

The use of phenology and plant morphological traits to reassemble invaded plant communities

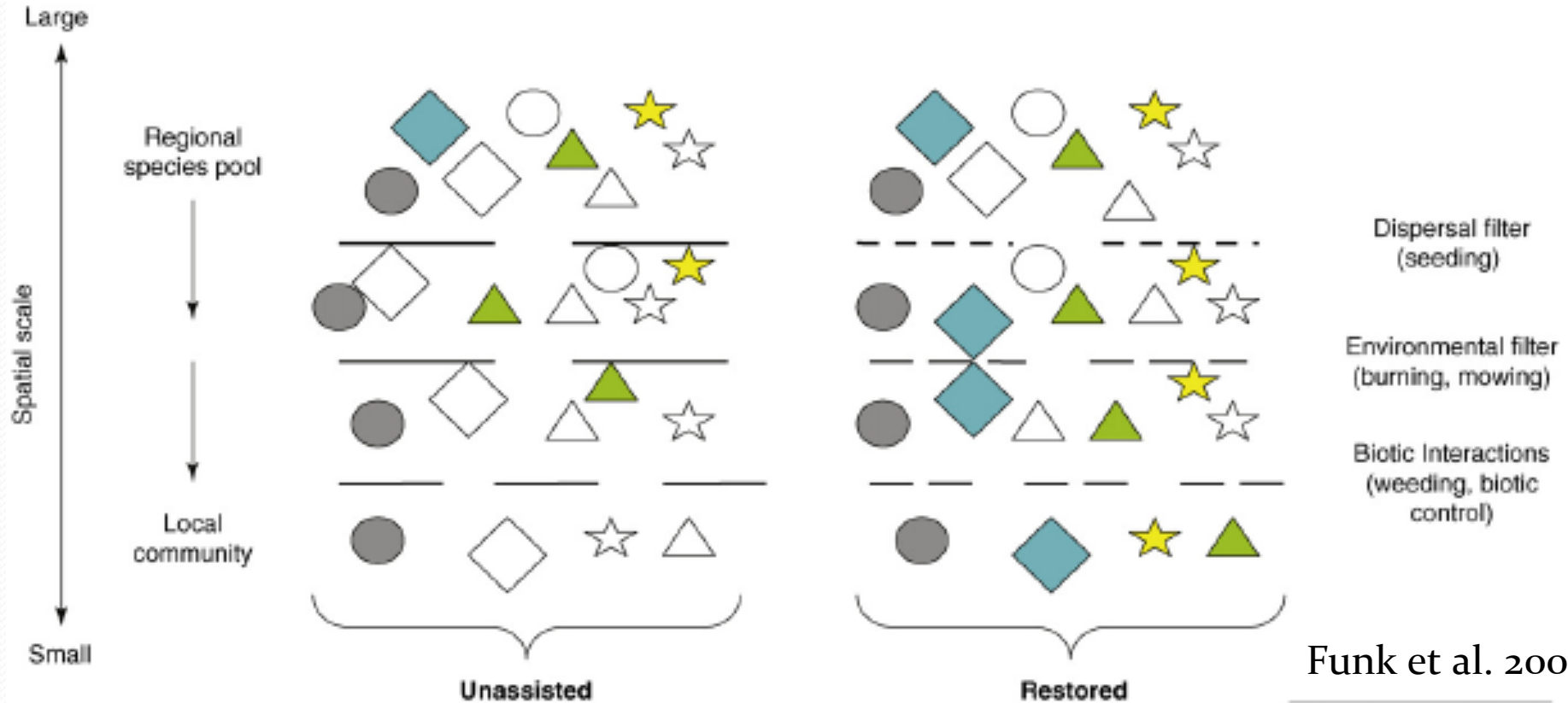
Hilbig, Bridget E.* and Edith B Allen. University of
California-Riverside Dept. of Botany and Plant
Sciences, Riverside, CA. *bhilb001@ucr.edu

Plant Community Assembly

- Community Assembly Rules
 - interspecific interactions lead to nonrandom co-occurring patterns
- Restoration is the ultimate community assembly



Community Assembly Through Restoration



- trait-environment approach: focuses on determining the key traits organisms possess and the environmental factors that filter these traits
- By influencing environmental filters restoration can guide community assembly

Functional Traits

- Functional traits are considered adaptations of species to their environments and, therefore, can reveal ecological niche differentiation.

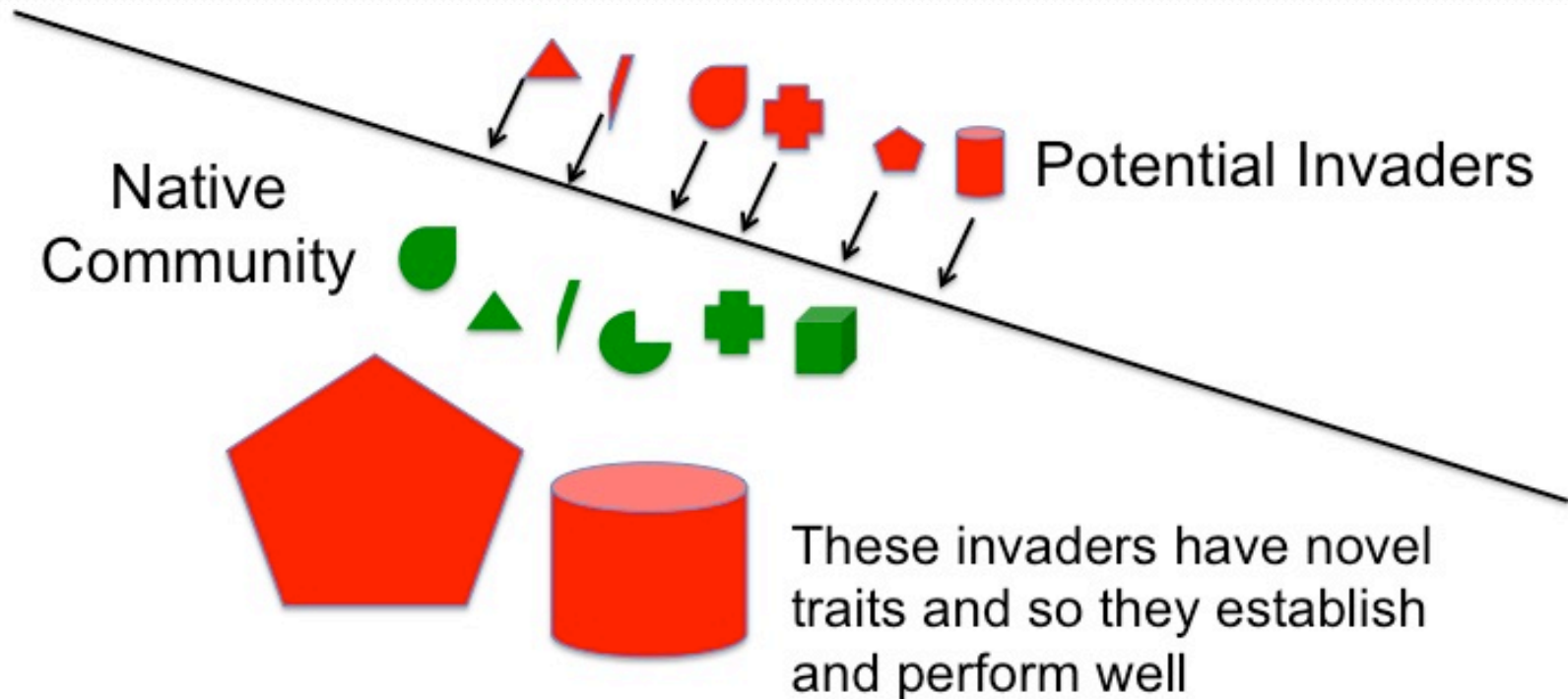
FUNCTION	FUNCTIONAL TRAITS
FECUNDITY DISPERSAL ESTABLISHMENT	SEED MASS SEED SET
LIGHT INTERCEPTION COMPETITIVE ABILITY	CANOPY HEIGHT BIOMASS
RESORPTION OF NUTRIENTS	TRAITS OF LIVING LEAVES
NUTRIENT AND WATER ABSORPTION	ROOT STRUCTURE AND DIAMETER

Functional Group

- In restoration, it may be more useful to consider plant functional types, or functional groups, rather than individual species.
 - Functional Group
 - Organisms that have similar responses to environmental factors
 - tend to share a set of morphological, physiological, or life history characteristics
- Functional Diversity and ecosystem stability
 - use of a few representatives of each functional group to restore and maintain ecosystem function and structure versus increasing biodiversity

Limiting Similarity

- predicts traits of coexisting species are more dissimilar due to the avoidance of competitive exclusion through niche differentiation
- suggests that invasive species may be less likely to establish if native species with similar resource-use traits are present.



OBJECTIVES:

- Use theories rooted in community assembly to restore and stabilize invaded plant communities
- To examine limiting similarity as a mechanism determining successful establishment of the exotic annual grass *Bromus diandrus*



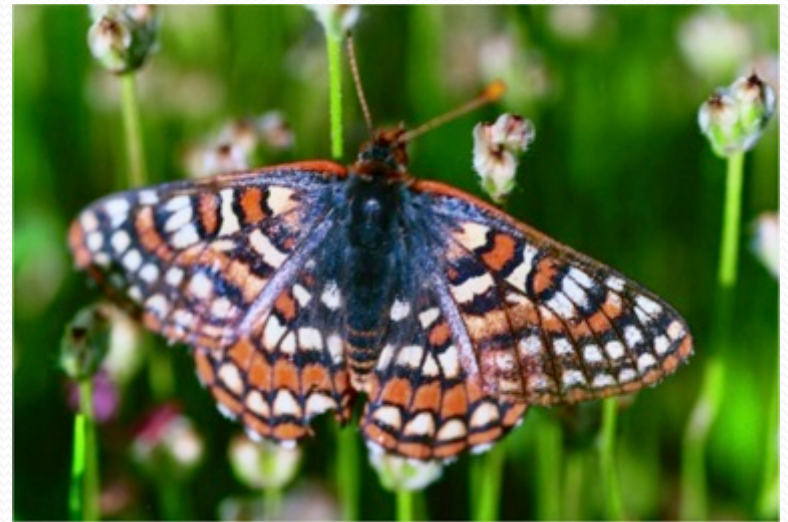
Study Site: Lake Mathews (Riverside, CA)

- Abandoned citrus agriculture
 - Historically disturbed by grazing and frequent fire
- Receives nitrogen deposition levels of 12-15 kg/ha/yr
- Currently dominated by *B. diandrus*



Restoration Goal

- Site was formerly coastal sage scrub and native annuals
 - Native vegetation types have been greatly reduced by anthropogenic disturbances and invasive species
- Currently poor quality habitat for endangered species Stephen's Kangaroo rat
- Goal: to restore herbaceous species to support Kangaroo rat and Quino checkerspot butterfly



Functional Groups at site

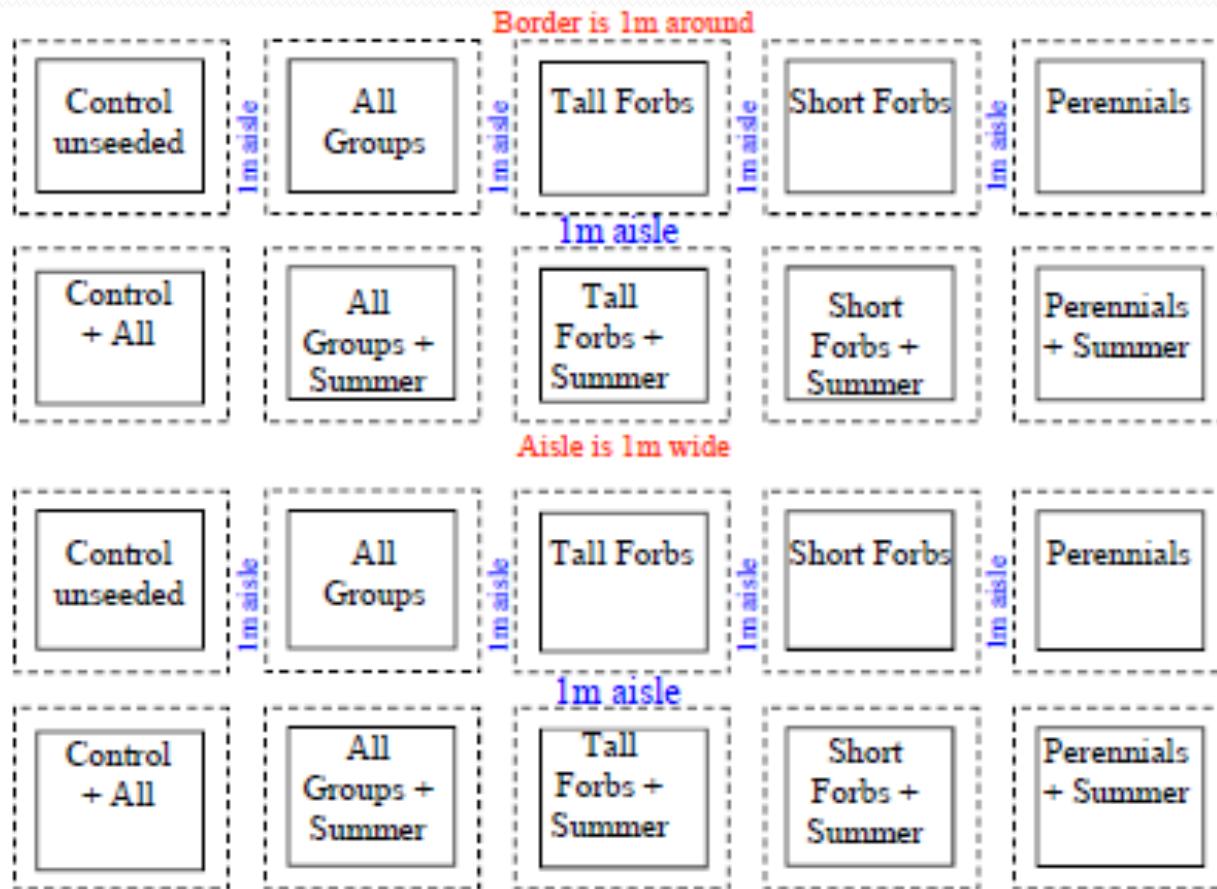
- Defined by phenology and morphological traits, such as total above ground biomass
 - Perennial Forbs
 - *Gutierrezia californica* and *Lessingia filaginifolia* (*Corethrogyne filaginifolia*)
 - Tall Winter Annual Forbs
 - *Amsinckia menziesii* and *Layia platyglossa*
 - Short Winter Annual Forbs
 - *Lasthenia californica* and *Plantago erecta*
 - Summer Annual Forbs
 - *Hemizonia fasciculata* and *Eremocarpus setigerus* (*Croton setigerus*)



Question and Hypothesis

- **Which functional groups will result in greater exclusion of *B. diandrus*?**
 - Hypothesis: Native communities that are functionally similar to *B. diandrus* will be more resistant to its establishment through direct competition for resources
 - Limiting similarity hypothesis
 - plots containing tall winter annuals will exclude *B. diandrus* better than plots without that functional group present

Experimental Design



10 treatments Brdia density = 50

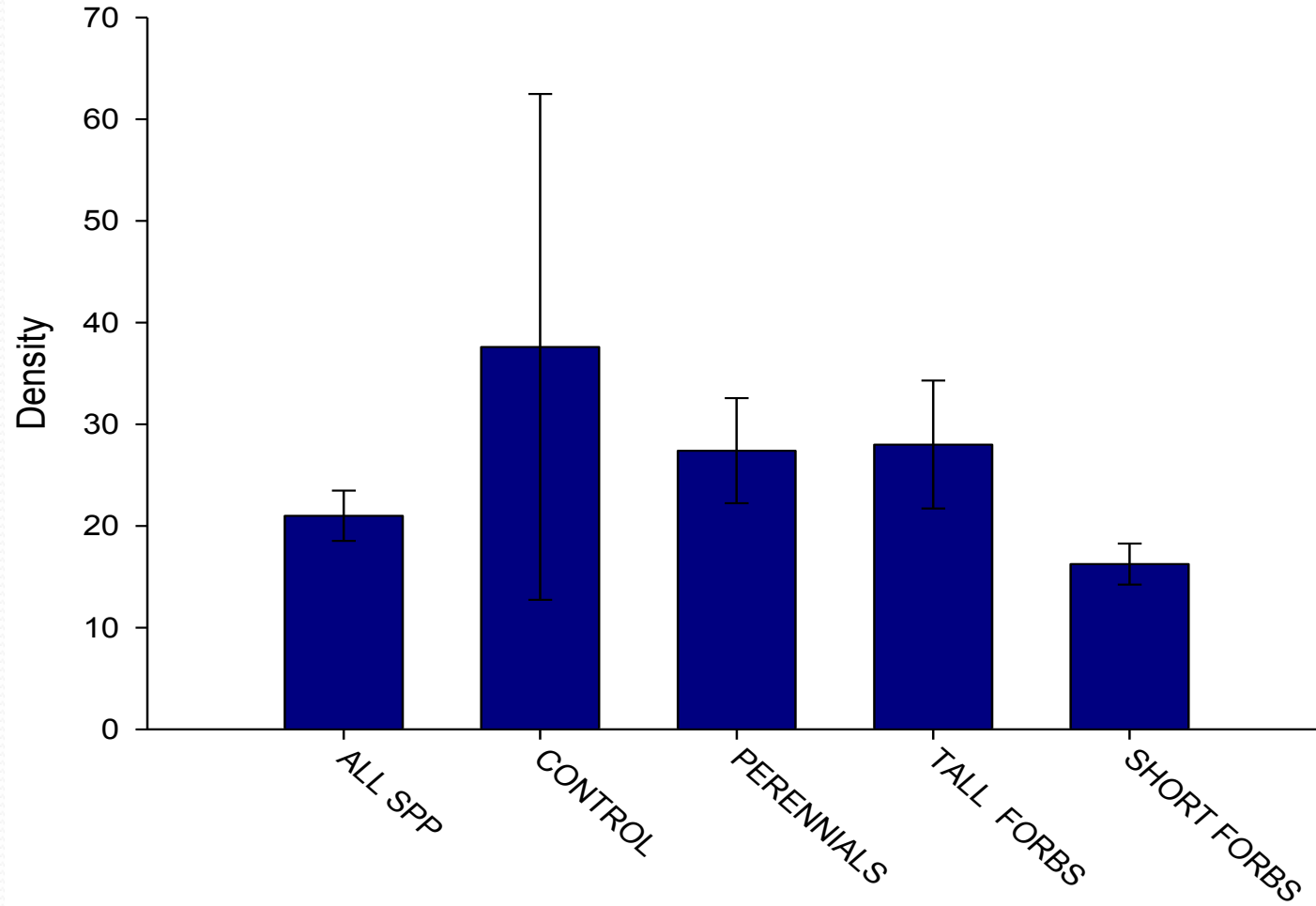
10 treatments Brdia density = 0

Methods

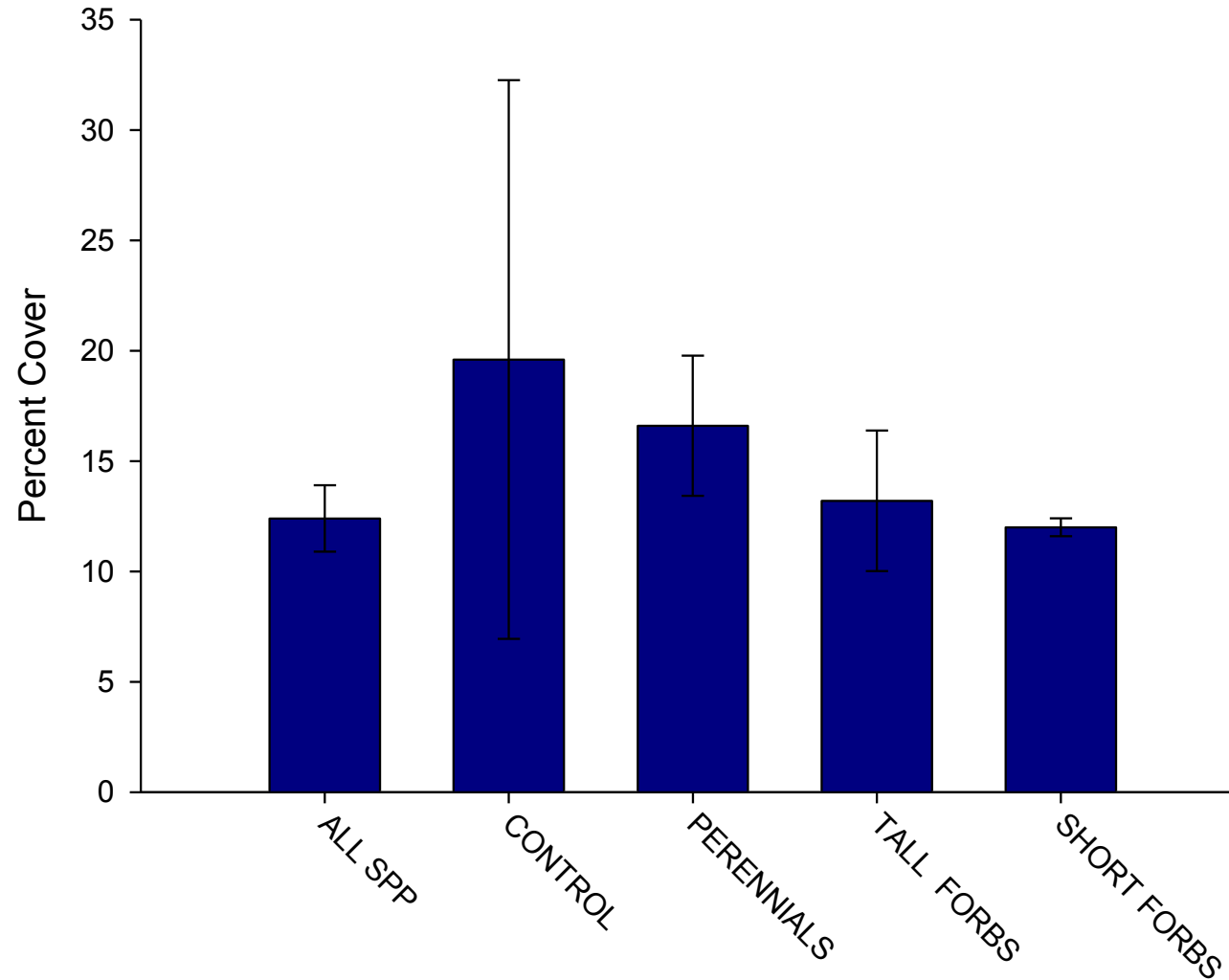
- Field plots were seeded with the four functional groups with and without *Bromus diandrus* in November 2012.
- Plots were sampled annually throughout the growing season for plant species richness, density, and percent cover.
- Traits considered and measured:
 - germination time
 - relative growth rate
 - maximum height
 - seed set
 - seed mass



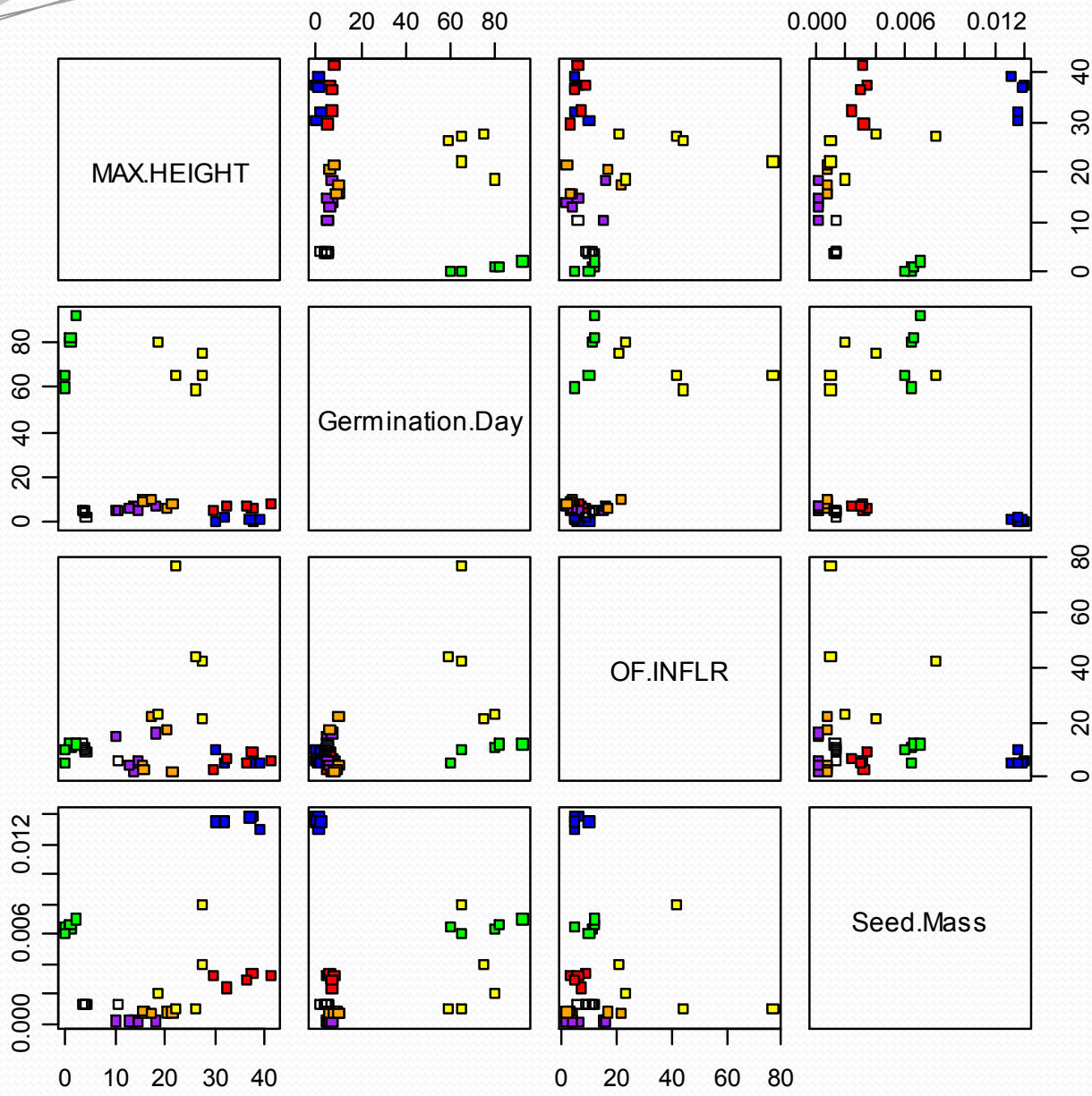
Bromus diandrus density when grown with different functional groups



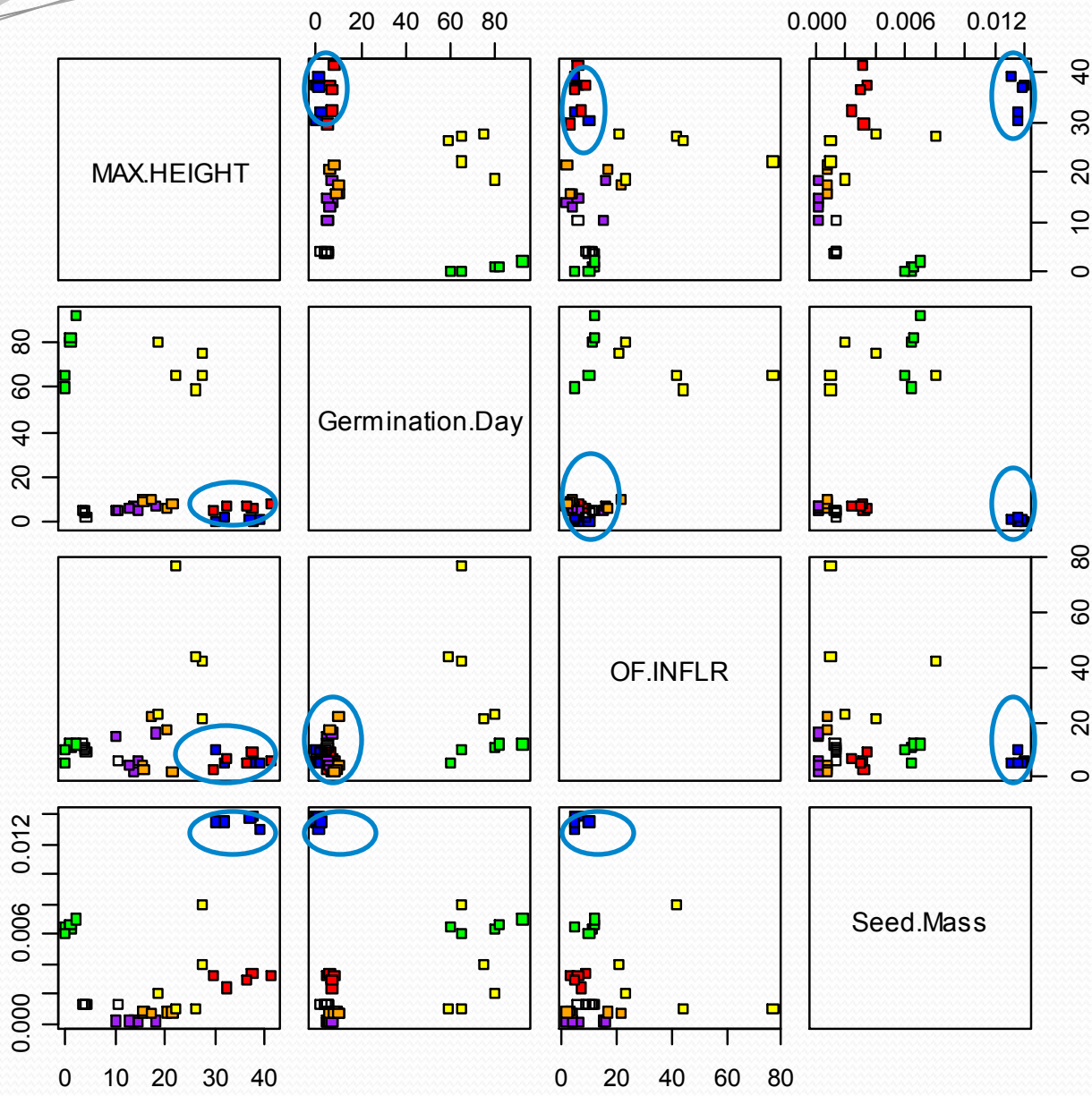
Percent cover of *Bromus diandrus* when grown with different functional groups



Drought like conditions resulted in most plots dominated by bare ground (3 inches of rain)



Red: Bromus
 Blue: Amsinckia
 Green: Eremocarpus
 Purple: Layia
 Orange: Lasthenia
 Yellow: Hemizonia



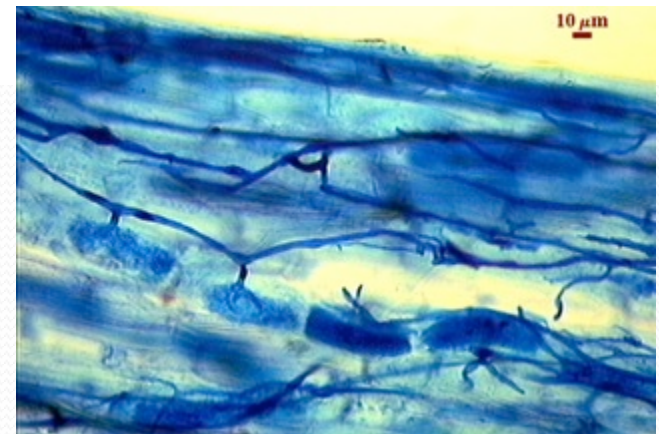
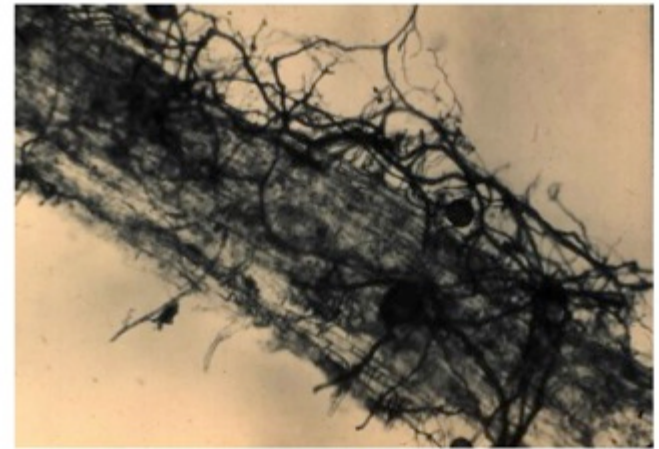
Red: Bromus
 Blue: Amsinckia
 Green: Eremocarpus
 Purple: Laya
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Discussion

- We found no evidence for limiting similarity
 - It was hypothesized that native communities that are functionally similar to *B. diandrus* would be more resistant to its establishment through direct competition for resources.
 - First year data, in a very dry year, suggests that none of the functional groups selected are significantly better at excluding *B. diandrus*.
- Plots need to be maintained and followed for multiple years

Future Directions

- How will changes in plant functional groups present affect the arbuscular mycorrhizal and non-mycorrhizal fungal community?
 - Plant-soil feedback contributes to species co-existence/ dominance, and invasive species success
 - Understanding how restoration may change the soil biota and thus plant-soil feedback will contribute to restoration success



Photos: Mike Allen

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