Implications of global change for exotic and native species in California grasslands

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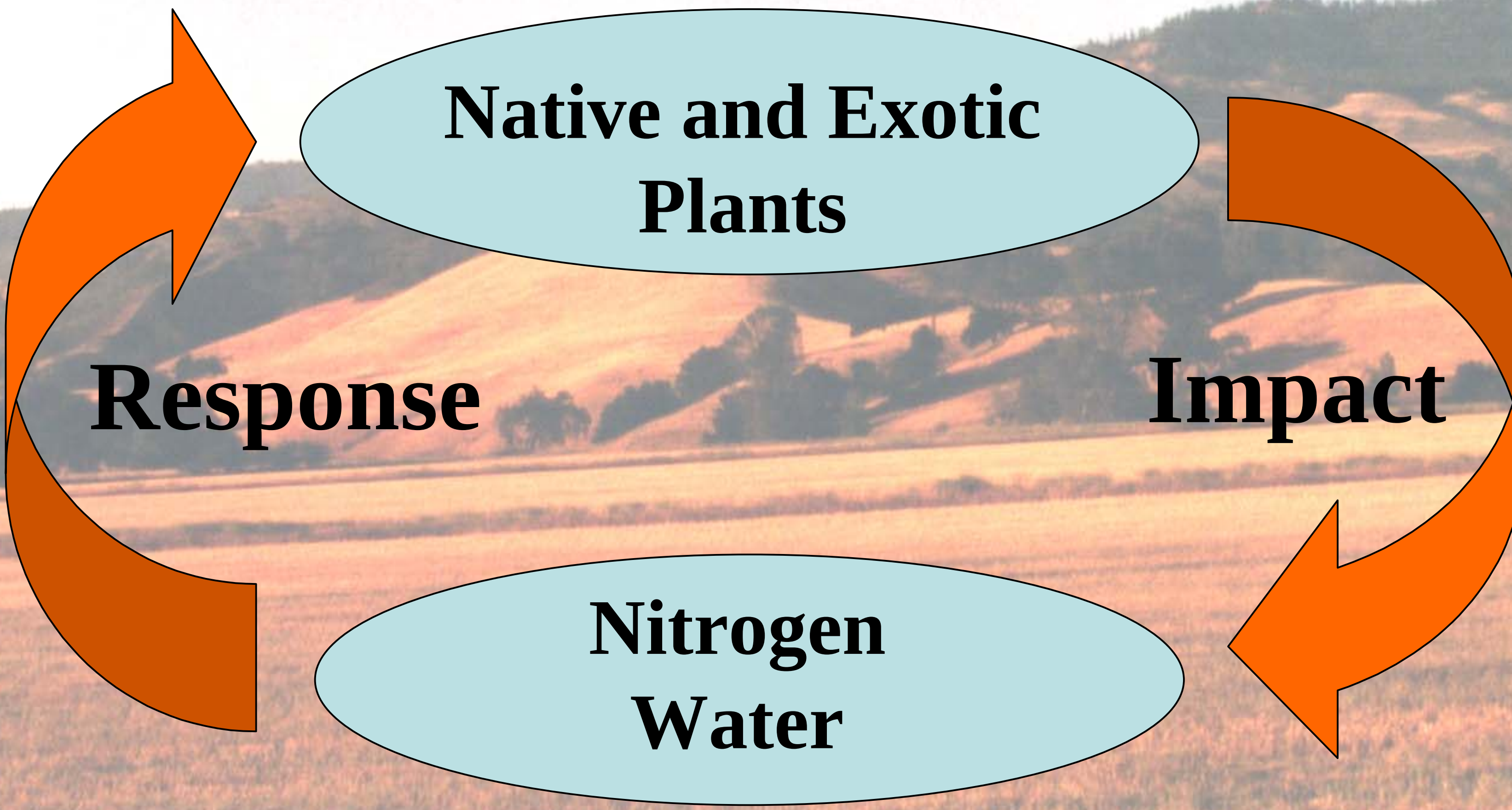
Limiting resources and patterns of species abundance



Limiting resources and patterns of species abundance

1. Community Level:

   Exotic Annual vs. Native Perennial

2. Species Level:

   Responses to, and Impacts on Resources

1. Dominance of Exotic Annual Grasses in California

- 10 million hectares dominated by exotic annual grasses introduced 1769
- Invading annuals replaced perennials = Paradox
- Successional replacement of annuals by perennials in other grasslands but **not** CA
- Perennial traits should make them better resource competitors

Hypotheses

1. Exotic annual species are better resource competitors
2. Native perennial grasses are better competitors but recruitment limited
3. Multiple Stable Equilibria (MSE)

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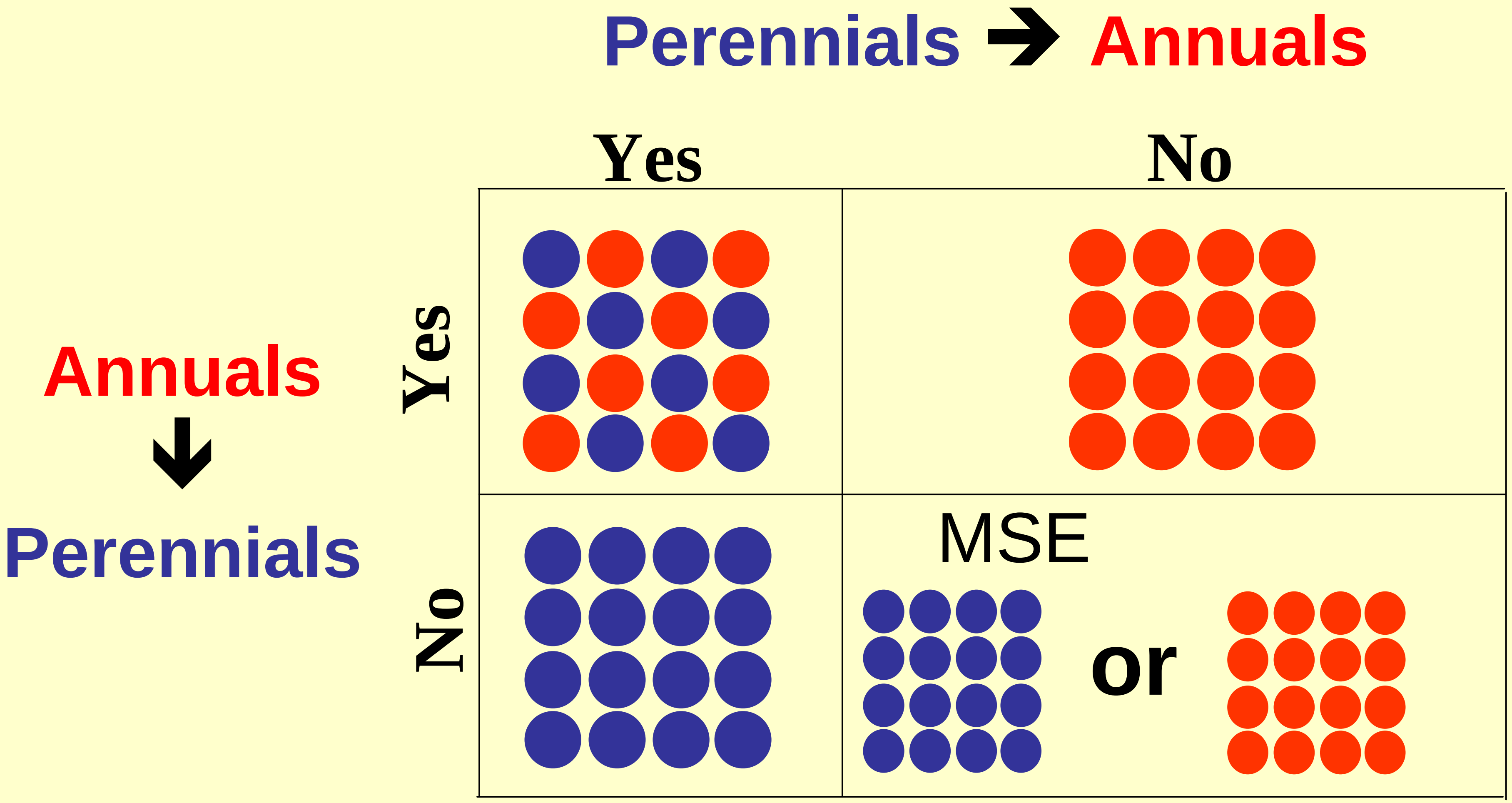
Mechanistic Approach:

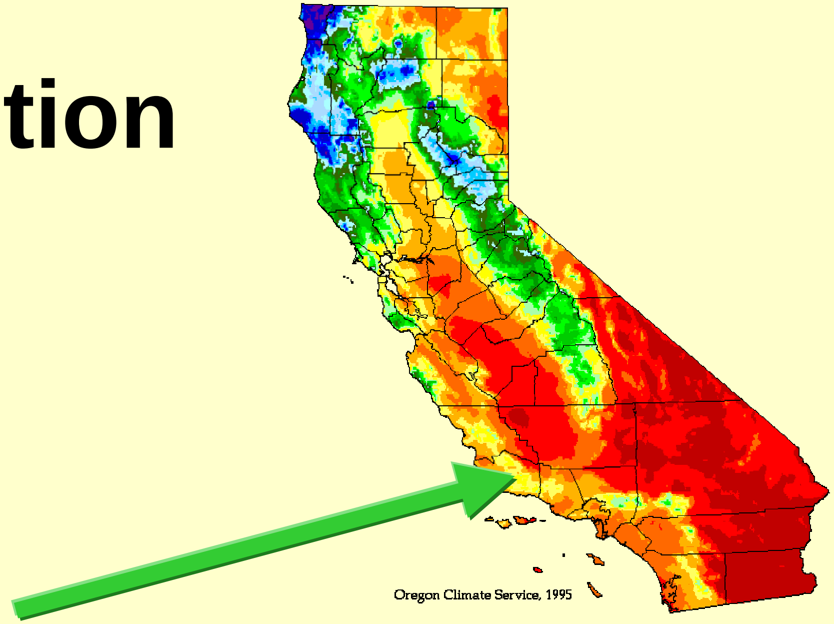
A. Competition for Resources

B. Mutual Invasibility

Reciprocal Invasibility Test



Community Composition



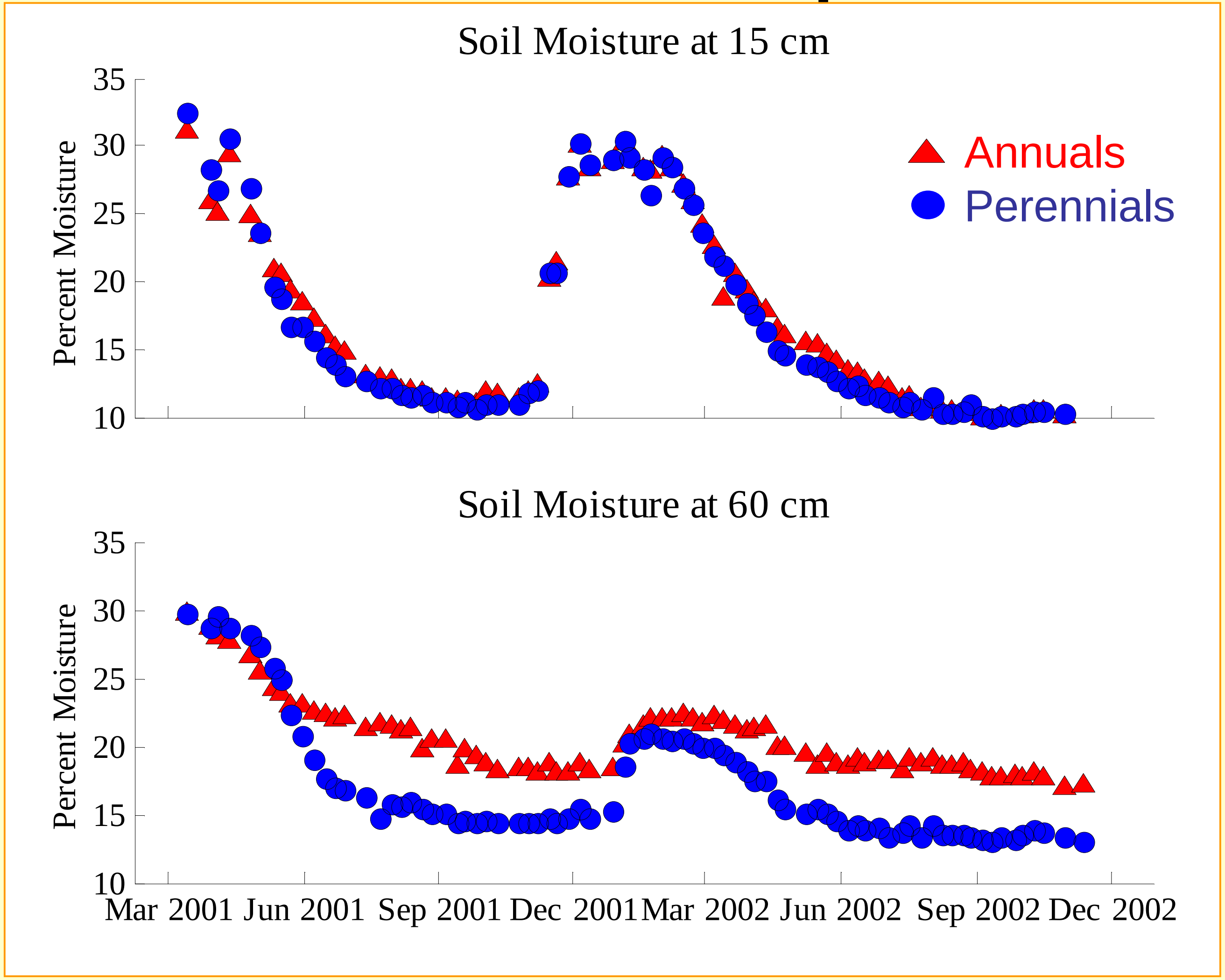
Sedgwick Reserve

Experimental Treatments:

Annual } Resources
Perennial }

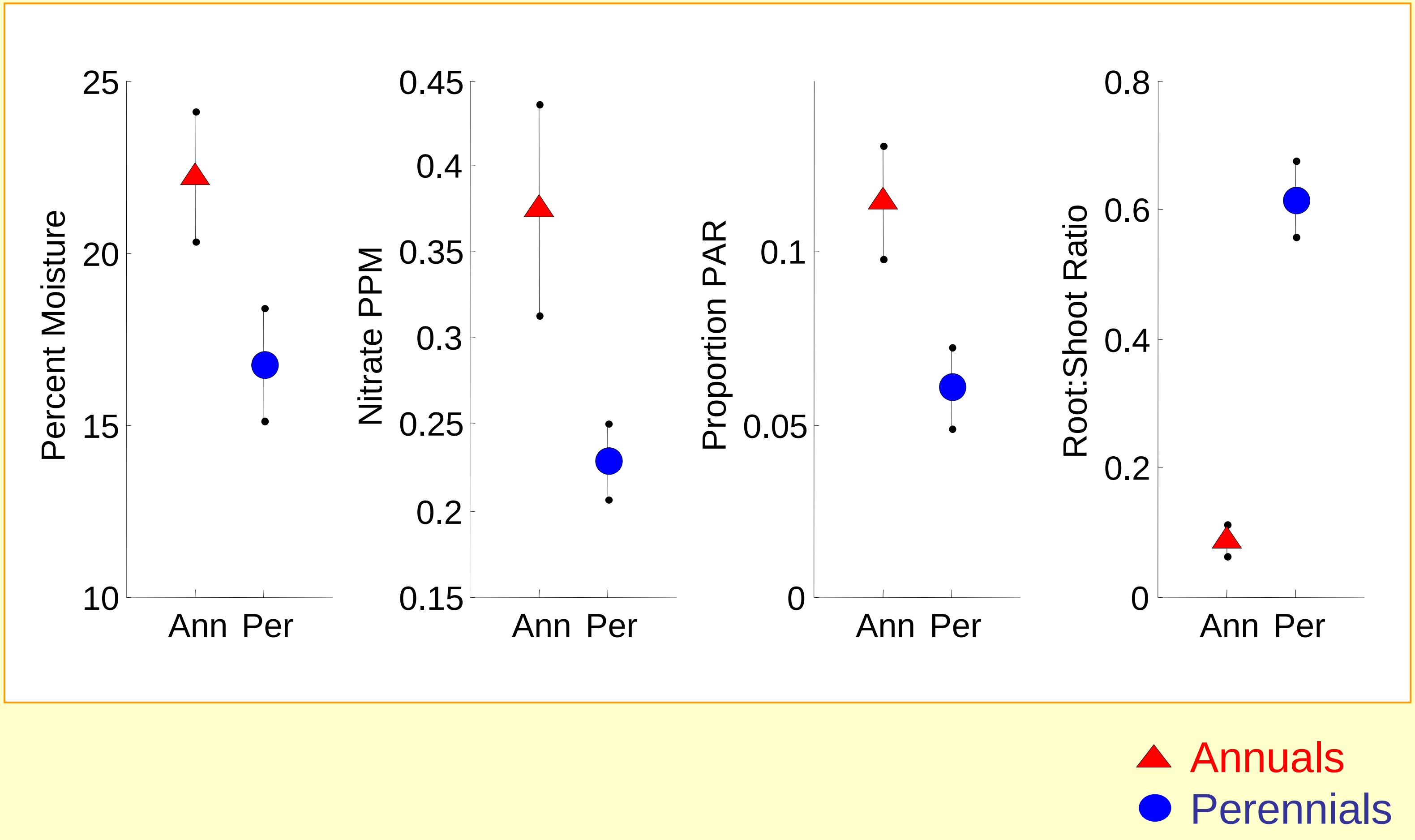
Annual + Perennial seeds } Reciprocal Invasion
Perennial + Annual seeds }

Resource Competition



Seabloom, Harpole, et al. 2003, PNAS

Resource Competition



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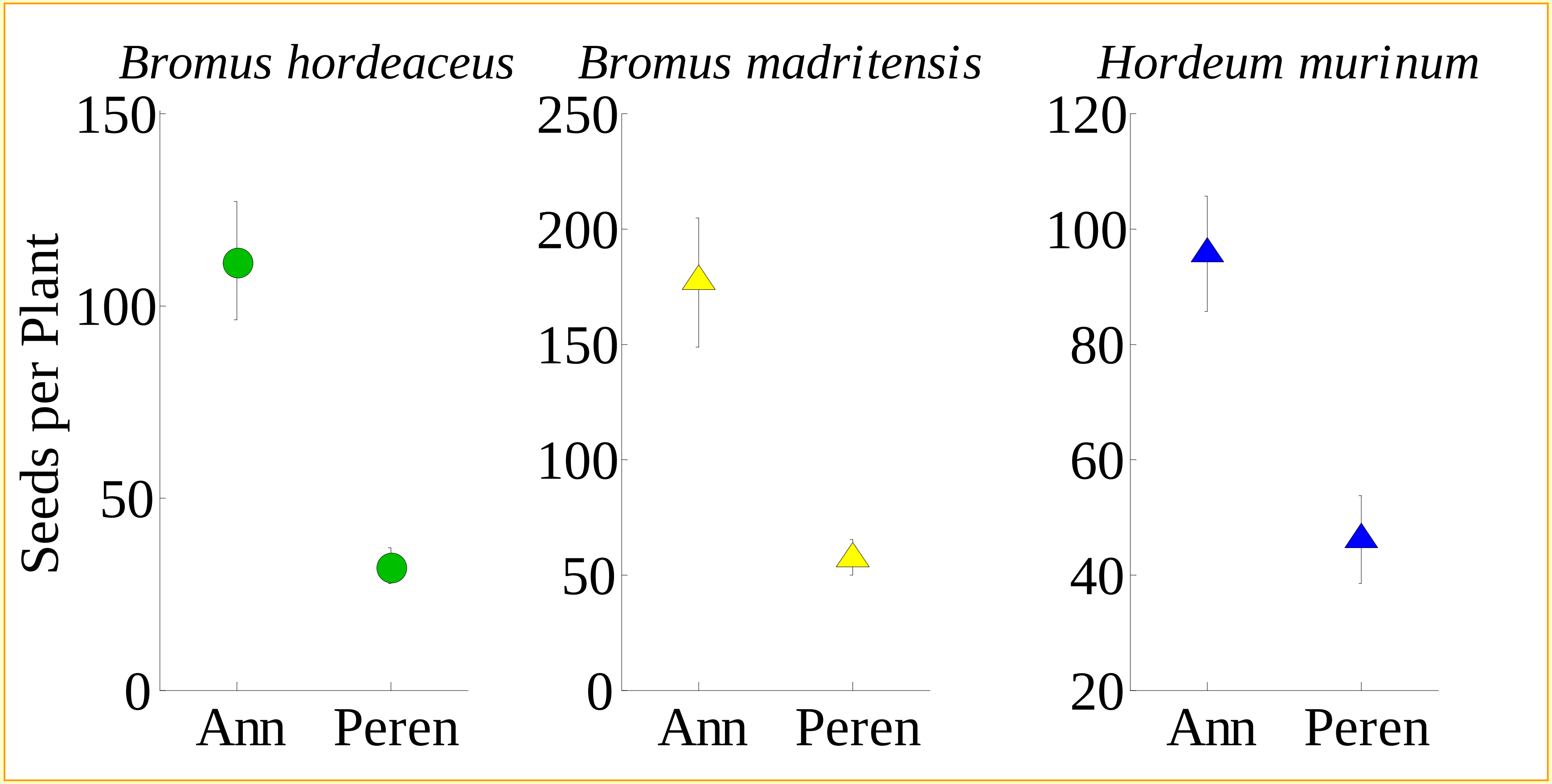
Resource Competition

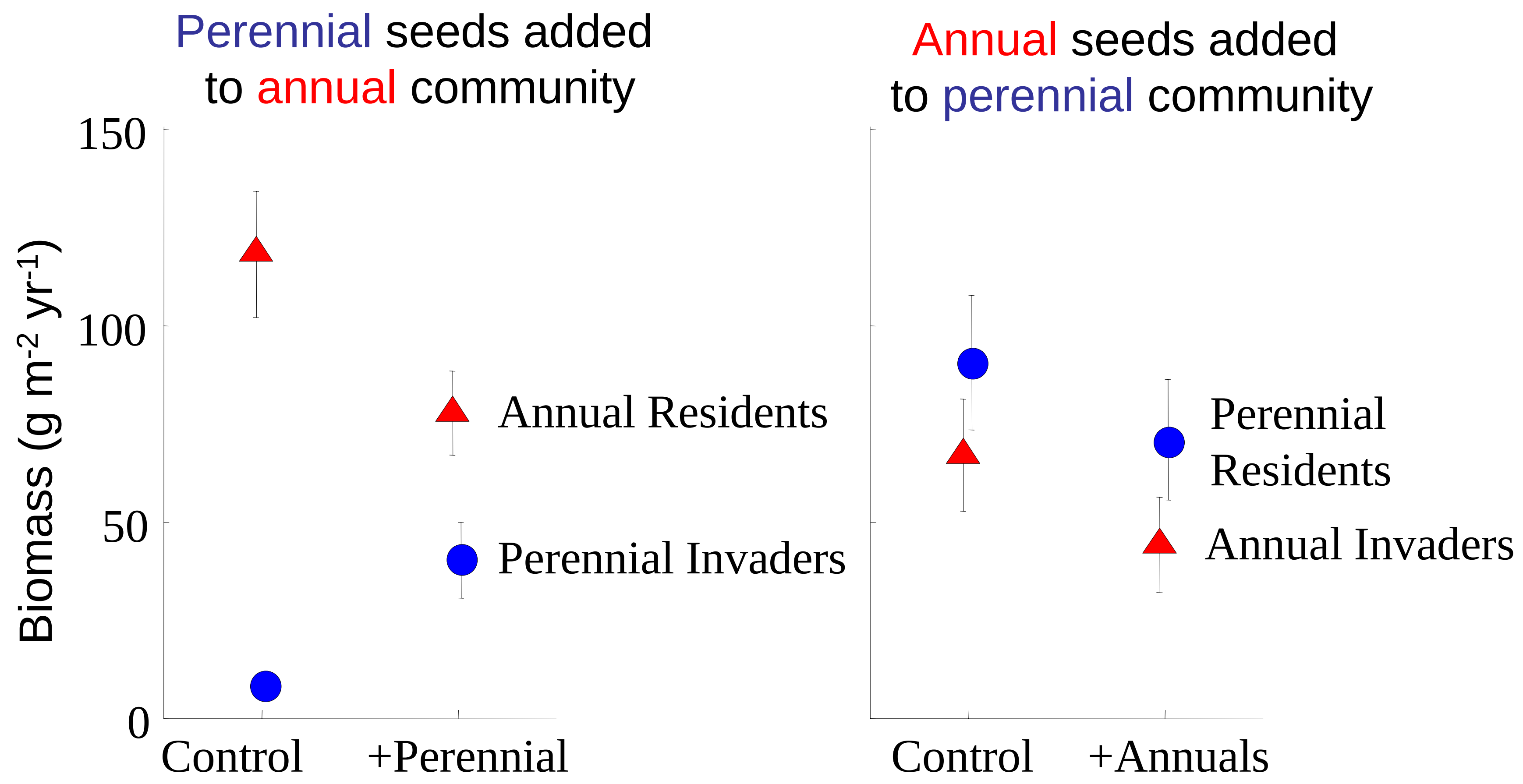


Seabloom, Harpole, et al. 2003, PNAS

Hypotheses

1. Exotic annual species are better resource competitors - **No**
2. **Native perennial grasses are better competitors - Yes**
3. Multiple Stable Equilibria (MSE)

Reciprocal Invasion



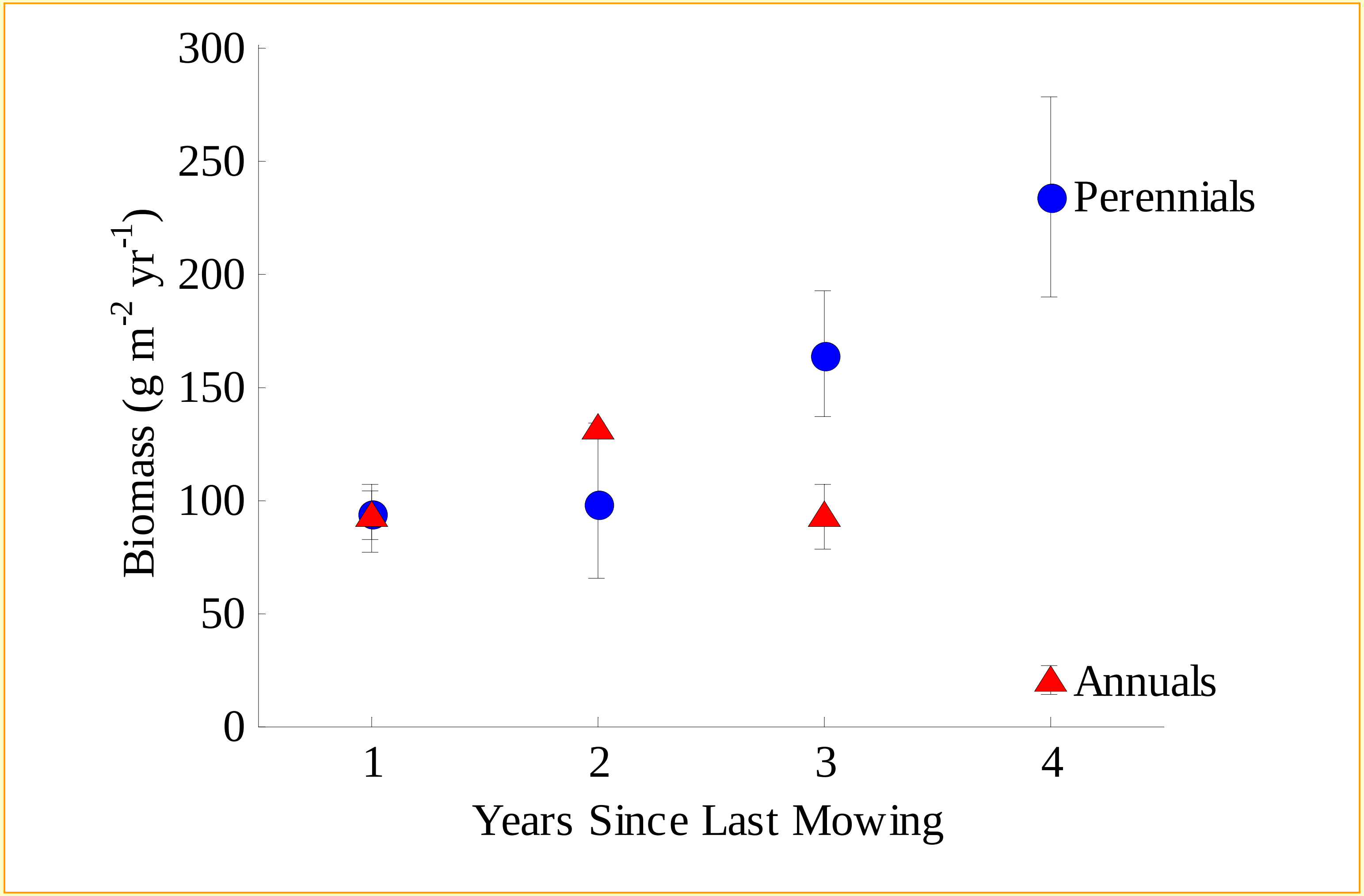
Seabloom, Harpole, et al. 2003, PNAS

Hypotheses

1. Exotic annual species are better resource competitors - No
2. Native perennial grasses are better competitors - Yes
3. **Multiple Stable Equilibria (MSE) - No**

> Why are annuals abundant?

Disturbance



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Restoration Implications

1. Exotic annual species are better competitors
   – Worst Case
2. **Native perennial grasses are better competitors but recruitment limited**
   – **Best Case**
3. Multiple Stable Equilibria (MSE)

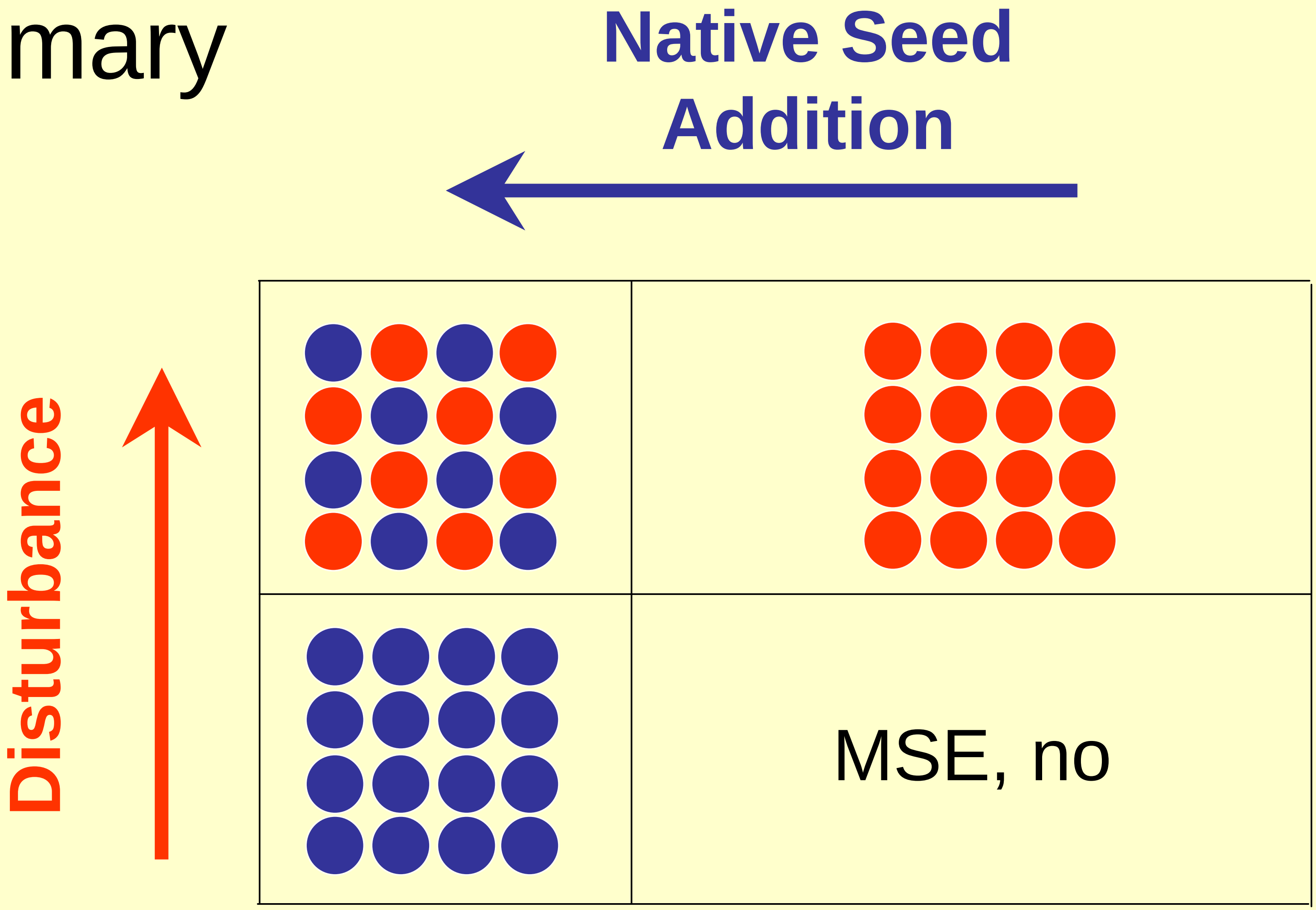
Global Change Implications

1. Increased N supply will favor poorer competitors for N (exotic annuals)
2. Dominance of exotic annuals:

   Greater N concentration and cycling

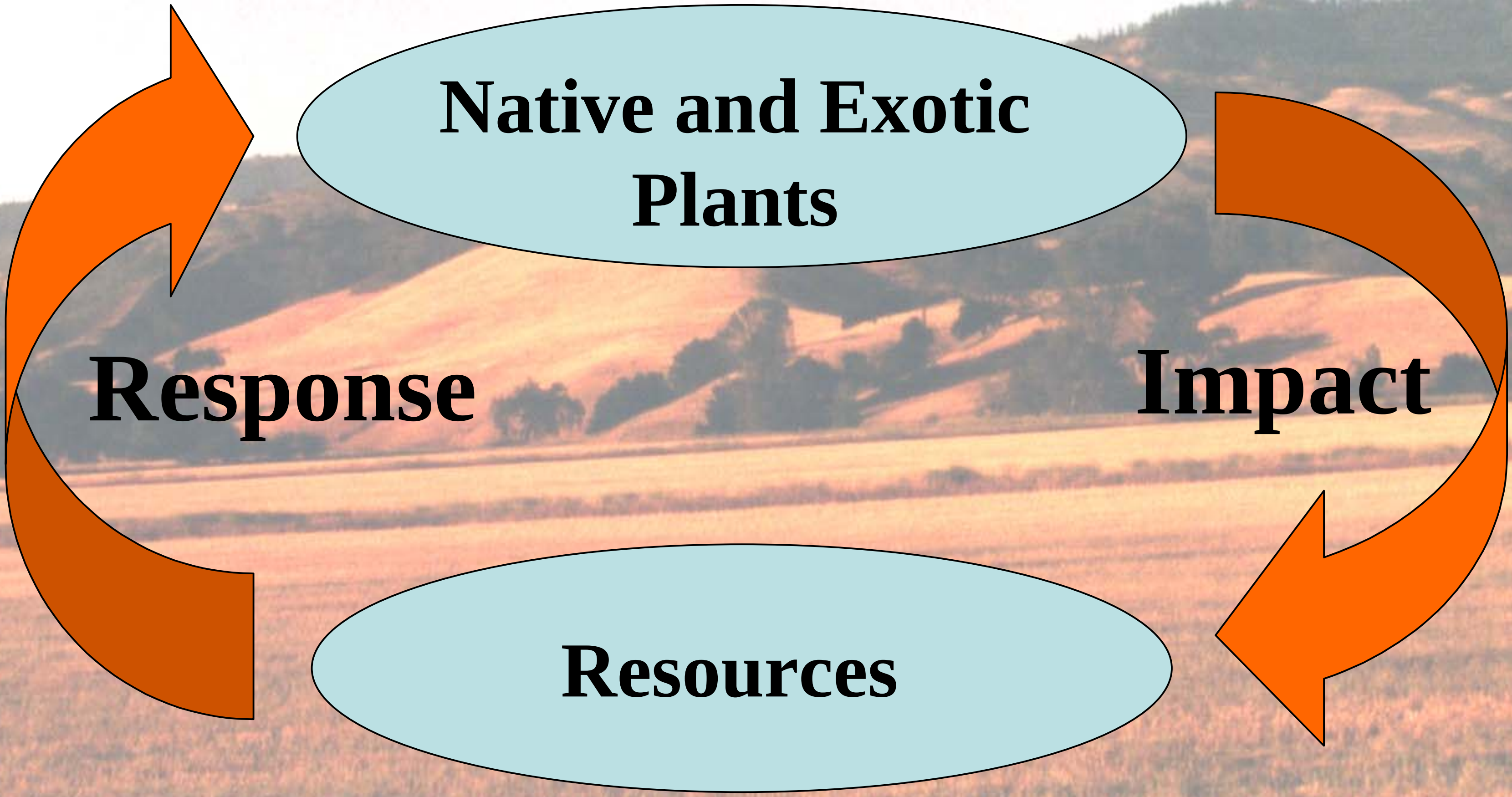
   Greater soil moisture at depth

Summary



Widespread, persistent domination by exotic species does not necessarily imply their competitive superiority

2. Species Responses to, and Impacts on Resources



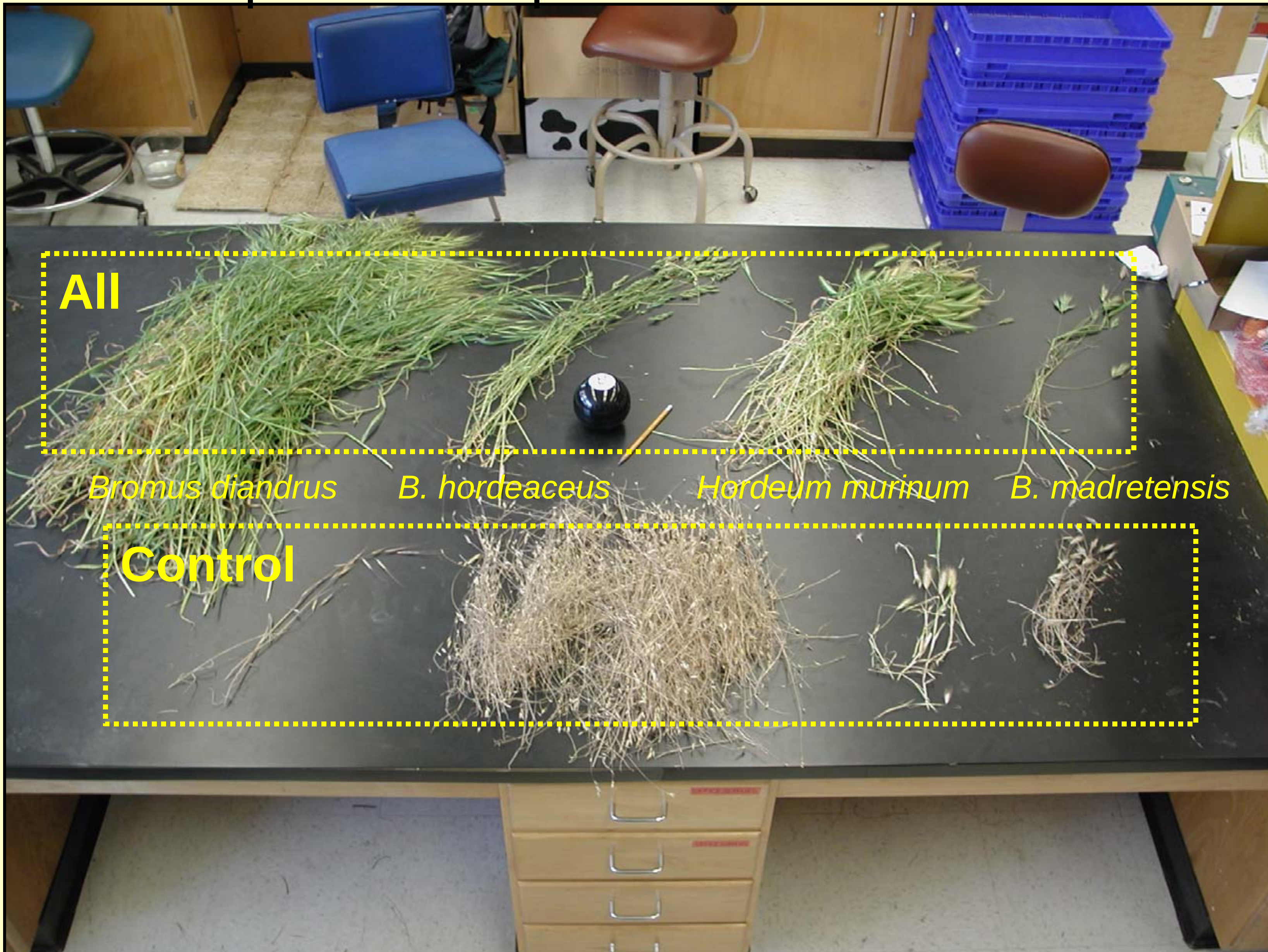
Species Response to Resources

- Factorial addition of:
  N, P, (Ca, K, Mg), Water
- 96 2m x 2m plots
- Aboveground biomass, sorted to species

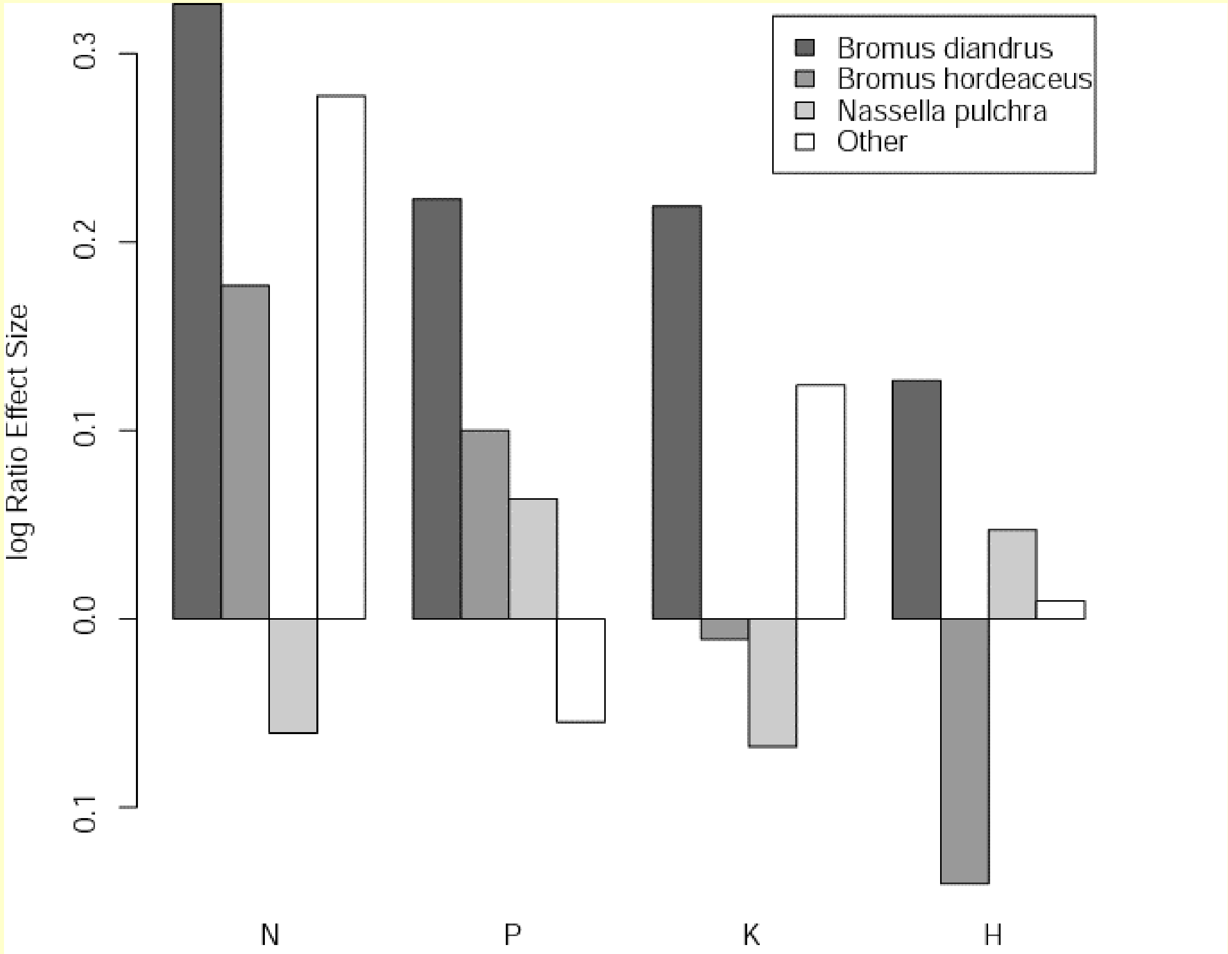
- > 4 Resources Limiting

Species Response to Resources

Species Response to Resources



Species Response to Resources



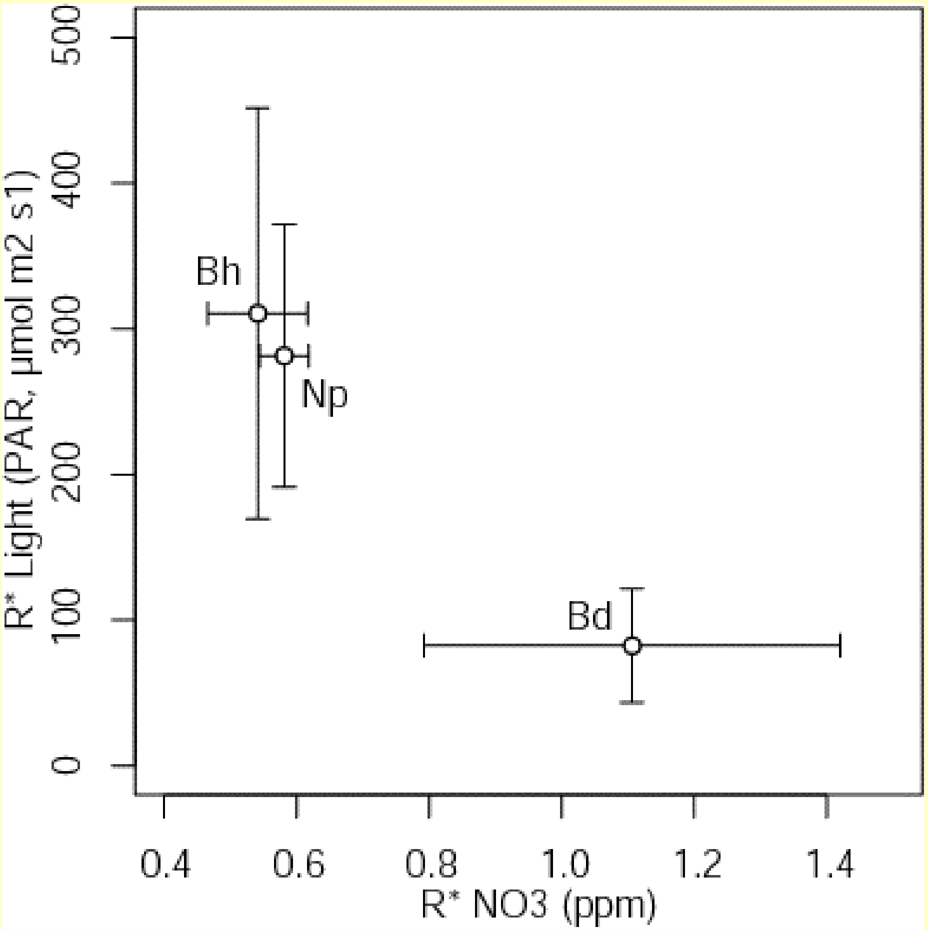
Species Impact on Resources

Monoculture Gardens

NO_3^-

Light

Species Impact on Resources



Species Responses to, and Impacts on Resources

- Nitrogen
  - *Bromus diandrus* > *B. hordeaceus* and *Nassella pulchra*
- Light
  - *Bromus diandrus* < *B. hordeaceus* and *Nassella pulchra*
- Increased N supply alters species composition
- Other Evidence:
  - Natural gradients, other tradeoffs

Current Research

- **Sedgwick, Santa Ynez (with Eric Seabloom)**
  - Long-term N-addition gradient
  - Impacts of exotic and native species on interacting water and nitrogen dynamics

- **UCI, Irvine (with Katharine Suding)**
  - Traits of invasive species
  - Scaling species traits to invasibility, community assembly, and ecosystem processes

Acknowledgments

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Sedgwick Reserve, UC Natural Reserve System, Andrew W. Mellon Foundation

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