# Can we keep invasive plants at bay by restoring with competitive native plants?

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# Is there something special about these plants?

# Outline

- Review ideas about rates of evolutionary change
- Experiments:
  - Are native species adapting to cheatgrass?
    - What traits help native grasses persist in cheatgrass invaded systems?
    - Can any plant affect cheatgrass???
- Implications for conservation, restoration and seed source choice

# Classic views of evolution

- Evolutionary change by natural selection is slow and gradual

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- Observations of artificial selection proof that evolution *can* work

# Examples of contemporary evolution

- Herbicide and pesticide resistance
- Mine tailings
- Invasive species
- ★Native species in response to invaders

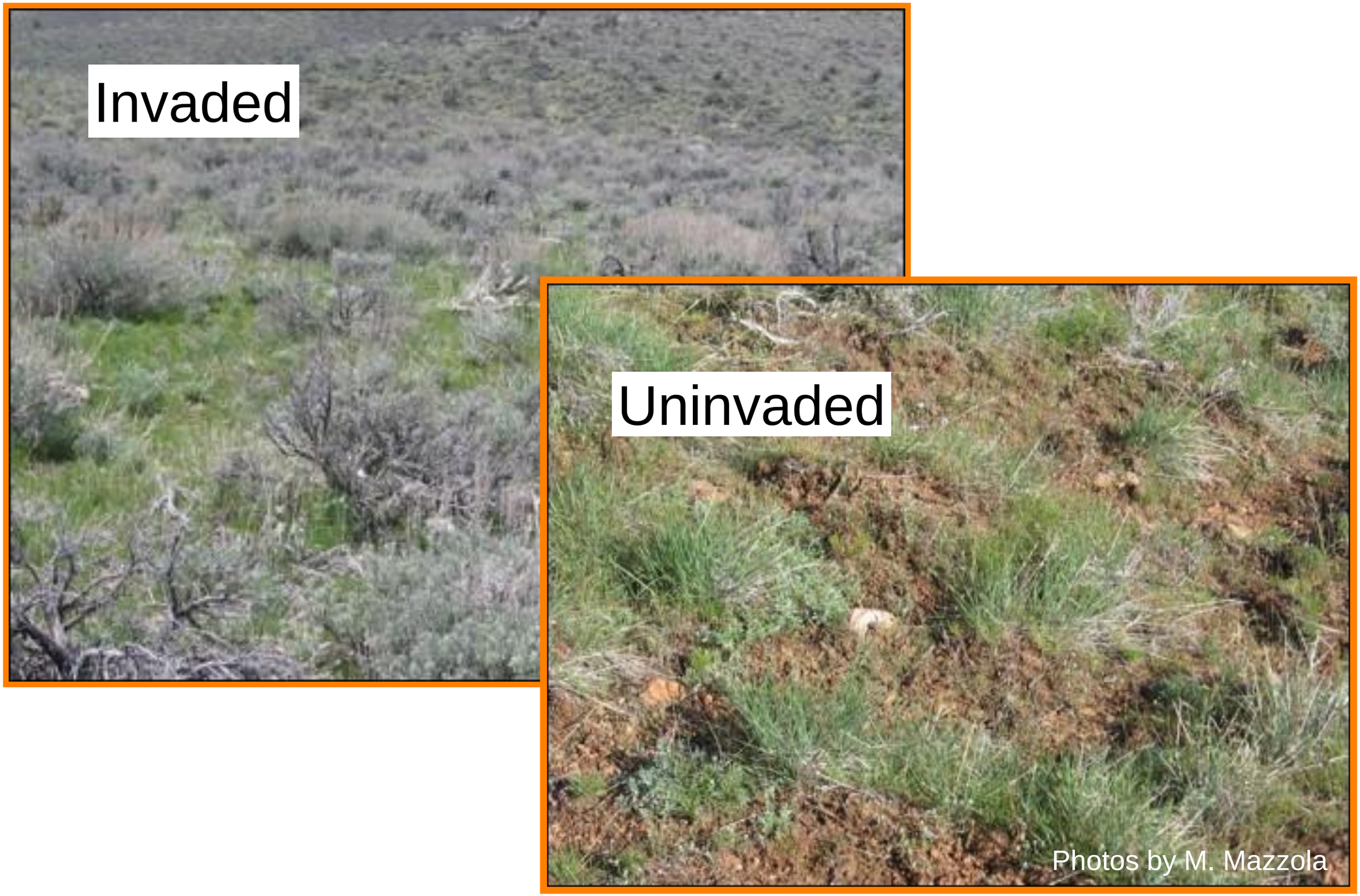
# Why should we care?

- Bodes well for long term diversity of invaded systems
- Possible that contemporary evolution in remnant natives can be used to improve restoration and weed control

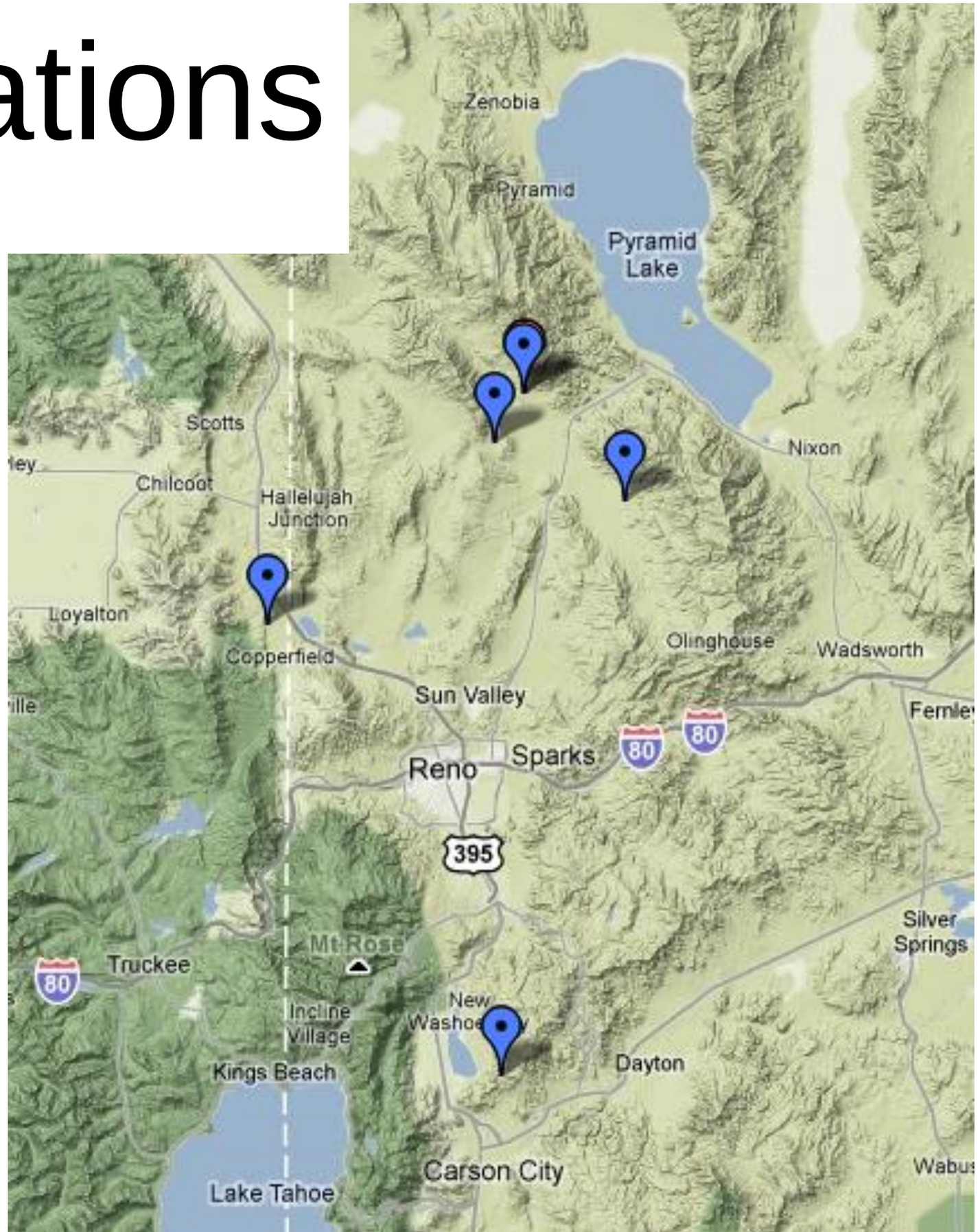
# Three goals:

1. Look for evidence that native plants can evolve in response to invaders
2. Identify what traits help native plants establish and persist in cheatgrass areas
3. Identify which species and individuals compete strongly with cheatgrass

# Studying invasions along boundaries


Invaded
Uninvaded
Photos by M. Mazzola

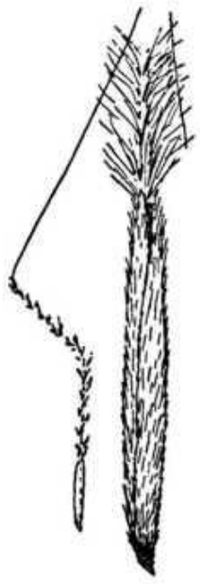
# 5 study locations



# Five perennial grasses

*E. multisetus*

*Poa secunda*



*Achnatherum thurberianum*

*Hesperostipa comata*

*Achnatherum hymenoides*

Collect adult plants from invaded and uninvaded locations

Split individual plants in half

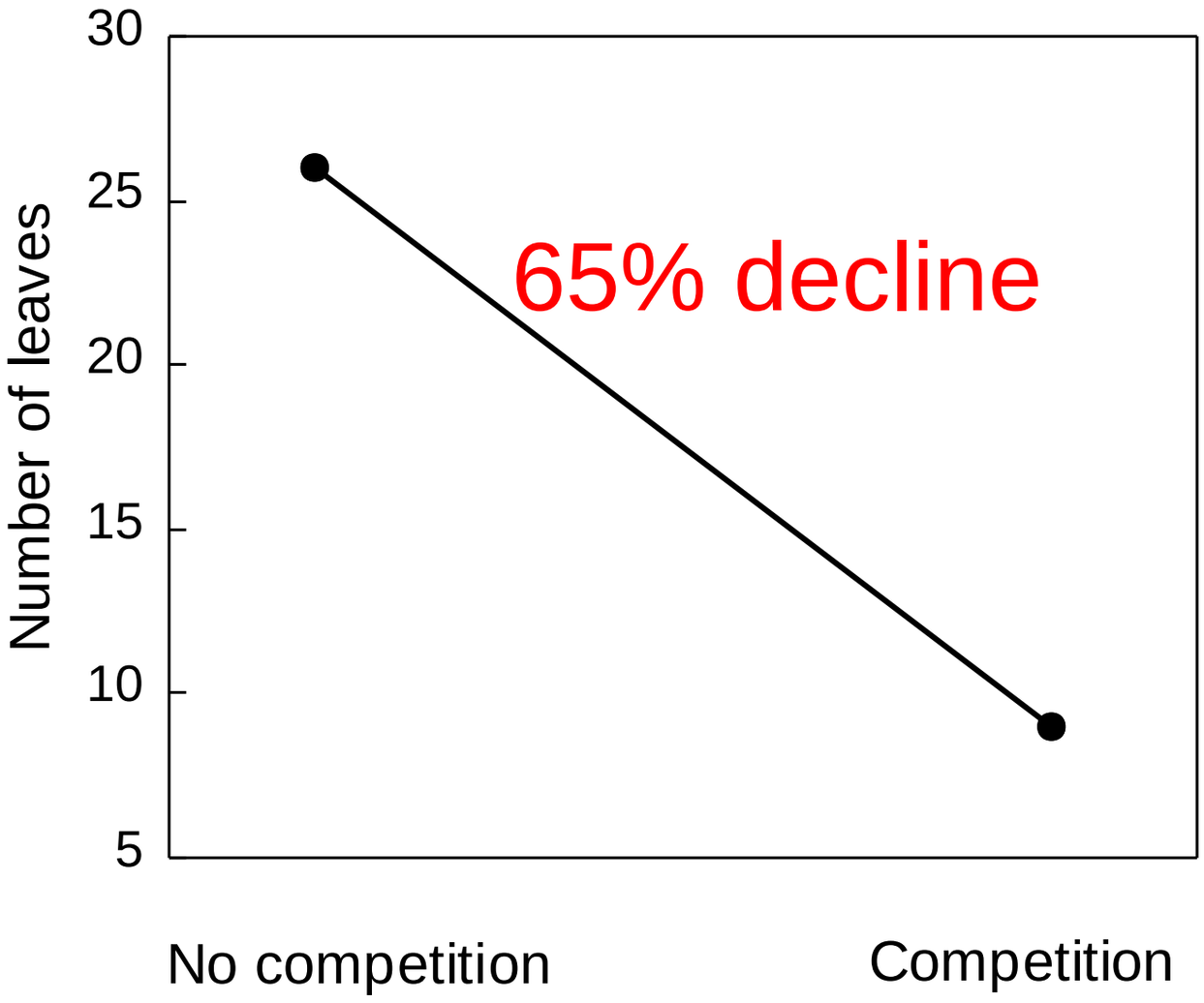
# Competition treatment

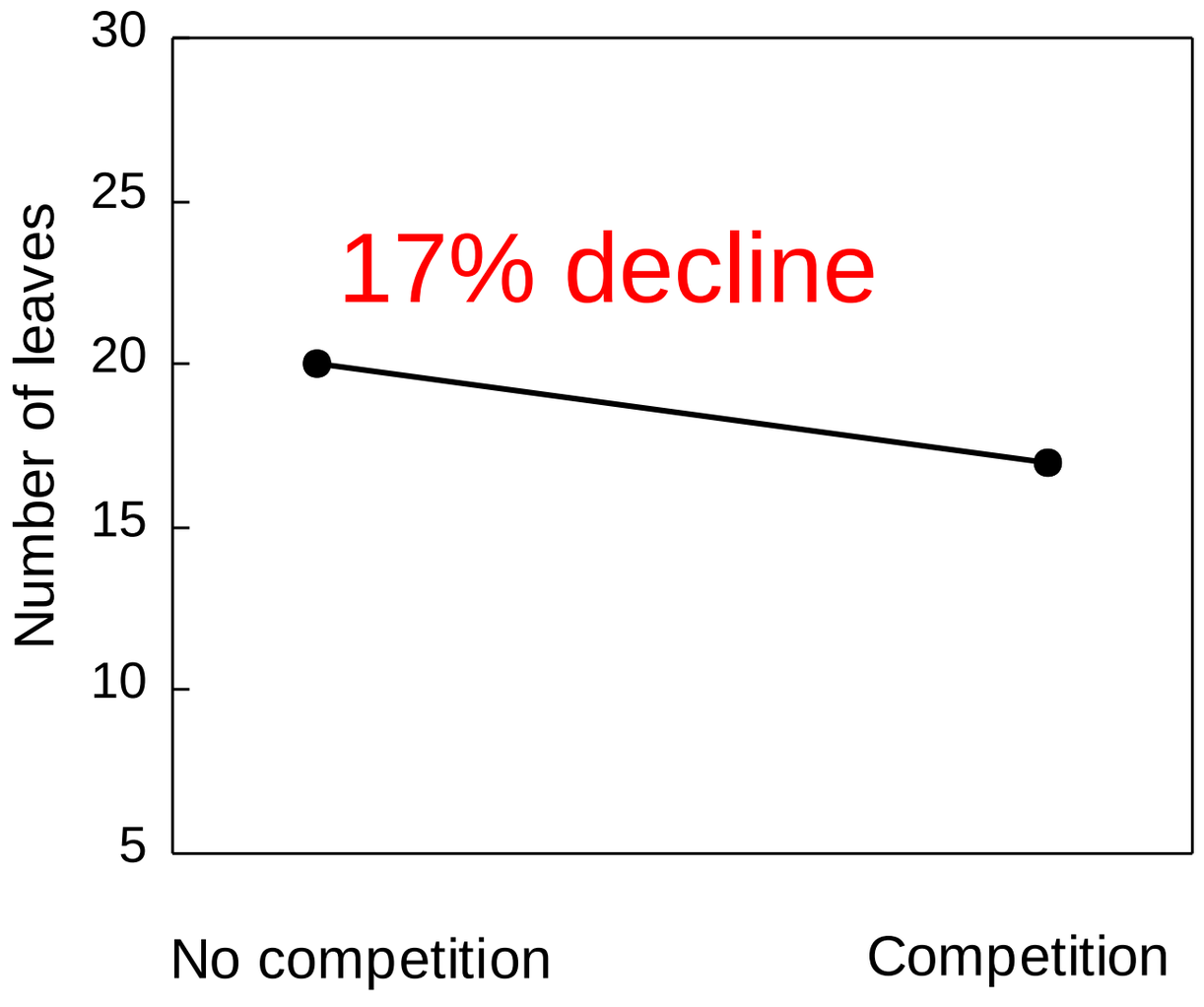
Treat one half of each individual (a pot) with cheatgrass (~150 seeds)

Grow until cheatgrass set seed (November-May)

Compare competitive abilities of individual plants

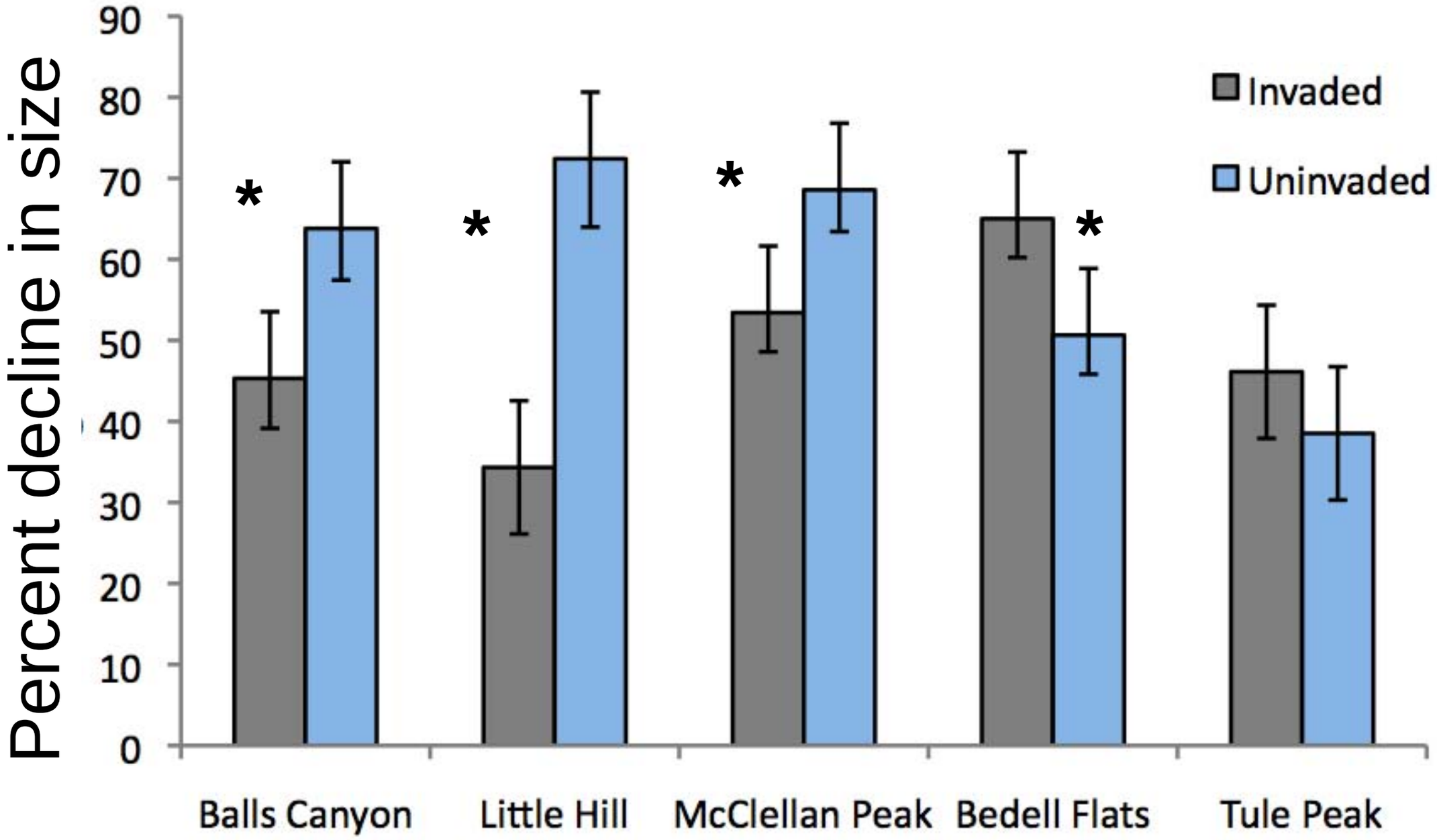
# Compare the percent decline in size when grown with competition



# 1. Are plants from invaded areas more competitive?

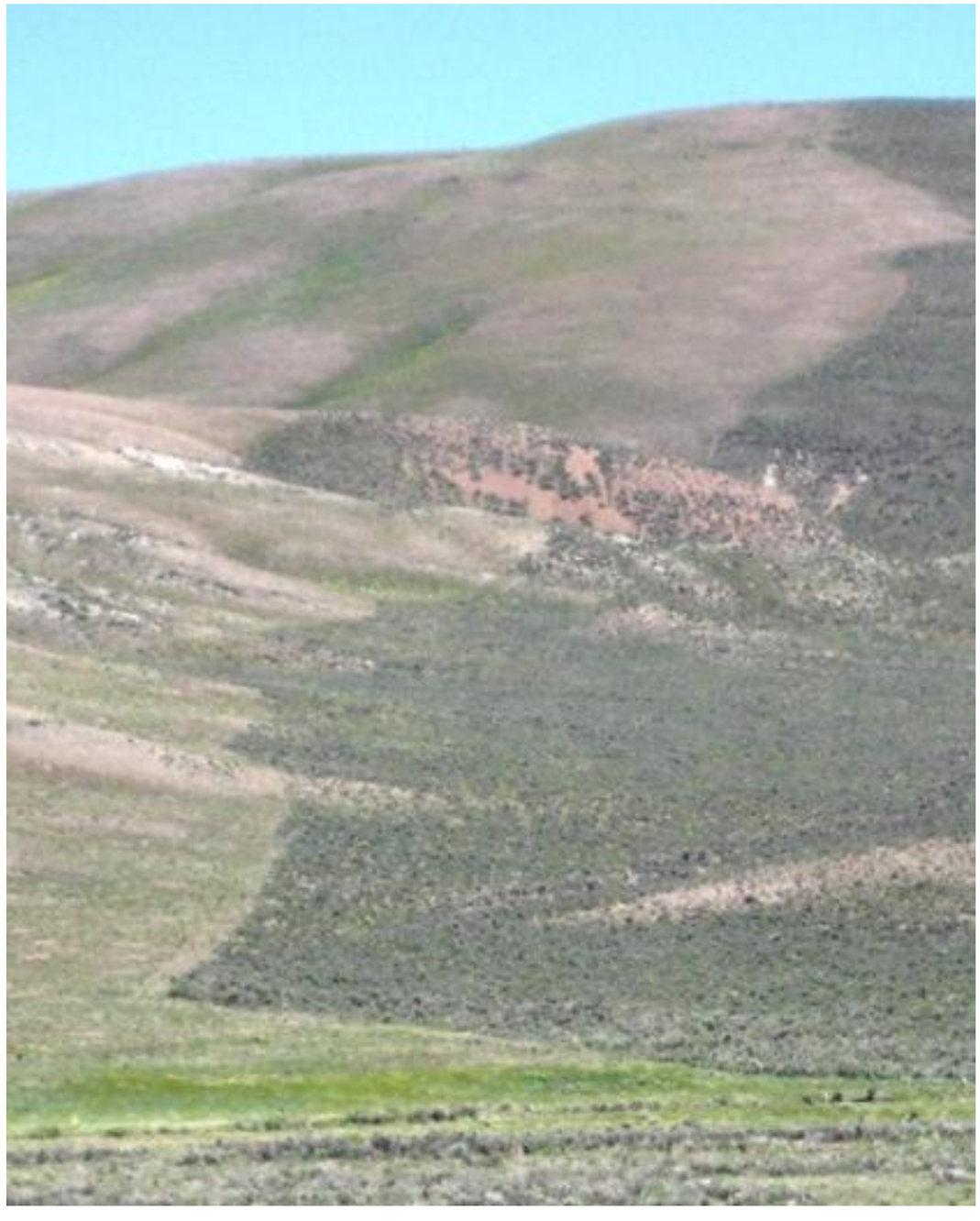
# Three out of five dentists agree



# 2. What are good traits?

# Two ways to figure this out:

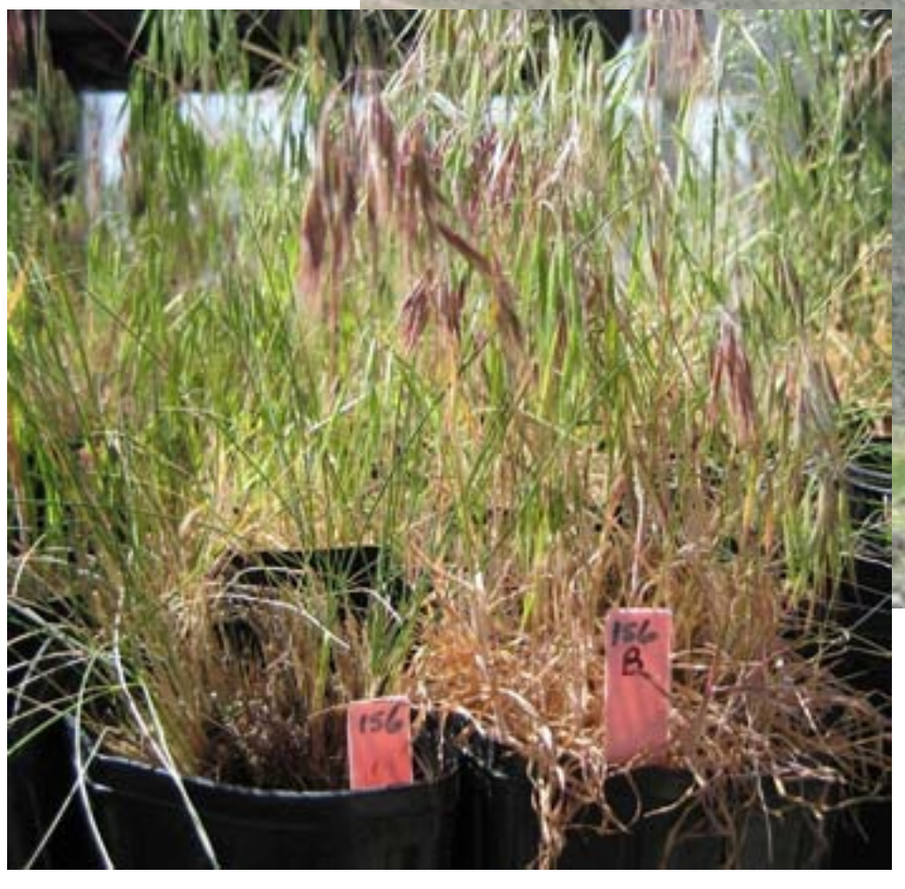
- Look for shifts in invaded/uninvaded populations



# Two ways to figure this out:

- Look for shifts in invaded/uninvaded populations
- Brute force method

screen a bunch of plants, see who performs best, then figure out why



# 2. What are good traits?

- Early green-up (adults)
- Early germination (seedlings)

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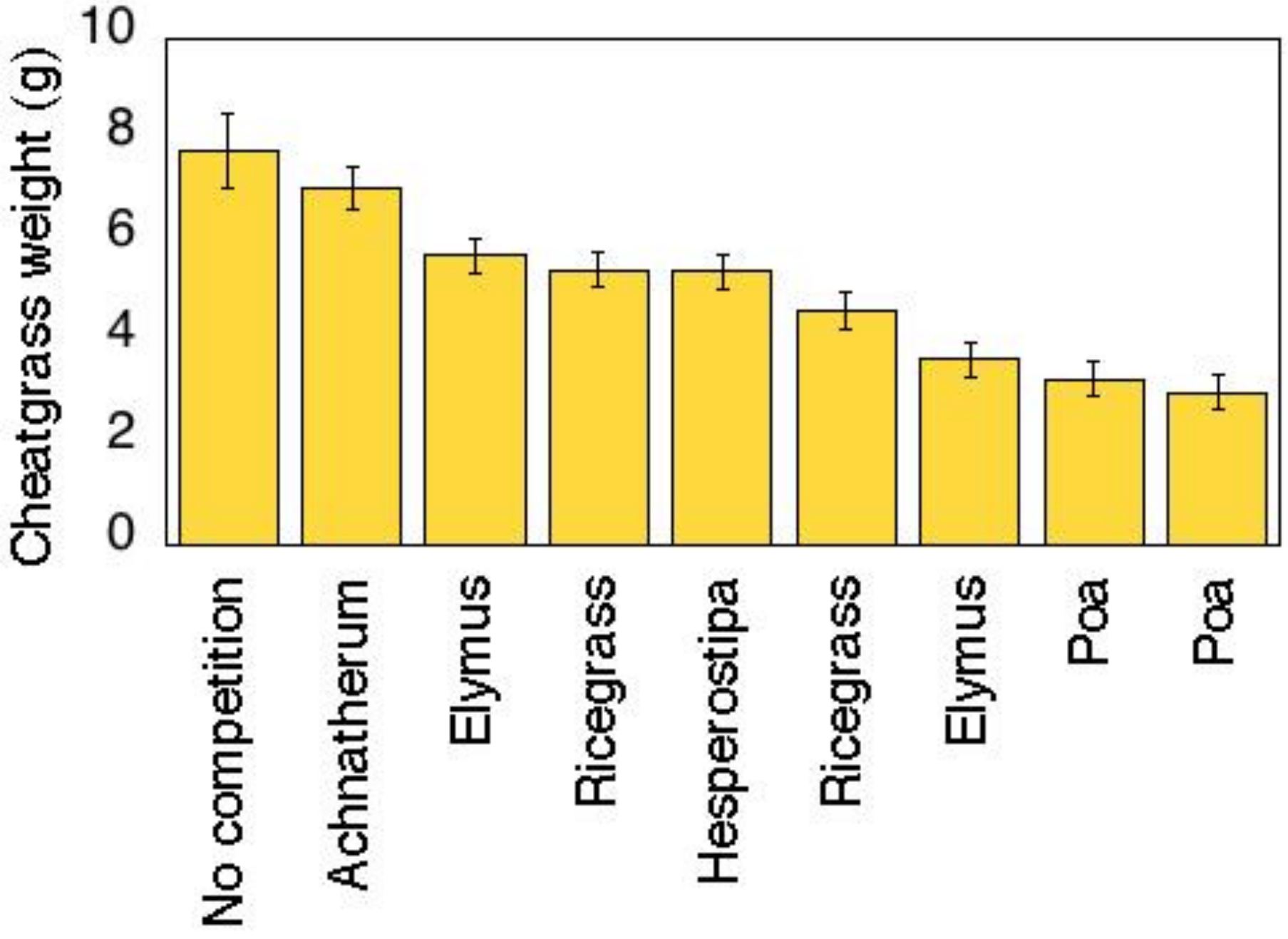
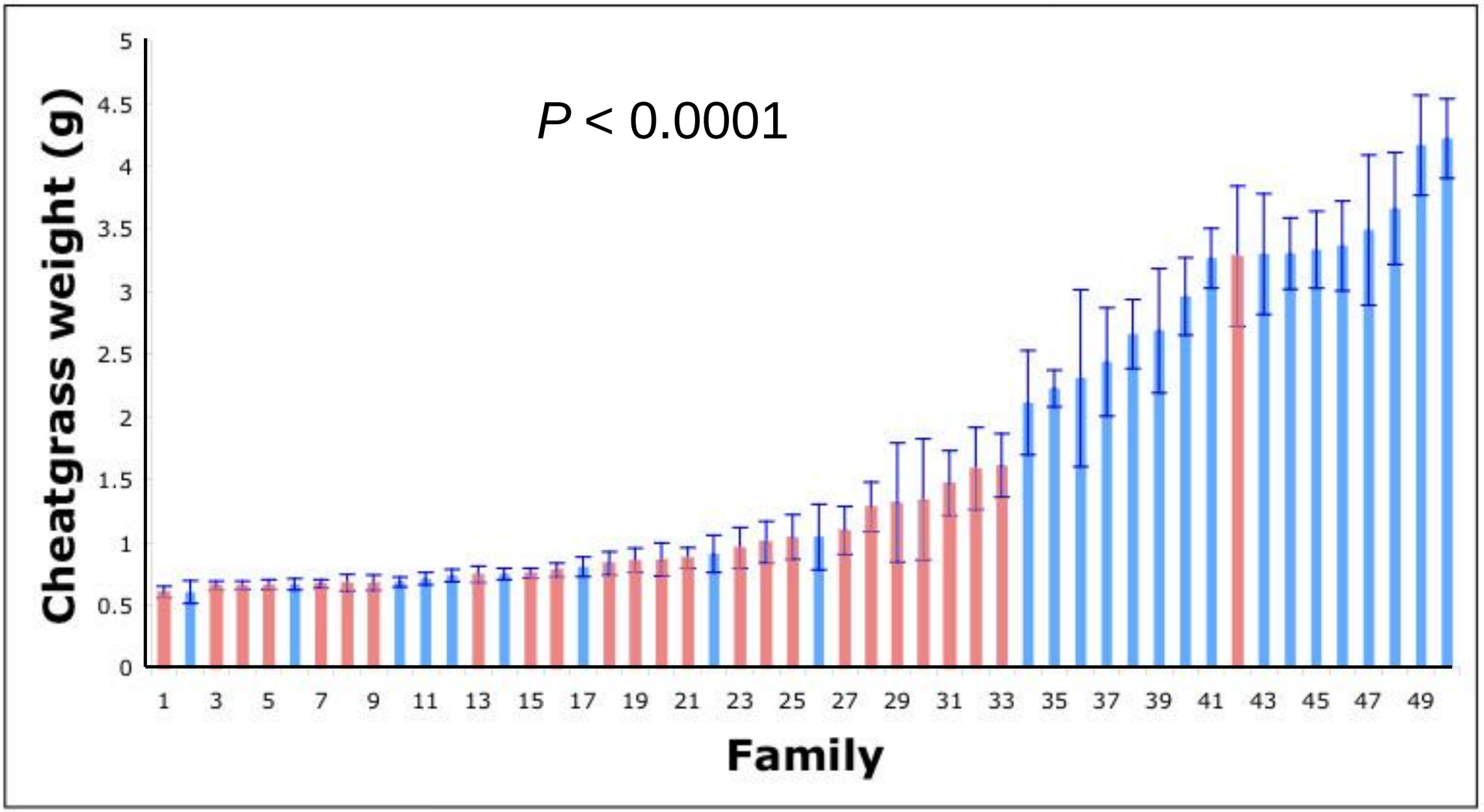
- Early green-up (adults)
- Early germination (seedlings)
- Early root growth (seedlings)
- Increased fine root production
- Increased root allocation


# 3. Who can stop cheatgrass?

# Cheatgrass weights, by species



# Individual *Elymus* plants differ in affect on cheatgrass



# Summary so far...

- In 3/5 locations, perennial grasses from invaded areas are more competitive with cheatgrass than naïve plant
- It is possible to identify potentially adaptive traits
- Some species, and some individual plants, are capable of affecting weeds more than others

# 3. Implications of rapid, adaptive change?

- How does this affect conservation priorities?
- How should this affect restoration material?
  - selection of materials for increase
  - artificial selection for competitive traits

# Conservation protocols

## Don’t give up on small, ugly populations

- Populations harboring competitive plants may be important!
- Conserving their evolutionary processes may also be important

# Importance for seed selection

- Restoration material may differ in ability to compete with weeds
- Rapidly evolving populations may be a source for valuable seed collections
- Alternately, rapidly evolving populations may identify traits that are of value in real-life situations
  - these traits could be targeted in breeding programs

# Conclusions and recommendations

- Cheatgrass has been here for a very short time, yet some native grasses may be adapting to grow with it
- Not all plants are equal competitors- select seeds based on particular traits known to be adaptive
- Invaded populations may be valuable sources of seed

# To-do (for us, and in general)

- Why are some populations able to evolve and others aren’t?
- Go multivariate:
  - Look for the ability to compete with more than one weed
  - Look at the effectiveness of species mixtures
  - Test performance of restoration material in combination with control methods
- Take it to the field

# Acknowledgements


- USDA CSREES National Research Initiative
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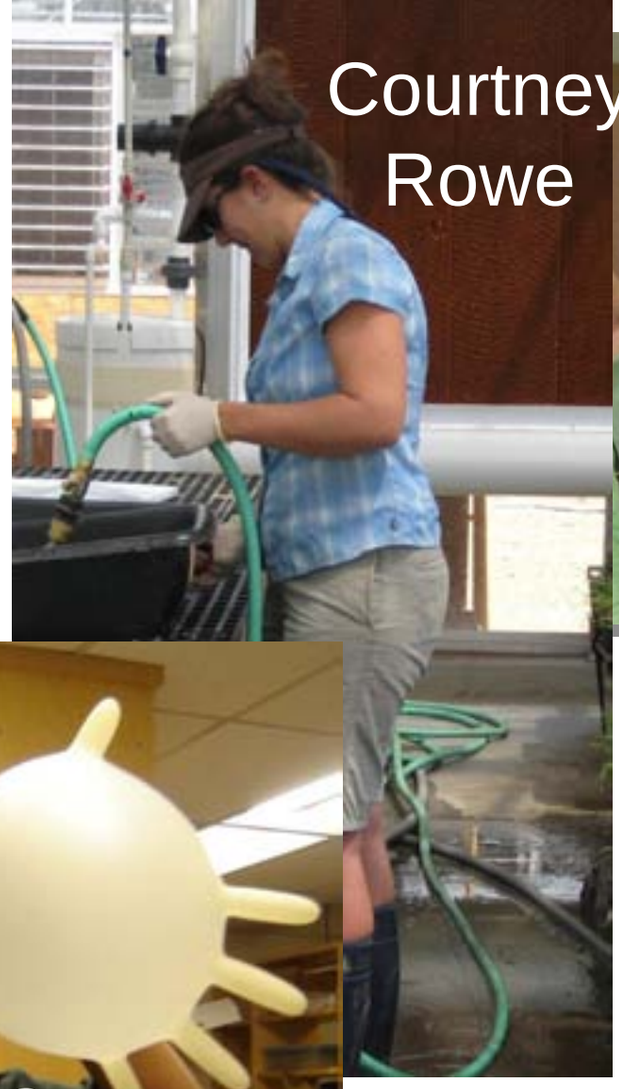
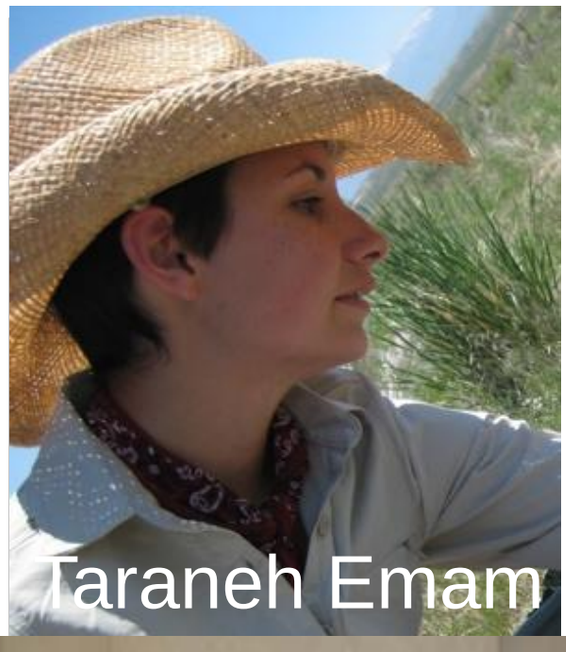
Erin
Espeland


Erin
Goergen


Courtney
Rowe


Kestrel
Schmidt


Hiro Zamma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# Questions


**Squirreltail**


**Native bluegrasses**


**Indian ricegrass**


**Bluebunch wheatgrass**

Young and Larson 2005

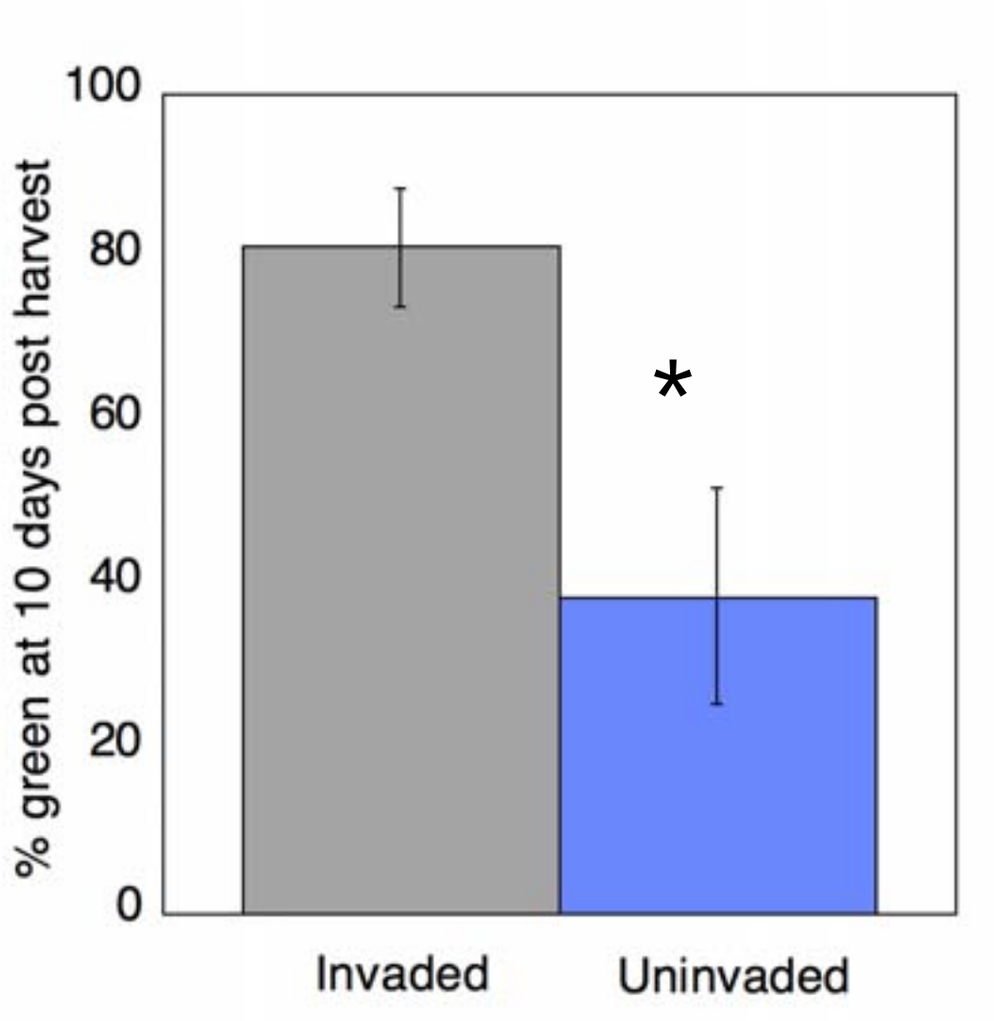

**Snake River wheatgrass**


**Thickspike wheatgrass**


**Basin wildrye**


**Western wheatgrass**

# Overall shift to early green-up in invaded populations

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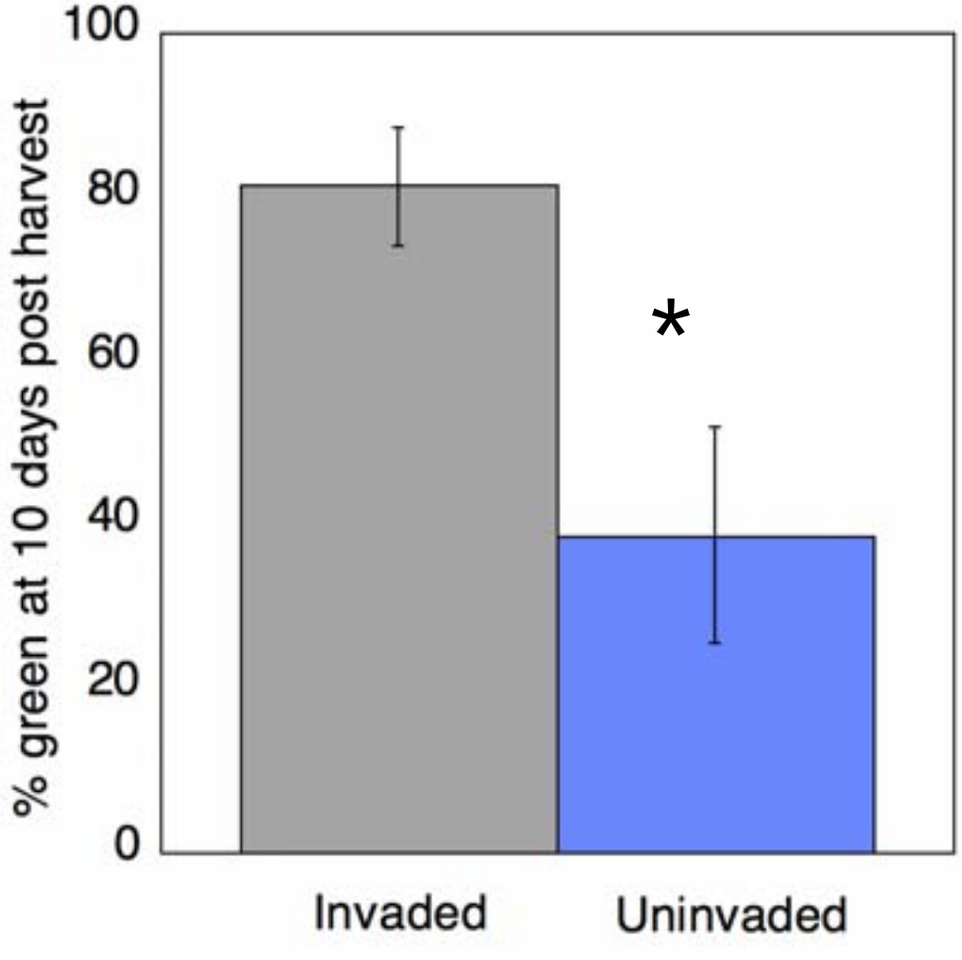


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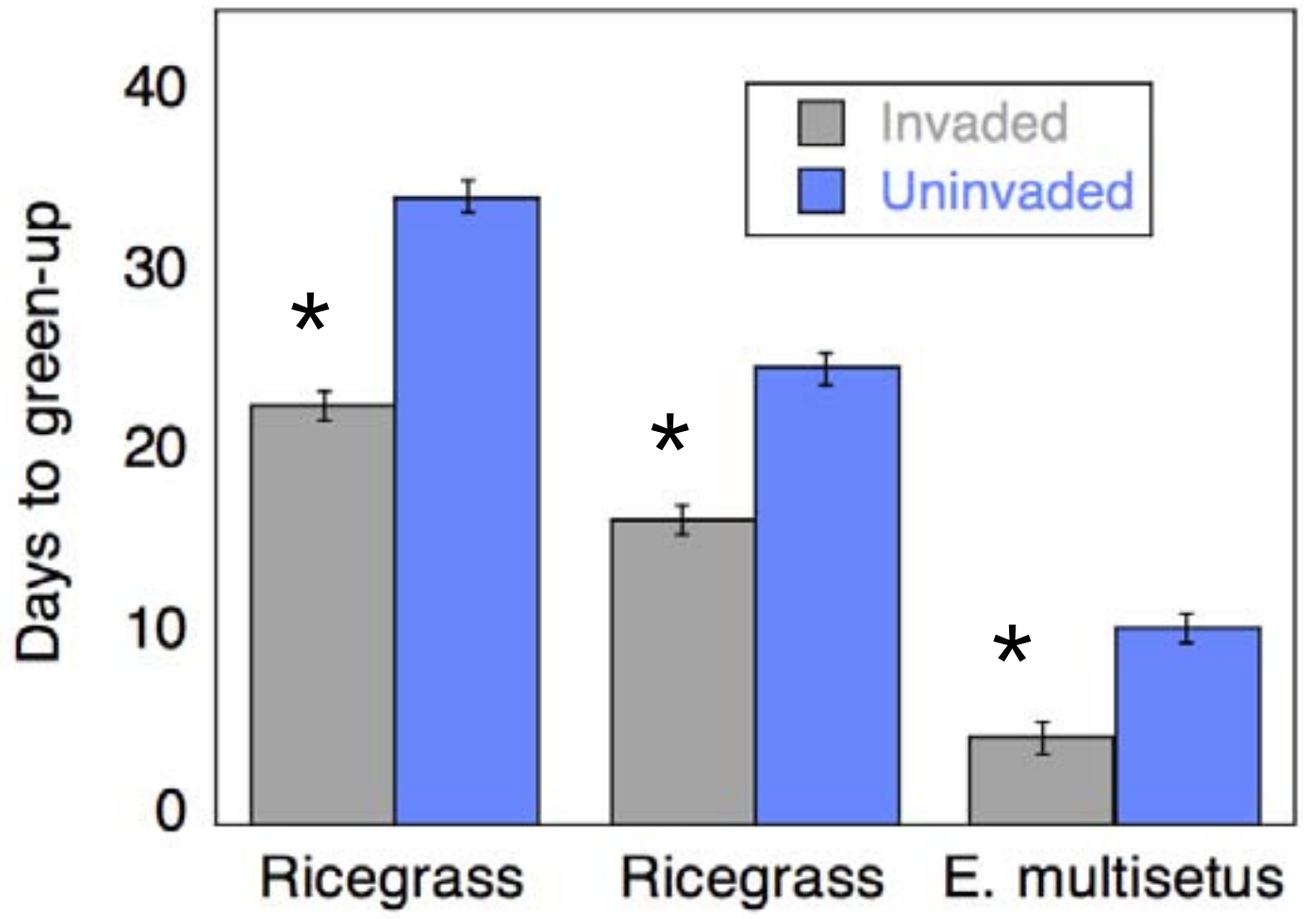
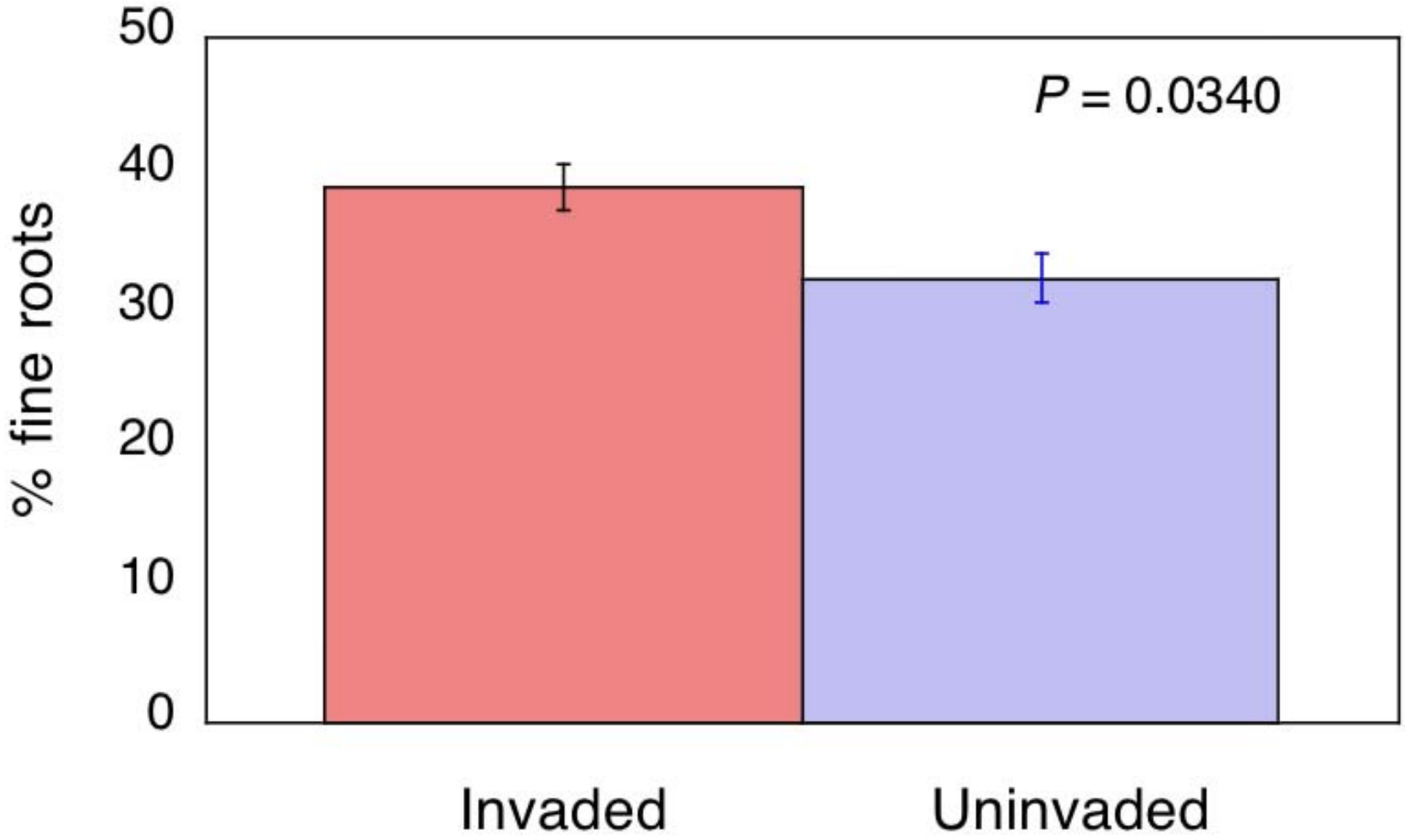
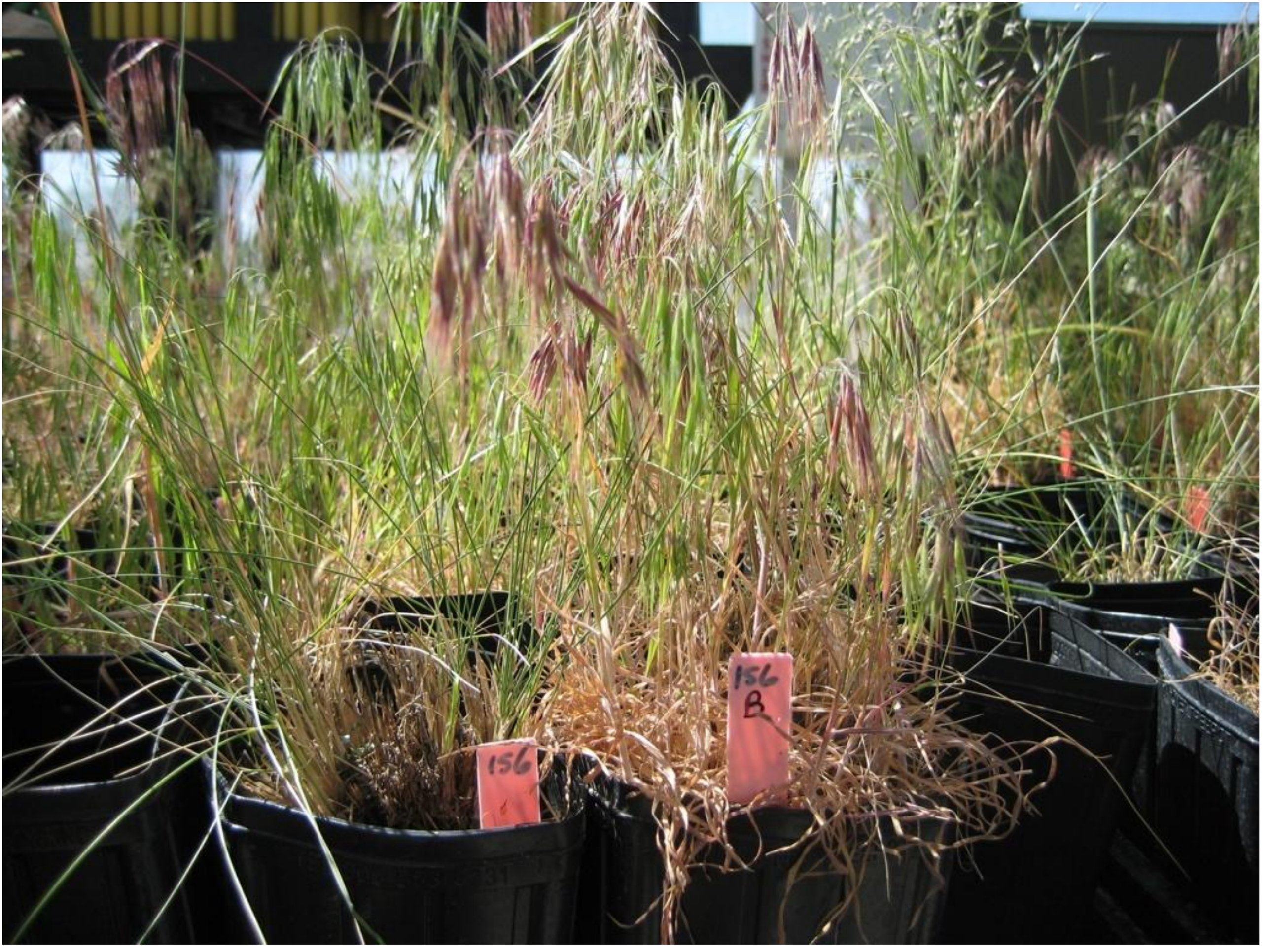



All P < 0.0001

# Invaded plants invest more in fine-root production

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