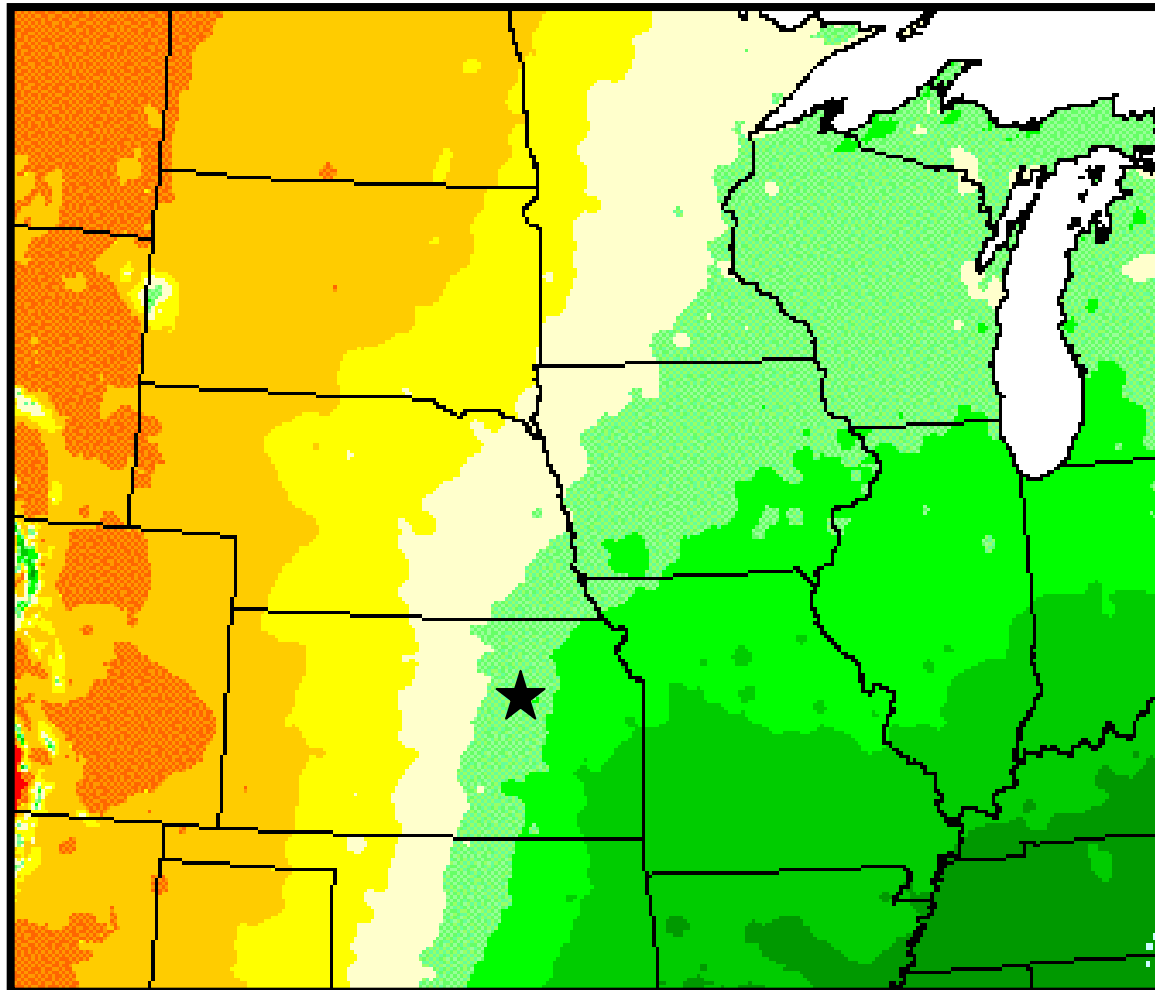


Grassland Restoration at KNZ LTER: Current research and future initiatives

Sara G. Baer, Department of Plant Biology & Center for Ecology
Southern Illinois University, Carbondale



Integration of LTER Research at KNZ

New LTER Initiatives

- Fire Reversal Exp.
- Season of Fire
- Bud Bank Demography \$
- Insect Biodiversity and Ecology \$
- Ecological Genomics \$

Management Issues

- Bison/Cattle Grazing \$
- Land Use / Land Cover Change \$
- Invasive Species
- Restoration \$
- Water Quality \$

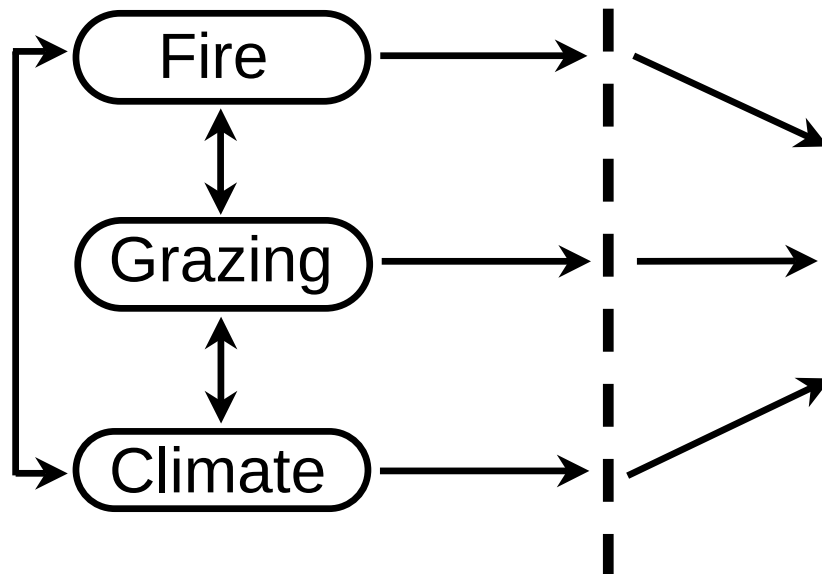
Climate Change

- Rainfall Manipulations \$
- Experimental Stream Studies \$
- Flux Towers CO₂, H₂O \$
- Climate Gradient Studies

Extending the Inference Of Konza Studies



Spatial and Temporal Heterogeneity



Tallgrass Prairie

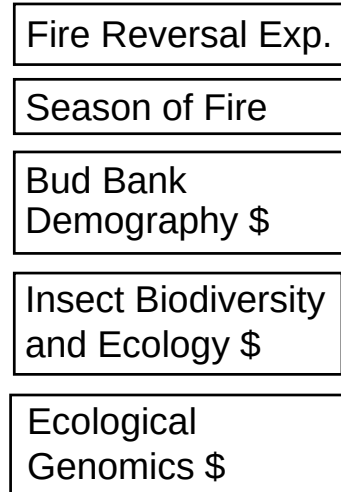
- Genes
- Organisms
- Populations
- Communities
- Ecosystems
- Landscapes

Plot-Level Mechanistic Studies

- Belowground Exp. Plots
- Irrigation Transects
- P Addition Experiment
- Mycorrhizae & Soil C Exp \$
- LINX II Studies \$

Integration of **Restoration** Research at KNZ

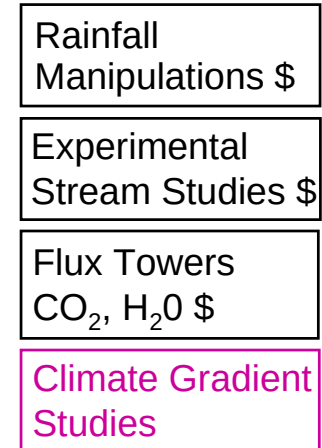
New LTER Initiatives



Management Issues



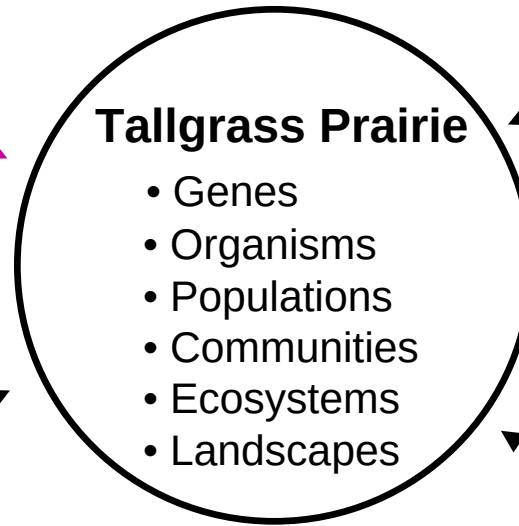
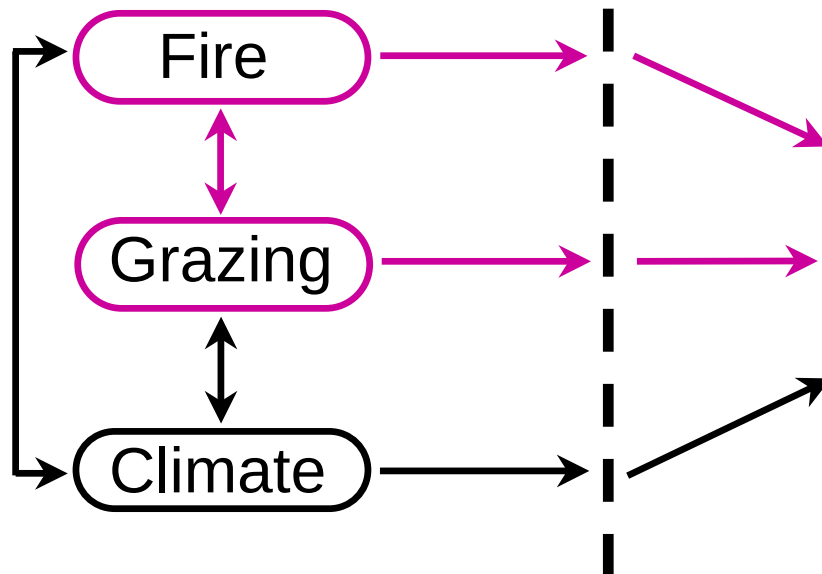
Climate Change



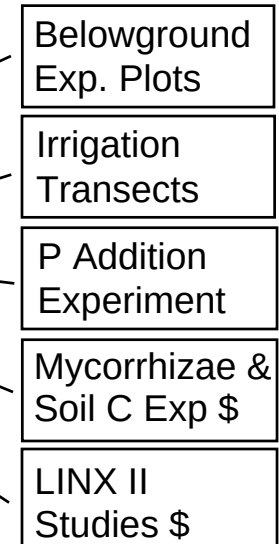
Cross-Site, Network International Studies

Extending the Inference Of Konza Studies

Spatial and Temporal Heterogeneity



Plot-Level Mechanistic Studies



Long-term Restoration Research at KNZ

New LTER Initiatives

- Fire Reversal Exp.
- Season of Fire
- Bud Bank Demography \$
- Insect Biodiversity and Ecology \$
- Ecological Genomics \$

Management Issues

- Bison/Cattle Grazing \$
- Land Use / Land Cover Change \$
- Invasive Species
- Restoration \$
- Water Quality \$

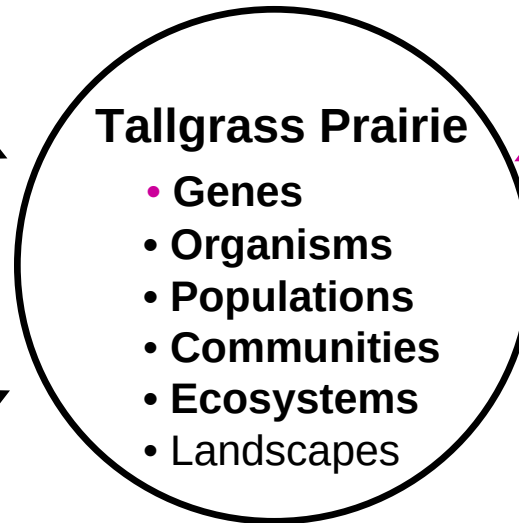
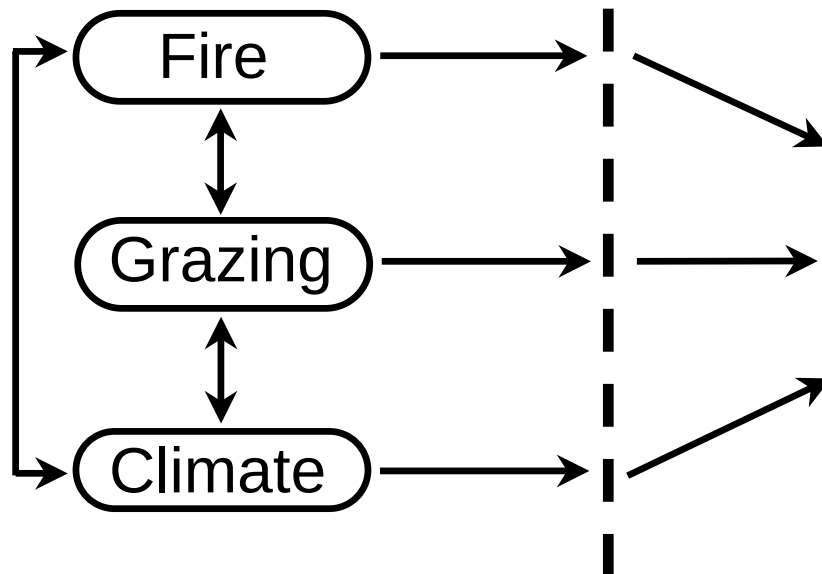
Climate Change

- Rainfall Manipulations \$
- Experimental Stream Studies \$
- Flux Towers CO₂, H₂O \$
- Climate Gradient Studies

Extending the Inference Of Konza Studies

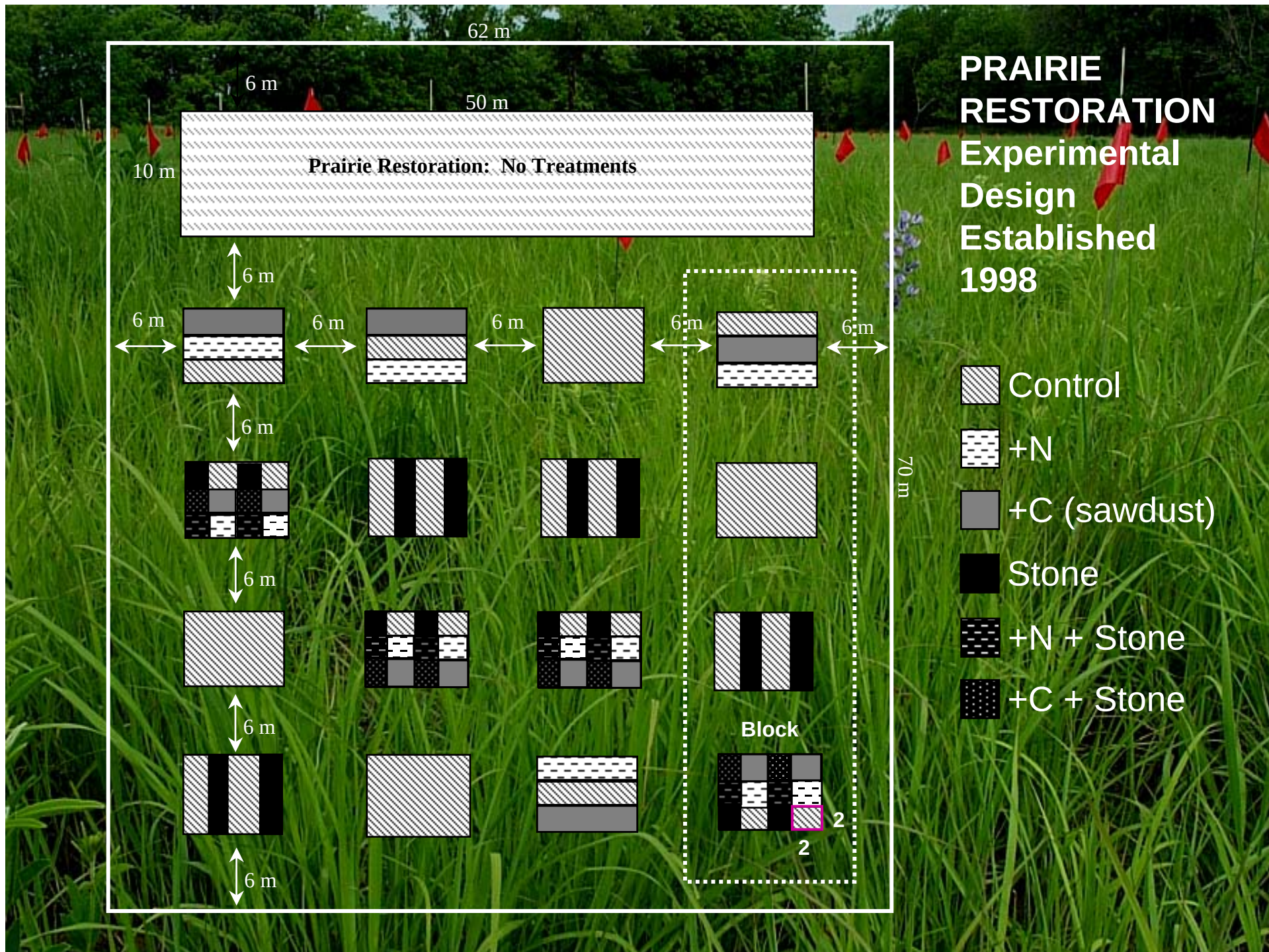


Spatial and Temporal Heterogeneity

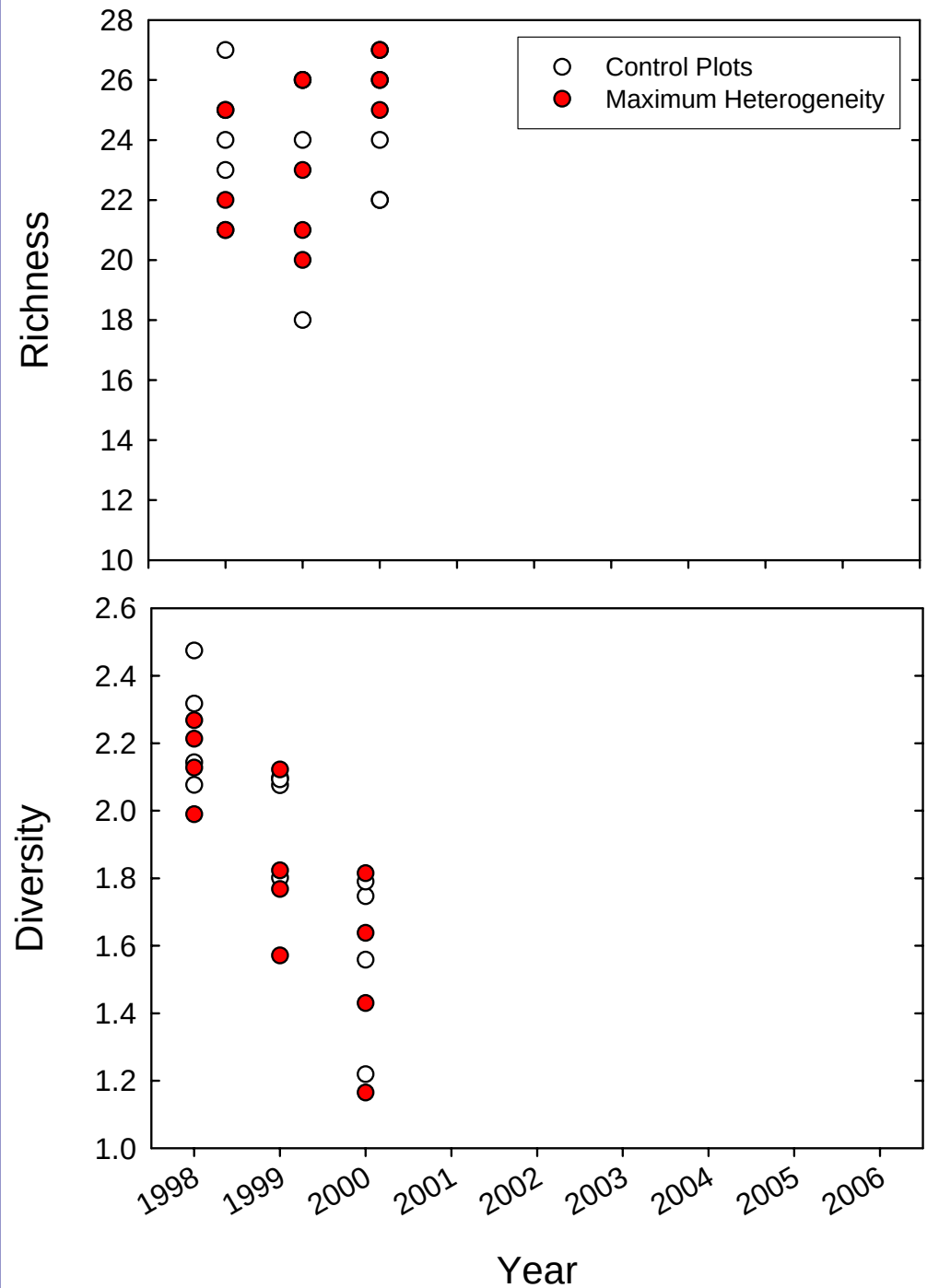


Plot-Level Mechanistic Studies

- Heterogeneity Plots \$ NSF



A test of the “Environmental Heterogeneity Hypothesis”



LTER V: Global Change and Grassland Dynamics

Land Use Changes

- Fire
- Grazing
- Land use legacies

Climate Change

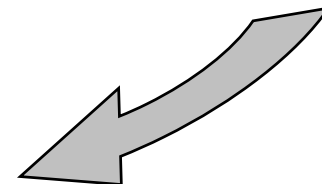
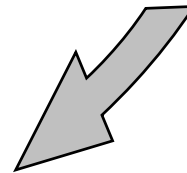
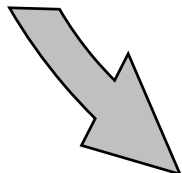
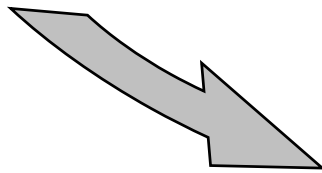
- Rainfall timing and amount
- Temperature

Nutrient Enrichment

- Elevated N deposition

Biological Invasions

- Species introductions



Tallgrass Prairie Ecosystems
Structure
Function

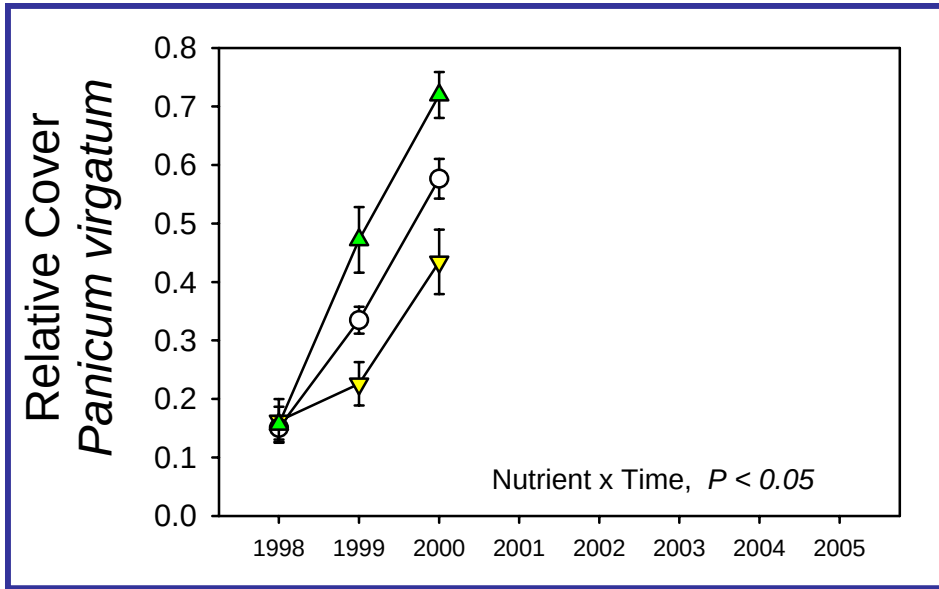
Contributions:

Diversity-Productivity Theory (Baer et al. 2003, *Ecology*)

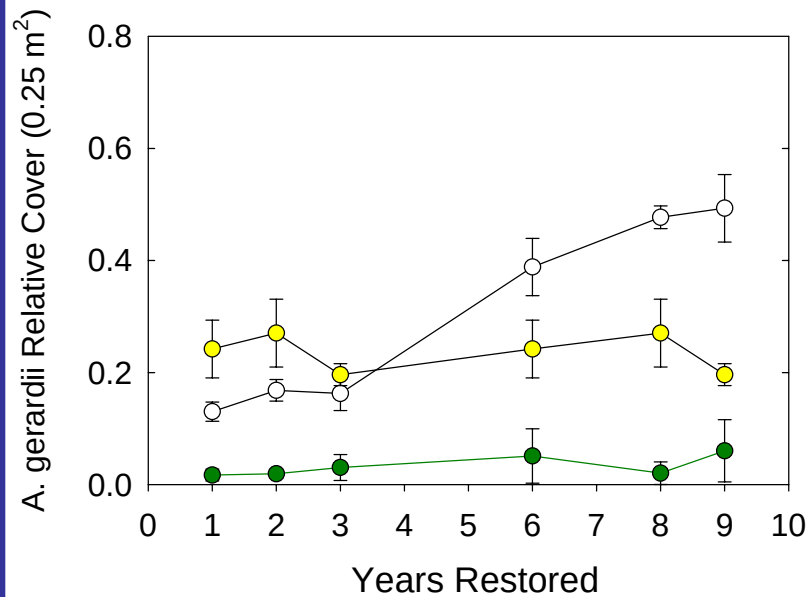
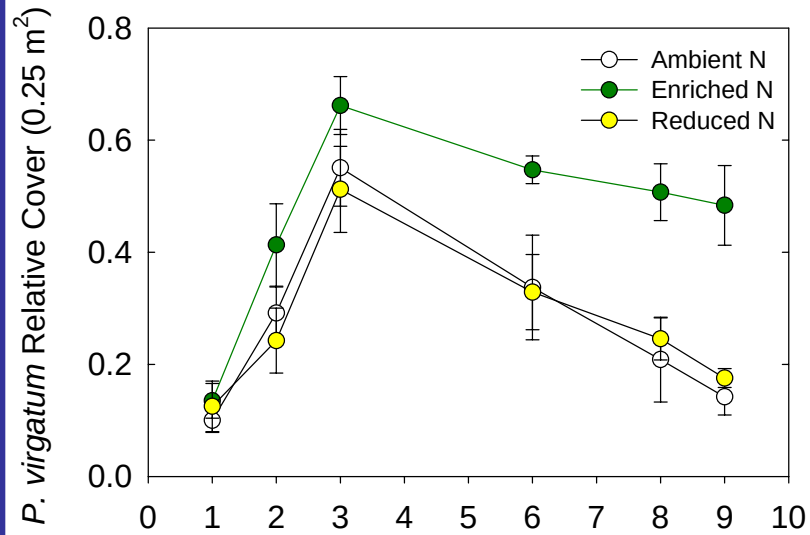
Dominance-Diversity Relationships (Baer et al. 2004, *Oecologia*; Baer et al. 2005, *Restoration Ecology*)

Test Positive & Negative Feedback Hypotheses (Baer and Blair, sub. *Ecology*)

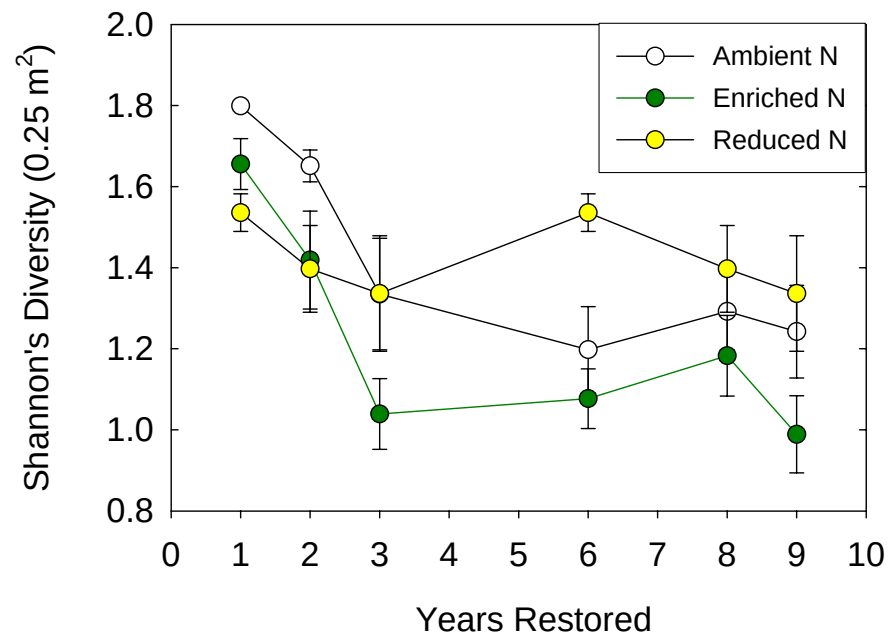
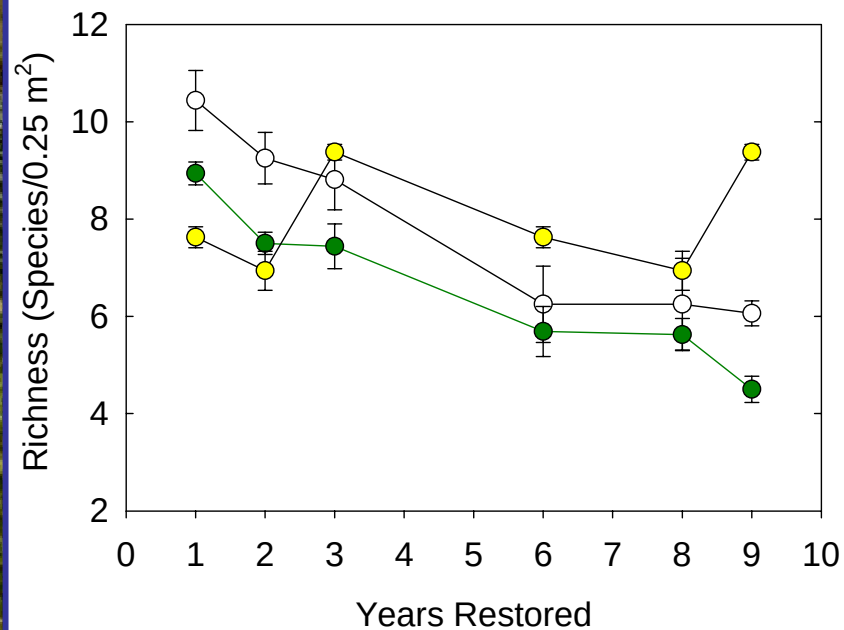
Changes in Dominance over Time



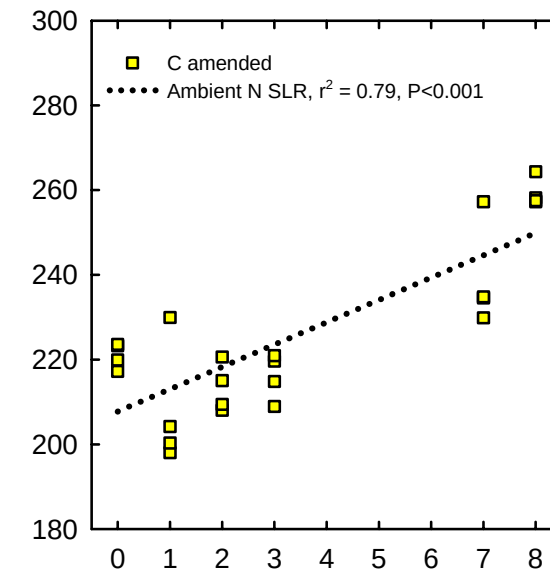
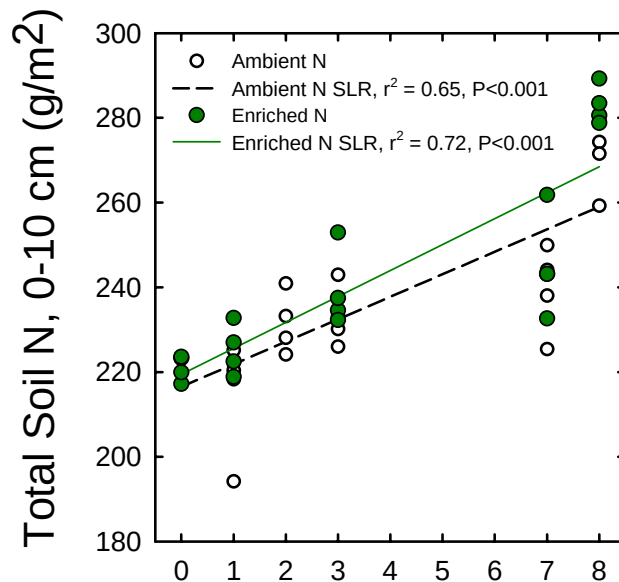
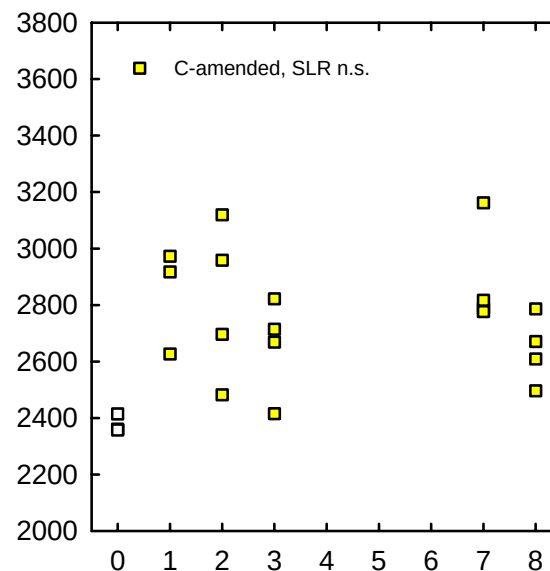
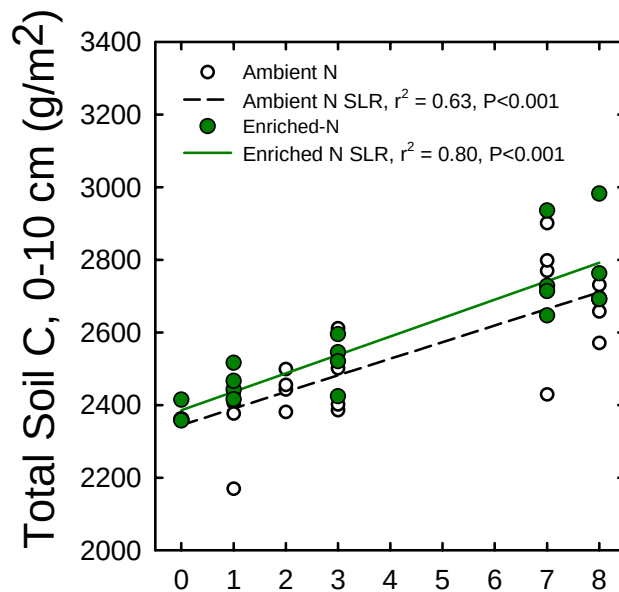
Changes in Dominance over Time



Changes in Richness and Diversity

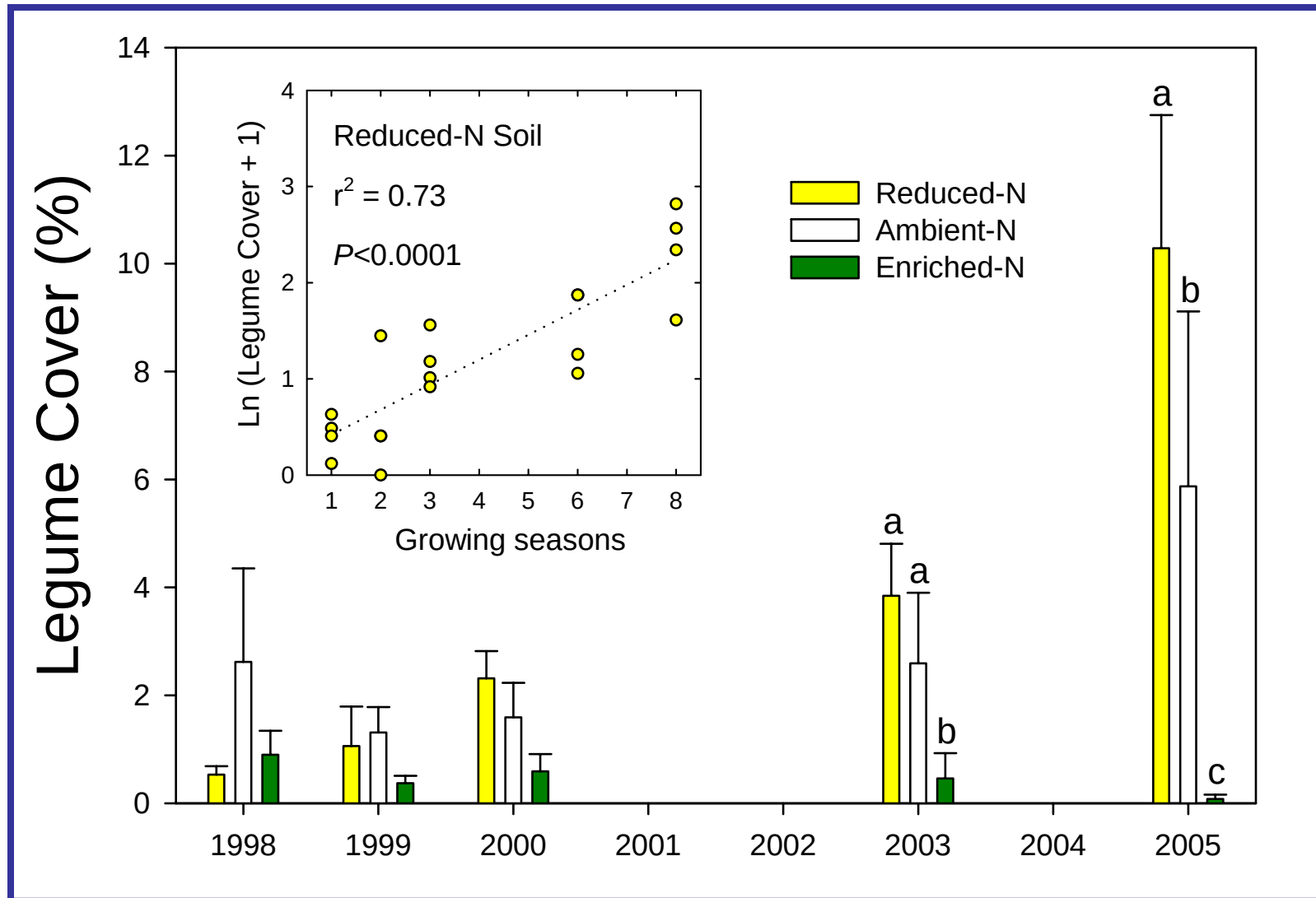


Total Soil C and N Accrual Rates



Years of Grassland Establishment

Interactions with Community Structure



New Initiatives during LTER V

New LTER Initiatives

Fire Reversal Exp.
Season of Fire
Bud Bank Demography \$
Insect Biodiversity and Ecology \$
Ecological Genomics \$

Management Issues

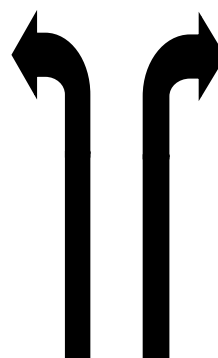
Bison/Cattle Grazing \$
Land Use / Land Cover Change \$
Invasive Species
Restoration \$
Water Quality \$

Climate Change

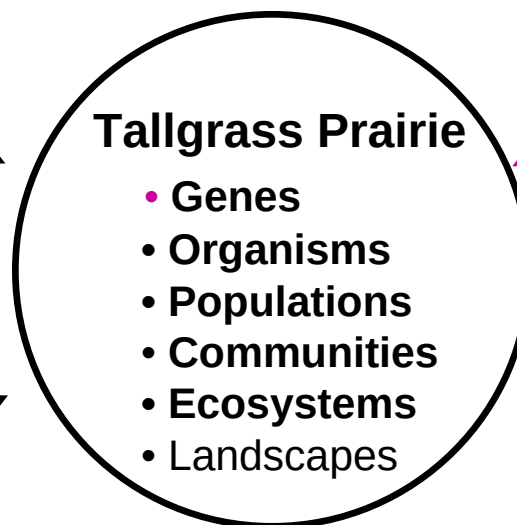
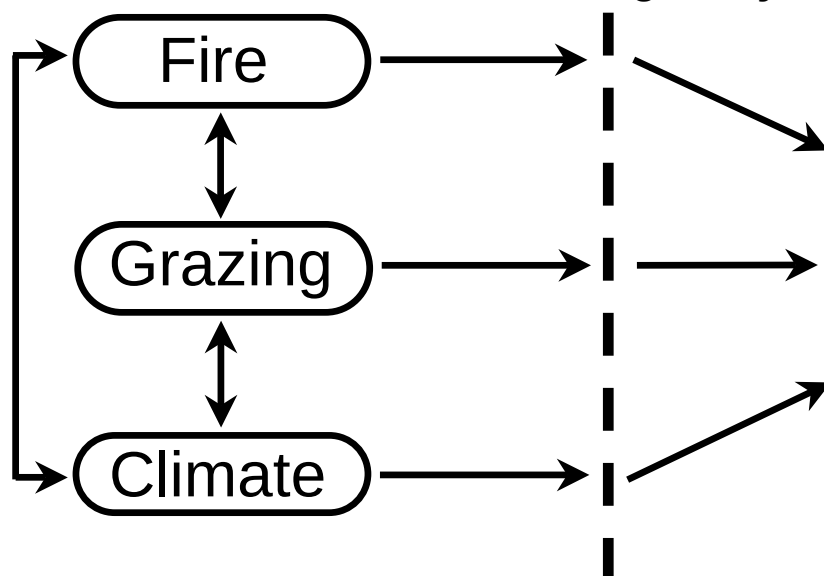
Rainfall Manipulations \$
Experimental Stream Studies \$
Flux Towers CO ₂ , H ₂ O \$
Climate Gradient Studies

Cross-Site, Network & International Studies \$

Extending the Inference Of Konza Studies



Spatial and Temporal Heterogeneity

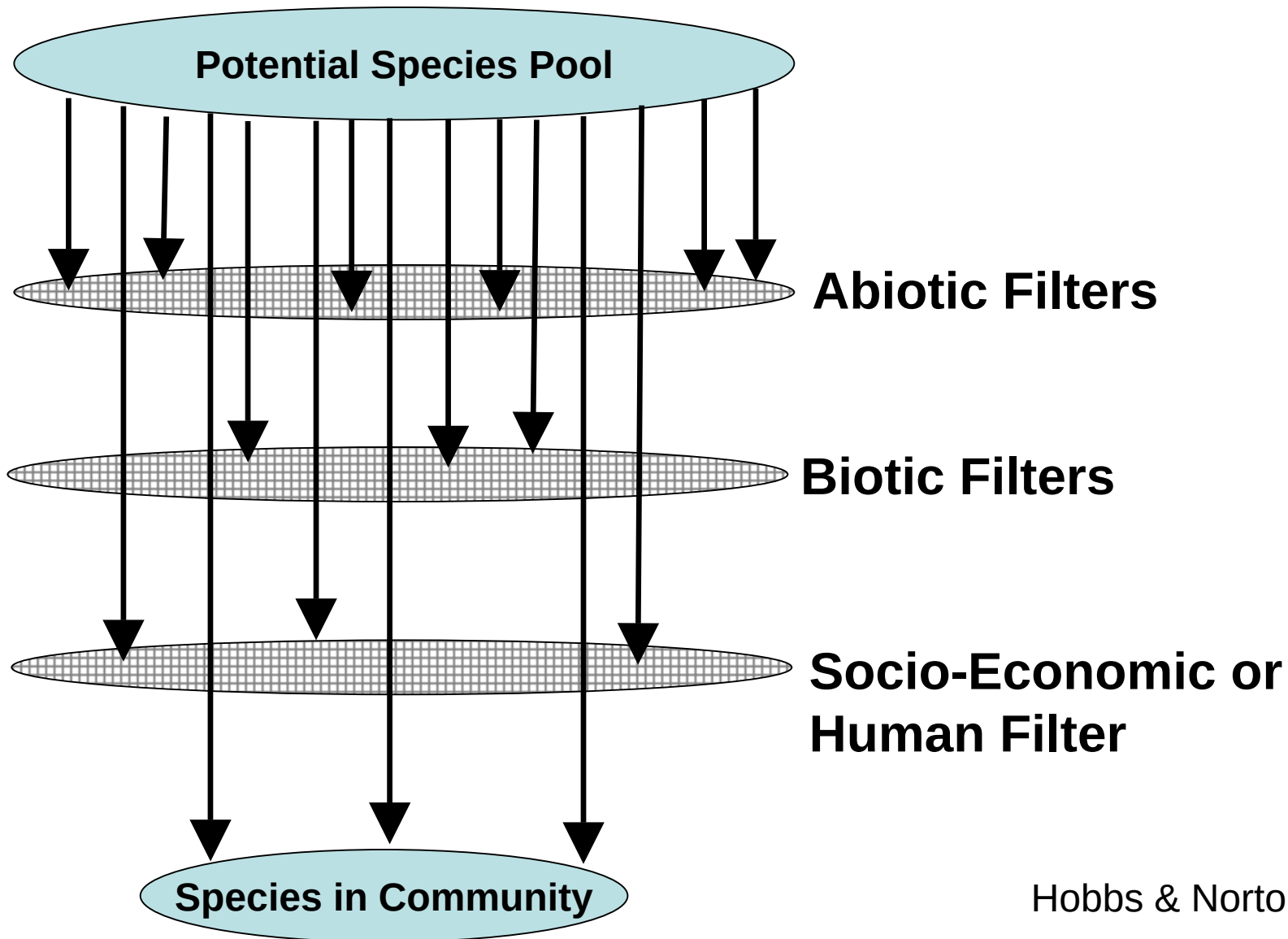


Plot-Level Mechanistic Studies

Heterogeneity Plots \$ NSF
Seed Source Dominance Gradient \$ LTER \$ SIUC \$ NSF



Filter-Model of Community Assembly



Hobbs & Norton 1999

Human filters unique to restoration in community and ecosystem assembly



**Population source
selection
(local vs. selected genotypes)**



**Seed composition
selection
(grass:forb)**

Intraspecific Variation

Cytology

Riley & Vogel 1982

Keeler & Davis 1999

Genetic structure

Gustafson et al.
1999, 2001, 2004

Ecophysiology

Skeel & Gibson

1996, 1998

Baer et al. 2005



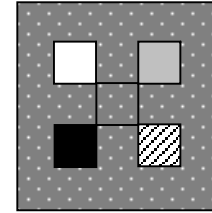
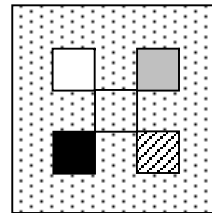
Population source selection (local vs. selected genotypes)

Cultivar
(selected)

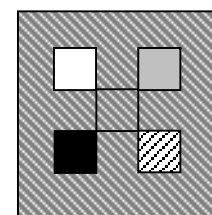
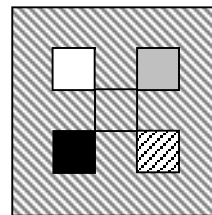
Native
(non-selected)

Species Pool

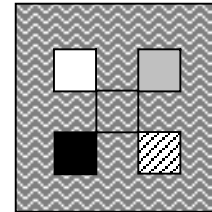
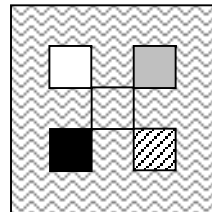
Design
Pool 1



Design
Pool 2



Design
Pool 3



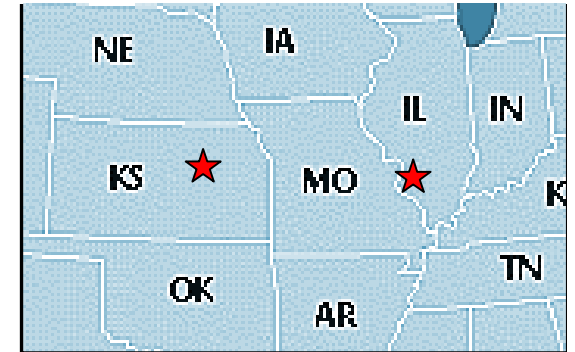
Embedded dominance
removal treatments

Hierarchical Approach:

Morphology
Physiology
Mutualism
Competition
Diversity
Productivity
Nutrient
cycling

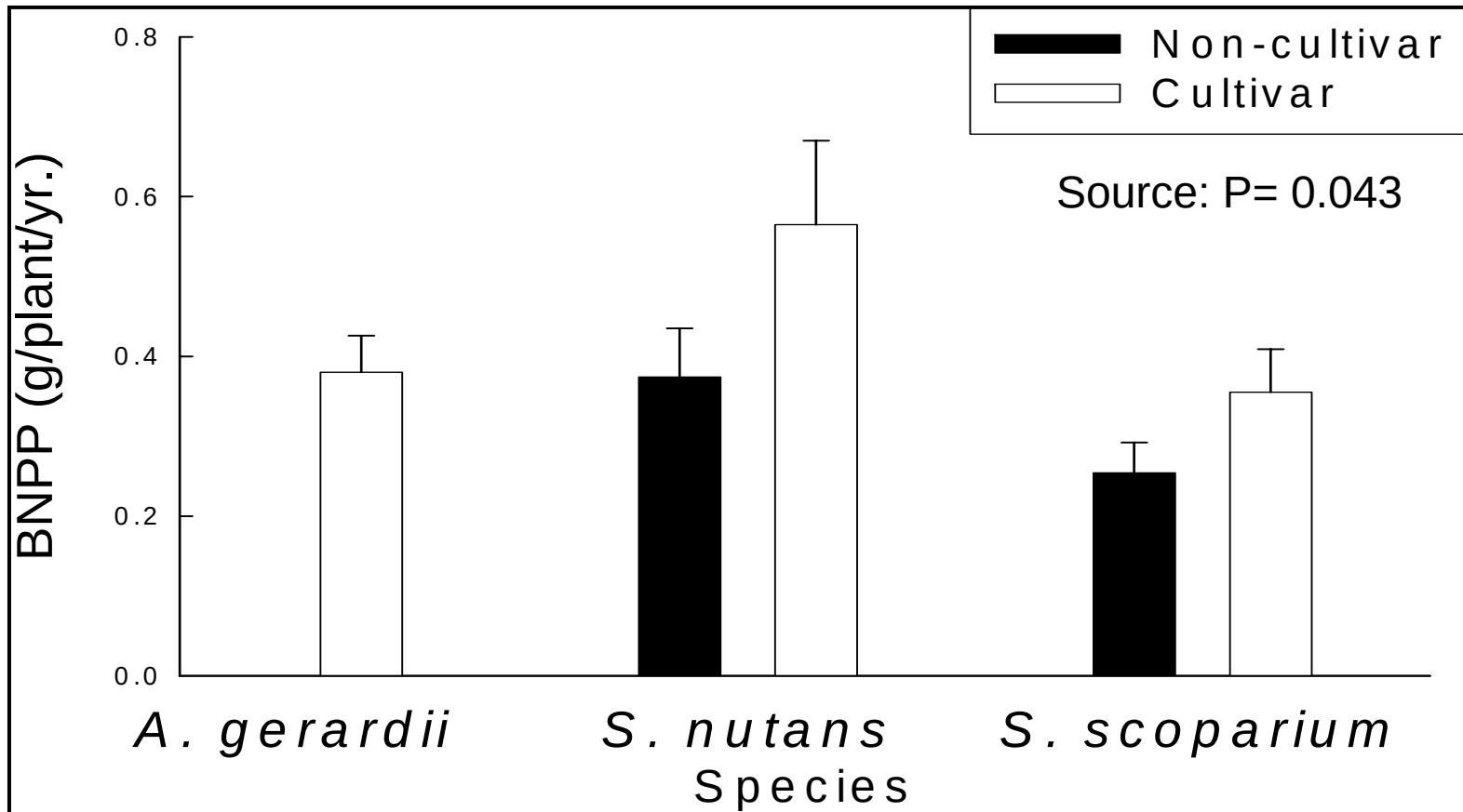
NSF \$

Source Population Selection X Seed composition selection Across a precipitation gradient

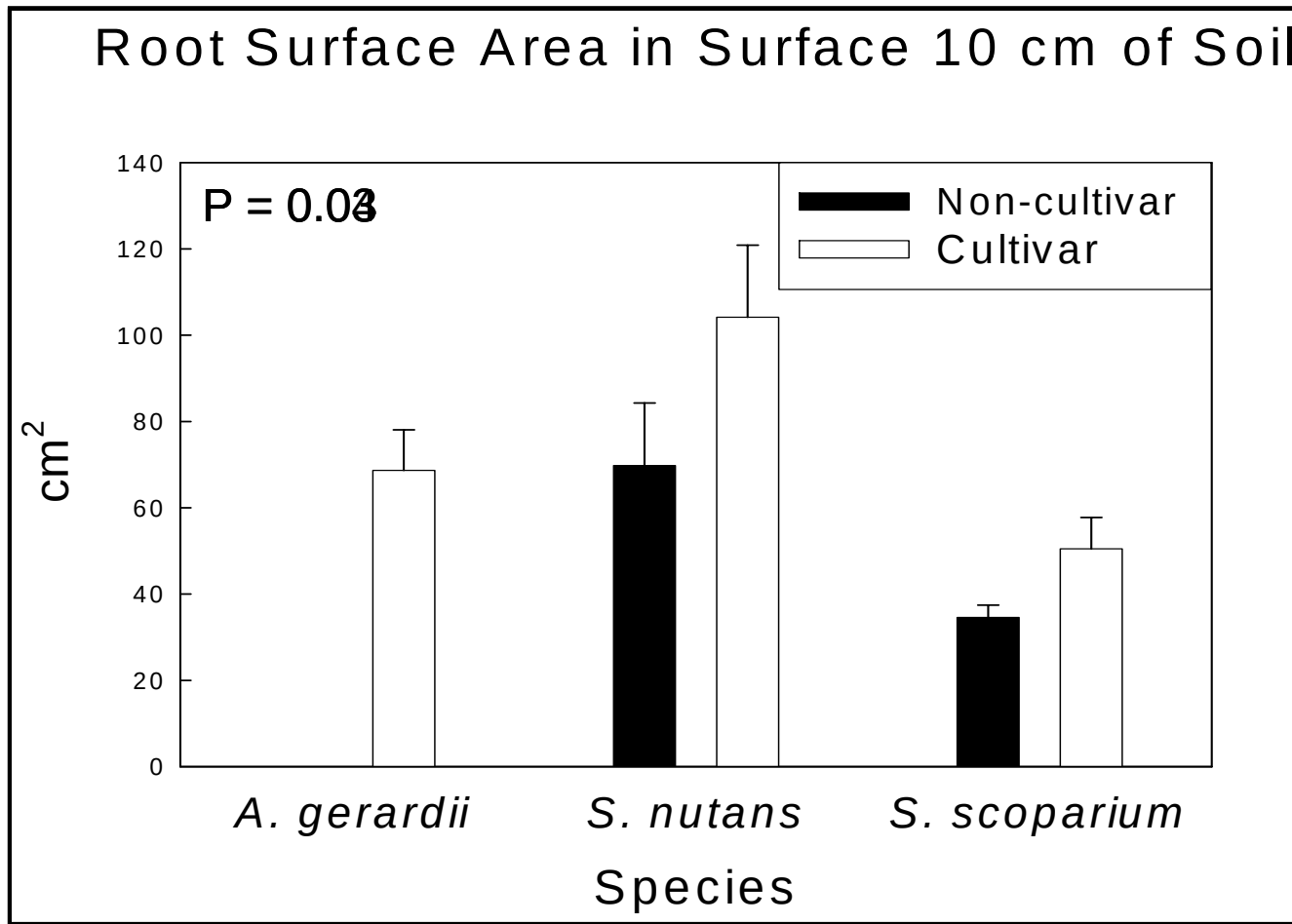


NSF \$ & LTER \$

Intraspecific Variation in BNPP Konza vs. Cultivar Sources

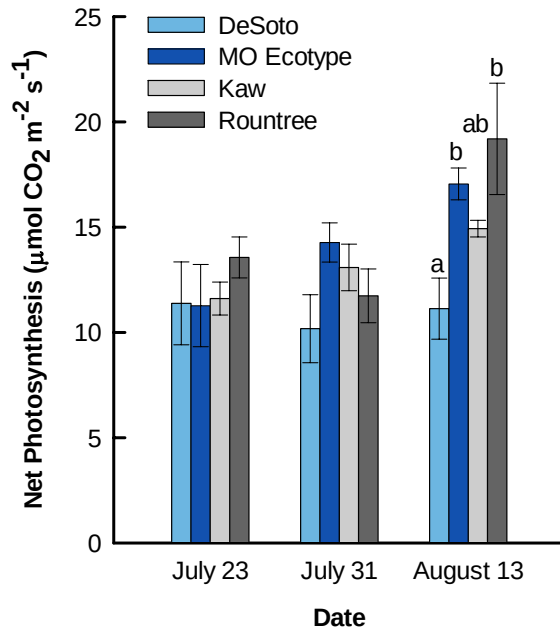


Intraspecific Variation in Root Architecture Konza vs. Cultivar Sources

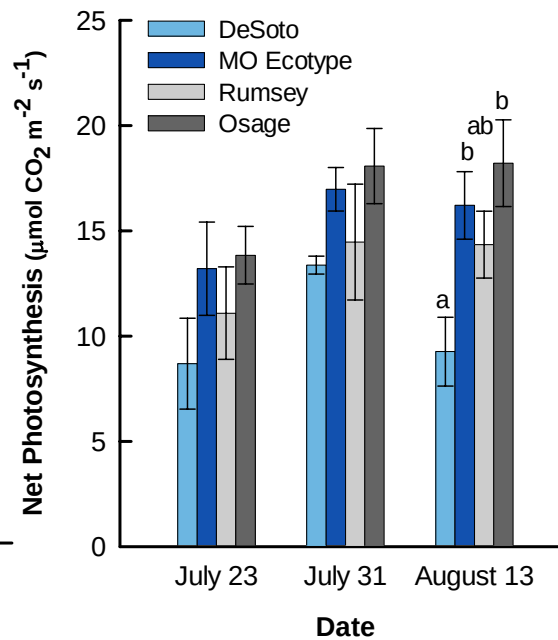


Intraspecific Variation in Net Photosynthesis

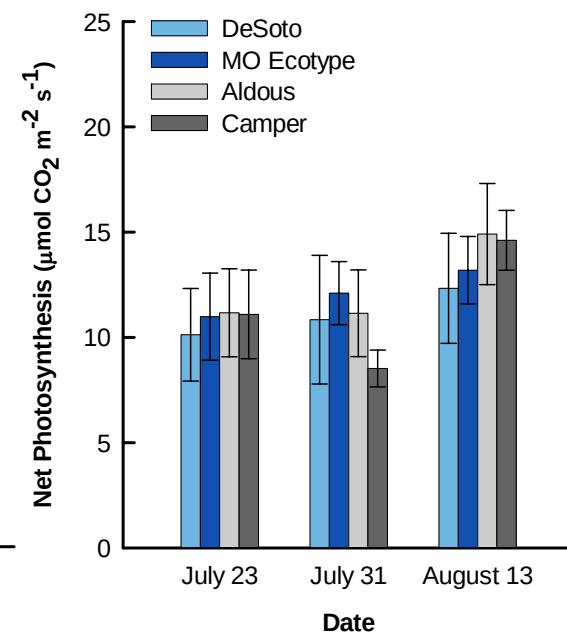
A. gerardii



S. nutans

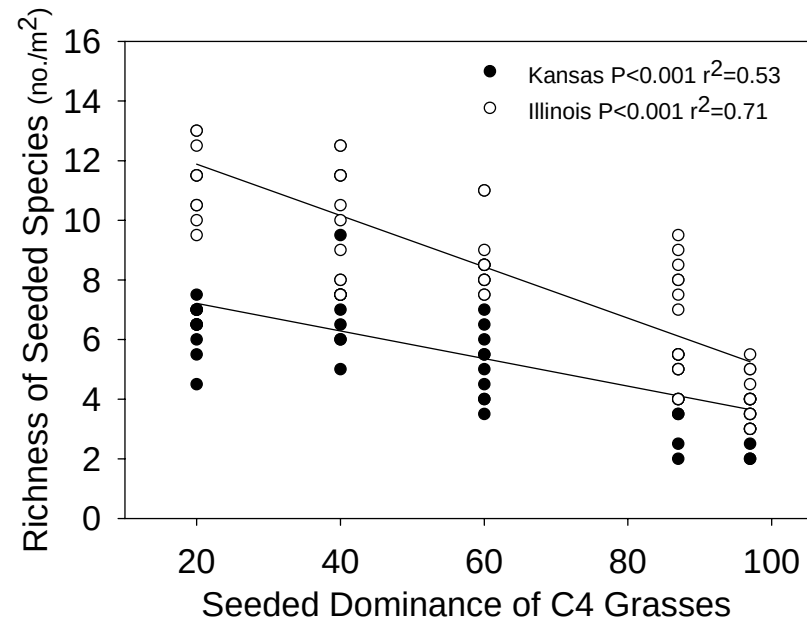
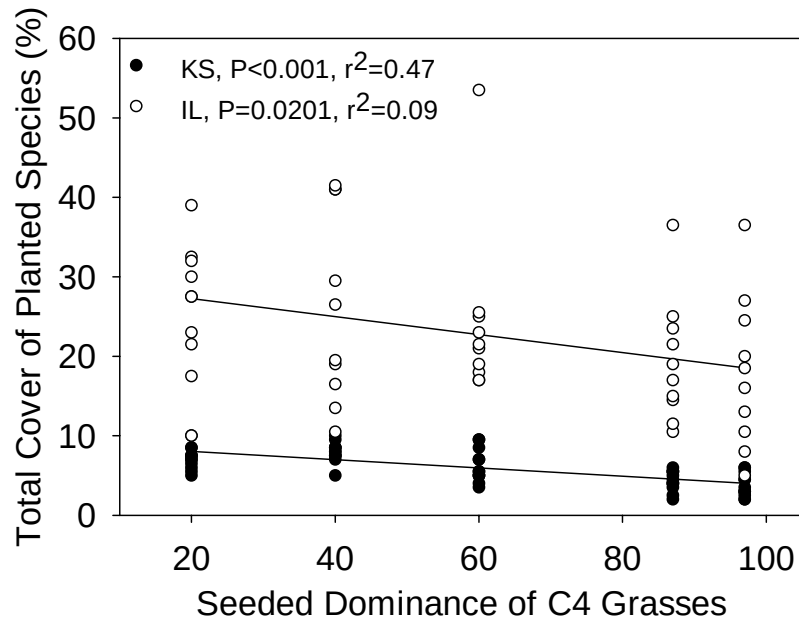


S. scoparium



Allison Lambert

Cross-site Variation in Community Assembly



Ryan Campbell & Ryan Klopf

New Initiatives for LTER VI

New LTER Initiatives

- Fire Reversal Exp.
- Season of Fire
- Bud Bank Demography \$
- Insect Biodiversity and Ecology \$
- Ecological Genomics \$

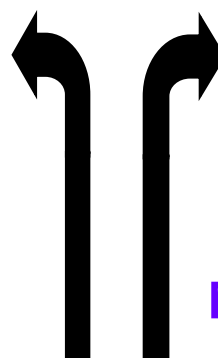
Management Issues

- Bison/Cattle Grazing \$
- Land Use / Land Cover Change \$
- Invasive Species
- Restoration \$
- Water Quality \$

Climate Change

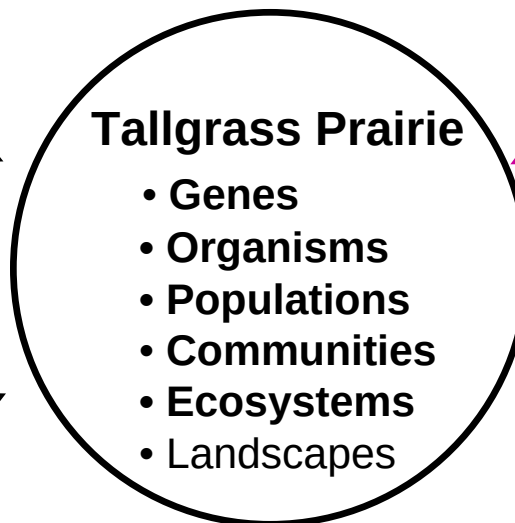
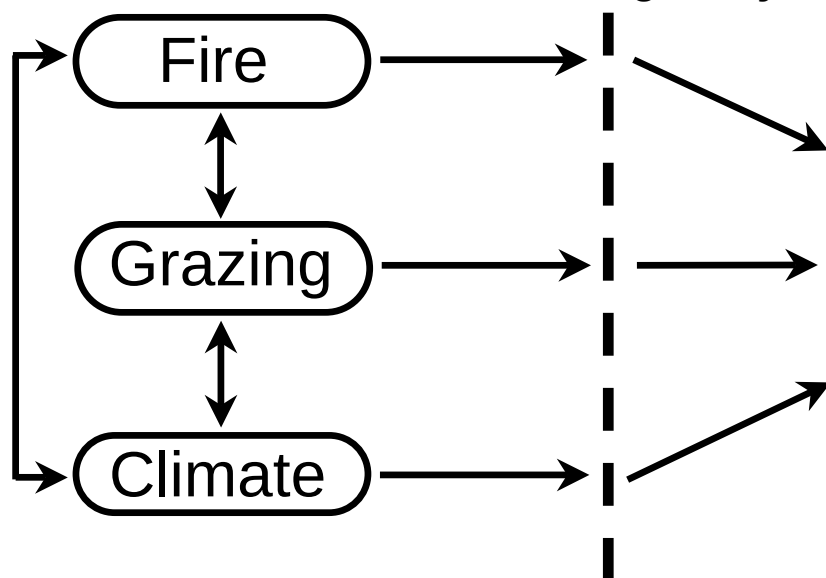
- Rainfall Manipulations \$
- Experimental Stream Studies \$
- Flux Towers CO₂, H₂O \$
- Climate Gradient Studies

Extending the Inference Of Konza Studies



Spatial and Temporal Heterogeneity

MAINTAIN Plot-Level Mechanistic Studies



- Heterogeneity Plots \$ NSF
- Seed Source Dominance Gradient \$ LTER \$ SIUC \$ NSF

New Initiatives for LTER VI

New LTER Initiatives

Fire Reversal Exp.
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Restoration \$
Water Quality \$

INCREASE

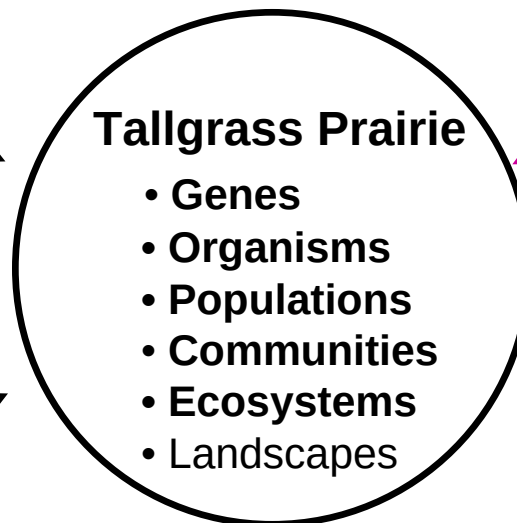
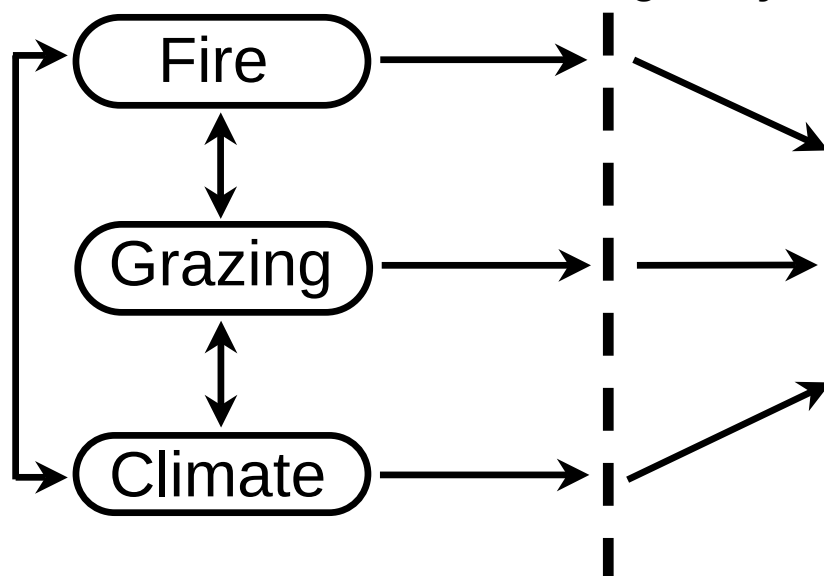
Cross-Site, Network & International Studies \$

Extending the Inference Of Konza Studies

Climate Change

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New Initiatives for LTER VI

New LTER Initiatives

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Extending the Inference Of Konza Studies

Climate Change

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Climate Gradient Studies

Spatial and Temporal Heterogeneity

INITIATE

Fire

Grazing

Climate

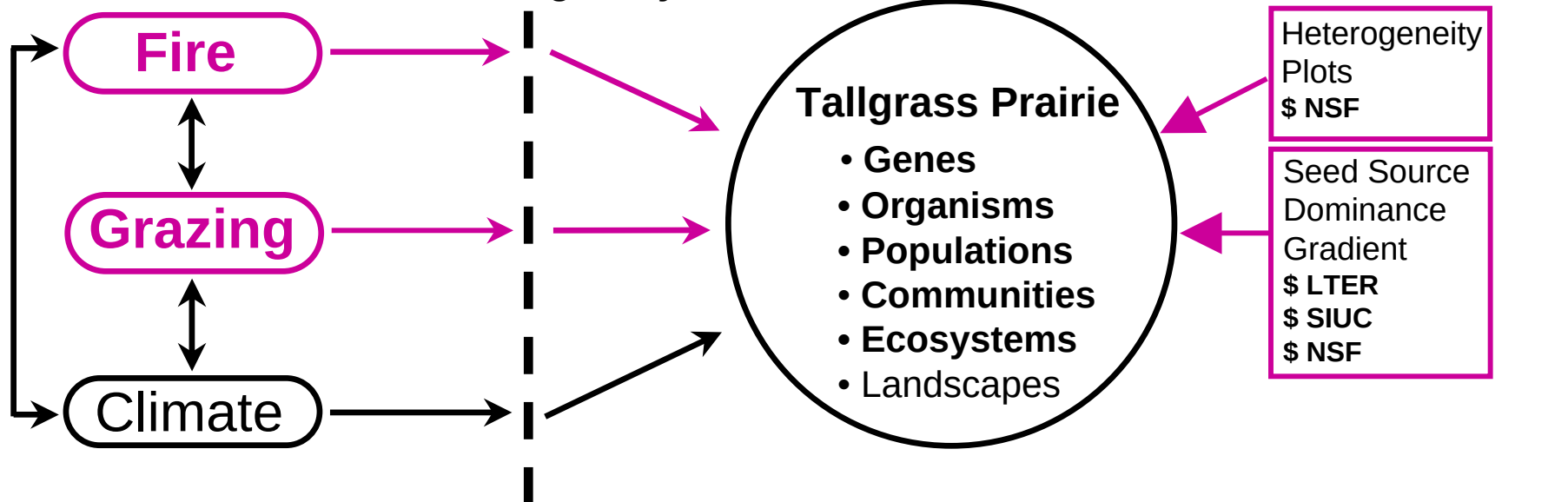
Tallgrass Prairie

- Genes
- Organisms
- Populations
- Communities
- Ecosystems
- Landscapes

MAINTAIN Plot-Level Mechanistic Studies

Heterogeneity Plots \$ NSF

Seed Source Dominance Gradient \$ LTER \$ SIUC \$ NSF



New Restoration Initiative

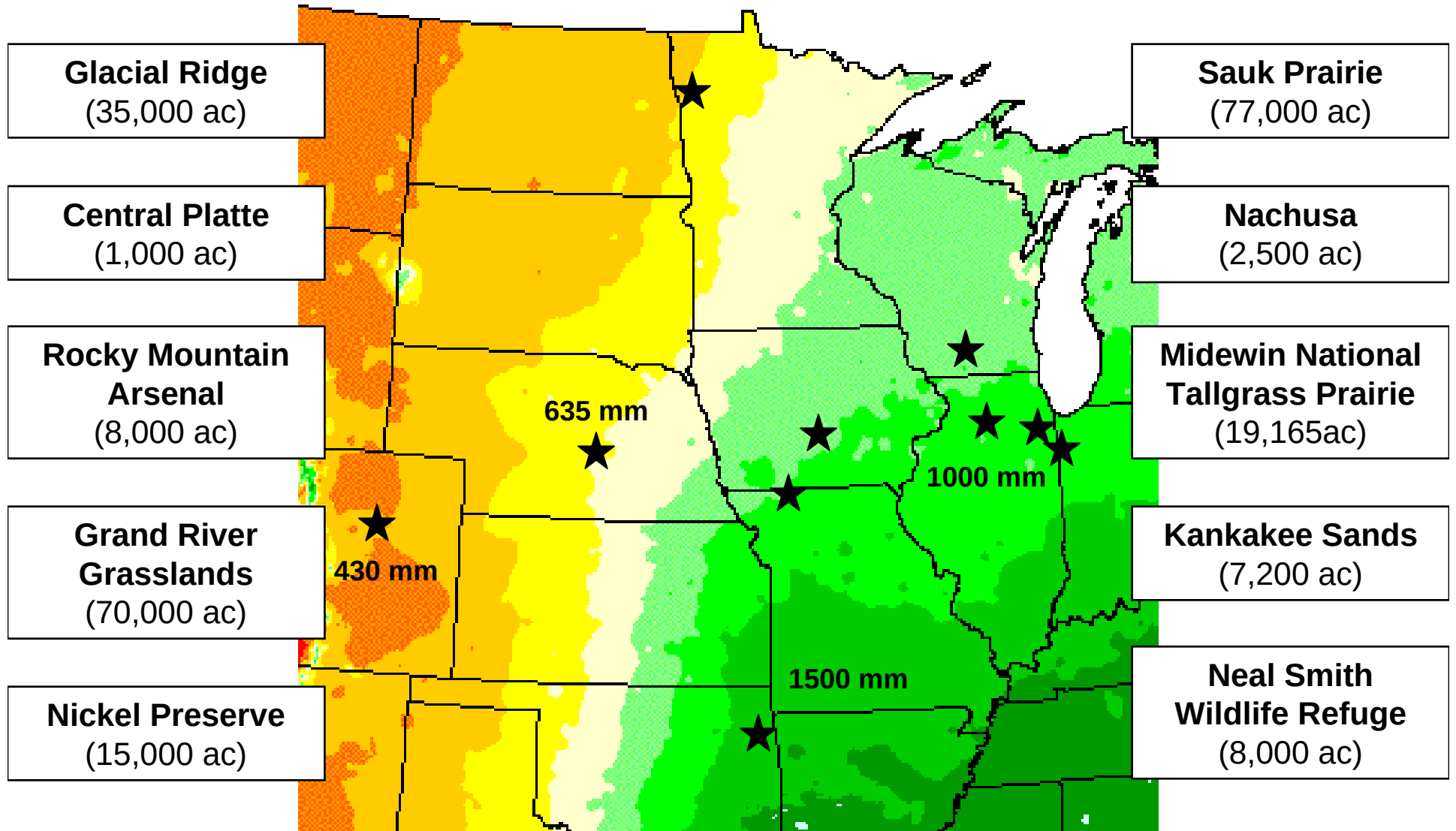
Establish large-scale restoration plots with fire and grazing treatments TO:

- 1) Broaden tests of ecological drivers and community assembly **theory**.
- 2) Expand **inference** from WS studies to restored grasslands.
- 3) Further contribute to the **management** objective of KNZ LTER.
- 4) Foster **collaboration**, as larger plots more conducive to studying higher trophic levels.
- 5) Increase **education** and **outreach**.
- 6) Initiate **cross-site studies** along a **climate gradient** using the **Grassland Restoration Network...**

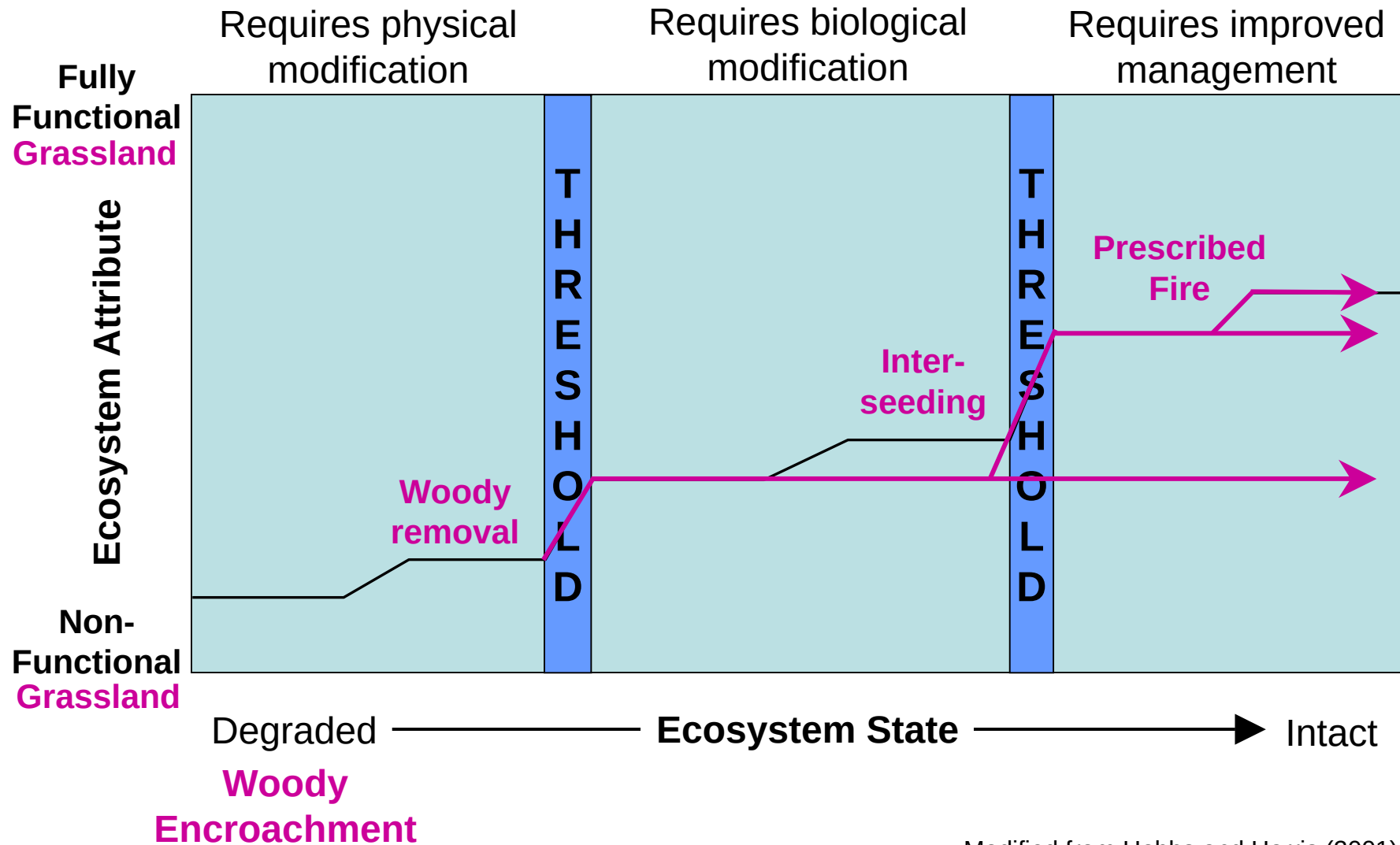


Grassland Restoration Network

“A consortium of restoration practitioners, scientists, and land managers interested in integrating the best science and management practices into large scale grassland restoration projects. “



Expanding Our Perception of Restoration



Modified from Hobbs and Harris (2001)



Acknowledgements

Graduate Students

Ryan Klopf

Ryan Campbell

Allison Lambert

Lewis Reed

Past & Current Undergraduates

Robin Garcia

David Dalzotto

Luke Koett

Dana Carver

Meredith Mendola

Stephanie Welsh