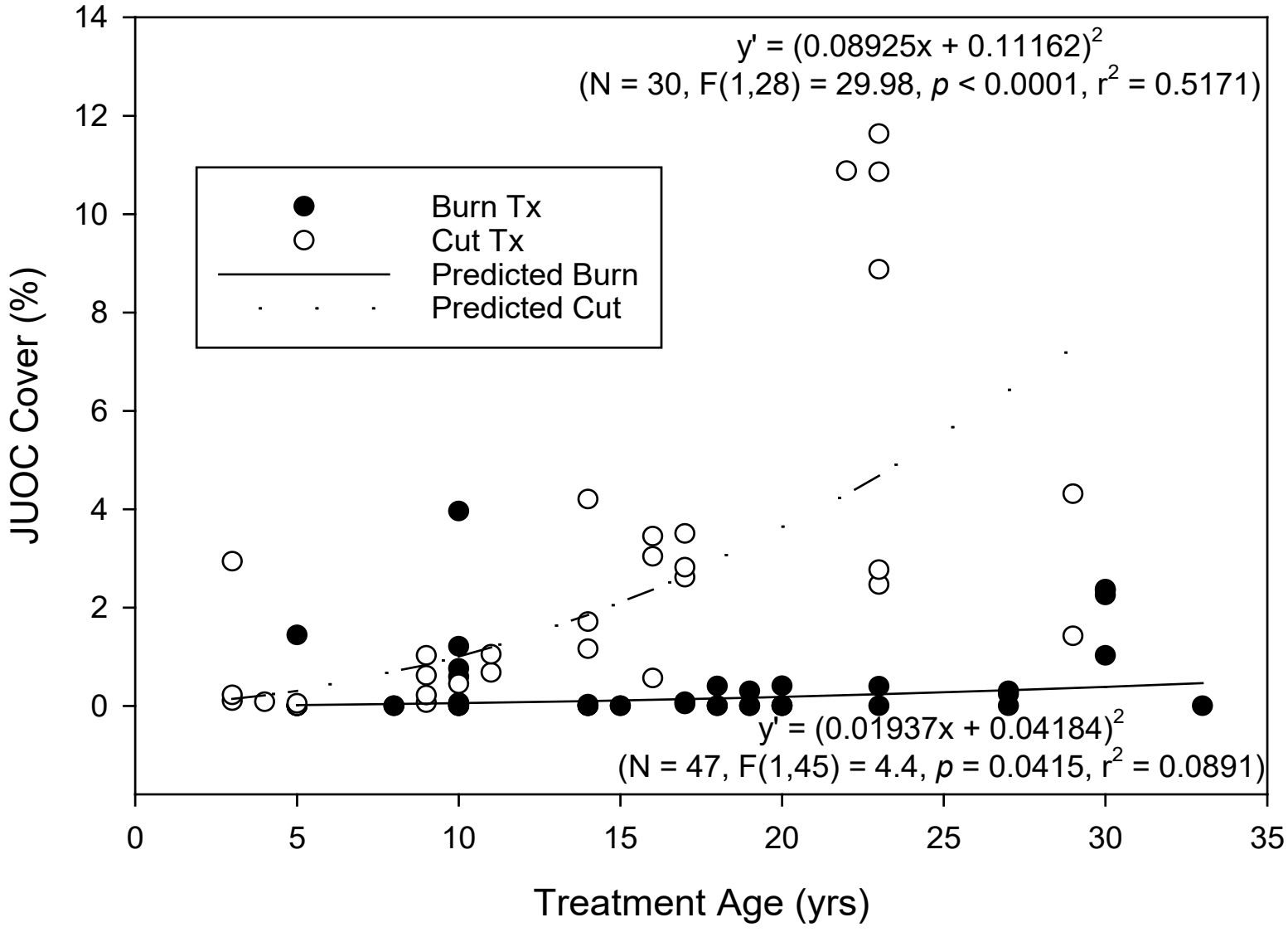


# Sagebrush Steppe Restoration & Conservation

**Kirk W. Davies**

**Eastern Oregon Agricultural Research Center**

# Juniper Cover




**Rate of increase greater in cut**

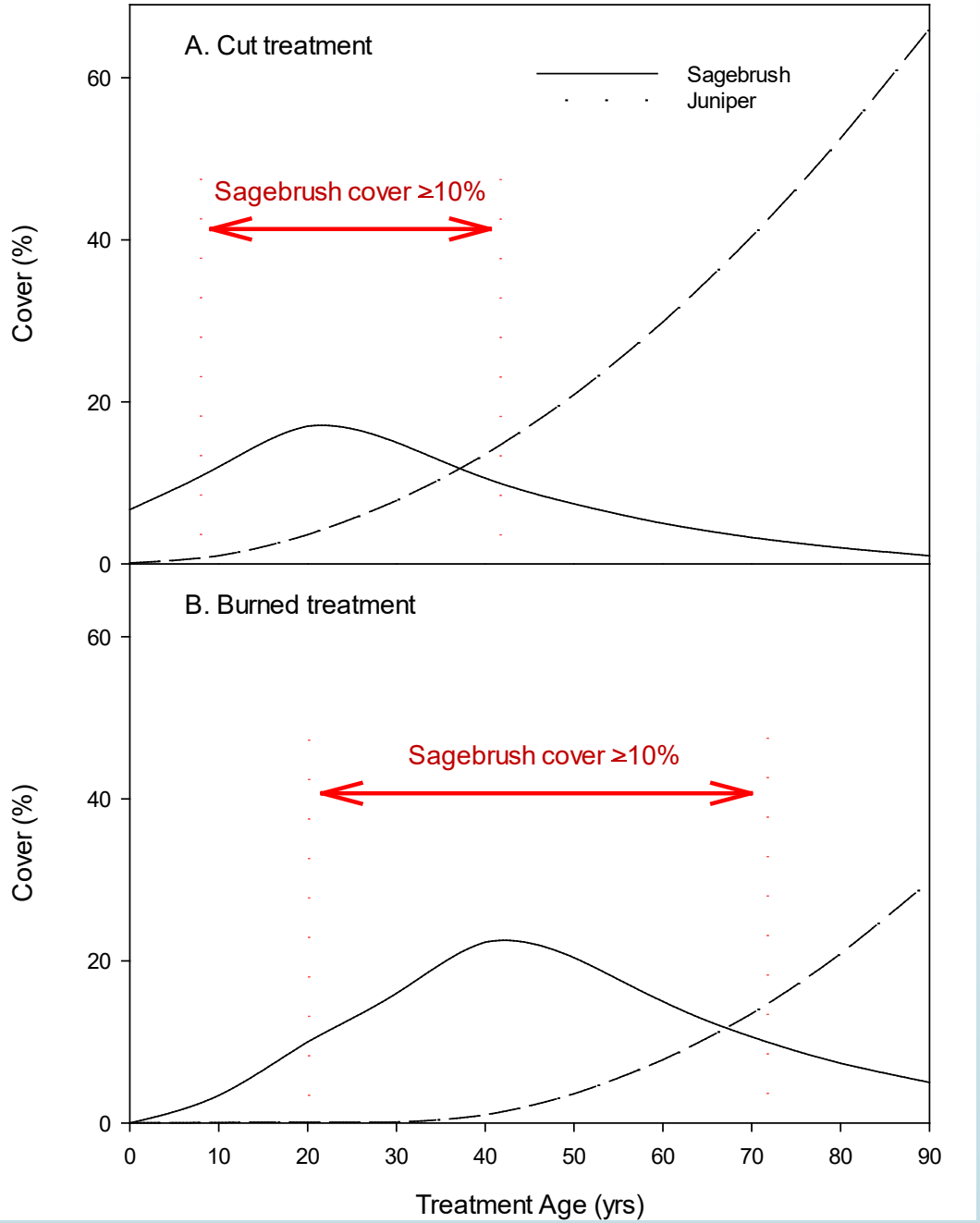
**30 yrs after treatment**

Burn = 0.4%

Cut = 7.8%

**Density**

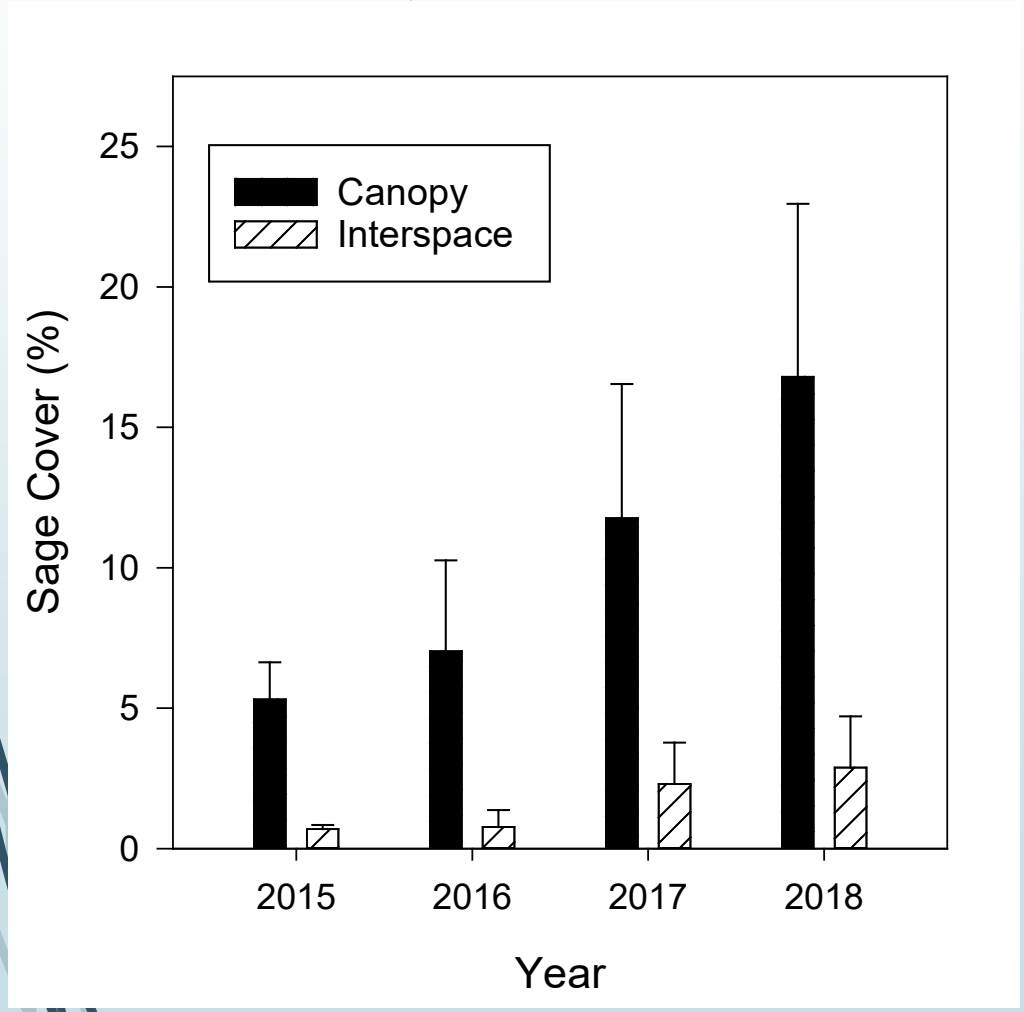
30 yr lag

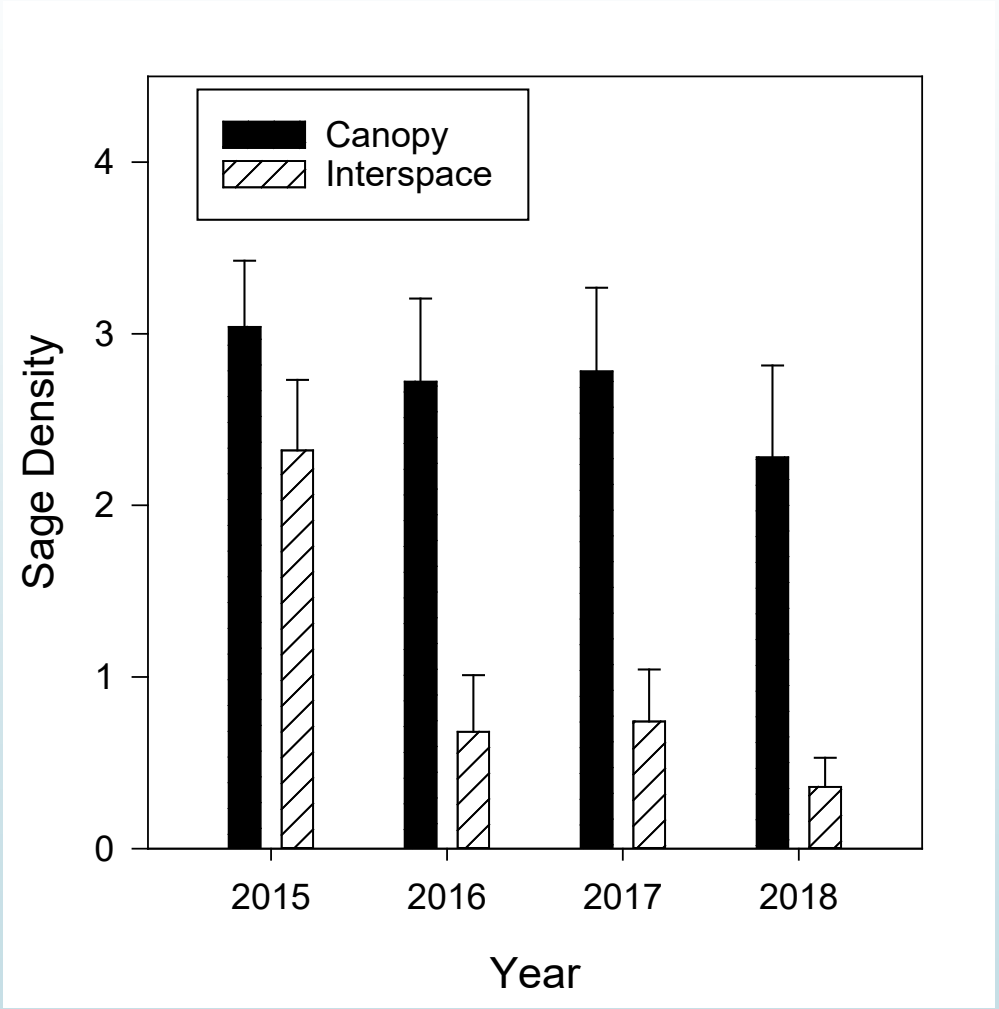



- Juniper effects on sage cover estimated from Miller et al. 2000
- Assumes only a 30 yr lag in juniper cover
- Sagebrush cover ≥10% 150% longer in burn than cut

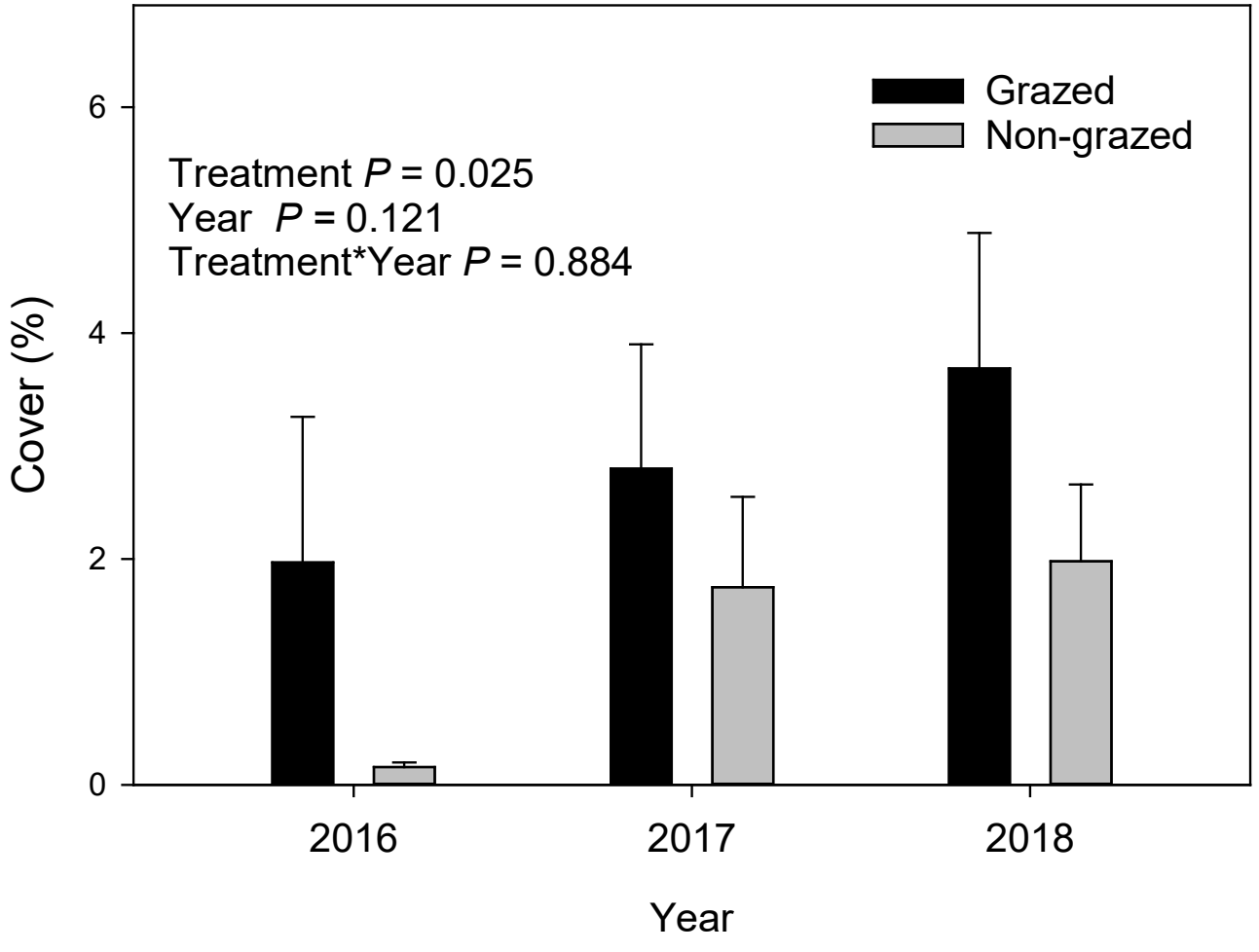
- Re-introducing fire more effective for long-term control of juniper
  - Better control of seedlings
  - Reduction in seeds
- Minimum 30 yr lag
- Cheatgrass response was related to site factors, **not burning**

# Restoring sagebrush: microsite effect



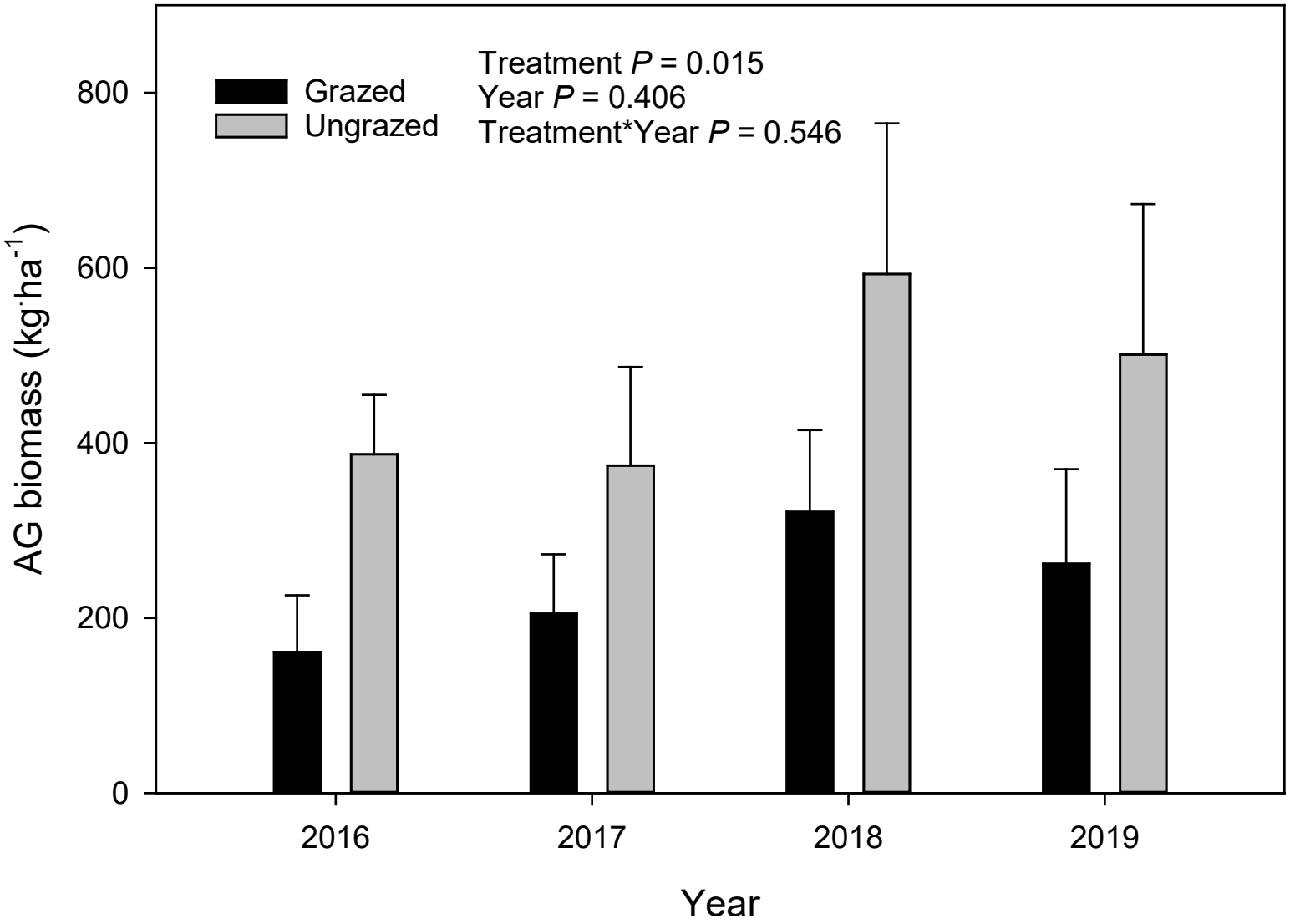



# Restoring sagebrush: spring grazing effects on planted sagebrush seedlings

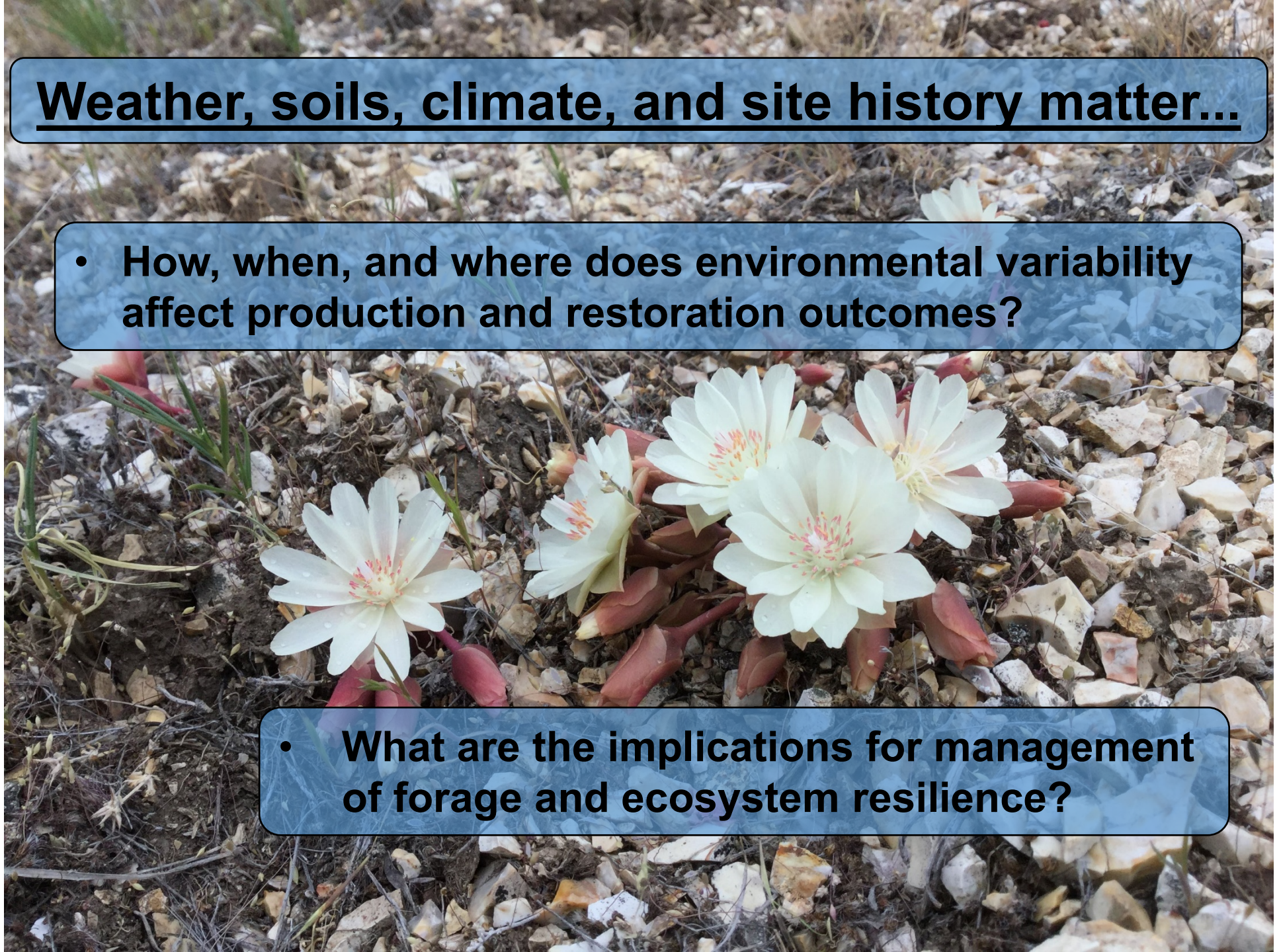



- Five years post-planting
- Similar density
- Larger sagebrush plants with grazing
- Density of herbaceous vegetation similar

# Winter grazing pre-fire



# Questions?

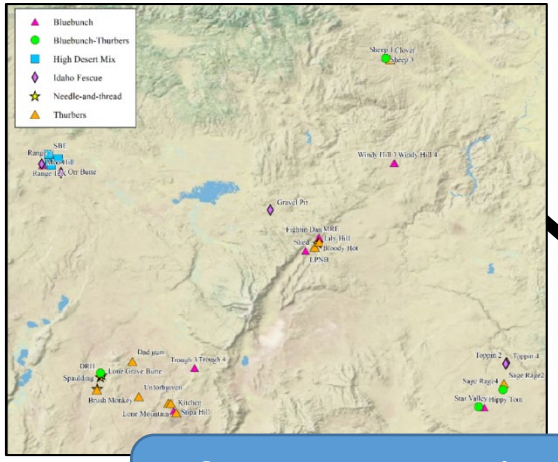


# Weather, soils, climate, and site history matter...

- How, when, and where does environmental variability affect production and restoration outcomes?

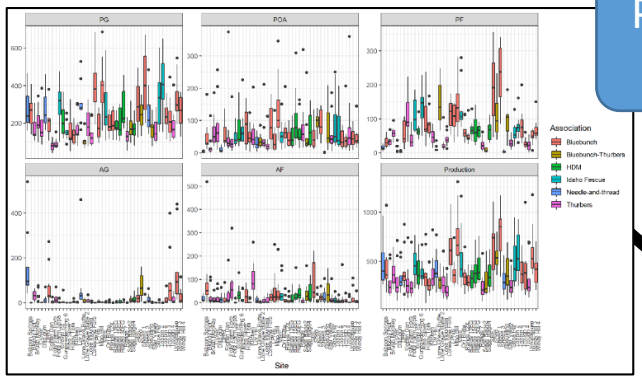
- What are the implications for management of forage and ecosystem resilience?

# How does **weather** impact **production** and **composition**?

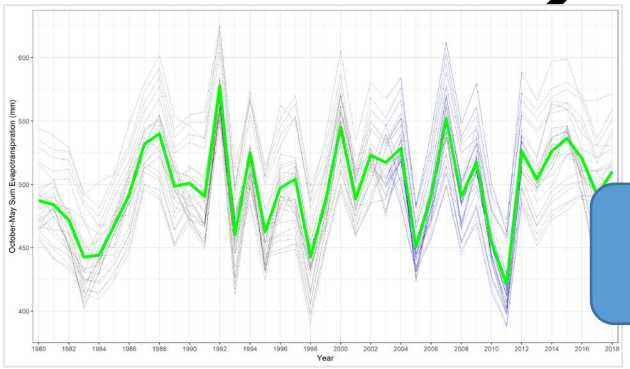



10 year - Vegetation Monitoring Plots

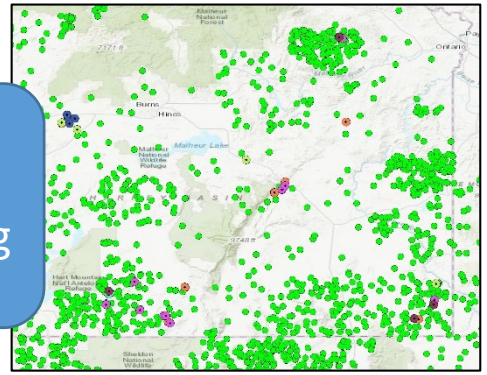
Predicting production across sagebrush plant community types - with Jon Bates




Production variability by community type



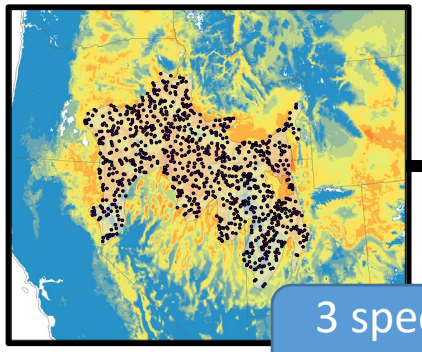

Weather Data



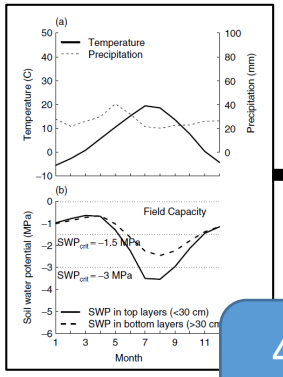
1000s of BLM AIM monitoring plots

# How does **weather** impact **restoration success?**

## Germination barriers across the Great Basin with multiple collaborators (TNC, USGS, ARS Fort Collins)



3 species, 15000 pts




40 yrs, soil moisture & temperature simulations

Germination from lab & field

Maps and predictions for barriers and variability

## Seasonal warming experiment

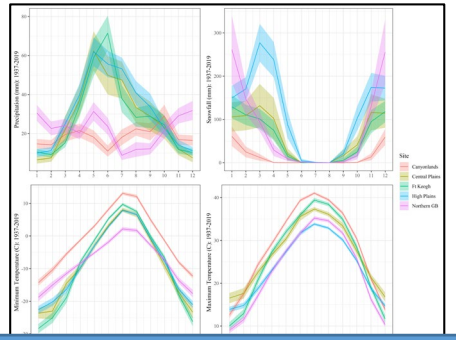
Three seasons of warming

9 seeded species

- Emergence
- Survival
- Growth

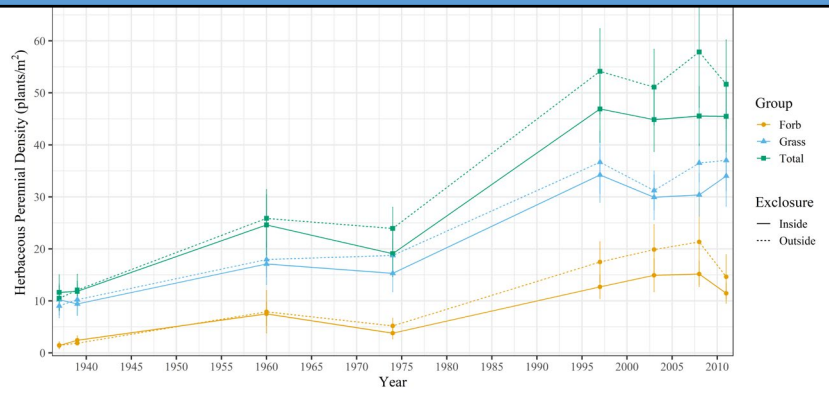
How does **historical** and **current grazing** impact **composition** and **production** across sites? Over time?

**"Grazing is not a noun"** – Boyd
Variable grazing response tied to climate and vegetation composition



- Six sites in the western US with long-term data
- Climate, soils, vegetation, grazing intensity
- Interactions with fire & invasives

At the Butte: Cattle grazing and recovery from intense sheep grazing pre-1930s



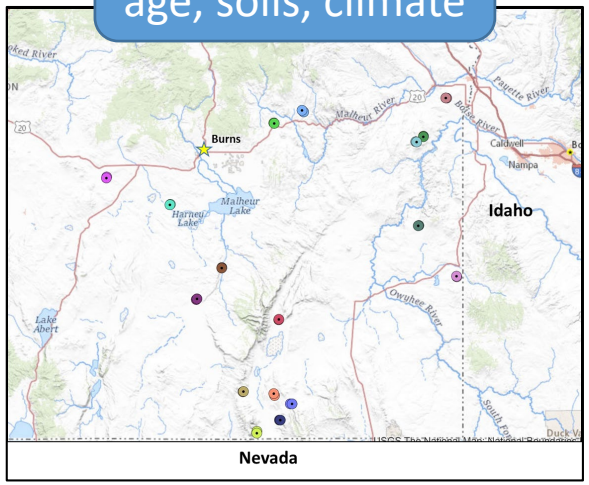

With cattle grazing:

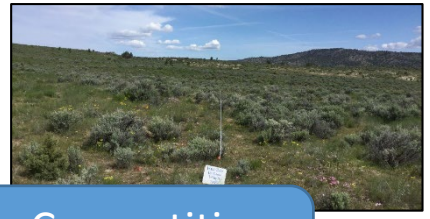
- Similar herbaceous density and composition
- Increase in density since early 1900s sheep grazing

# How do **climate, soils,** and **site history** affect diversity in crested wheatgrass seedings?

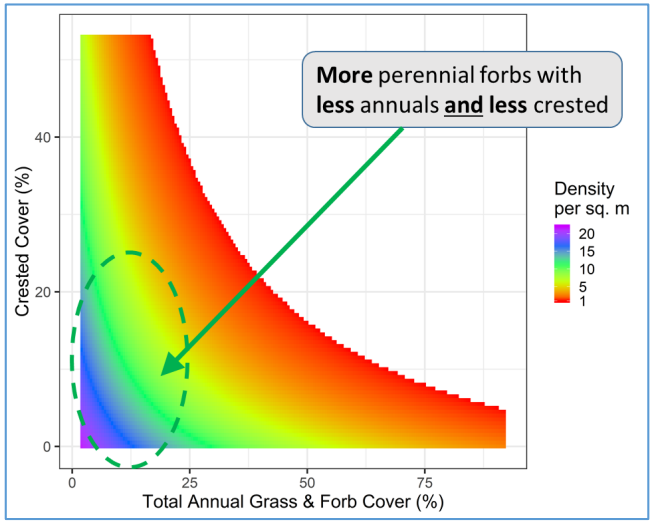
- Environmental variables associated with forb density and diversity in crested seeding sites (follow-up on Aleta Nafus & Kirk Davies work)
- Candidate forb species for seeding in crested sites

Sites of various age, soils, climate



- Competition
- Composition




Potential seeding species: Milkvetch, largeflower hawksbeard, or longleaf phlox

Thank you!
Questions?

***A critical feature of success****: Crested wheatgrass consistently produces good seed.

***A critical question****: how?

**Note "A", not "The"*

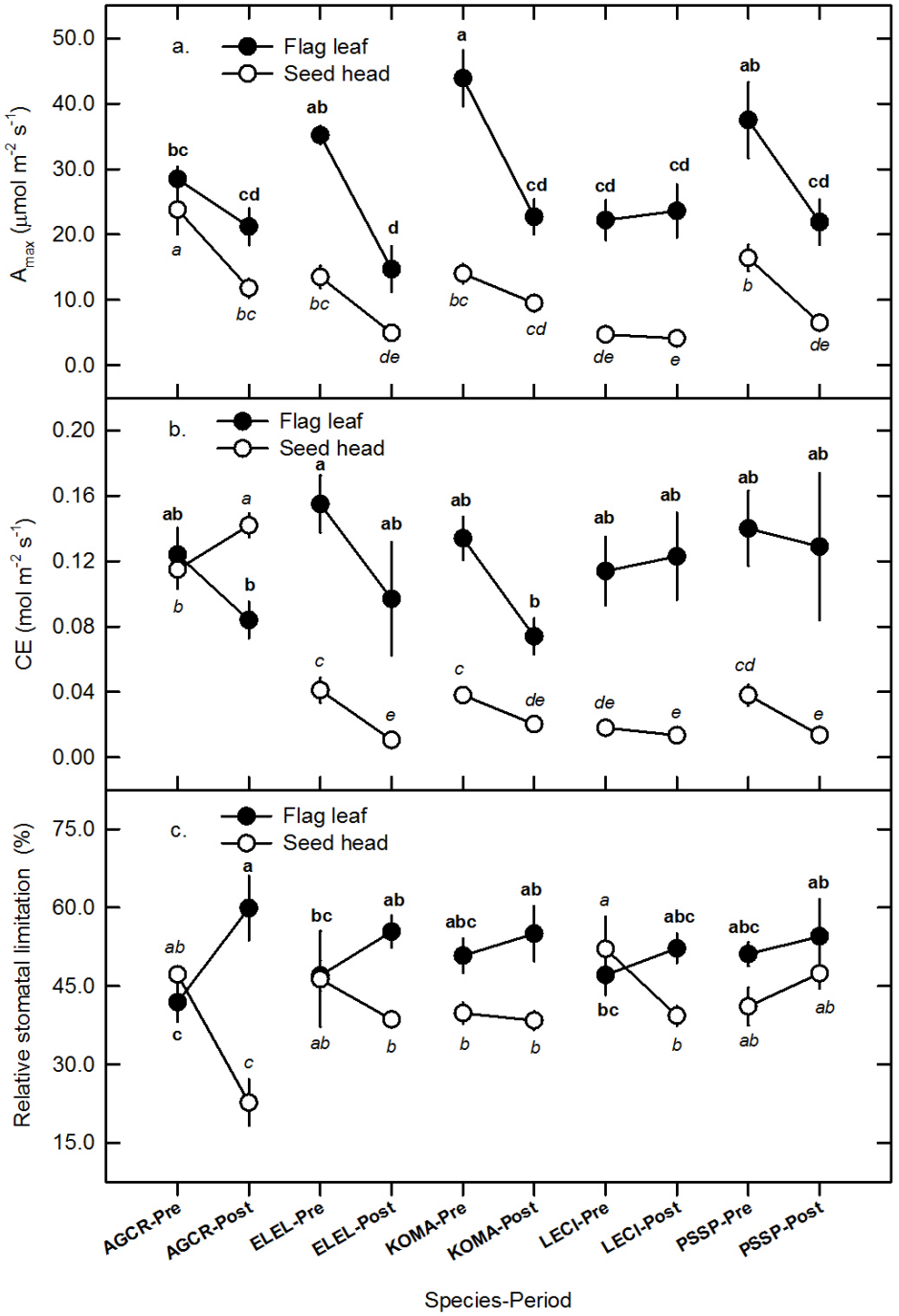
**Carbon from seed head:**
***Principal source in the <u>one</u> perennial grass studied***

**Carbon from flag leaf:**
***Principal source in high-yielding wheat varieties***

***How does photosynthesis in these structures vary?***

Reproductive photosynthesis consistent with making high quality seed:

| Flag Leaf | Seed head |
|---|---|
| **Crested > Native** | Crested = Native |
| Crested = Native | **Crested > Native** |
| **Crested > Native** | **Crested > Native** |




$A_{max}$ (photosynthetic capacity) = *horsepower*:

Flag leaf: Crested = Natives

**Seed head: Crested > Natives**

CE (carboxylation efficiency) = *mileage:*

Flag leaf: Crested = Natives

**Seed head: Crested > Natives**

RSL (Rel. stomatal limitation) = *valves*:

Flag leaf: Crested = Natives

**Seed head: Crested > Natives**,

*depending on phenological period*

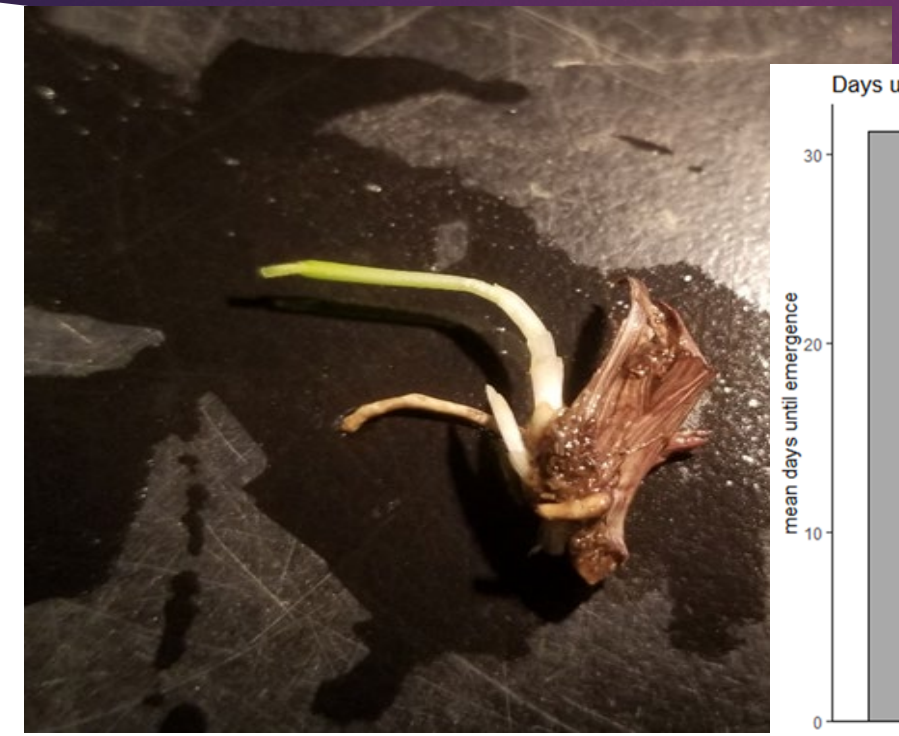
**It's not just greater allocation …**

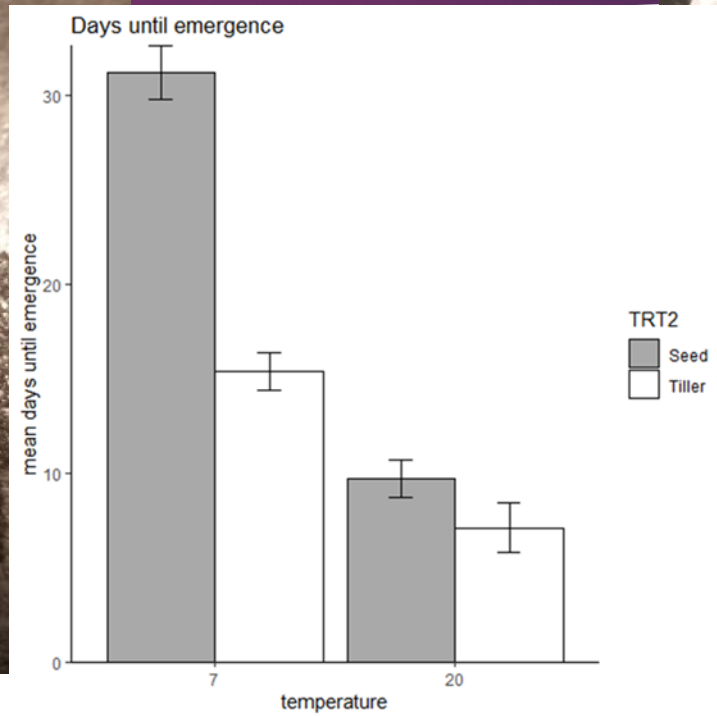
| Species | $A_{max}$ ratio | CE ratio | RSL ratio | Composite ratio |
|---|---|---|---|---|
| Crested wheatgrass | $0.76^{a}$ (0.075) | $1.40^{a}$ (0.201) | $0.80^{a}$ (0.148) | **0.99** |
| Squirreltail | $0.37^{b}$ (0.041) | $0.22^{b}$ (0.054) | $0.86^{a}$ (0.123) | 0.48 |
| Prairie junegrass | $0.39^{b}$ (0.052) | $0.31^{b}$ (0.042) | $0.76^{a}$ (0.043) | 0.49 |
| Basin wildrye | $0.21^{c}$ (0.030) | $0.16^{b}$ (0.035) | $0.93^{a}$ (0.074) | 0.43 |
| Bluebunch wheatgrass | $0.41^{b}$ (0.041) | $0.21^{b}$ (0.044) | $0.86^{a}$ (0.058) | 0.49 |

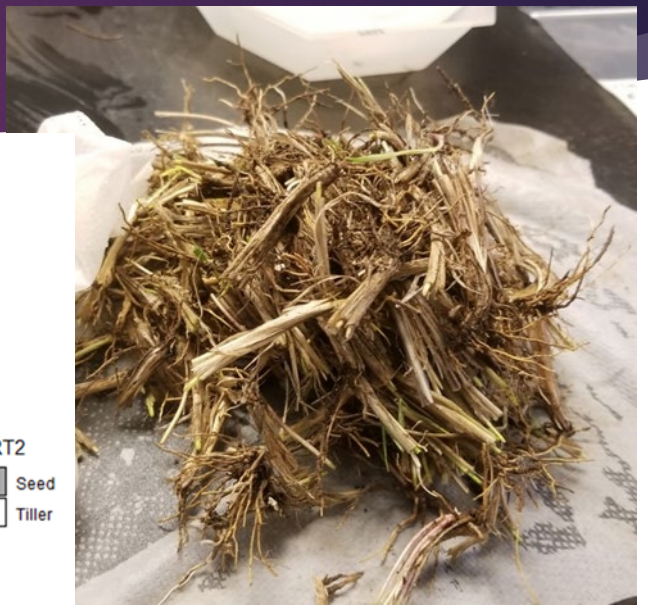
**… it's allocation that *acts like a leaf*.**

# Matching Seeds with Safe Places for Growth during Broadcast Seeding

# Using Crown Buds with Seed during Restoration

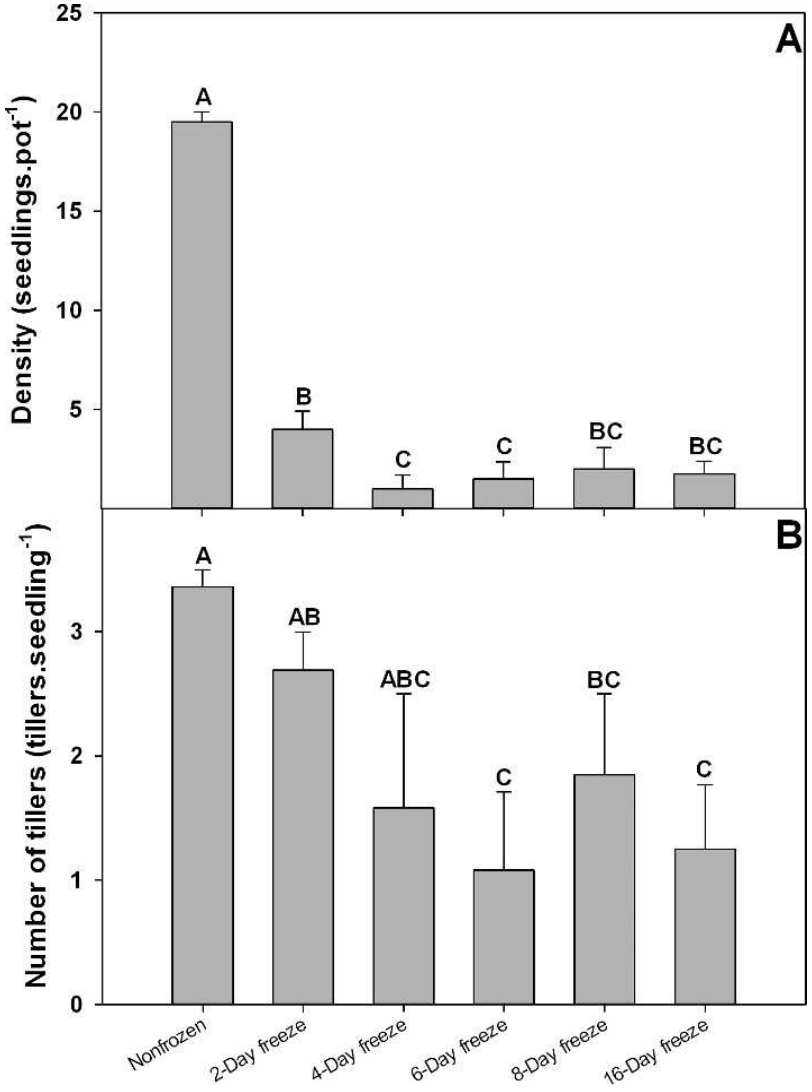




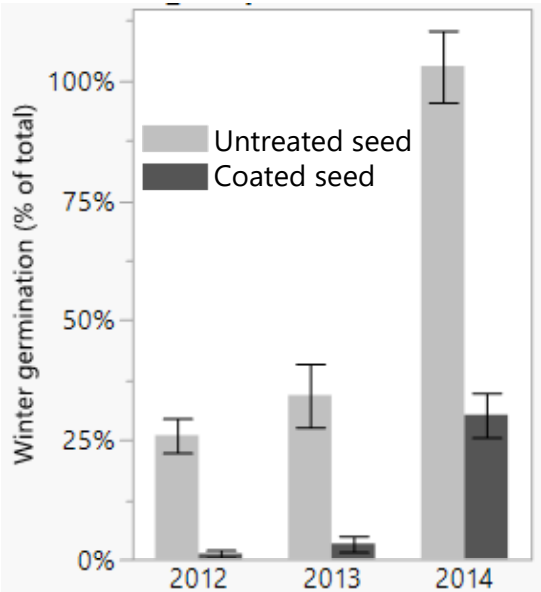



# New Native Seed Industry

# Pre-emergent thermal stress

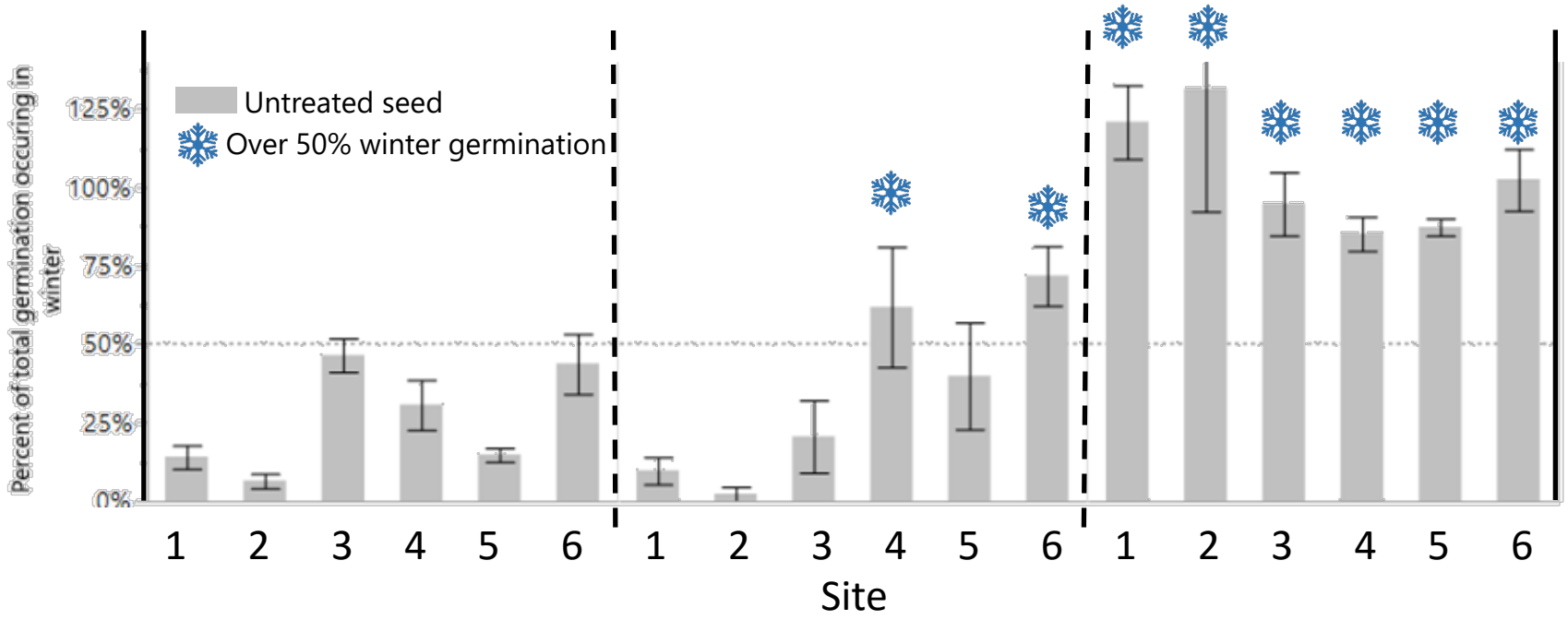


# Q1: Can hydrophobic coating reliably reduce winter germination of grass seeds in the cold desert?

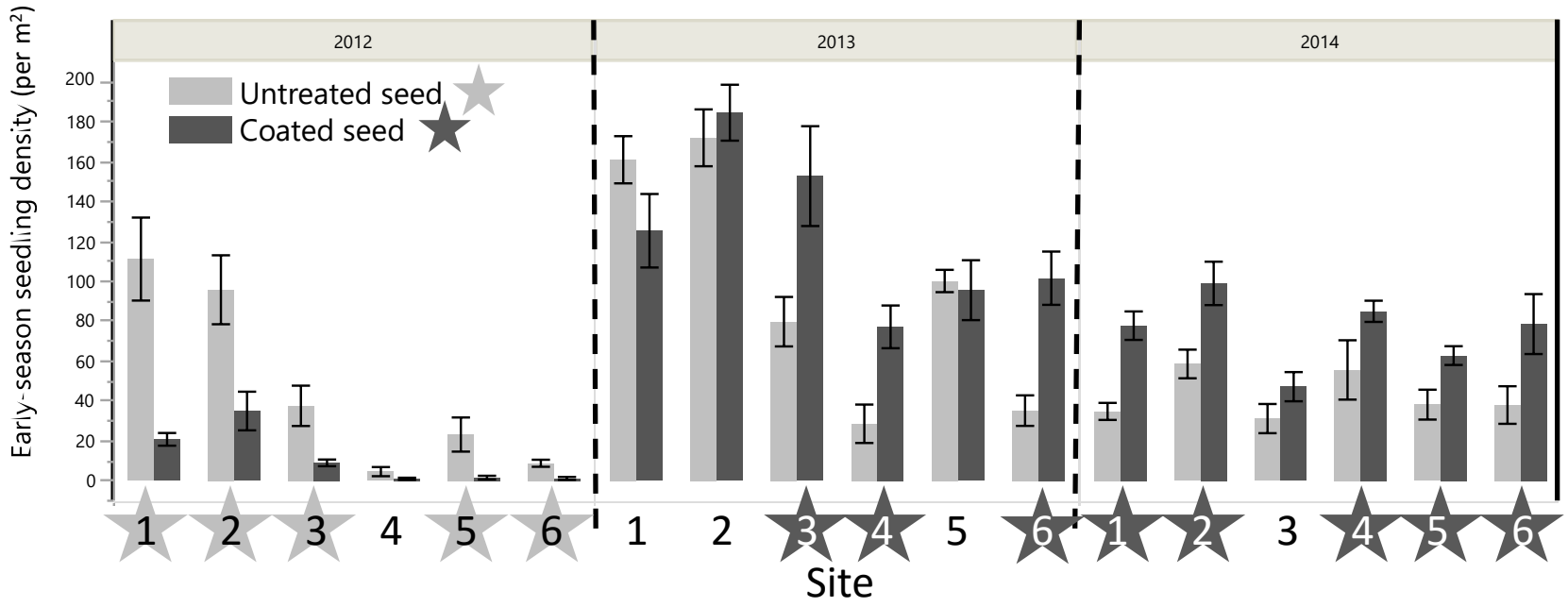



**YES!**

- **Coating reduced winter germination by ~78%**
- Consistent effect across all sites and years

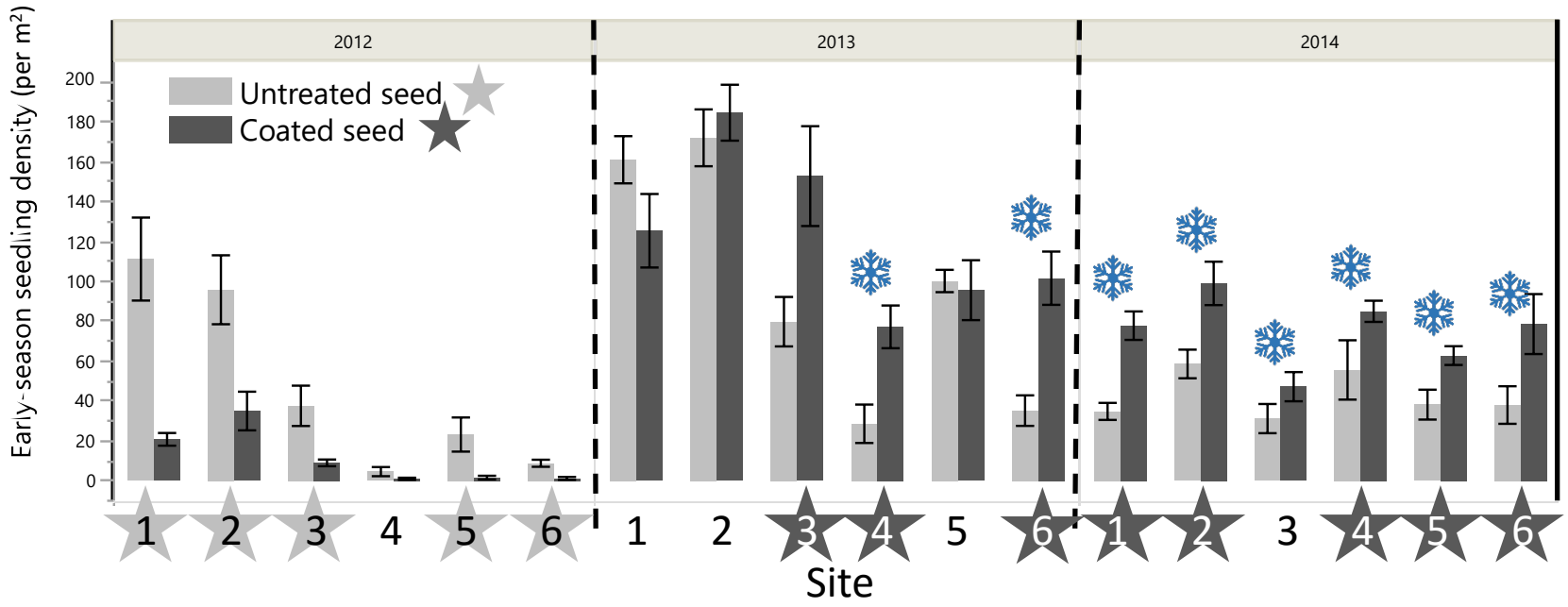



**8 of 18 trials had winter germination above 50%**




# Q2: How often does reduced winter germination improve establishment? Not always…

★ Coated improved establishment in only 8 of 18 trials (44%)



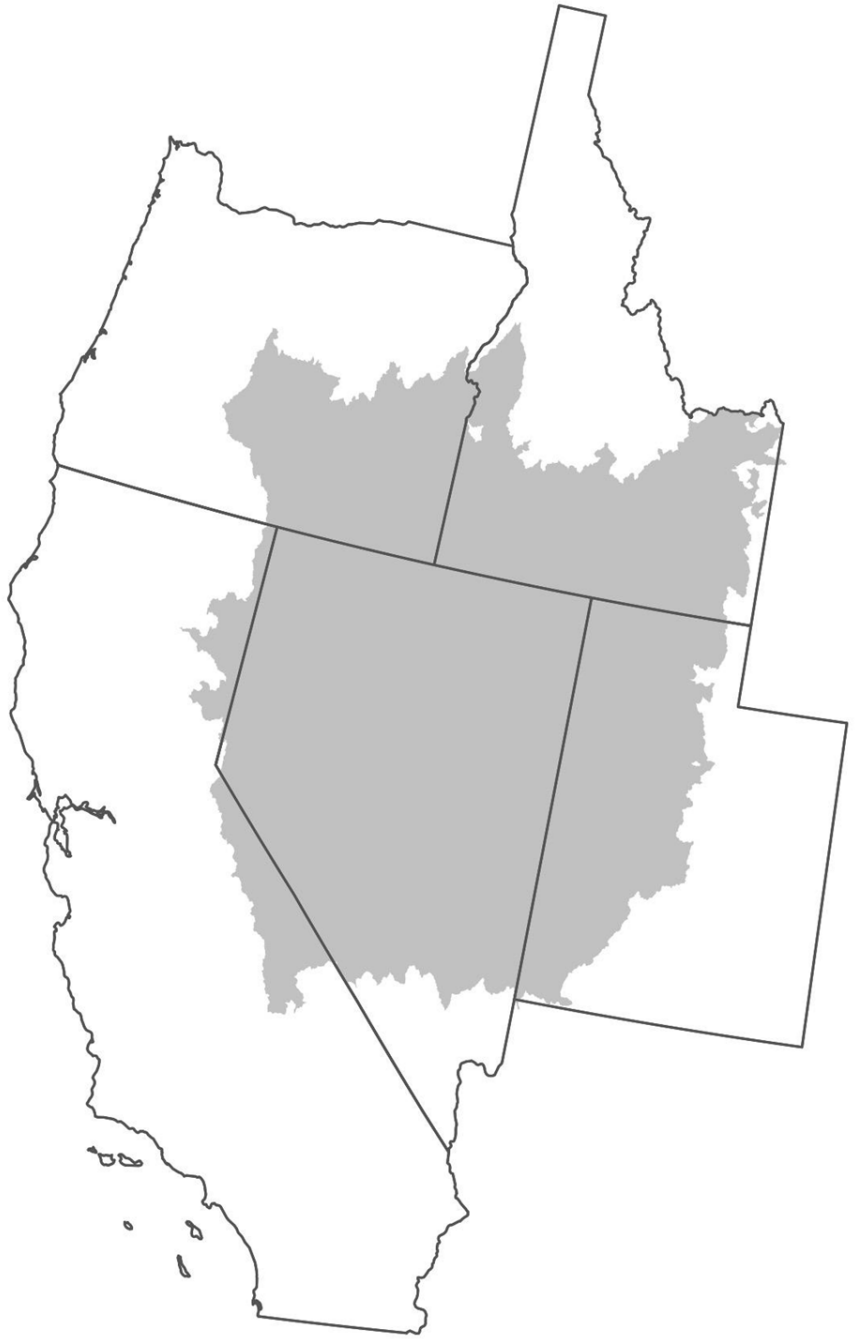

Q2: How often does reduced winter germination improve establishment? **Not always…**

★ Coated improved establishment in only 8 of 18 trials (44%)

**…but *nearly every time* that winter germination barrier was present**

**Objective 2:** Determine how abiotic and biotic variables drive occurrence/amount of wildfire and recovery after wildfire in the Great Basin.

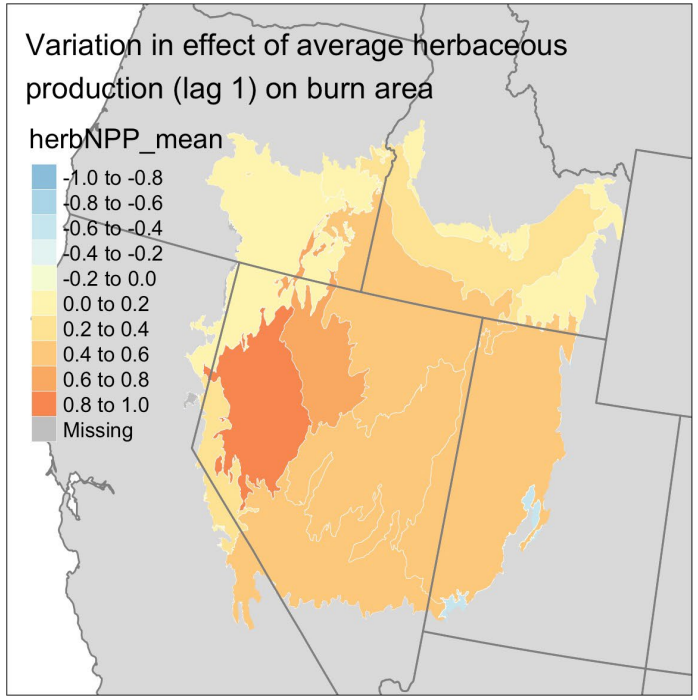
- Relative effects of BIOTIC (RAP) and ABIOTIC variables
- Interaction between biotic and abiotic, and how that changes in a scale-dependent fashion

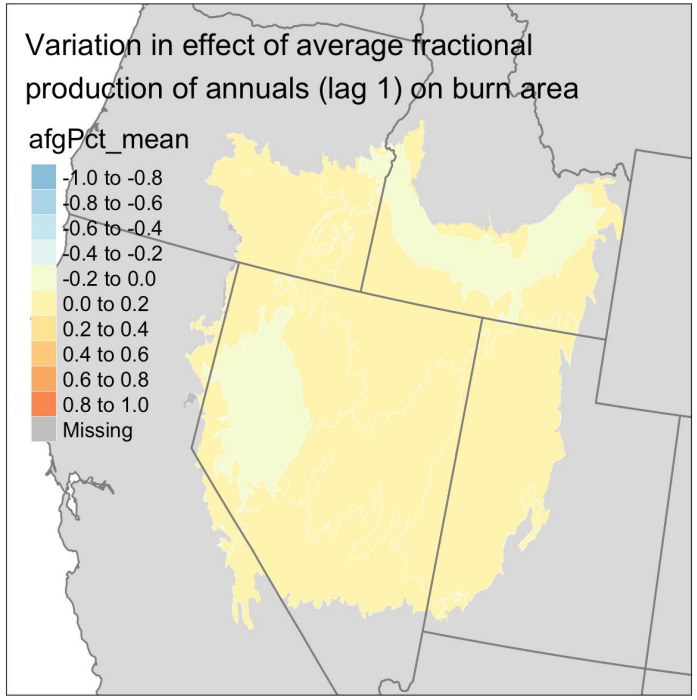


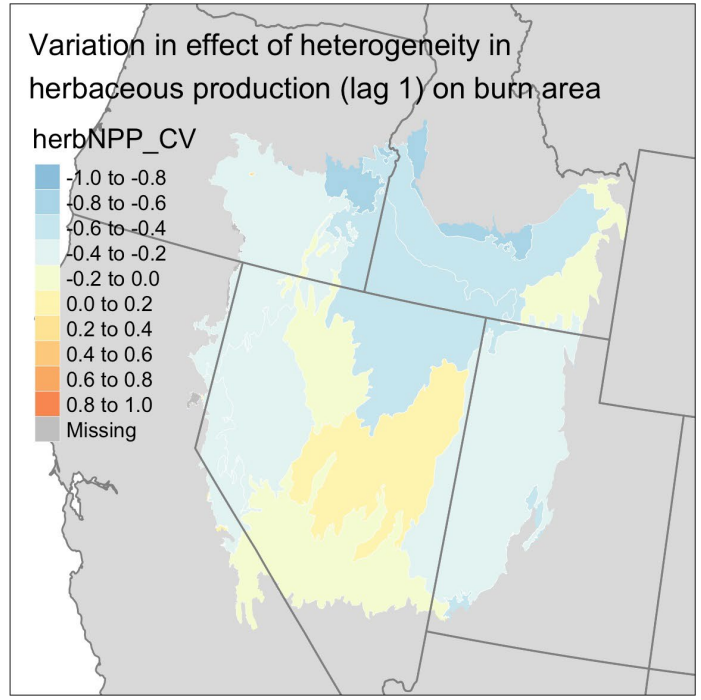
# Test runs:

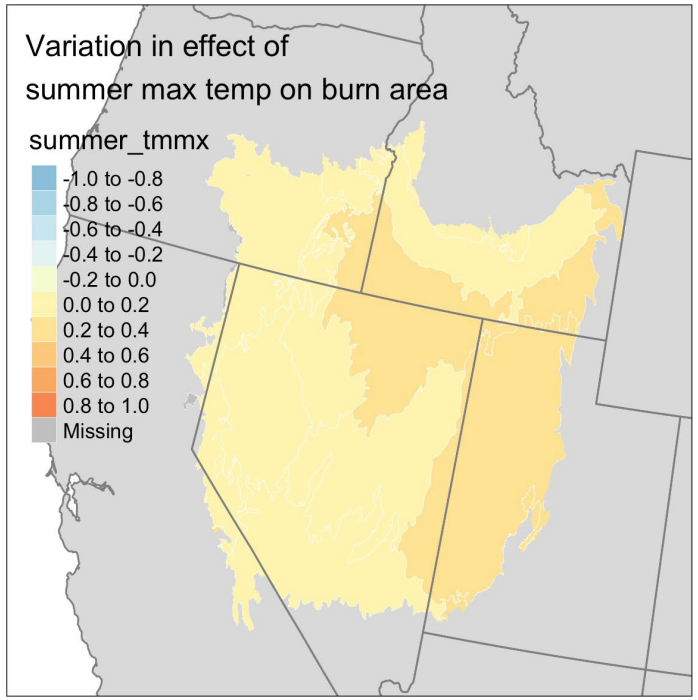
- Scale: watersheds (HUC10, *n* = 1,009)
- 1987 - 2007

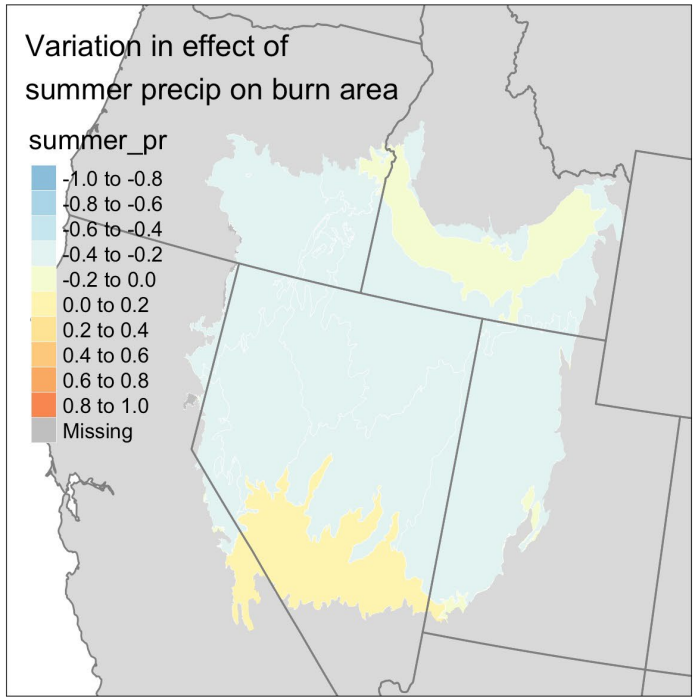
**1987 - 2007**


Variation in effect of average herbaceous production (lag 1) on burn area
herbNPP_mean
-1.0 to -0.8
-0.8 to -0.6
-0.6 to -0.4
-0.4 to -0.2
-0.2 to 0.0
0.0 to 0.2
0.2 to 0.4
0.4 to 0.6
0.6 to 0.8
0.8 to 1.0
Missing


Variation in effect of average fractional production of annuals (lag 1) on burn area
afgPct_mean
-1.0 to -0.8
-0.8 to -0.6
-0.6 to -0.4
-0.4 to -0.2
-0.2 to 0.0
0.0 to 0.2
0.2 to 0.4
0.4 to 0.6
0.6 to 0.8
0.8 to 1.0
Missing


Variation in effect of heterogeneity in herbaceous production (lag 1) on burn area
herbNPP_CV
-1.0 to -0.8
-0.8 to -0.6
-0.6 to -0.4
-0.4 to -0.2
-0.2 to 0.0
0.0 to 0.2
0.2 to 0.4
0.4 to 0.6
0.6 to 0.8
0.8 to 1.0
Missing


Variation in effect of summer max temp on burn area
summer_tmmx
-1.0 to -0.8
-0.8 to -0.6
-0.6 to -0.4
-0.4 to -0.2
-0.2 to 0.0
0.0 to 0.2
0.2 to 0.4
0.4 to 0.6
0.6 to 0.8
0.8 to 1.0
Missing


Variation in effect of summer precip on burn area
summer_pr
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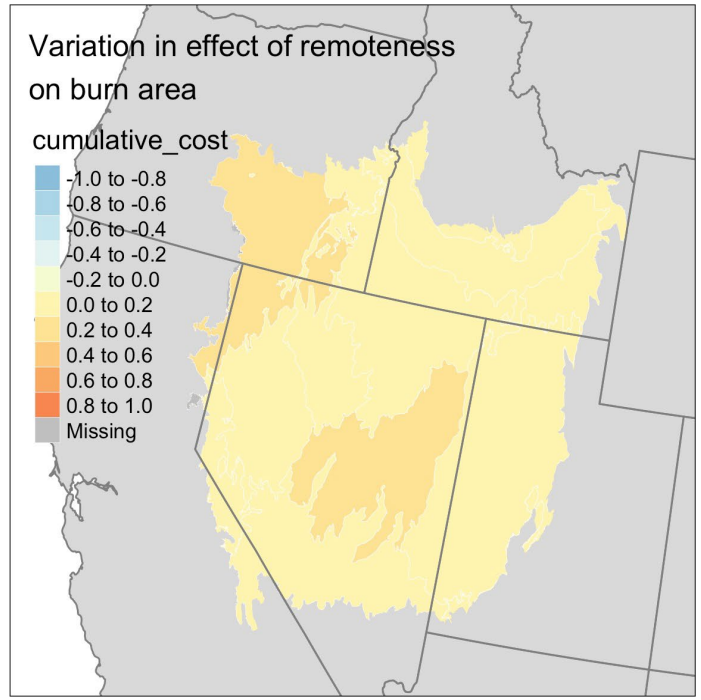
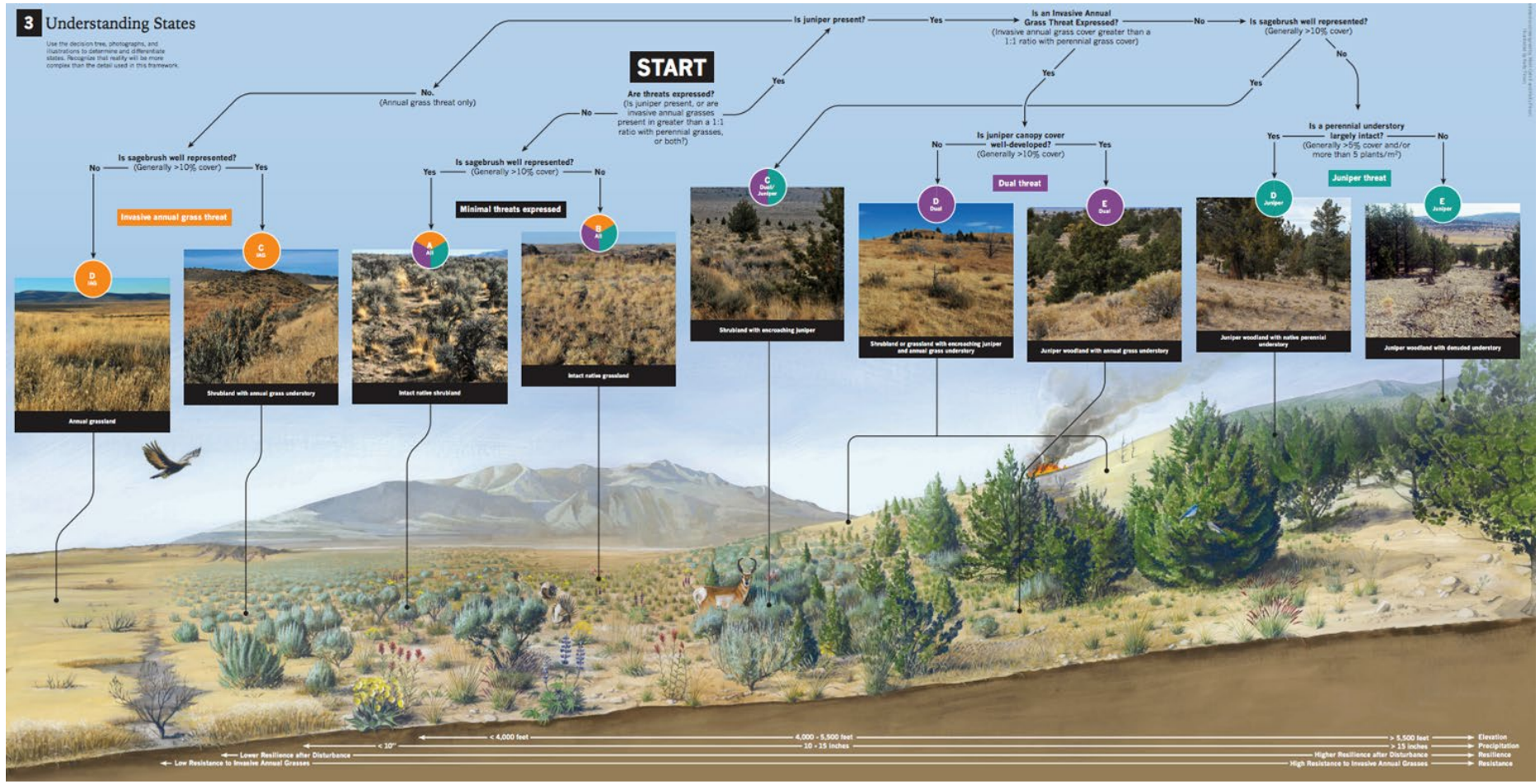
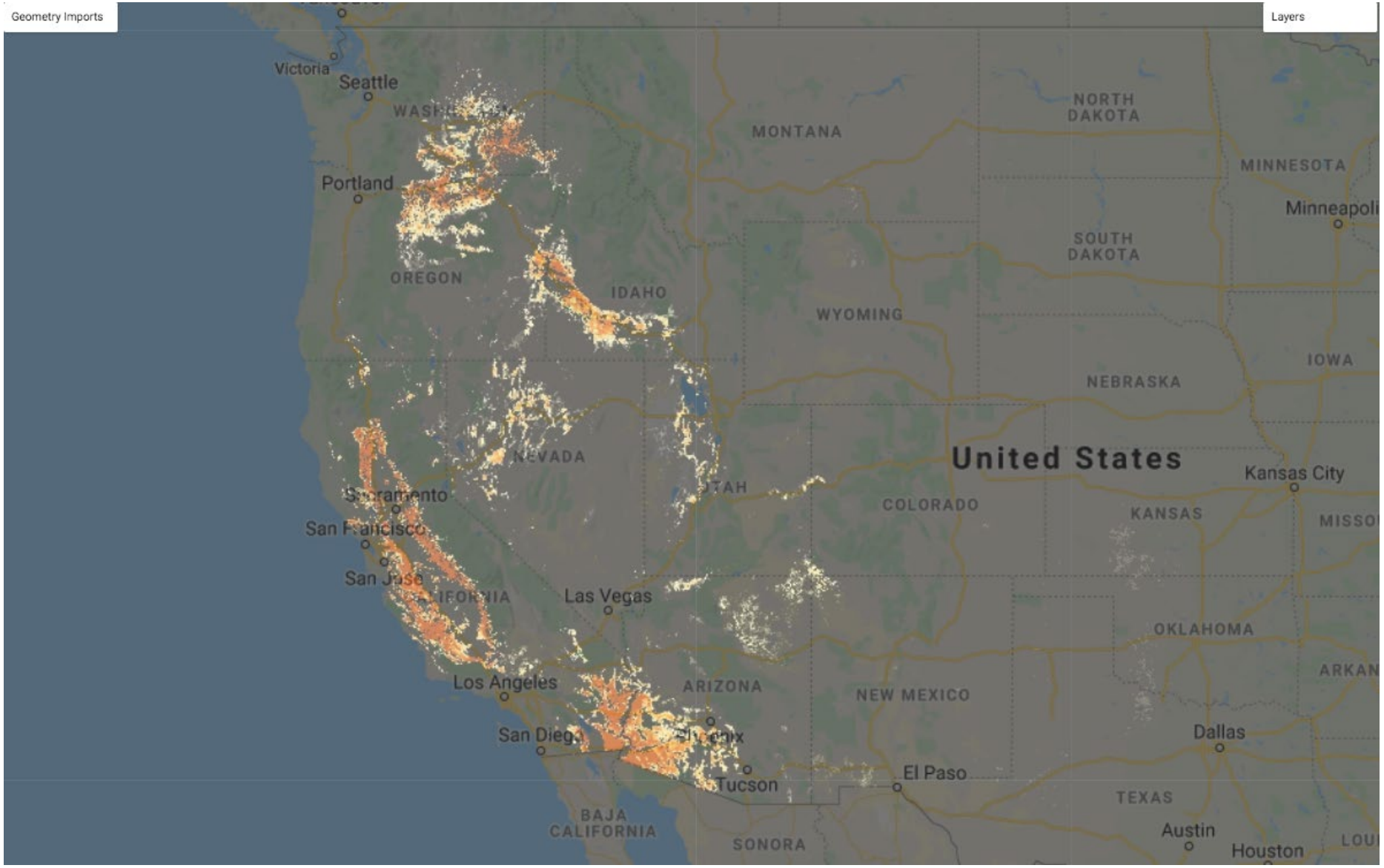
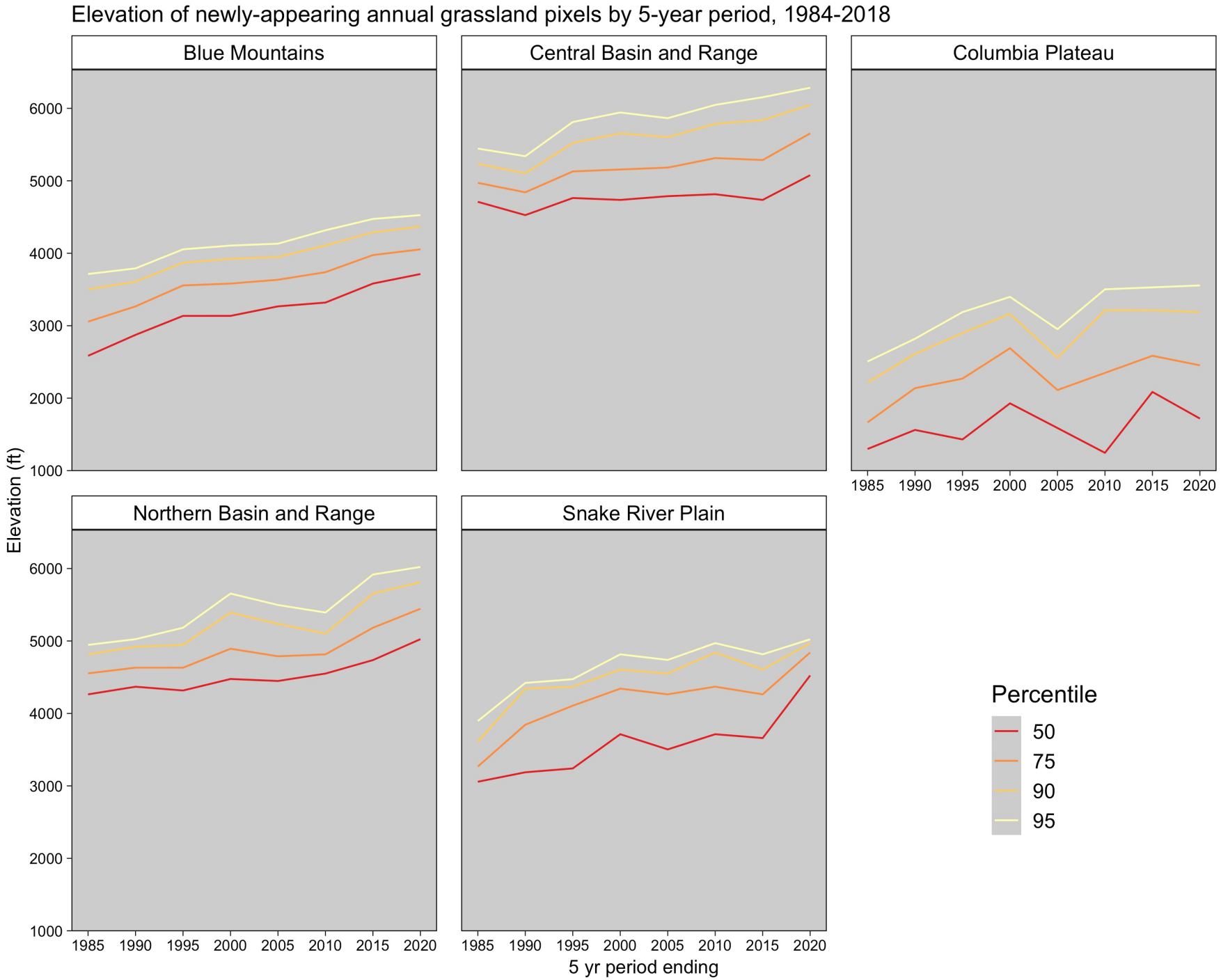
-0.8 to -0.6
-0.6 to -0.4
-0.4 to -0.2
-0.2 to 0.0
0.0 to 0.2
0.2 to 0.4
0.4 to 0.6
0.6 to 0.8
0.8 to 1.0
Missing


Variation in effect of remoteness on burn area
cumulative_cost
-1.0 to -0.8
-0.8 to -0.6
-0.6 to -0.4
-0.4 to -0.2
-0.2 to 0.0
0.0 to 0.2
0.2 to 0.4
0.4 to 0.6
0.6 to 0.8
0.8 to 1.0
Missing


3 Understanding States
Use the decision tree, photographs, and illustrations to determine and differentiate states. Recognize that reality will be more complex than the detail used in this framework.
START
Are threats expressed? (Is juniper present, or are invasive annual grasses present in greater than a 1:1 ratio with perennial grasses, or both?)
Is juniper present?
Yes
No
(Annual grass threat only)
Is an Invasive Annual Grass Threat Expressed? (Invasive annual grass cover greater than a 1:1 ratio with perennial grass cover)
Is sagebrush well represented? (Generally >10% cover)
Is sagebrush well represented? (Generally >10% cover)
Is sagebrush well represented? (Generally >10% cover)
Is juniper canopy cover well-developed? (Generally >10% cover)
Is a perennial understory largely intact? (Generally >5% cover and/or more than 5 plants/m²)
Invasive annual grass threat
Minimal threats expressed
Dual threat
Juniper threat
D IAG
C IAG
A All
B All
C Dual/ Juniper
D Dual
E Dual
D Juniper
E Juniper
Annual grassland
Shrubland with annual grass understory
Intact native shrubland
Intact native grassland
Shrubland with encroaching juniper
Shrubland or grassland with encroaching juniper and annual grass understory
Juniper woodland with annual grass understory
Juniper woodland with native perennial understory
Juniper woodland with denuded understory
< 4,000 feet
4,000 - 5,500 feet
> 5,500 feet
Elevation
< 10"
10 - 15 inches
> 15 inches
Precipitation
Lower Resilience after Disturbance
Higher Resilience after Disturbance
Resilience
Low Resistance to Invasive Annual Grasses
High Resistance to Invasive Annual Grasses
Resistance

No. years classified as annual grassland, 1984–2018




Elevation of newly-appearing annual grassland pixels by 5-year period, 1984-2018
Blue Mountains
Central Basin and Range
Columbia Plateau
Northern Basin and Range
Snake River Plain
Elevation (ft)
1000
2000
3000
4000
5000
6000
1985
1990
1995
2000
2005
2010
2015
2020
5 yr period ending
Percentile
50
75
90
95