The susceptibility of strip-seeded restoration sites to invasive species

***Julea A. Shaw**, Leslie M. Roche, Travis Bean, Emilio A. Laca, Andrew P. Rayburn, and Elise S. Gornish*

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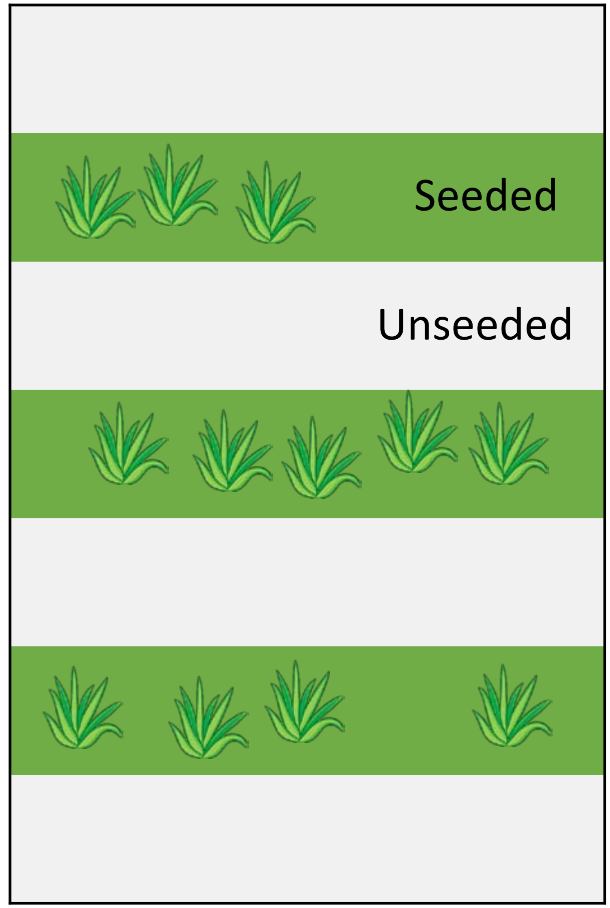
Spatially Patterned Seeding

- Dense patches of native seeds
- Seeded species disperse to non-seeded areas
- Strip seeding
  - Horizontal patches



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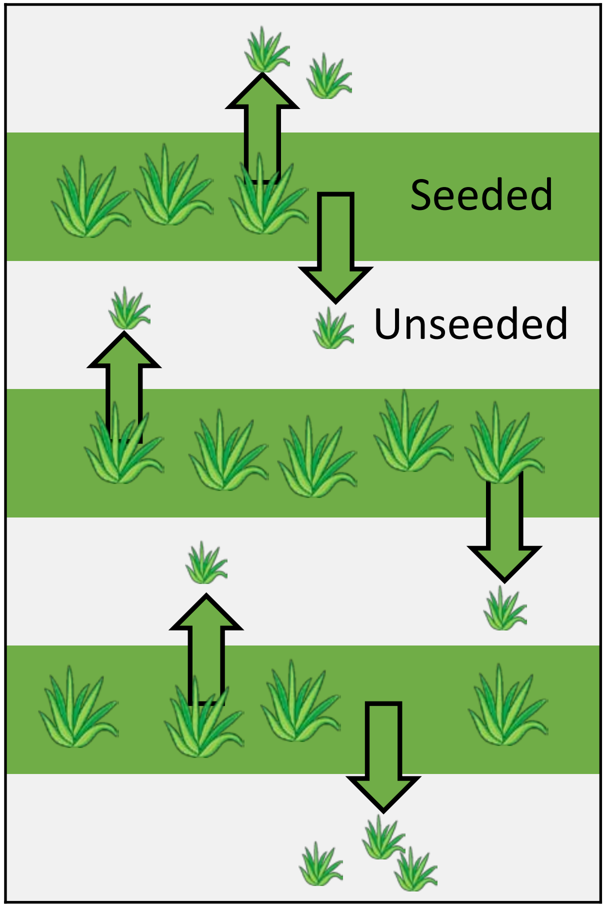

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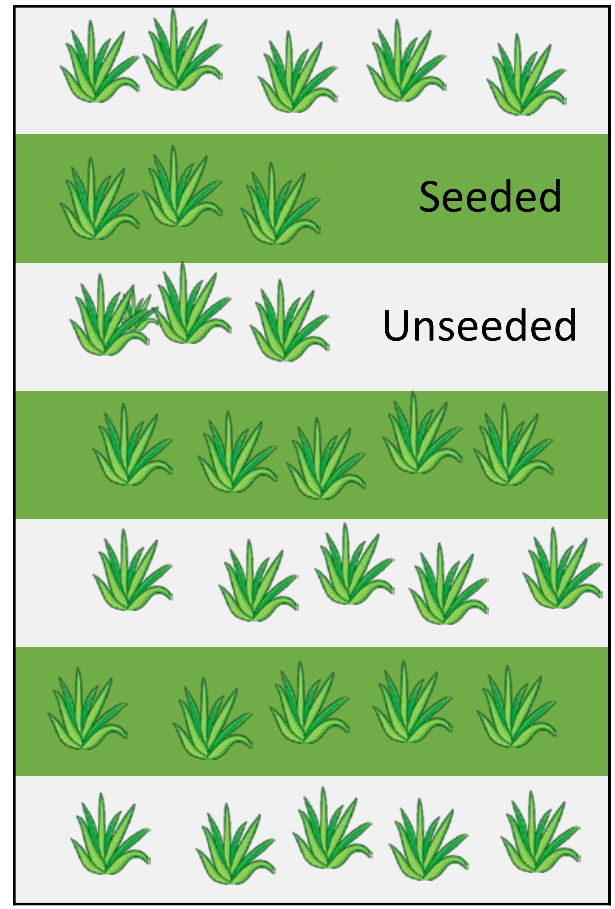

Strip seeding benefits

- Reduced cost
- Increase native diversity and cover
- Reduce invasion success
    - Dense seeding of natives
    - Invasion resistance



Strip seeding benefits

- Lower seed and labor costs
- Increase native diversity and cover
- Reduce invasion success
    - Dense seeding of natives
    - Invasion resistance

Site Description

- UC Davis Research Farm
- Fall 2011: mix of 7 native grass species seeded
    - 6 perennials
    - 1 annual


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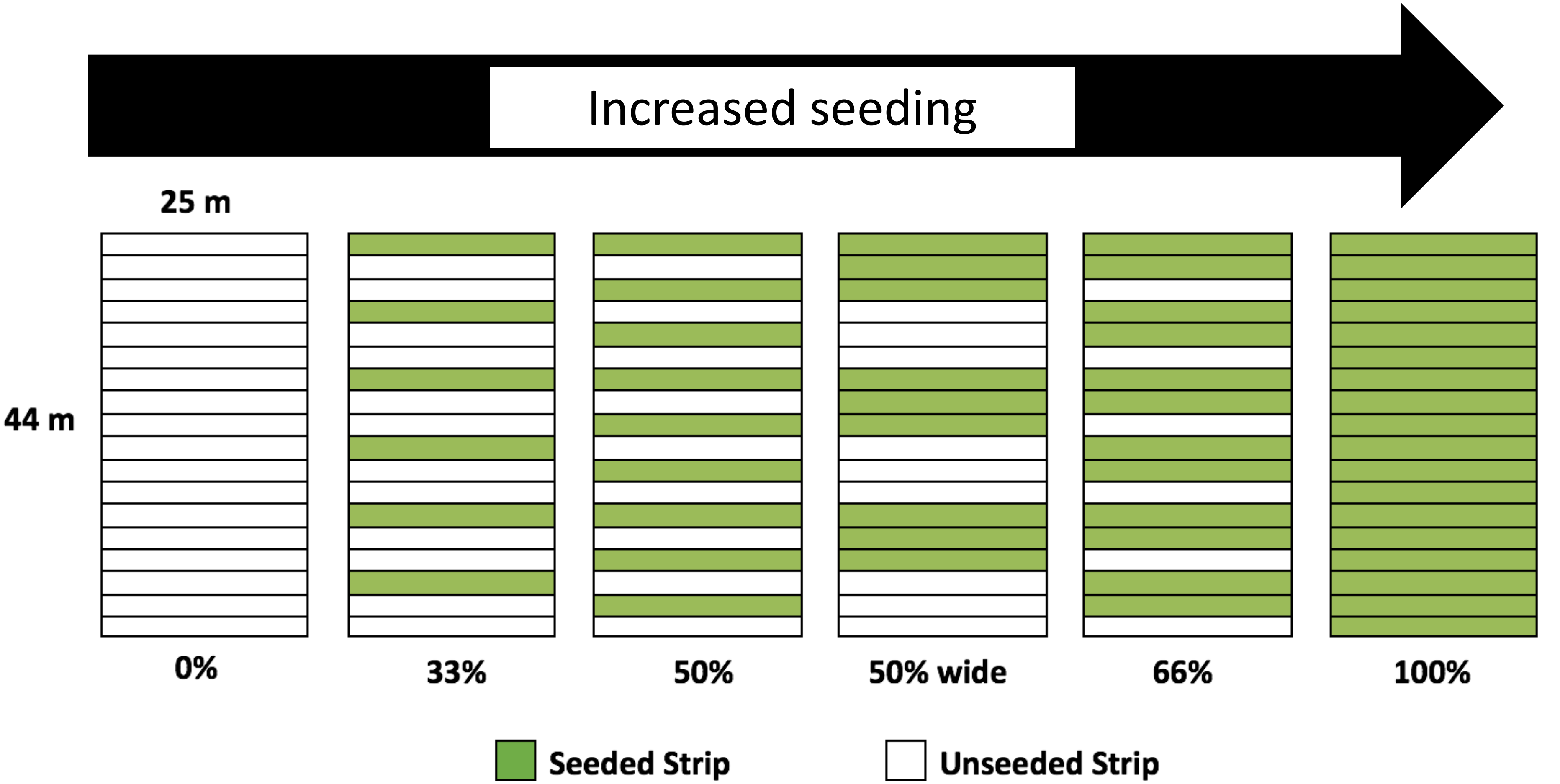
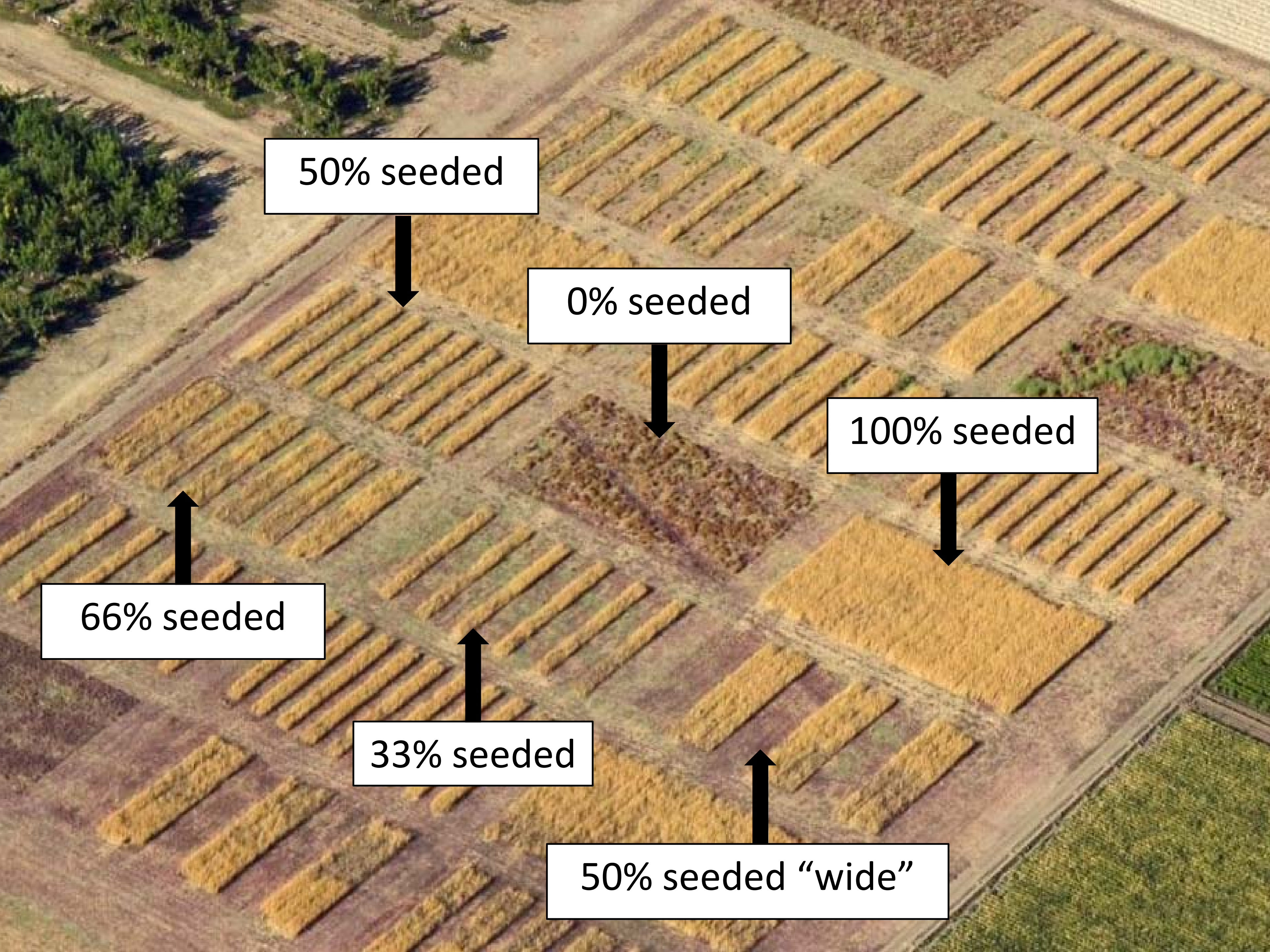
Strip Seeding Treatments



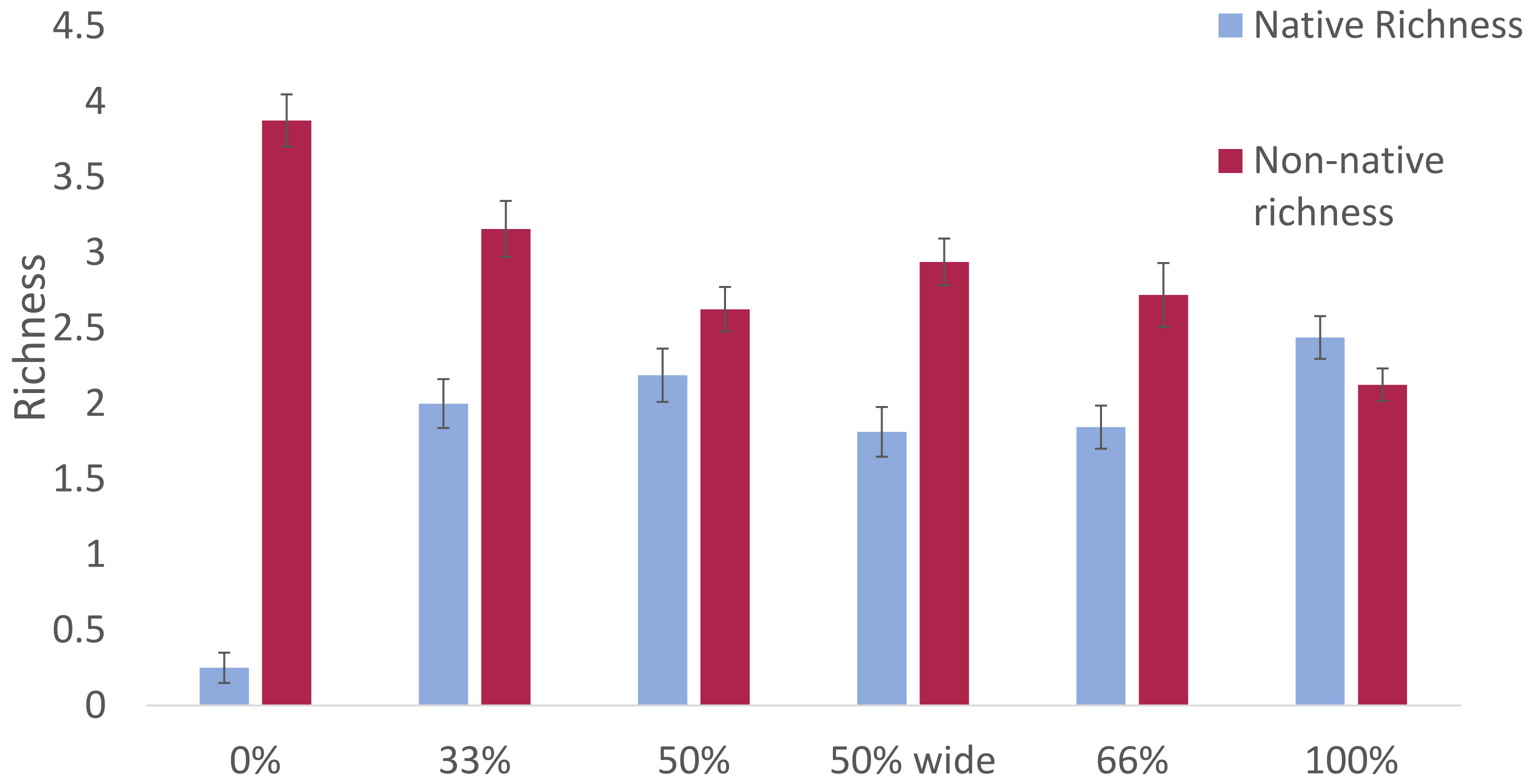
Adapted from Rayburn & Laca 2013


50% seeded
0% seeded
100% seeded
66% seeded
33% seeded
50% seeded “wide”

Question

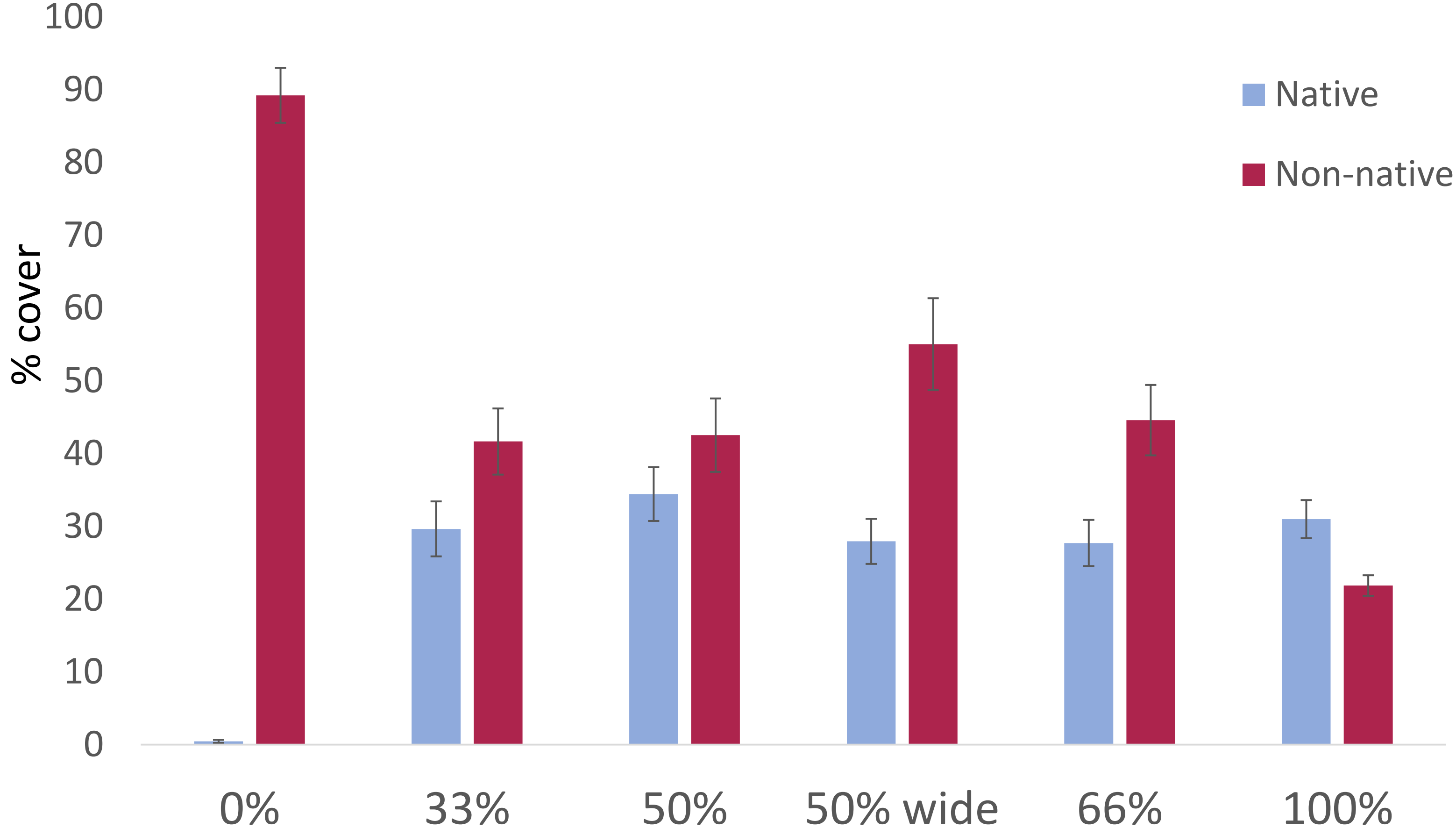
- How does seeding of natives at different levels influence invasion success?
    - Community
    - Invasion resistance
    - Growth and reproduction

Species richness



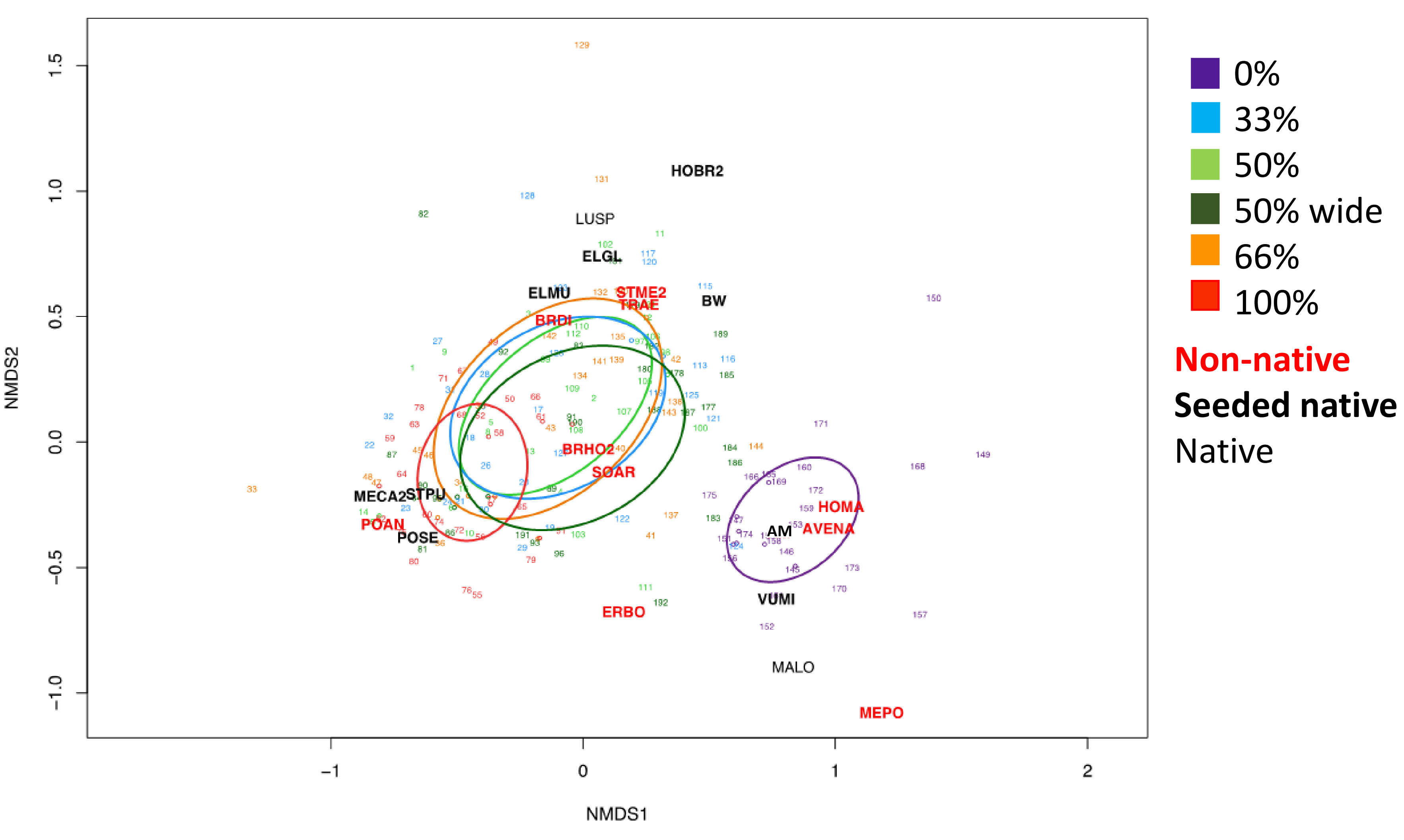
- All seeding treatments reduced non-native richness

Species Abundance



- Decreased non-native cover with seeding

NMDS by Treatment



Most Common Invasive Species

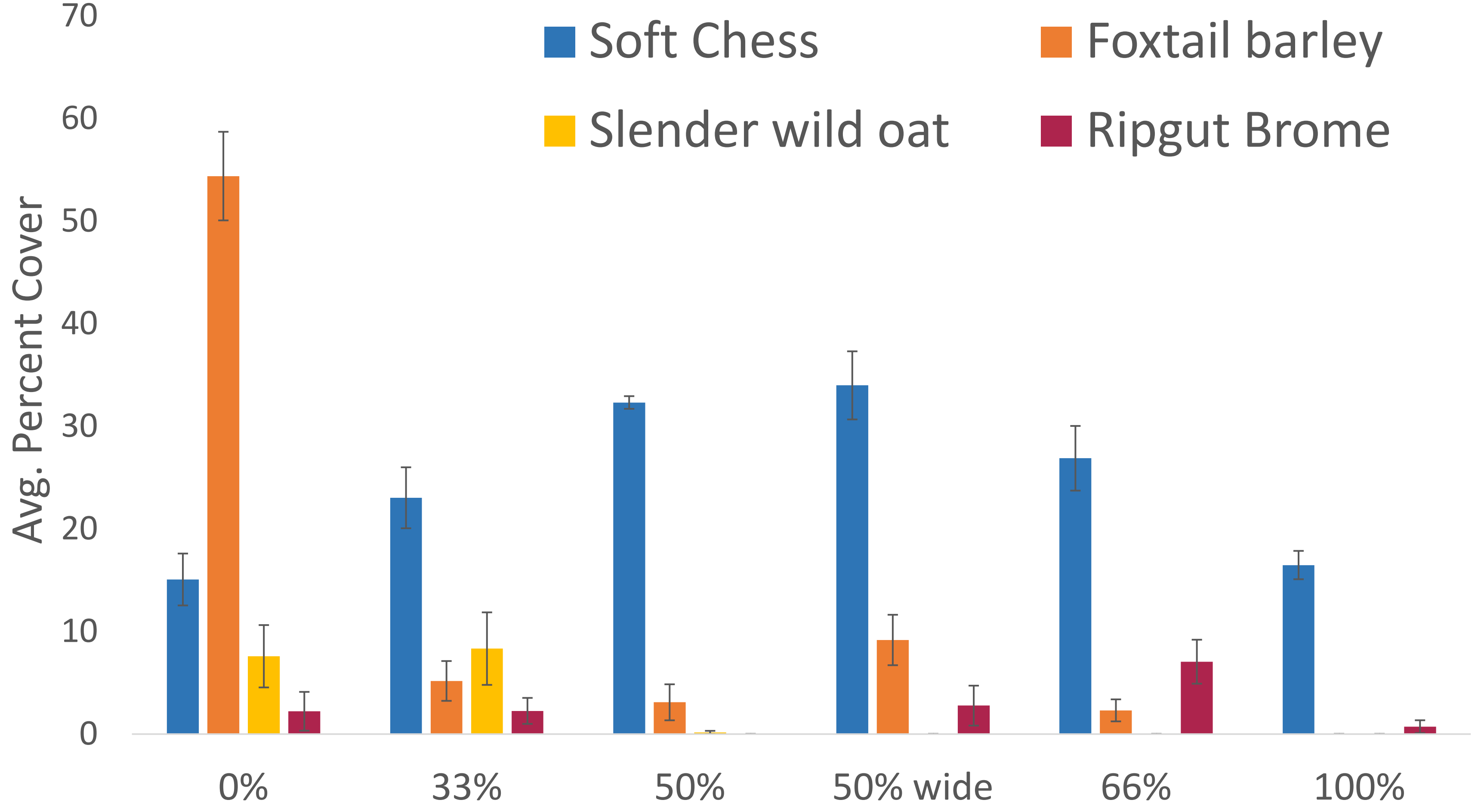
Foxtail barley,
Hordeum murinum

Ripgut brome,
Bromus diandrus

Slender wild oat,
Avena barbata

Soft chess,
Bromus hordeaceus

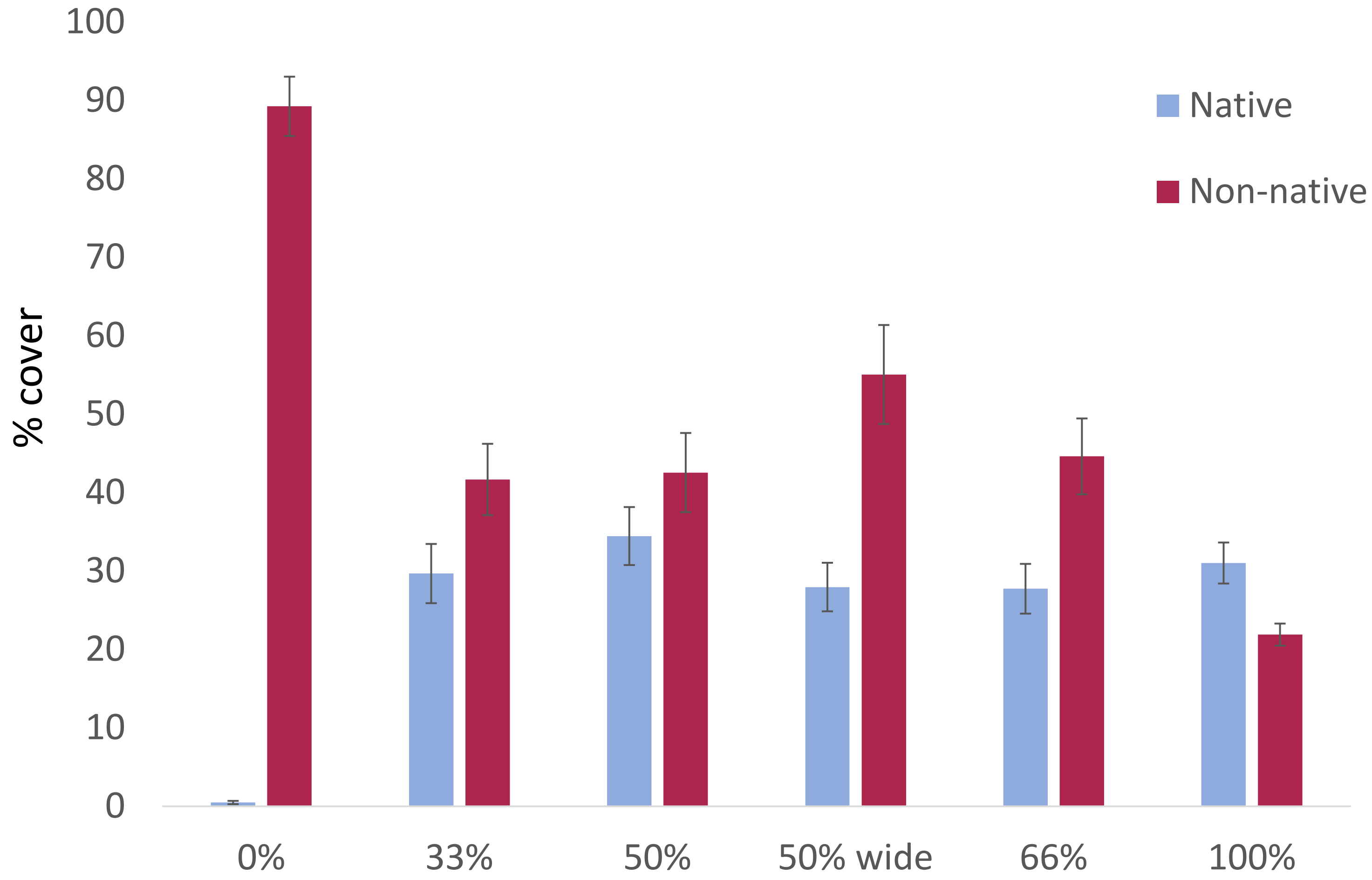
Invasive cover by treatment

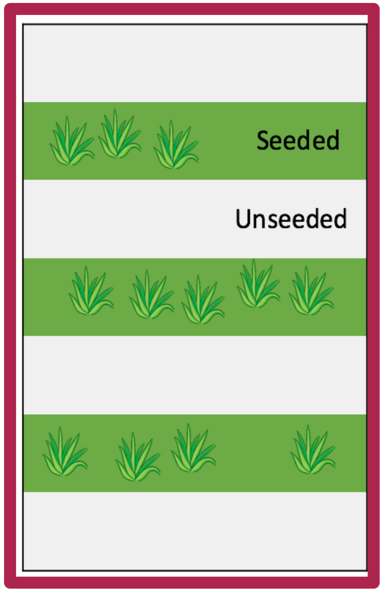


Conclusions

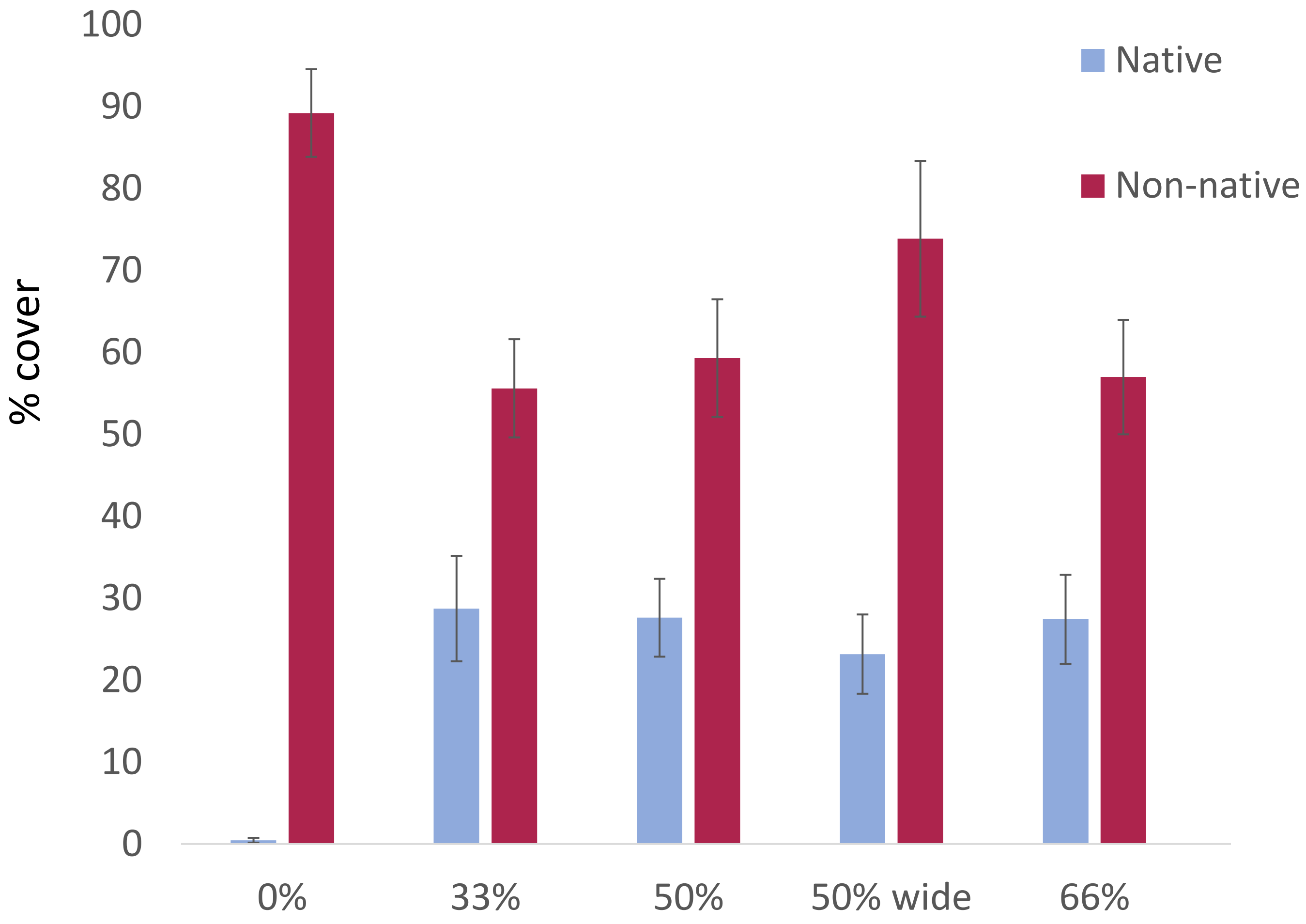
- How does seeding of natives at different levels influence invasion success?
  - **Community**
    - **Decreases overall non-native richness and abundance**
  - Invasion resistance
  - Growth and reproduction

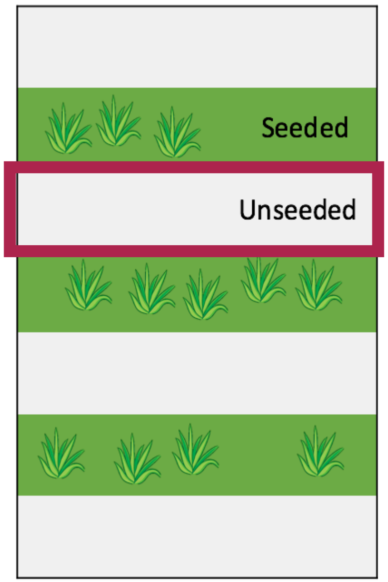
Non-native Abundance





Abundance In Unseeded Strips





Conclusions

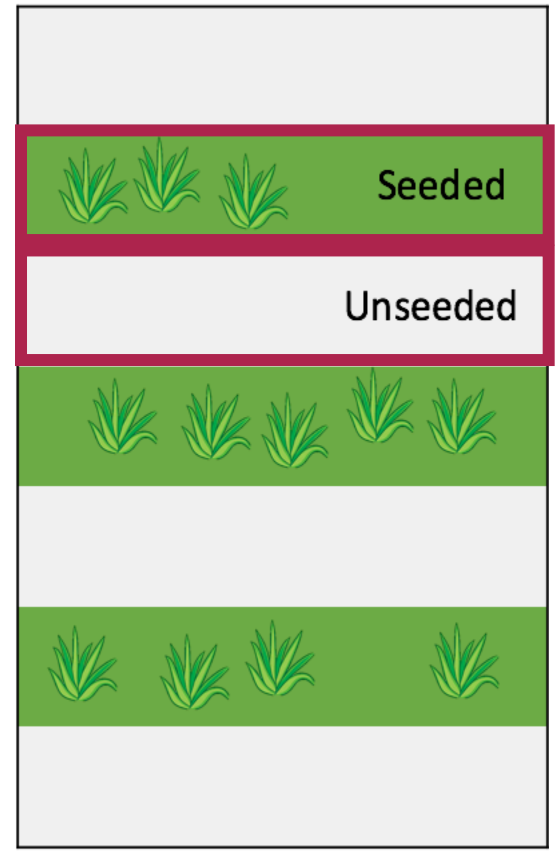
- How does seeding of natives influence invasion success?
  - Community
    - Decreases overall non-native richness and abundance
      - Response depends on species
  - Invasion resistance
    - Confers some degree of invasion resistance to unseeded strips
  - Growth and reproduction

Most Common Late-Season Invasives

Prickly lettuce,
Lactuca serriola

Field bindweed ,
Convolvulus arvensis

Late-season invasives in seeded vs unseeded strips



- Height
- Biomass
- Number of flowers

Dechen Silva et al. in review

Field Bindweed

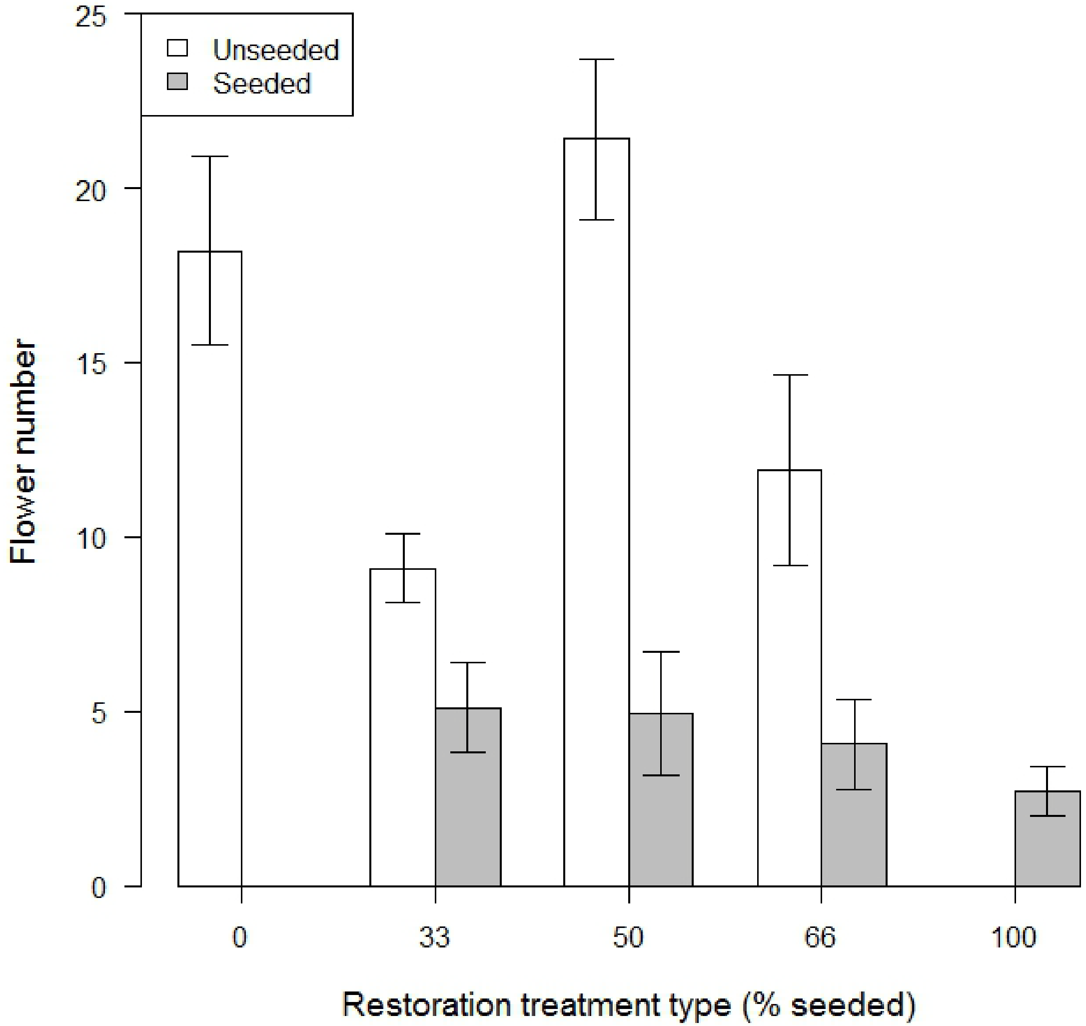
- Reduced height for all seeding levels
- Biomass response depended on treatment

Prickly Lettuce

- Height response depended on seeding level
- No difference in biomass

Dechen Silva et al. in review

Field Bindweed Flower Number



- 71% reduction in flower number in seeded vs. unseeded

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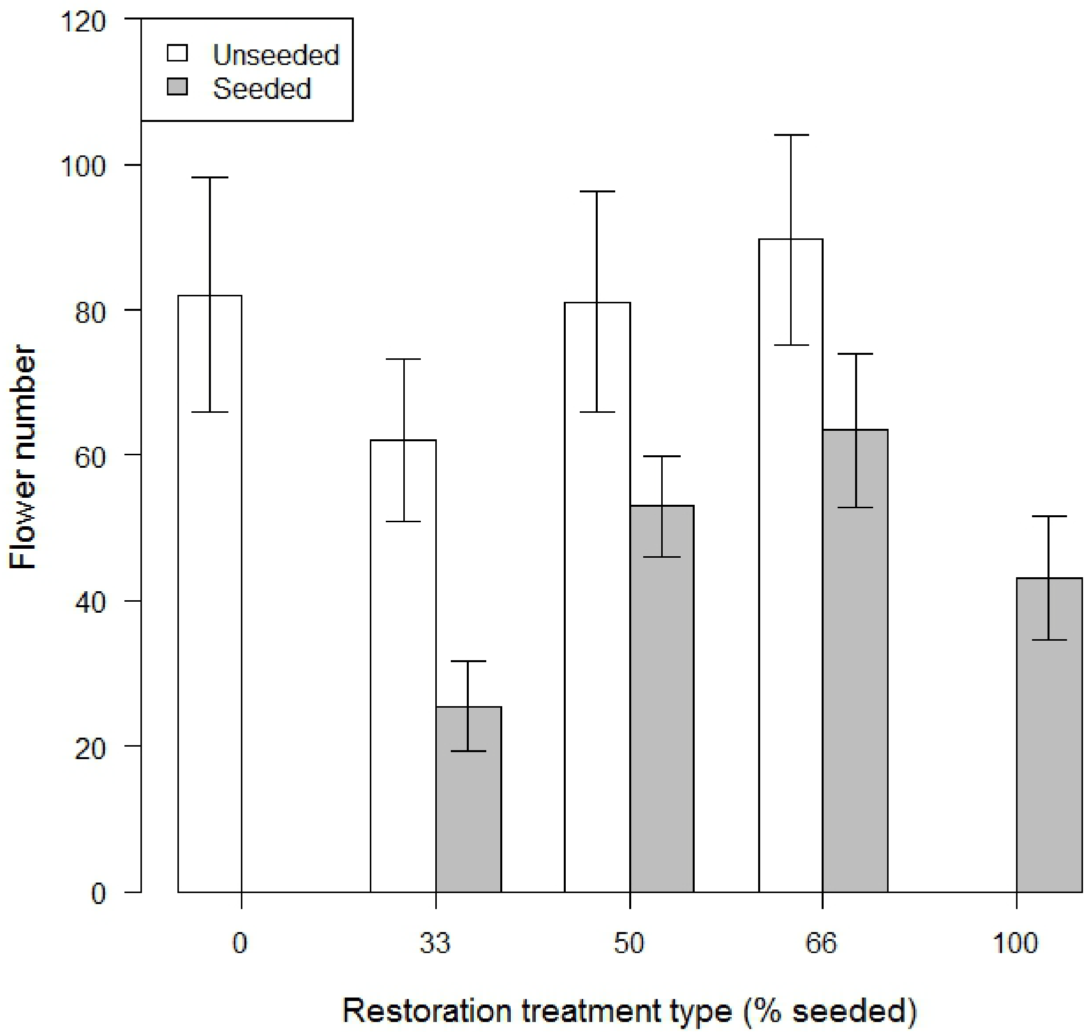
Prickly Lettuce Flower Number



- 45% reduction in flower number in seeded vs. unseeded strips

Dechen Silva et al. in review

Conclusions

- Strip seeding decreases non-native richness and abundance regardless of seeding level
- Seeded patches confer invasion resistance to adjacent non-seeded areas
- Invasive species in seeded areas are less successful in terms of flower production

Acknowledgements

- Gornish Lab
- UC Rangeland Labs: DJ Eastburn & Kelsey DeRose
- UC Davis Field HQ staff

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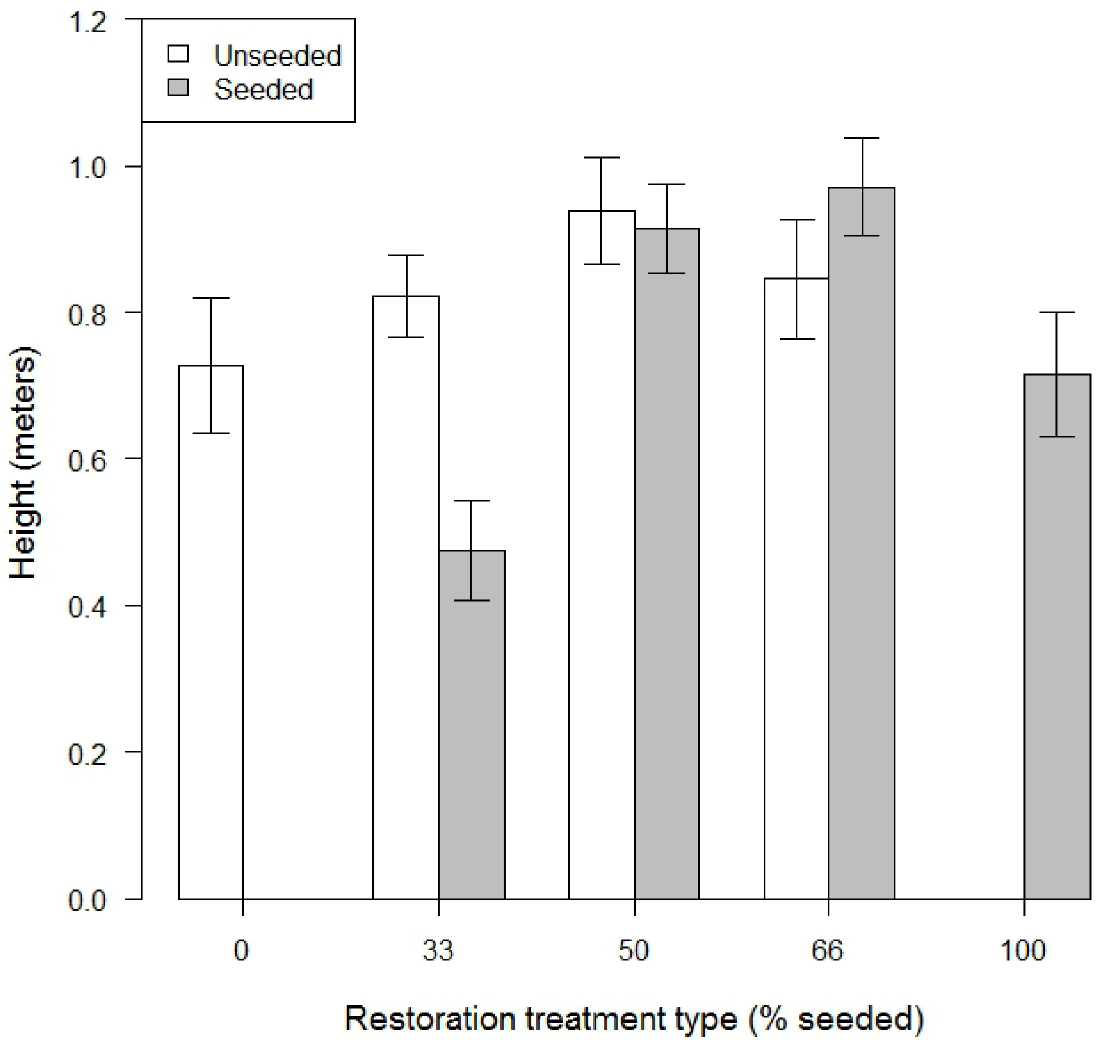
Prickly Lettuce Height



- Average decrease 12%
- Driven by the 33% seeded treatment

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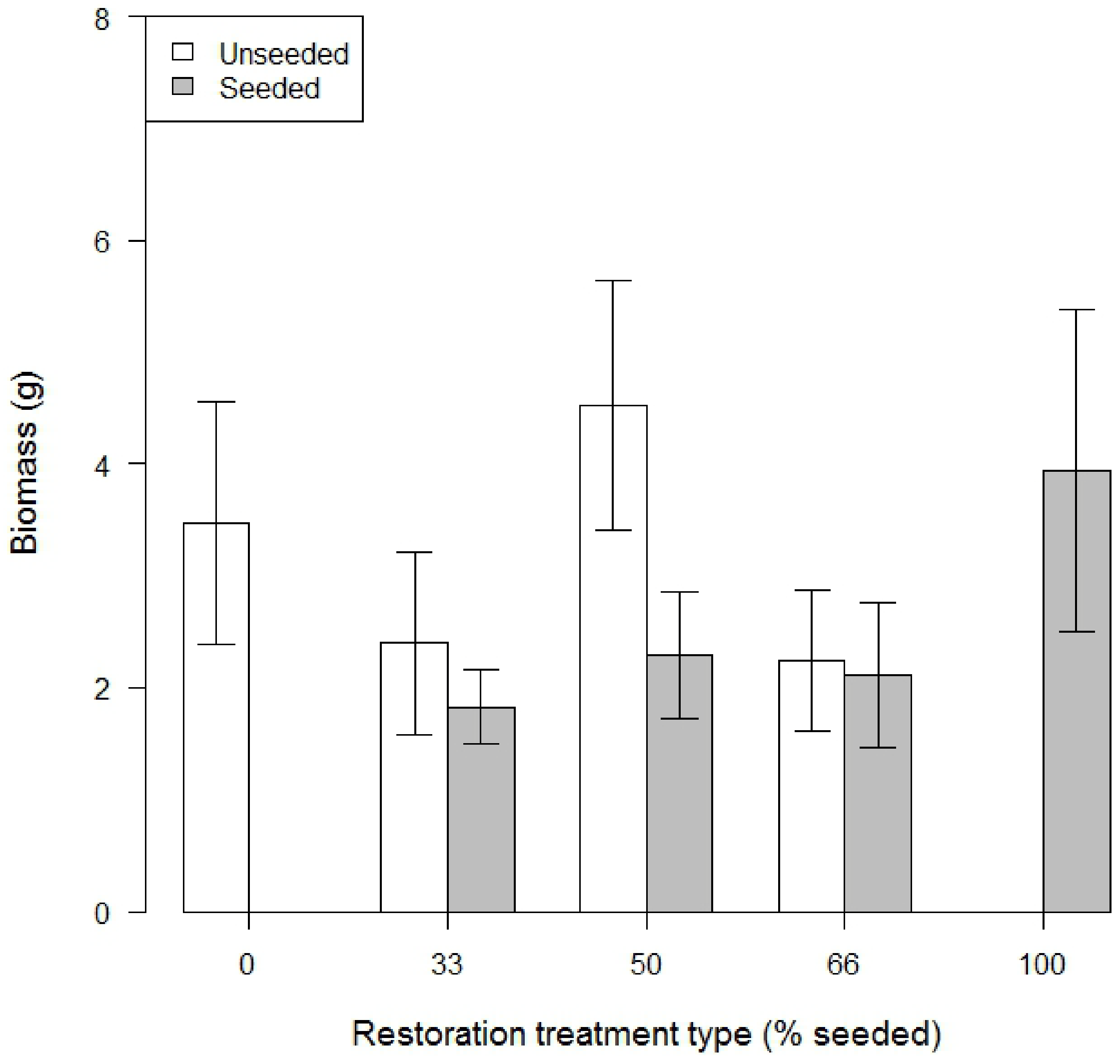
Prickly Lettuce Biomass



- No difference in biomass, on average

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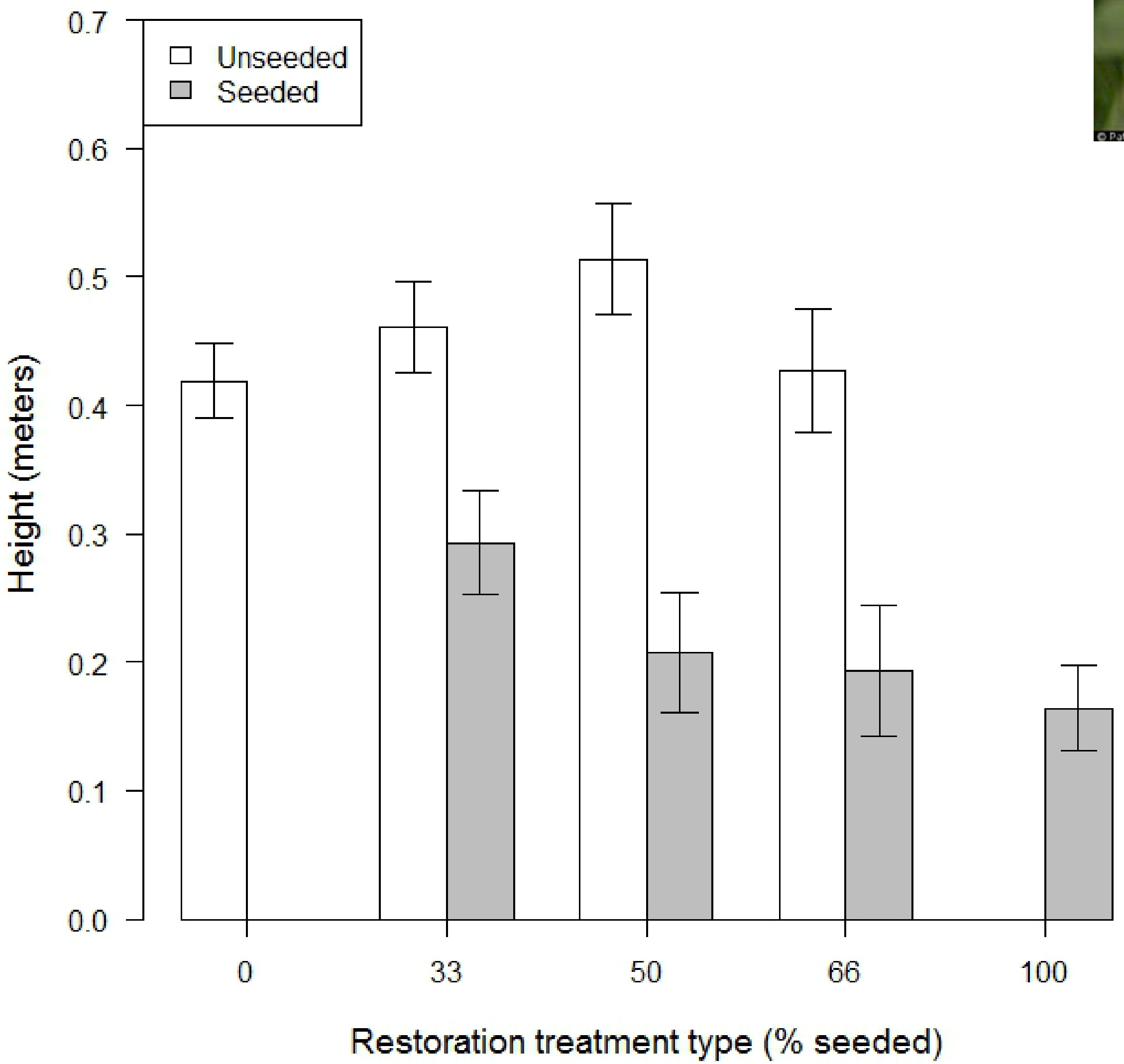
Field Bindweed Height



- Reduced height in seeded strips

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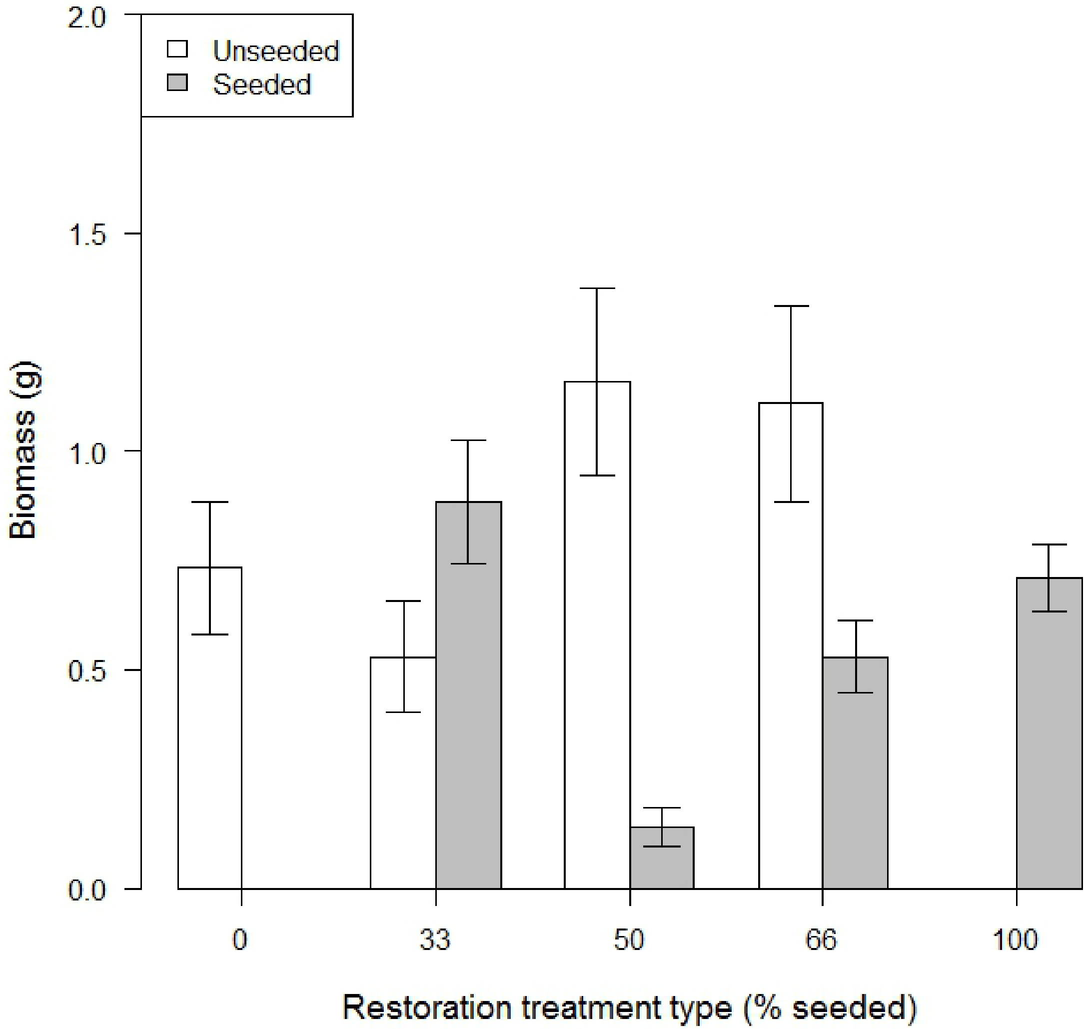
Field Bindweed Biomass



- Reduced biomass in plots with higher seeding level
- Lower biomass on average (25% lower)

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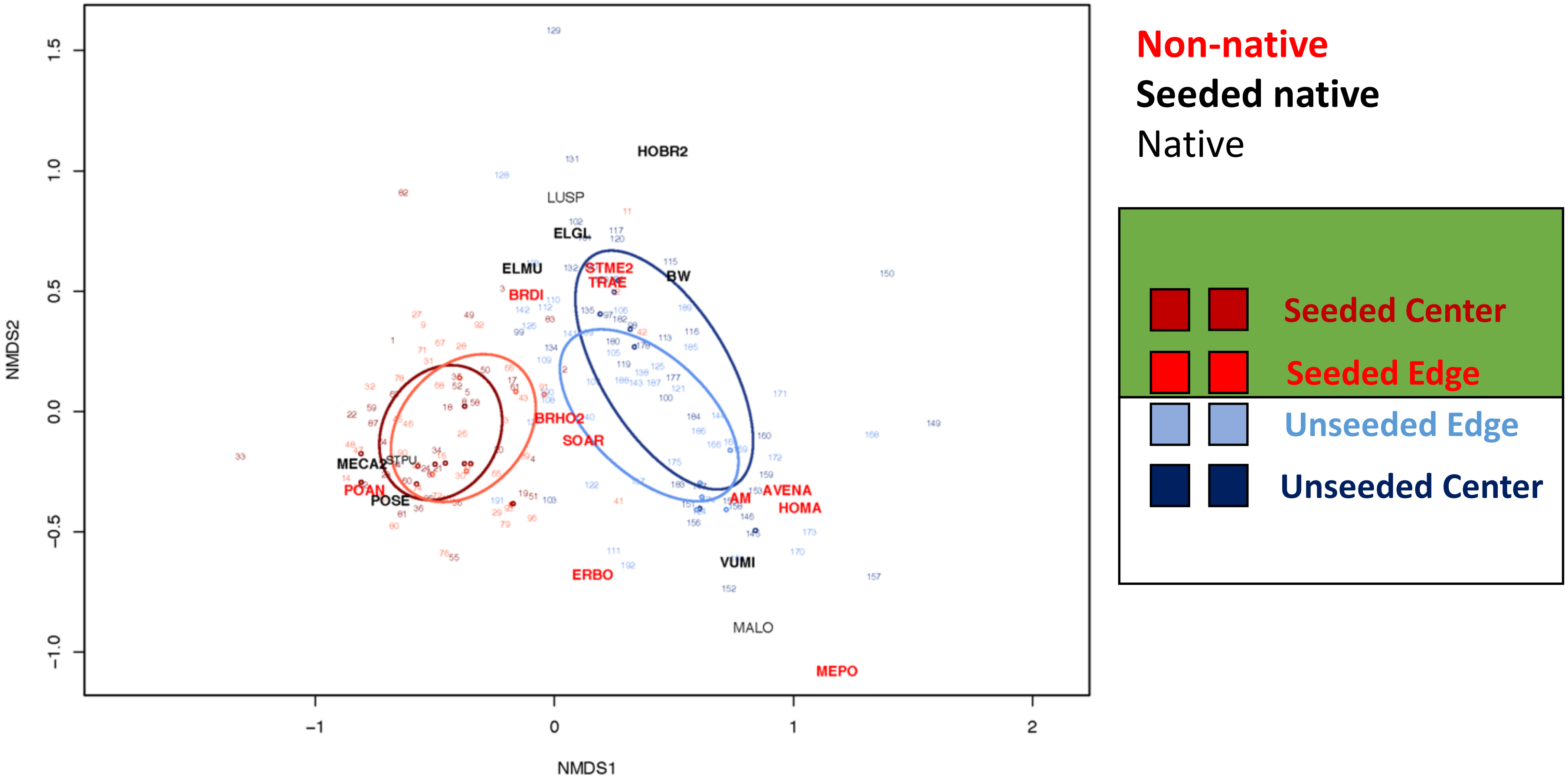
Native grasses

- *Hordeum brachyantherum*
- *Poa secunda*
- *Melica californica*
- *Elymus multisetus*
- *Elymus glaucus*
- *Stipa pulcra*
- *Vulpia microstachys* (A)

Seeding rates

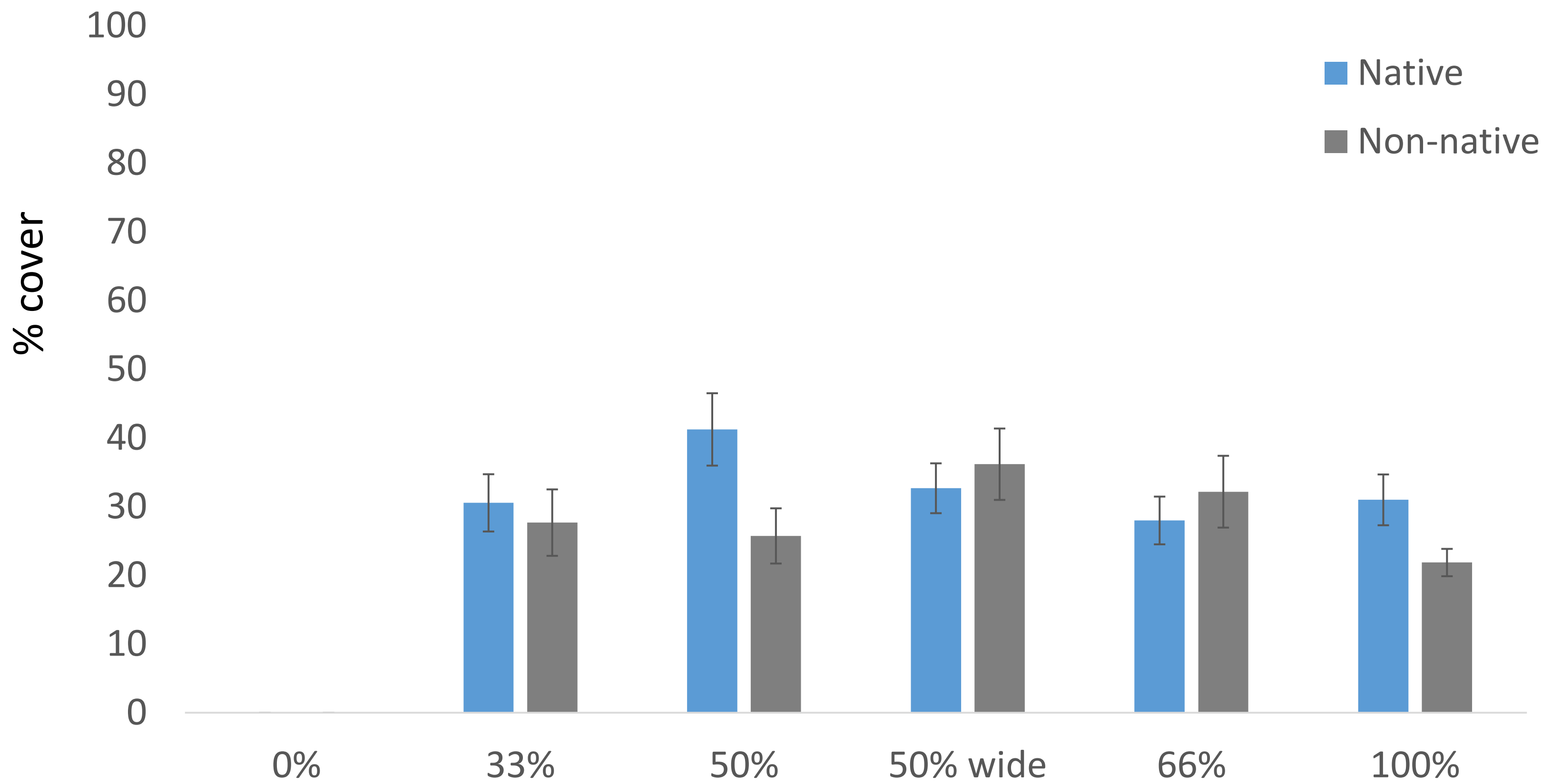
Botanical Name (Common Name)	Ecotype/Orgin	Appproximate Live Seeds/Bulk Lb.	Approximate Live Seeds/Square foot	Bulk lb/Acre
Poa secunda (pine bluegrass)	Yolo County: Fiske Creek	680,000	23.4	1.50
Vulpia microstachys (three weekfescue)	Yolo County: Fiske Creek	330,000	7.6	1.00
Elymus multisetus (big squirreltail)	Yolo County: Lynch Creek	52,000	3.6	3.00
Melica californica (California oniongrass)	Yolo County: Fiske Creek	238,000	13.7	2.50
Nassella pulchra (purple needlegrass)	Yolo County: Fiske Creek	50,000	6.9	6.00
Elymus glaucus (blue wildrye)	Yolo County: Yolo Bypass	118,000	5.4	2.00
Hordeum californicum (California barley)	Colusa County: Hwy 120	141,000	6.5	2.00
	Total:		67.0	18.0

NMDS by Location and Strip Type



- PERMANOVA showed a significant location * strip type interaction (p > 0.05)

Native vs. Non-native Abundance In Seeded Strips



- No differences in native or non-native abundance among treatments