

Management of rare native plants amidst exotic plant competition

Insights from the Sandhills of Santa Cruz County

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Unique Edaphic Communities...



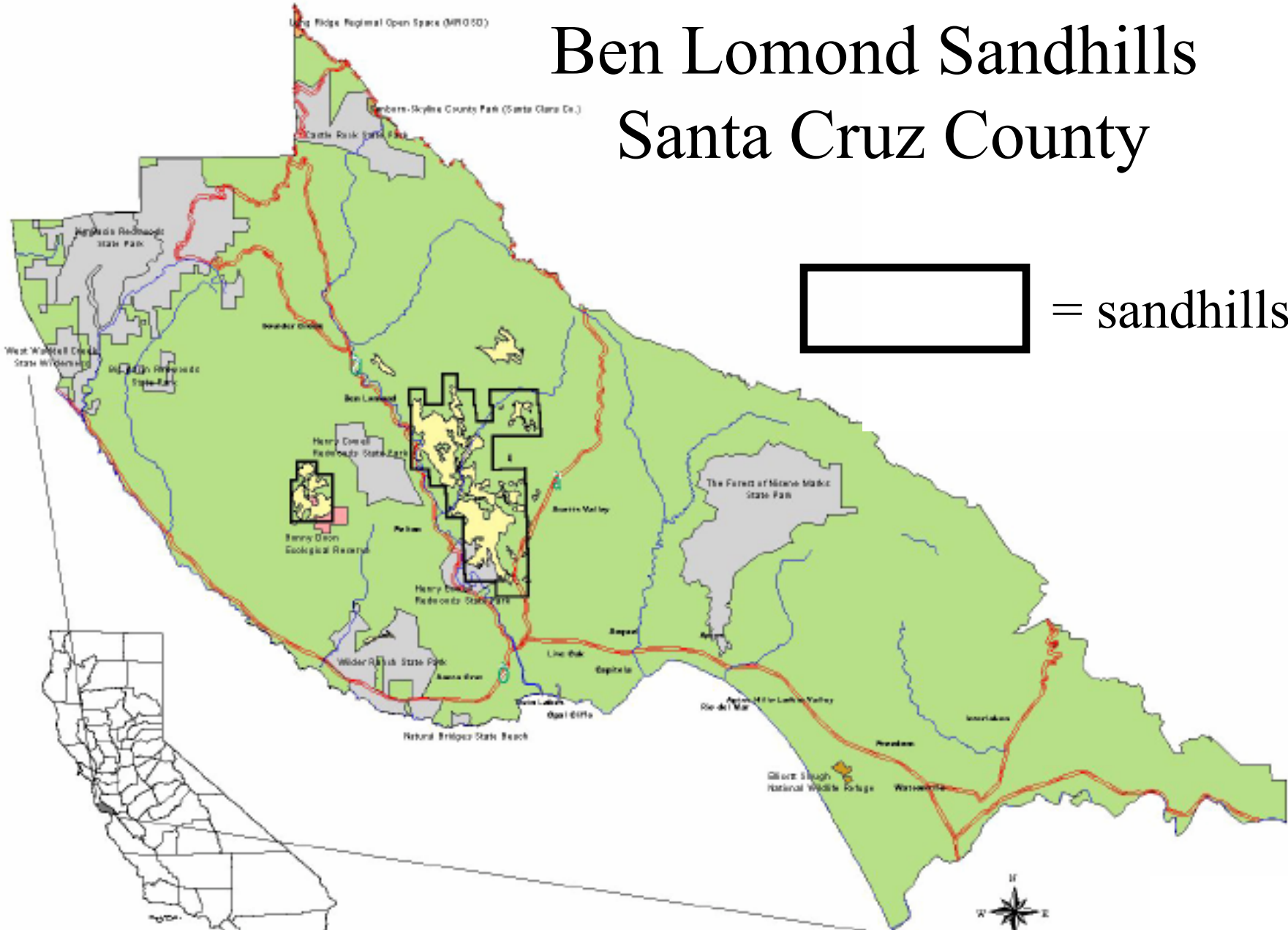
..High Endemism, High Diversity



Exotic Plants Species

- **have invaded endemic communities**
 - **compete with native plant species**
 - **threaten biodiversity**

Ben Lomond Sandhills Santa Cruz County



Map courtesy USFWS

0



10 miles

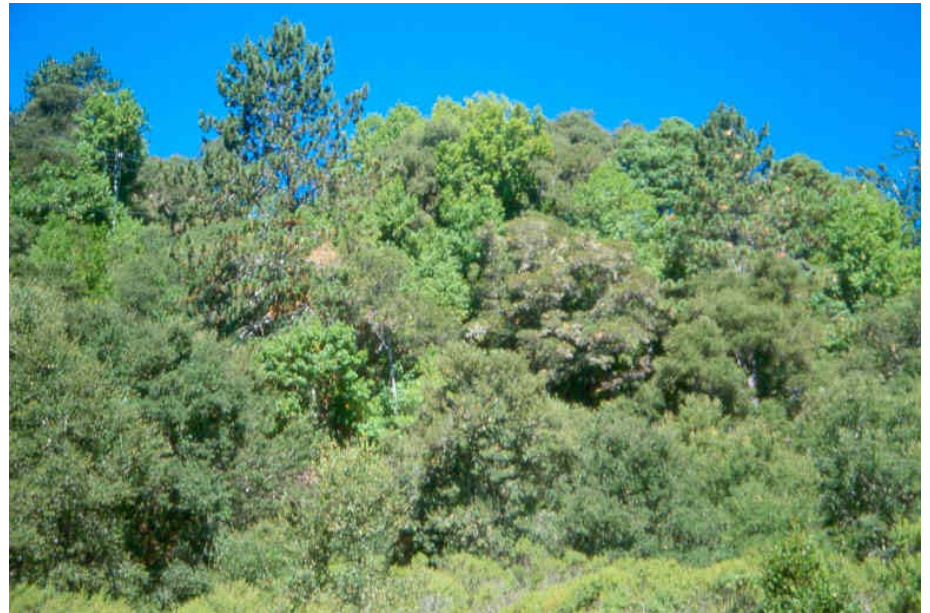
Ben Lomond Soils

(Soil Conservation Service 1980)

Zayante Sand	Characteristic	Felton Loam
low	Soil Profile Development	medium-high
<0.5%	Organic carbon	3-5%
0.5-2.1	Base exchange capacity (meq/100g soil)	4.0
course sand	Texture	loam
3-5%	Moisture	18-30%



Plant Communities on Loam Soil, Ben Lomond CA



Plant Communities on Sand Soil, Ben Lomond, CA



The Diverse Sandhills Flora



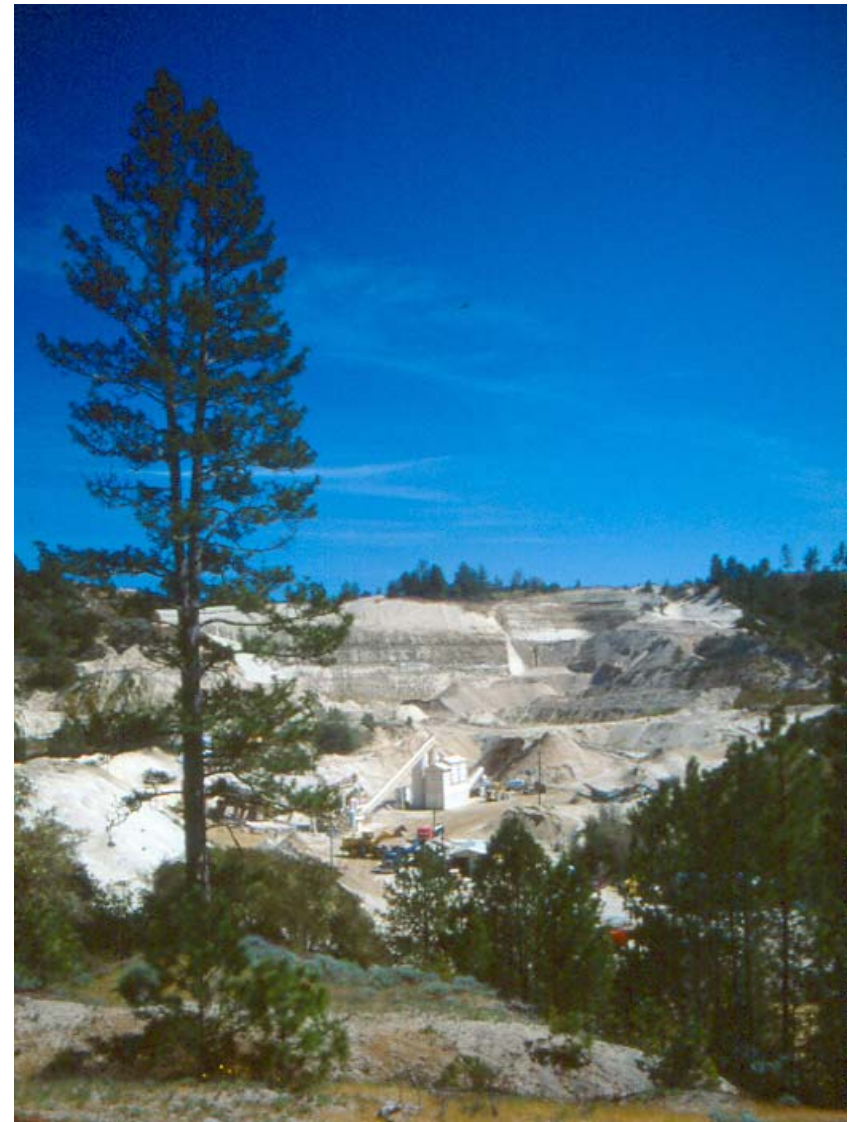
Endemism and Rarity (*sensu* Rabinowitz 1981)

Geographic Range	Large		Small	
	Wide	Narrow	Wide	Narrow
Habitat Specificity				
Large Populations	Common	Predictable	Unlikely Endemic	<i>Rare</i>
Small Populations	Sparse	Predictable-Small	Non-Existent	<i>Very Rare</i>

Endemics: Small Geographic Range
+ Narrow Habitat Specificity
Rarest of Species Naturally

Sandhills Habitat Destruction

- Sand quarrying
- Urbanization
- Agricultural conversion



Ben Lomond spineflower
(*Chorizanthe pungens* var. *hartwegiana*)
Polygonaceae



Santa Cruz wallflower
(*Erysimum teretifolium*)
Brassicaceae

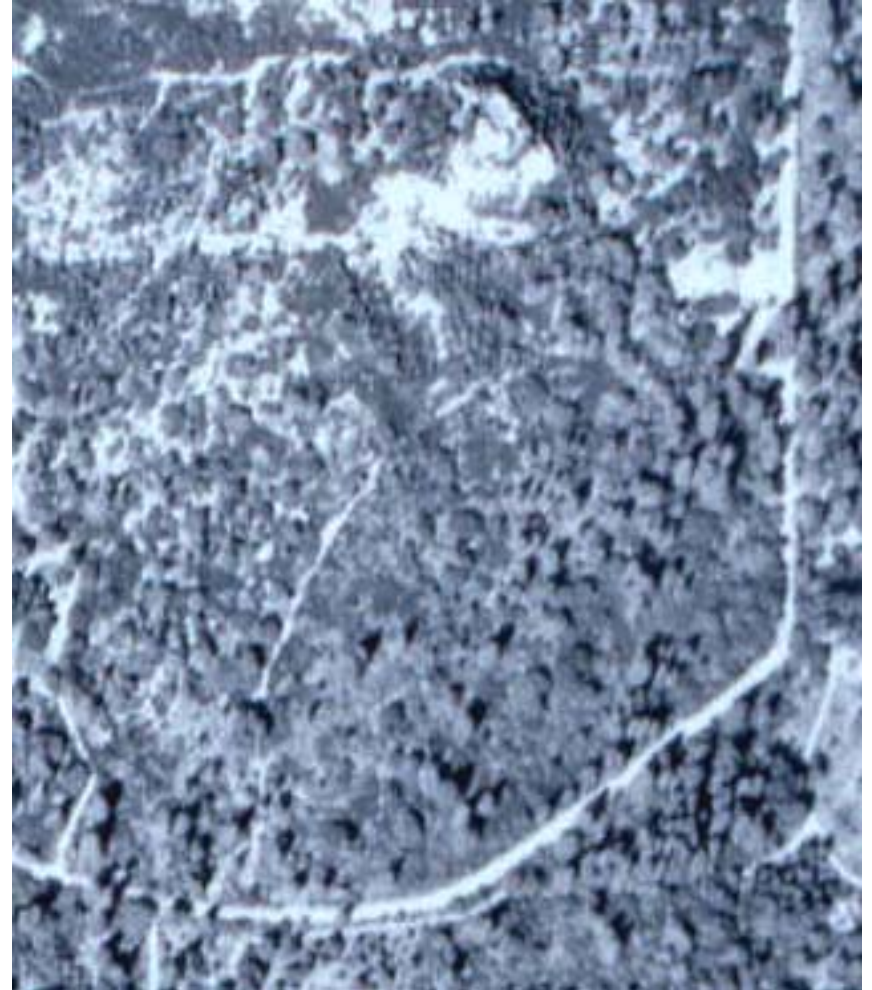


Fire Suppression Increases Woody Vegetation

1940



1997



Trees Restrict Native Plant Distributions



Tree Effects Experimental Treatments

Shade



Litter

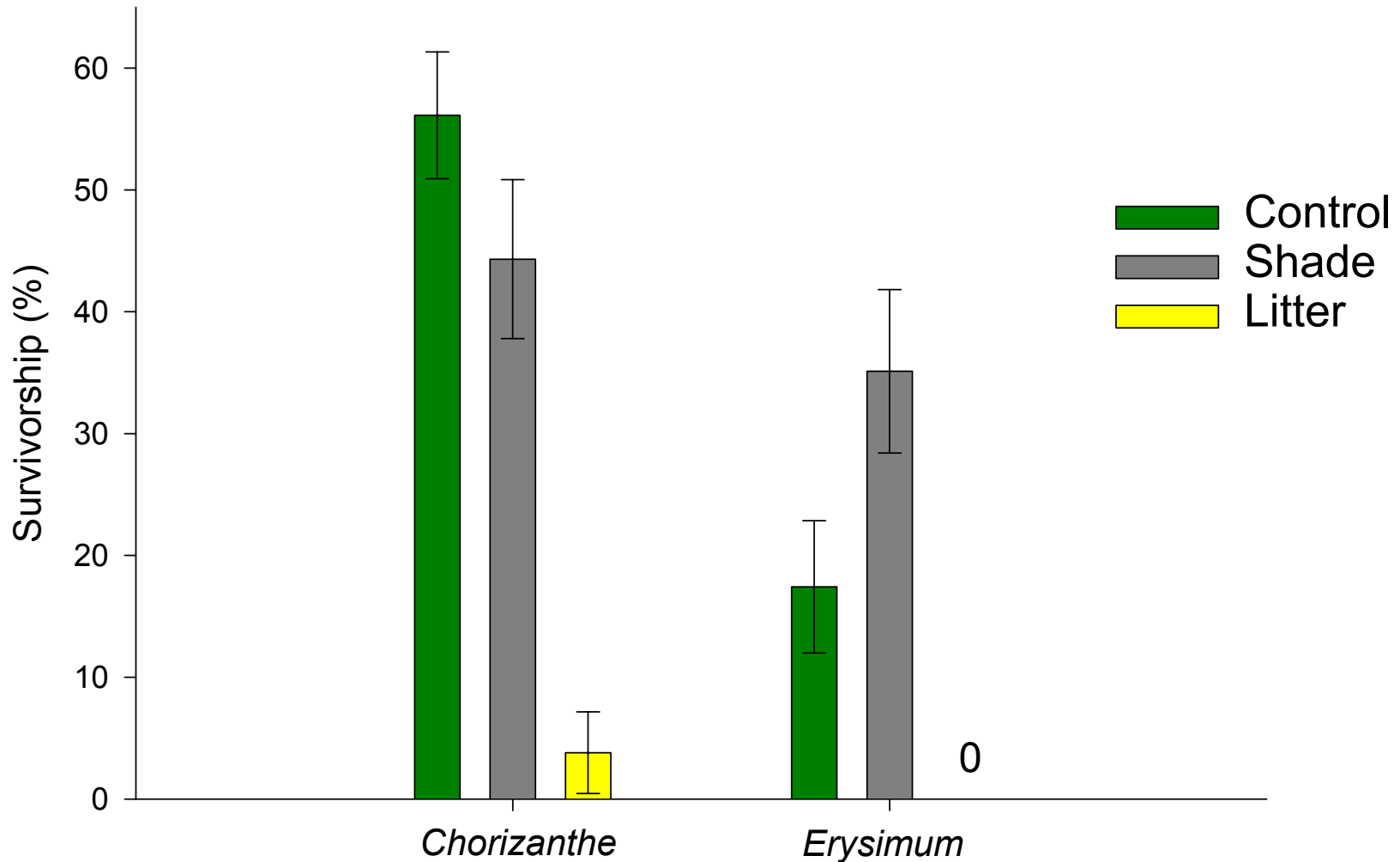


Exotic Species

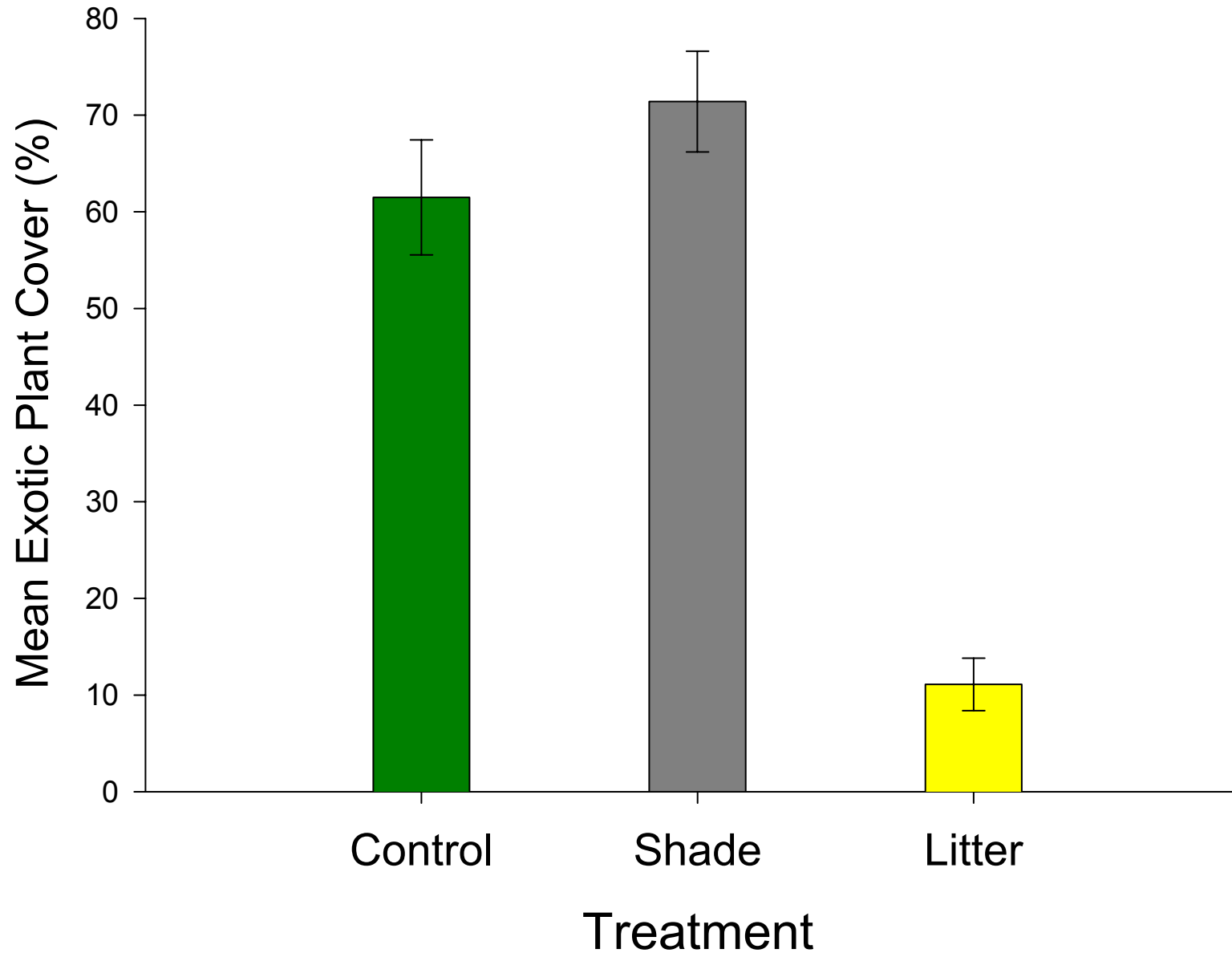


Litter Suppresses Endangered Plants

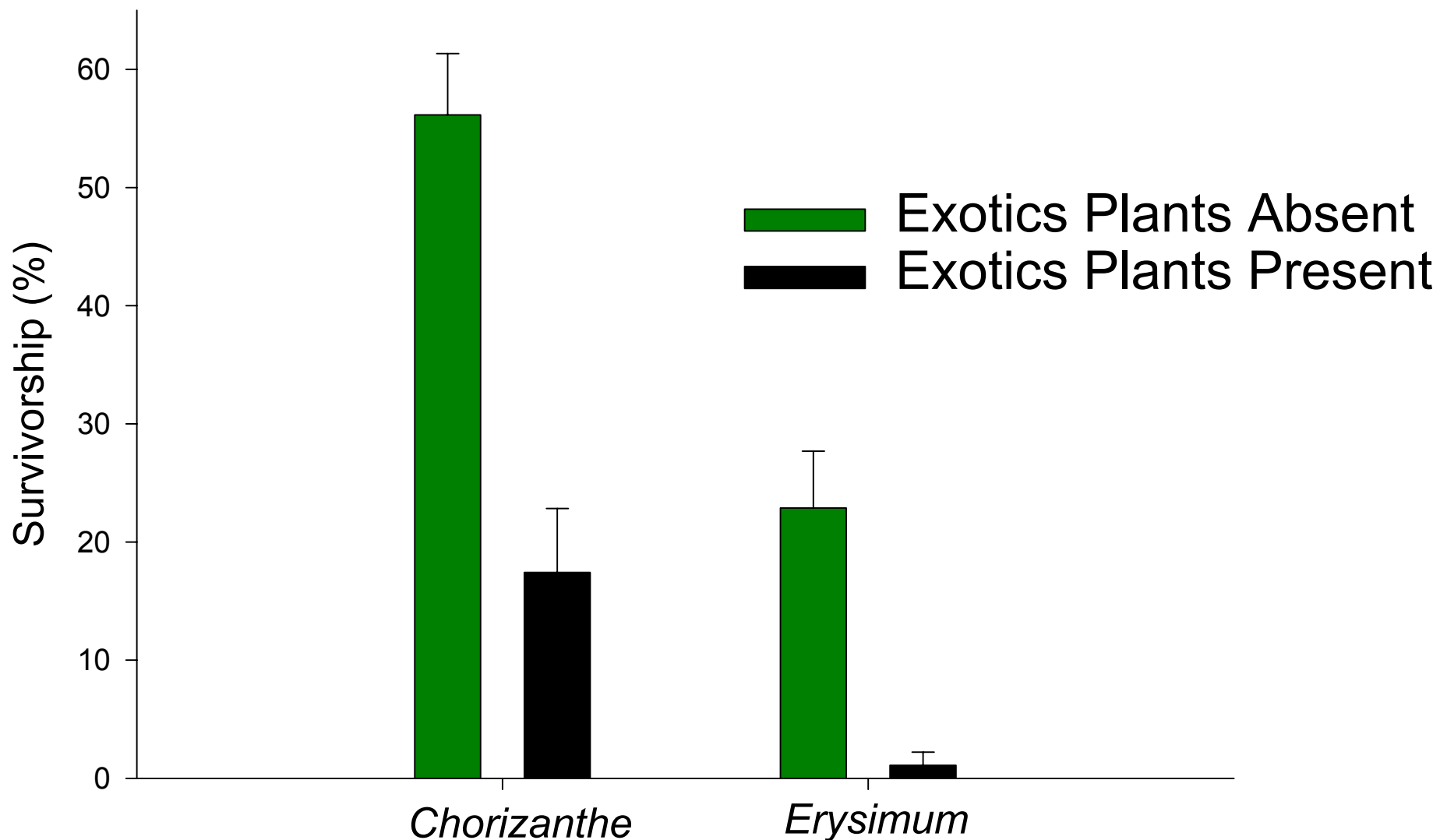
Survivorship of *Chorizanthe* and *Erysimum*



Litter Suppresses Exotic Plant Cover



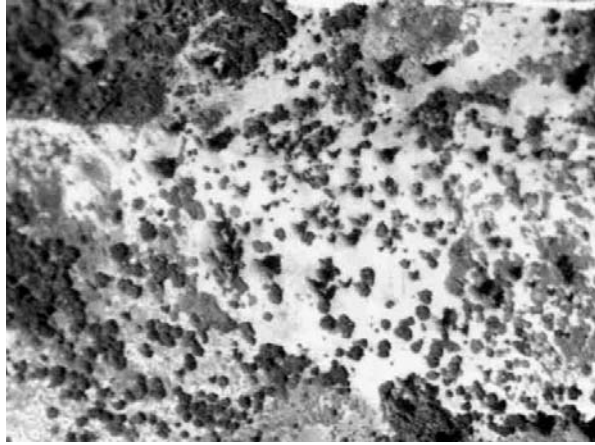
Exotic Plants Species Impact Endangered Species



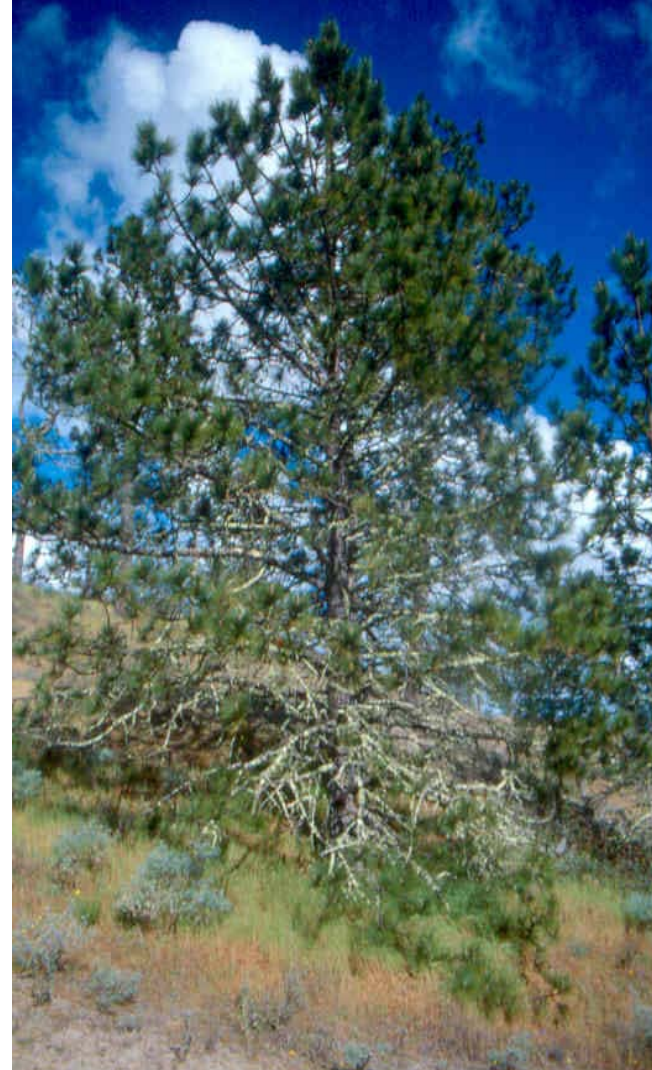
Fire Suppression increases Tree Density and...

North Ridge

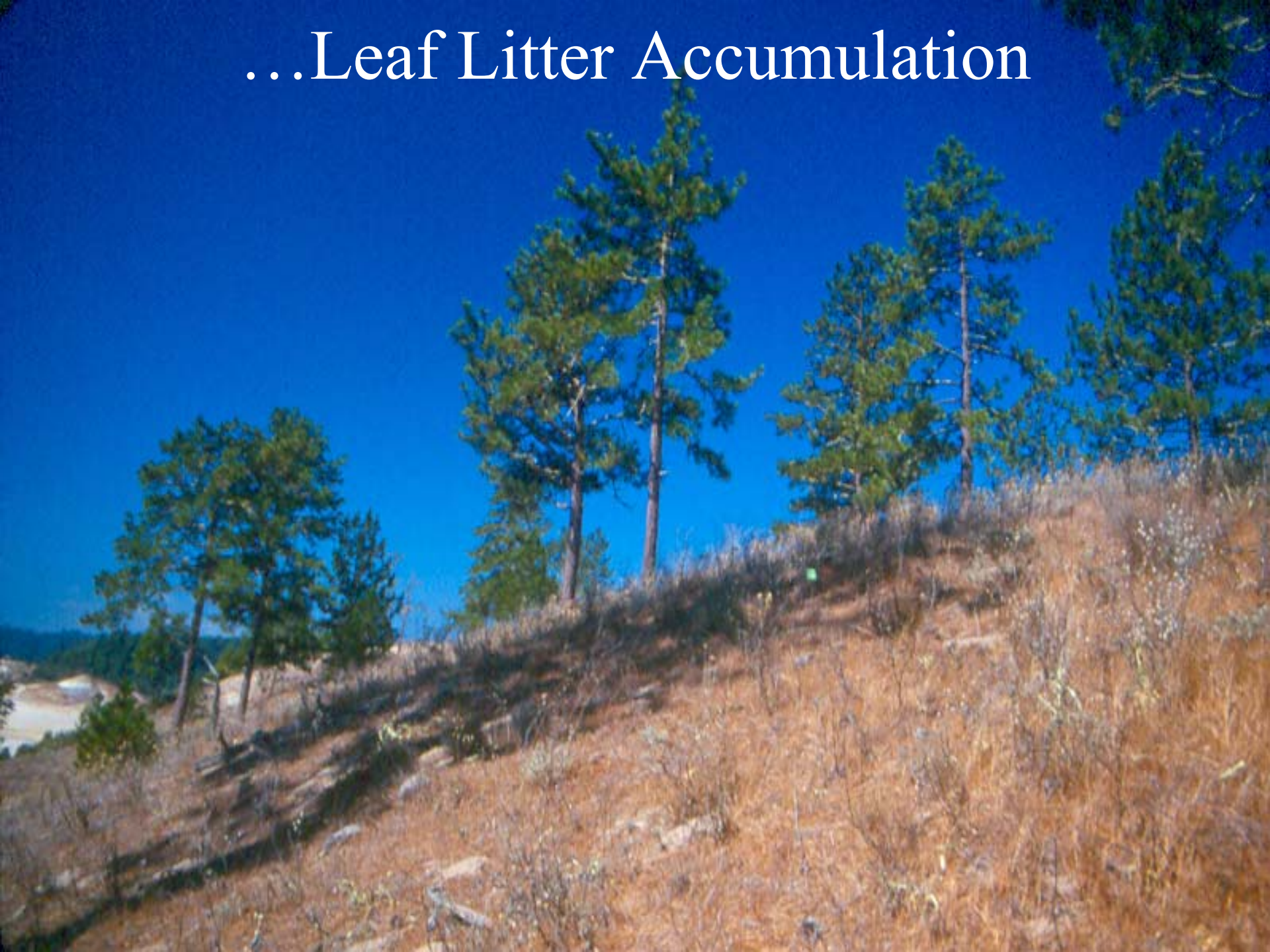
1963



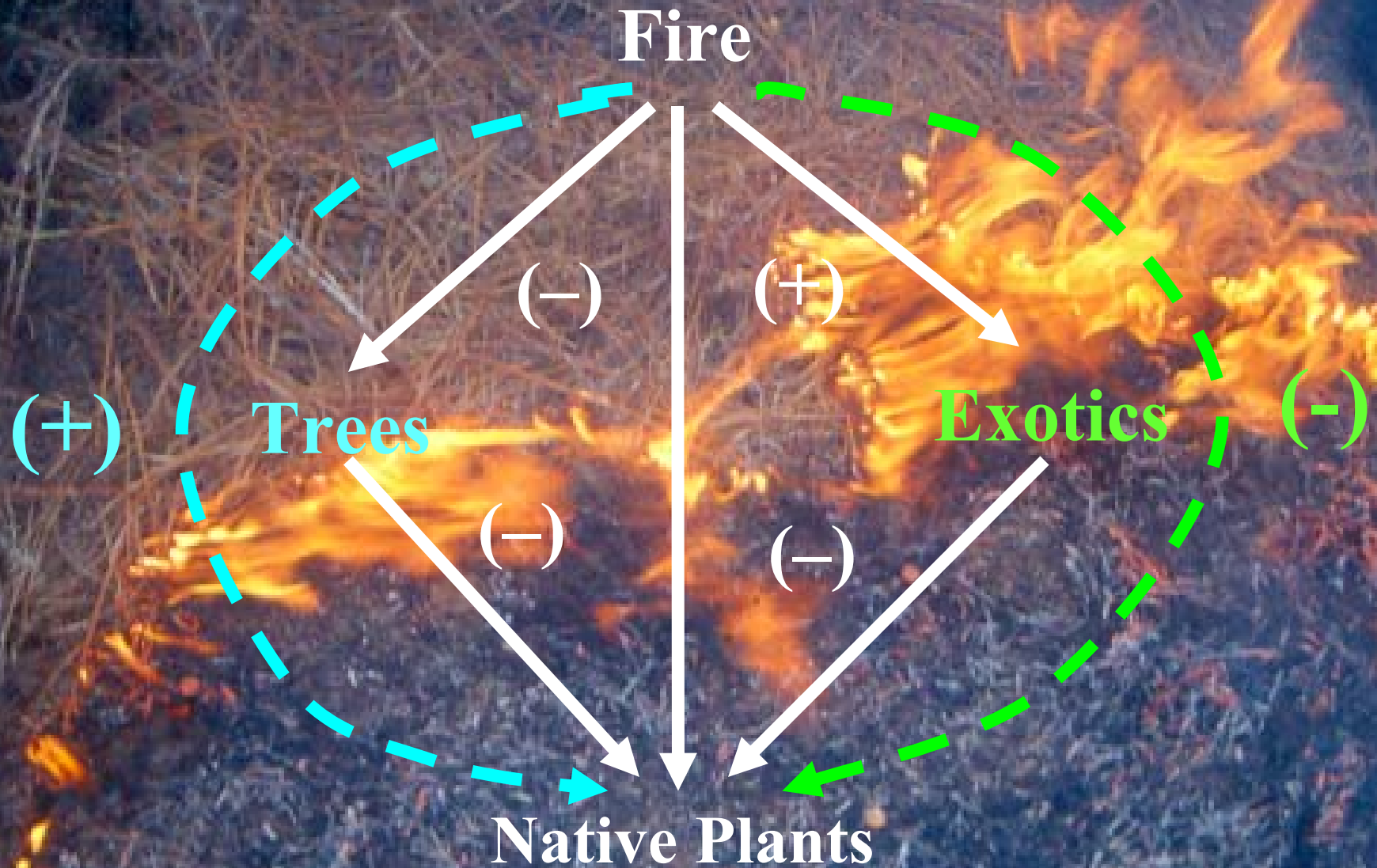
1994



...Leaf Litter Accumulation



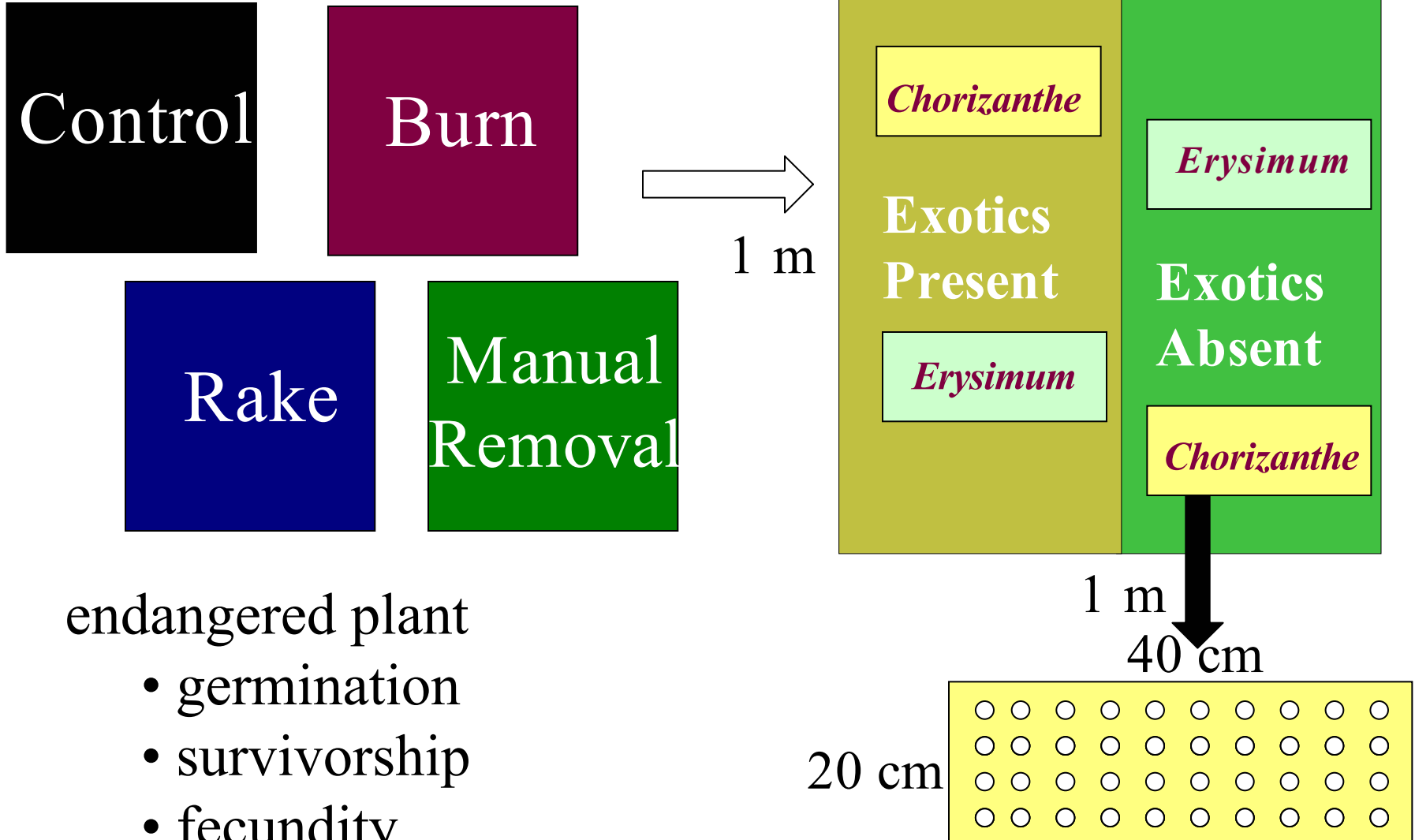
Reintroducing Fire Presents a Conundrum



Fire Experiment



Fire Experiment Design



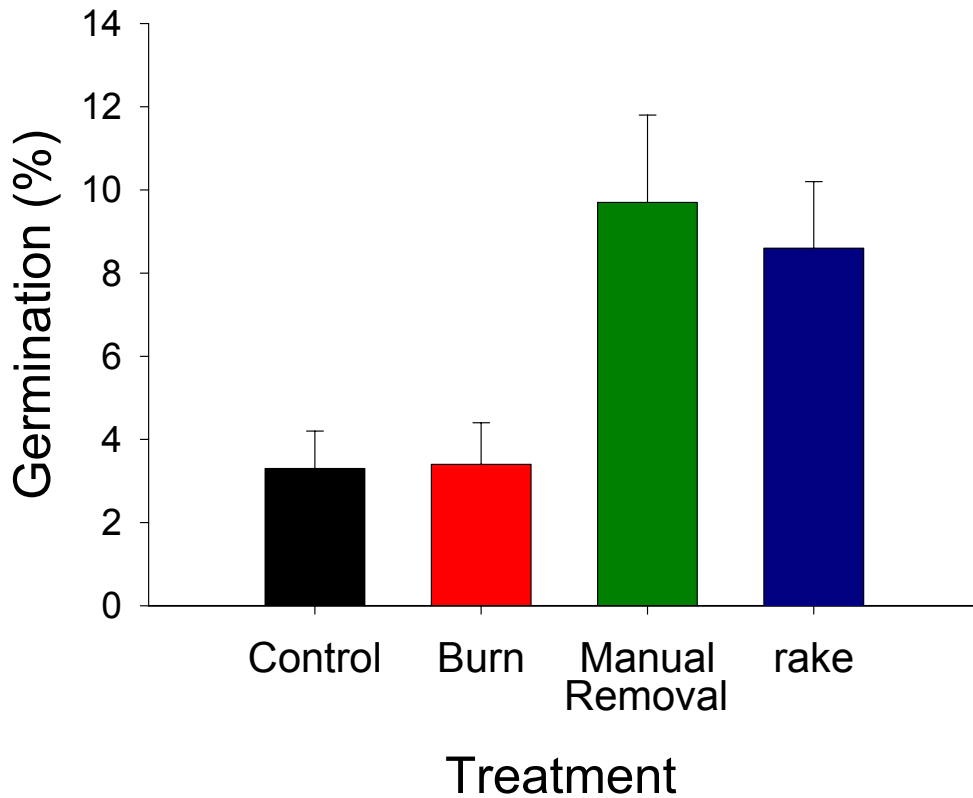
endangered plant

- germination
- survivorship
- fecundity

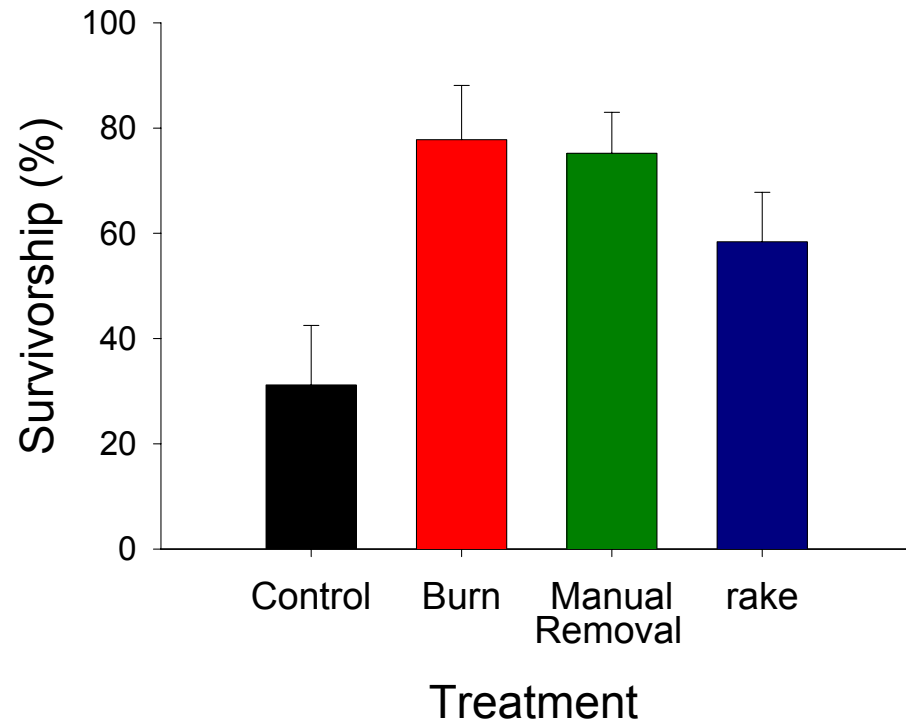
cover of naturally recruiting plants

Chorizanthe Demography

Germination

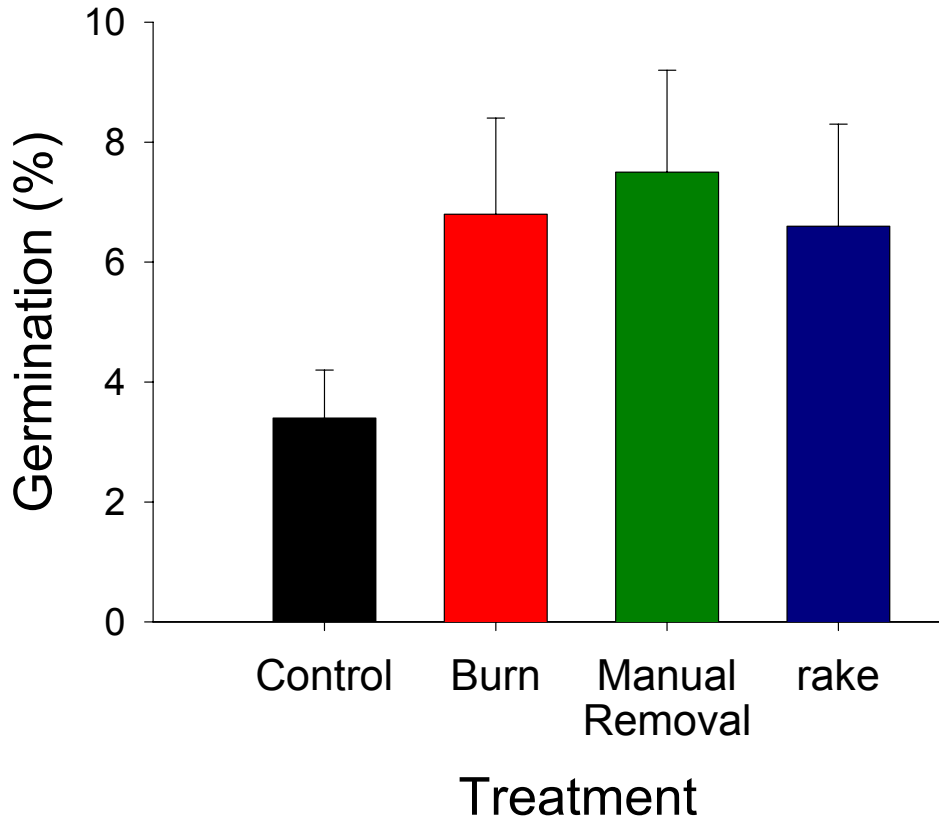


Survivorship

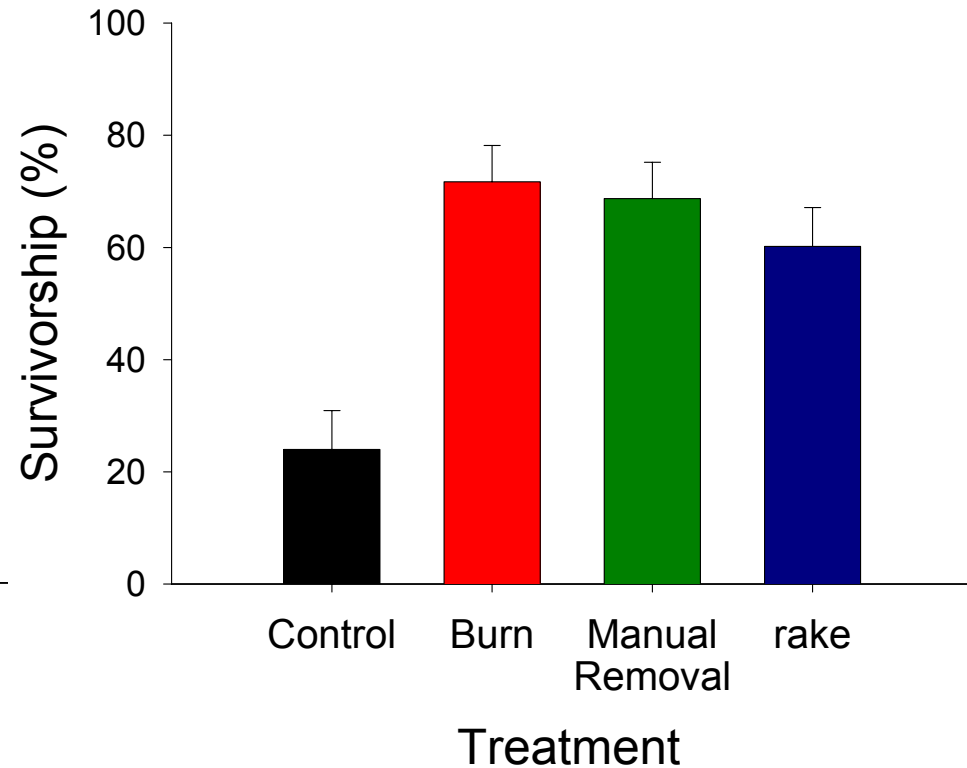


Erysimum Demography

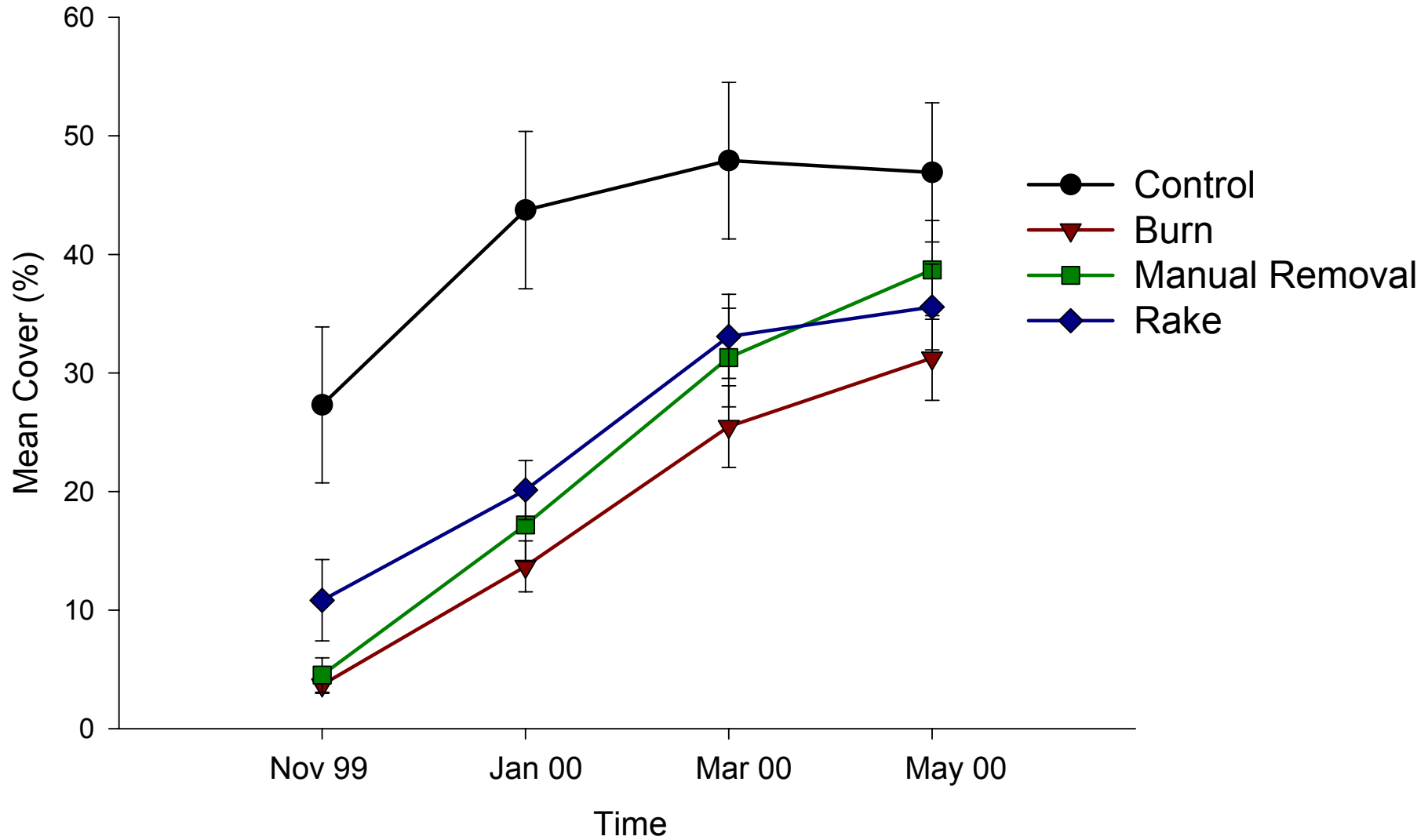
Germination



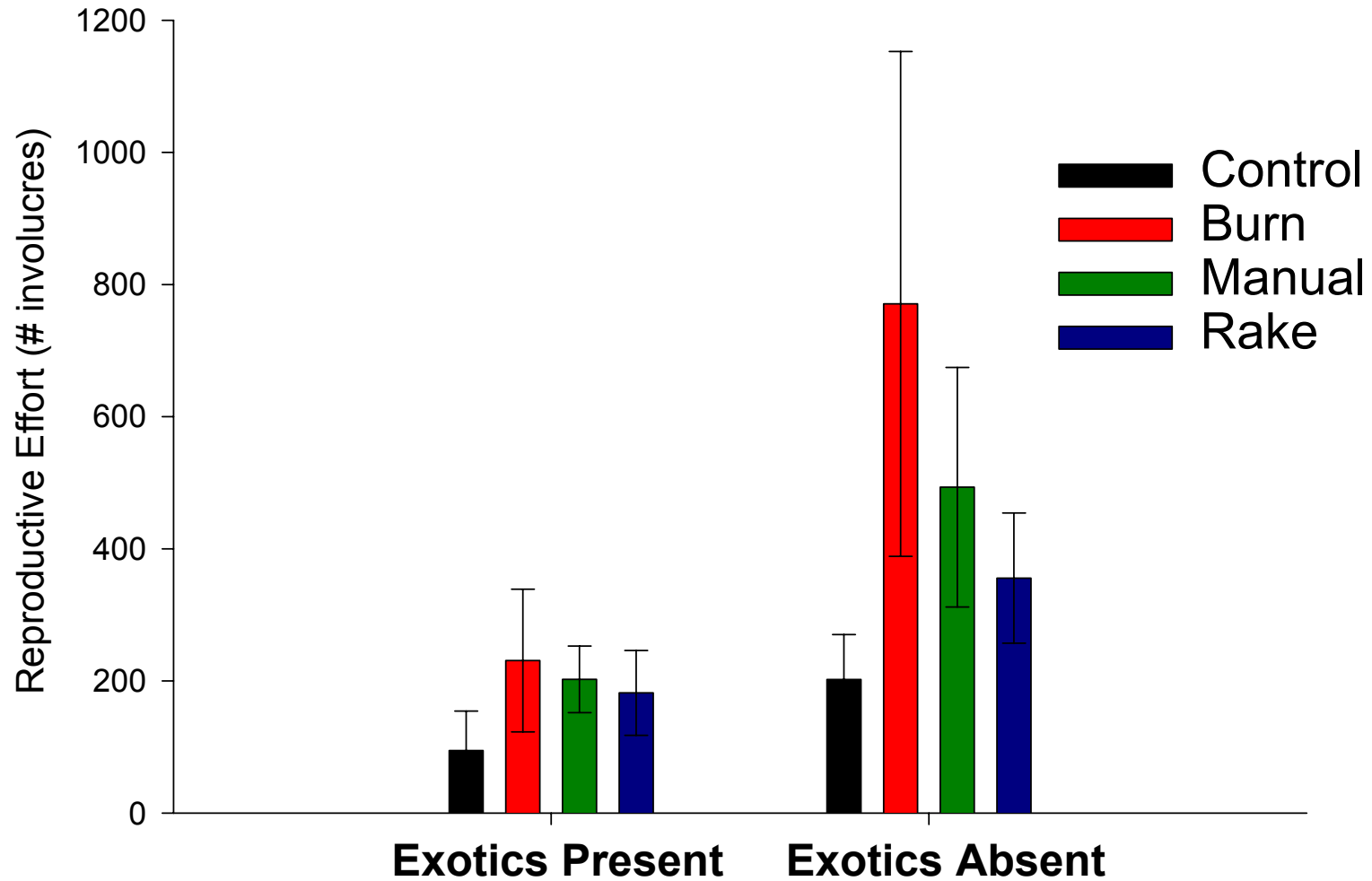
Seedling Survivorship



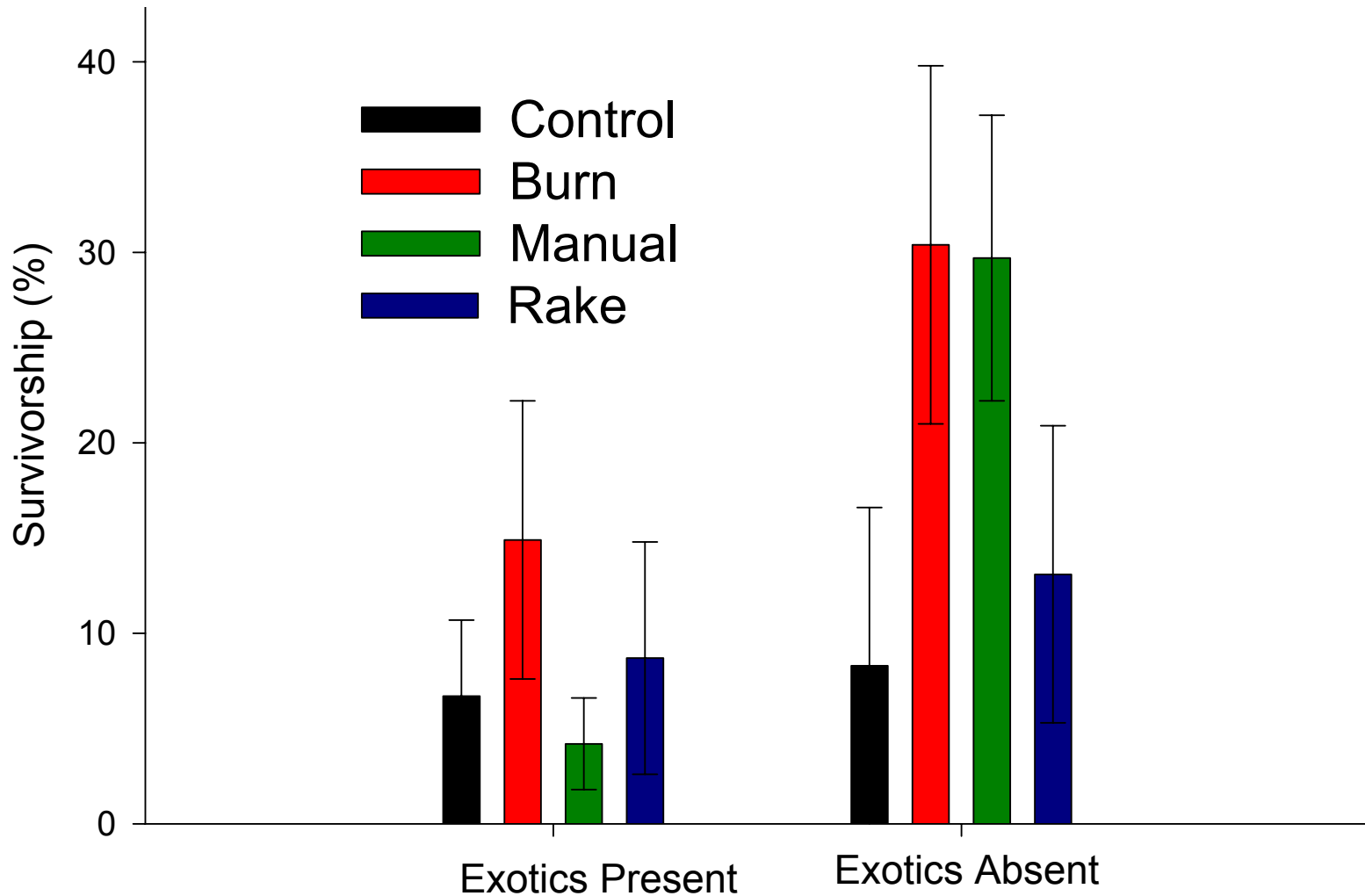
Exotic Plant Cover Through Time



Reproductive Effort of *Chorizanthe*

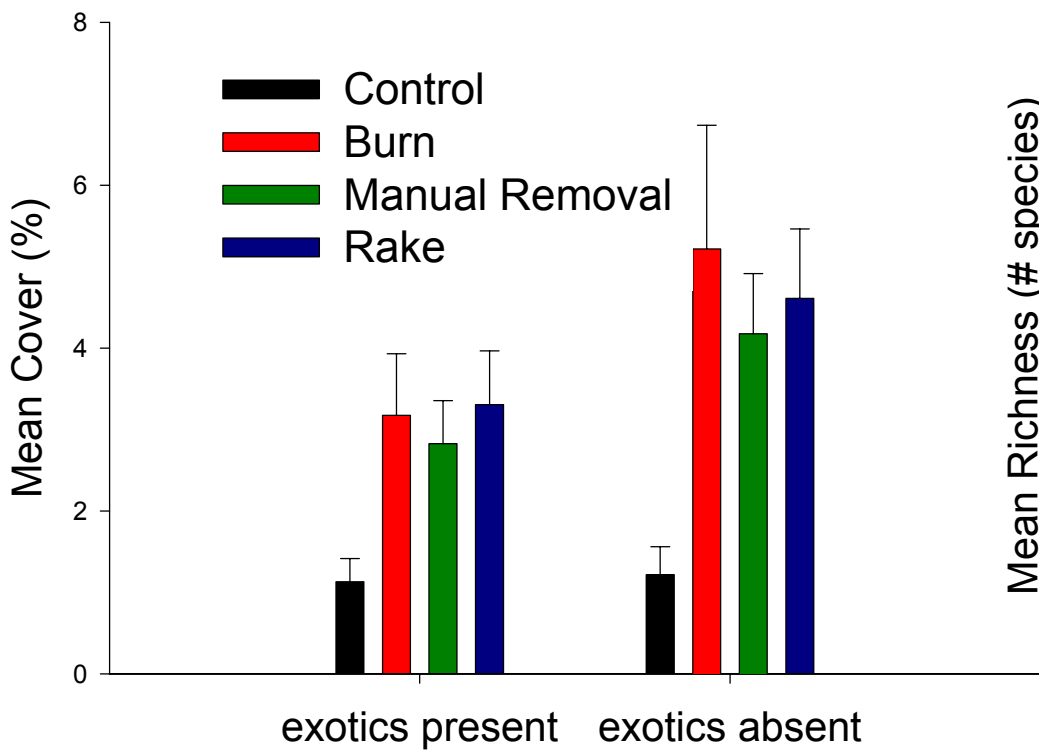


Erysimum Survivorship to Flower

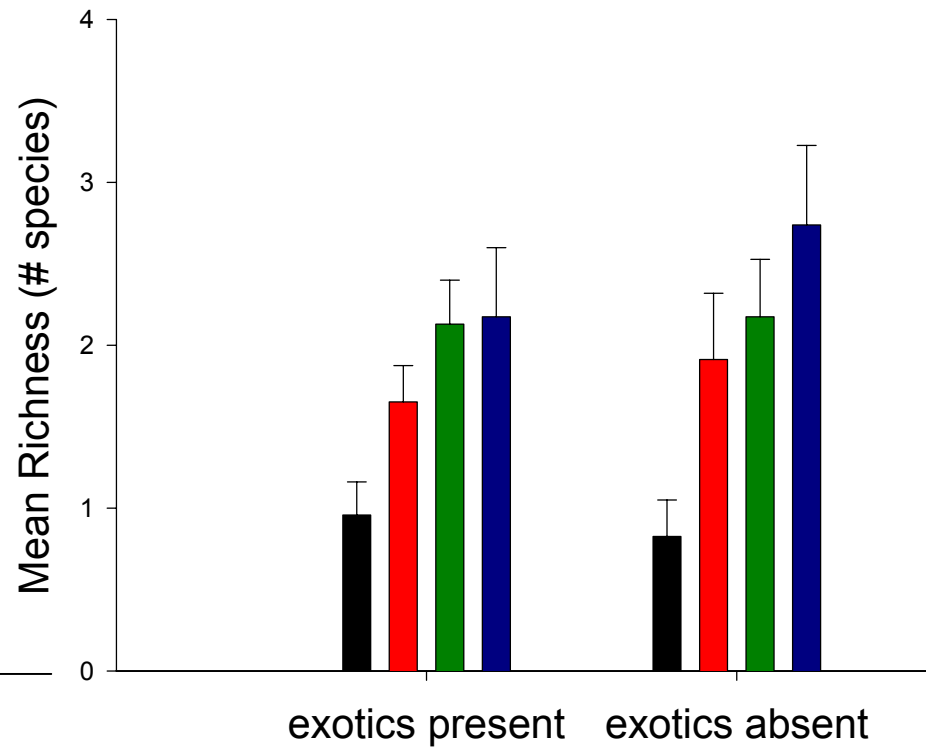


Native Plant Cover and Richness

Cover



Species Richness



Results Summary



Fire and Raking increased

- *Chorizanthe* survivorship
- *Erysimum* germination and seedling survivorship
- Native plant cover
- Native plant species richness

AND decreased exotic plant establishment

Exotic plants reduced

- *Chorizanthe* fecundity
- *Erysimum* survivorship to flower
- Native plant cover

Management Implications

Reintroducing fire can enhance

- **population growth of two endangered plants**
- **cover and richness of native herbs**

Anthropogenic methods can mimic these effects

Fire reduces exotic plant cover and therefore does not present a conundrum in the sandhills.

Small-Scale Soil Disturbances

Slides



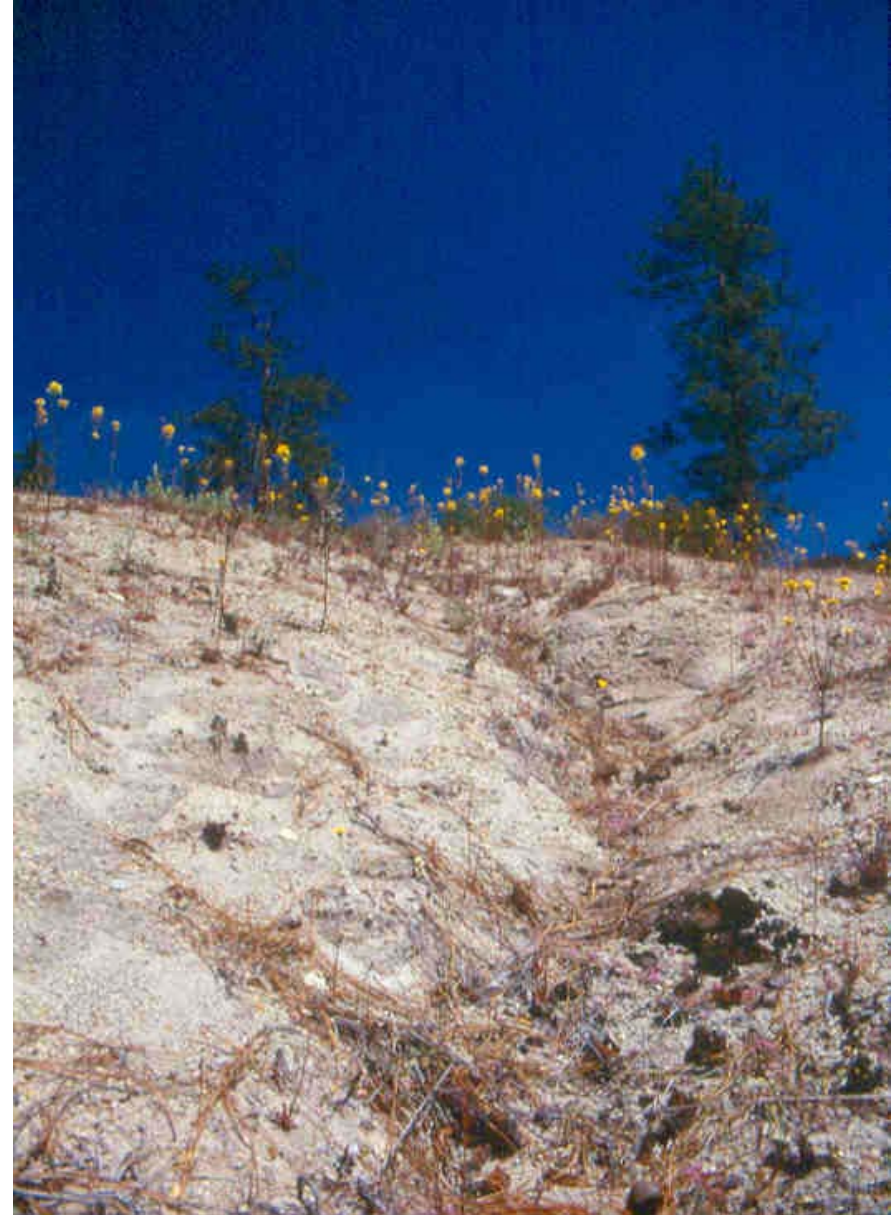
Trails



Gopher
Mounds



Slides



Trails



Gopher Mounds



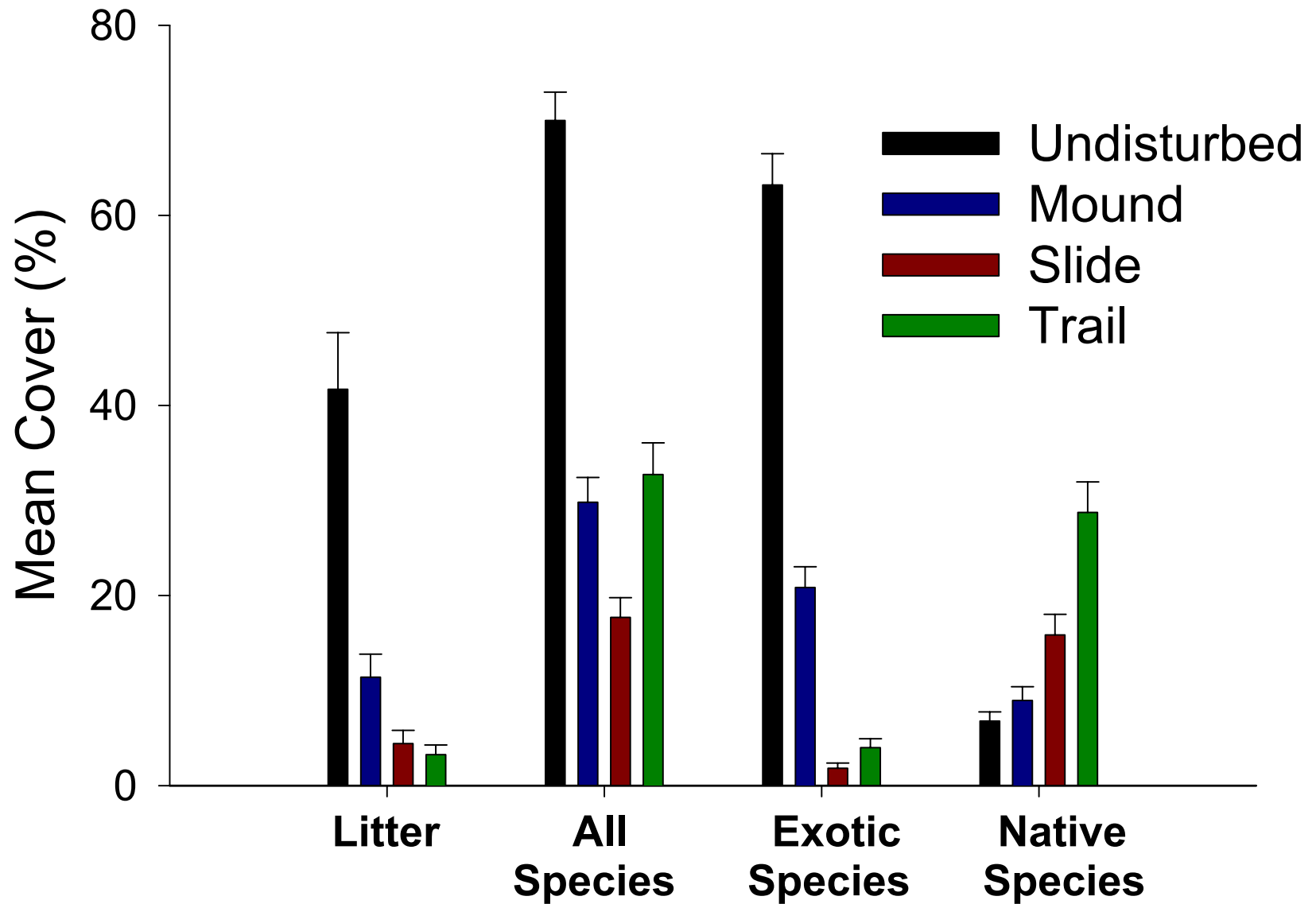
Effects of Soil Disturbances

A photograph of a sandy dune landscape. The foreground and middle ground are covered in light-colored sand with sparse, low-lying vegetation, including small green plants and some pinkish flowers. In the background, there are several tall, dark green coniferous trees. The sky is bright blue with scattered white clouds.

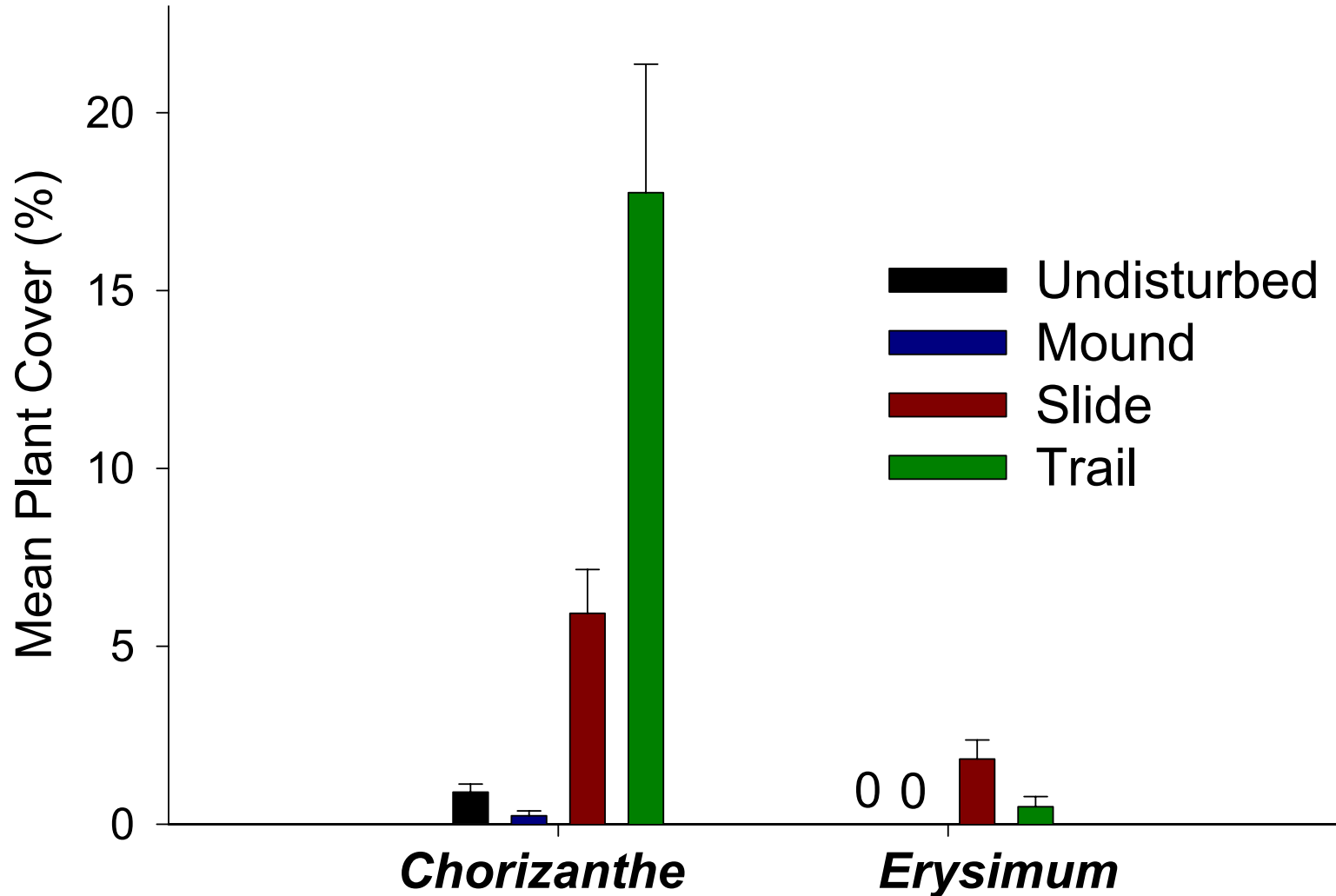
What are the effects of soil disturbances on populations of the two endangered plant species and on the native plant community?

What are the indirect effects of soil disturbances via their effects on exotic plant species?

Disturbance Sampling Study



Disturbance Sampling: Endangered Plant Cover



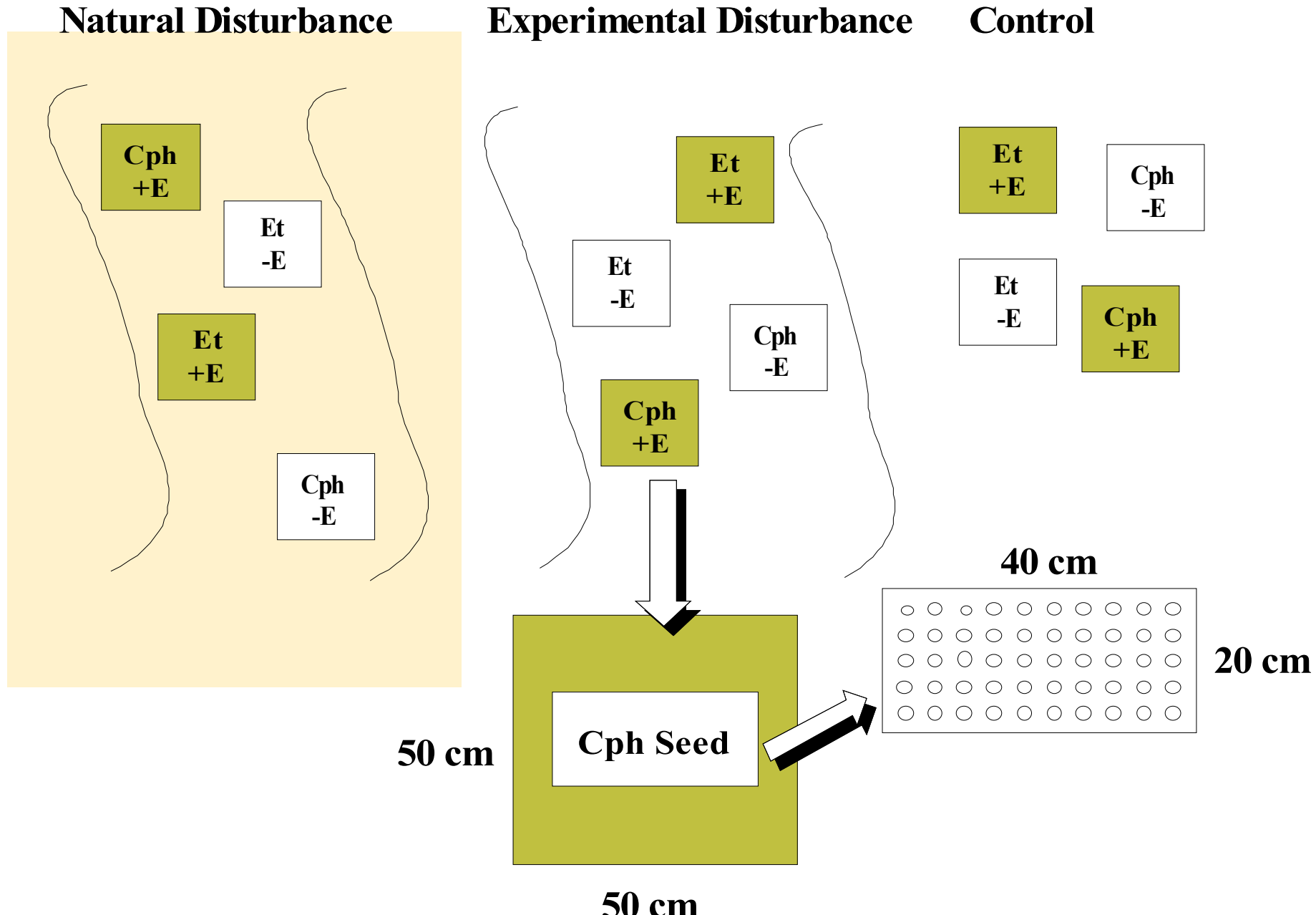
Hypotheses

Soil disturbances facilitate native plants by

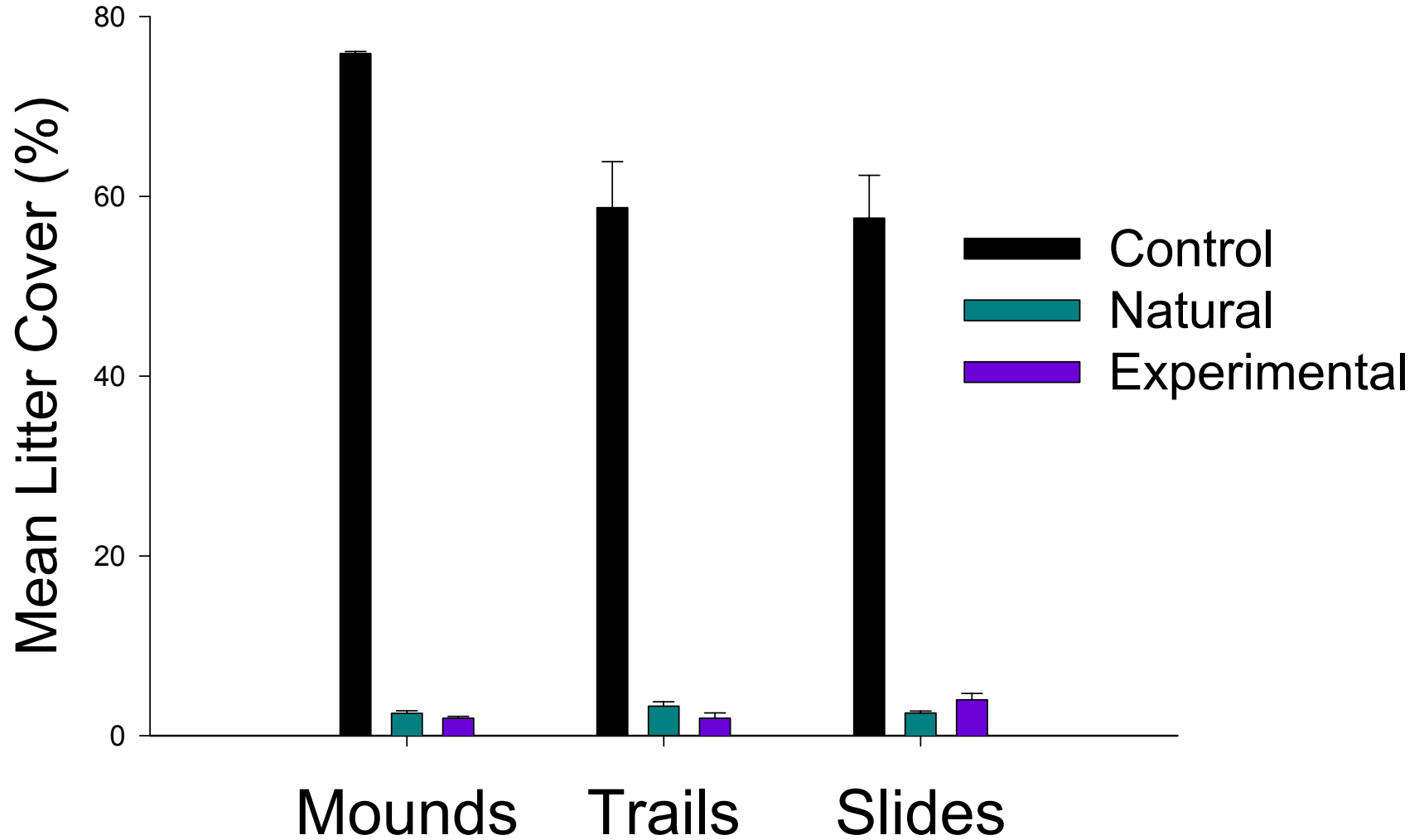
- removing accumulated leaf litter
- reducing exotic plant cover



Disturbance Experiment Design

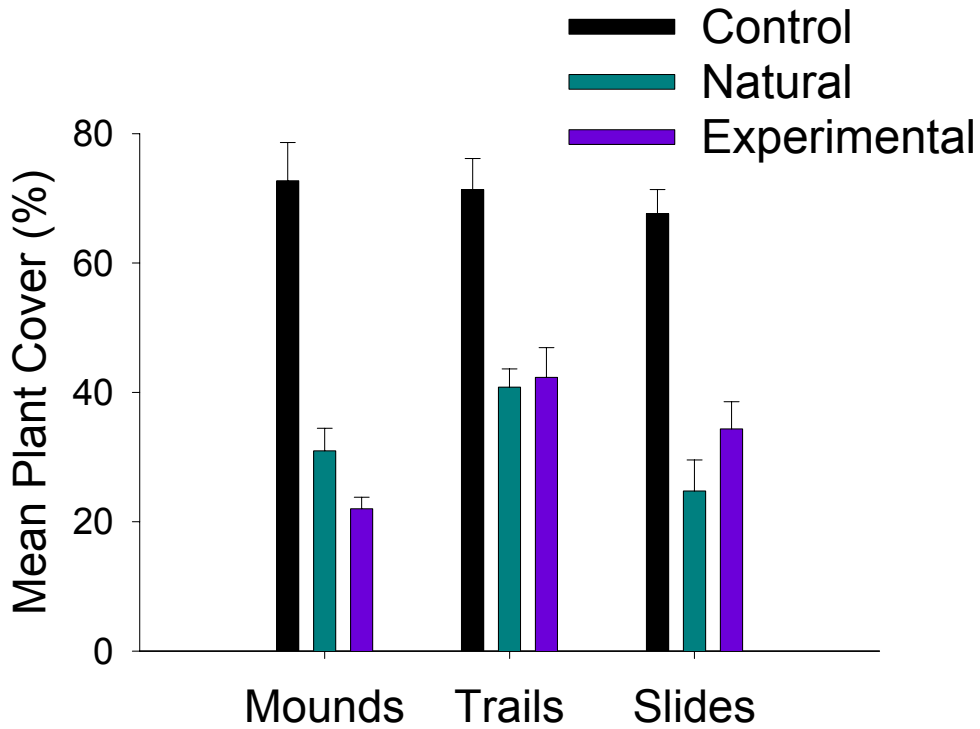


Disturbances Reduced Litter

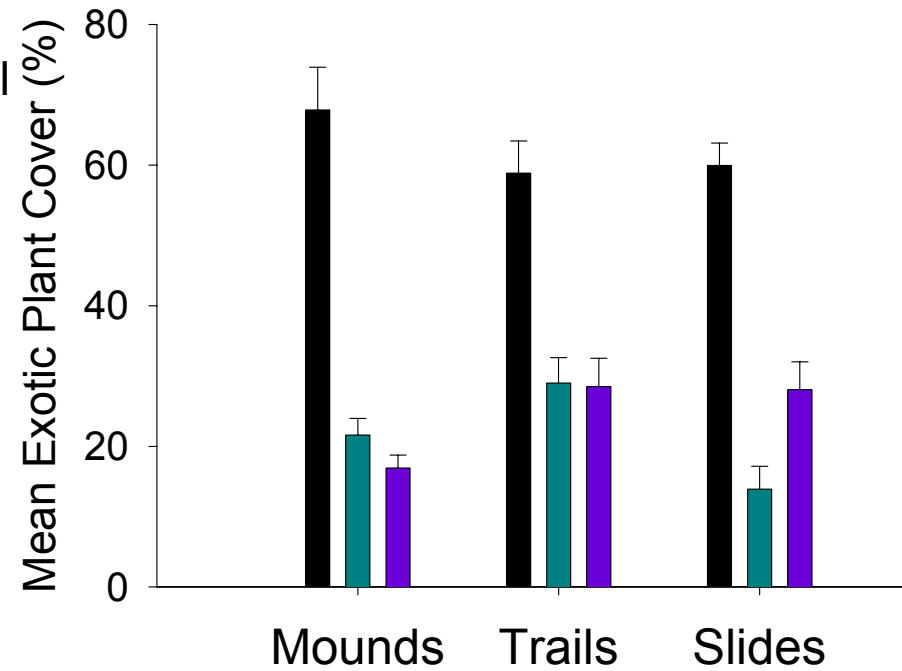


Disturbances Reduced Plant Cover

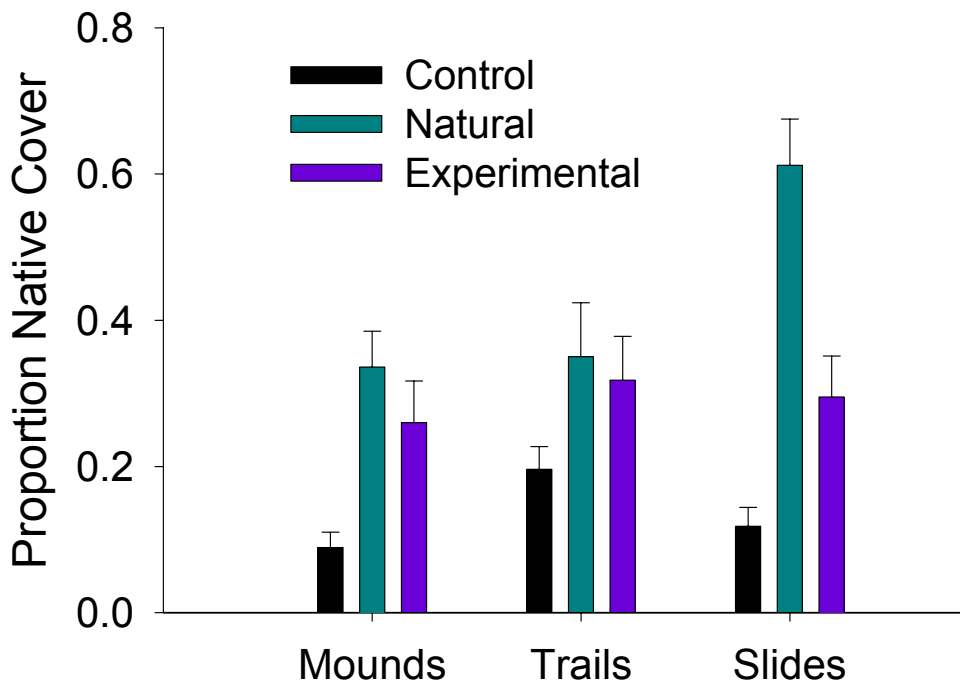
All Species



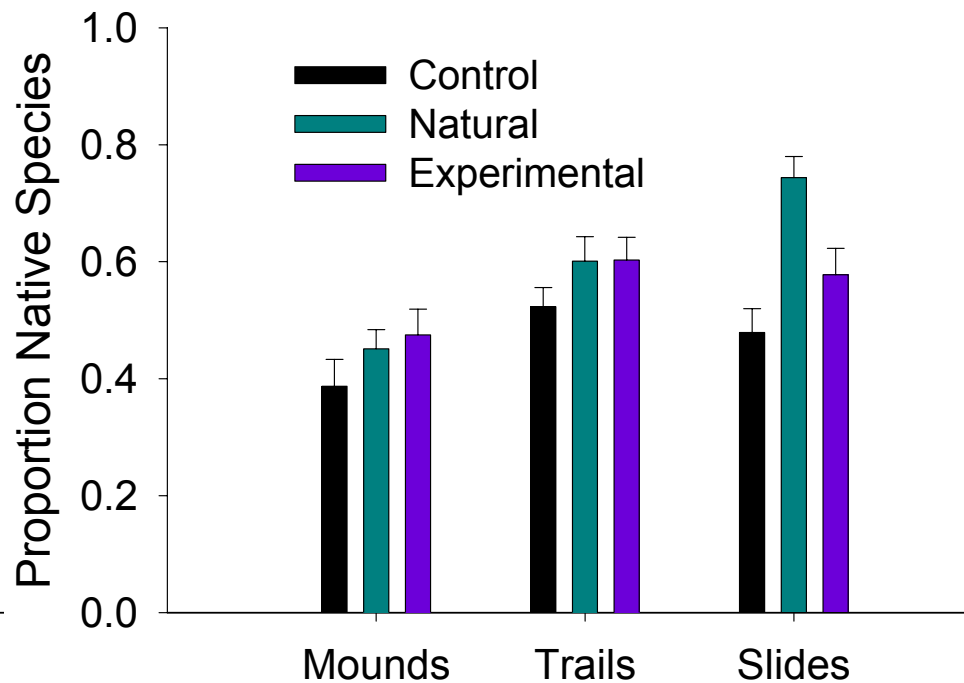
Exotic Species



Proportion Native Cover

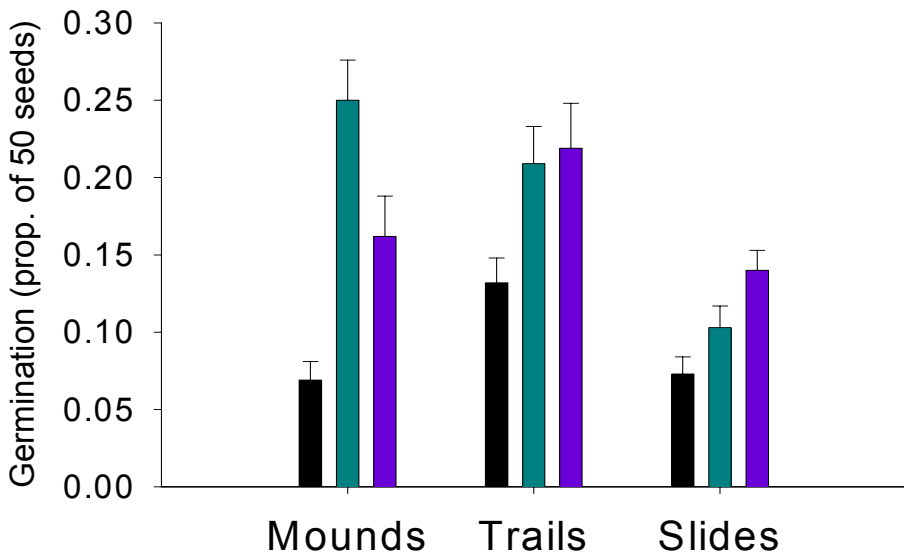


Proportion Native Species

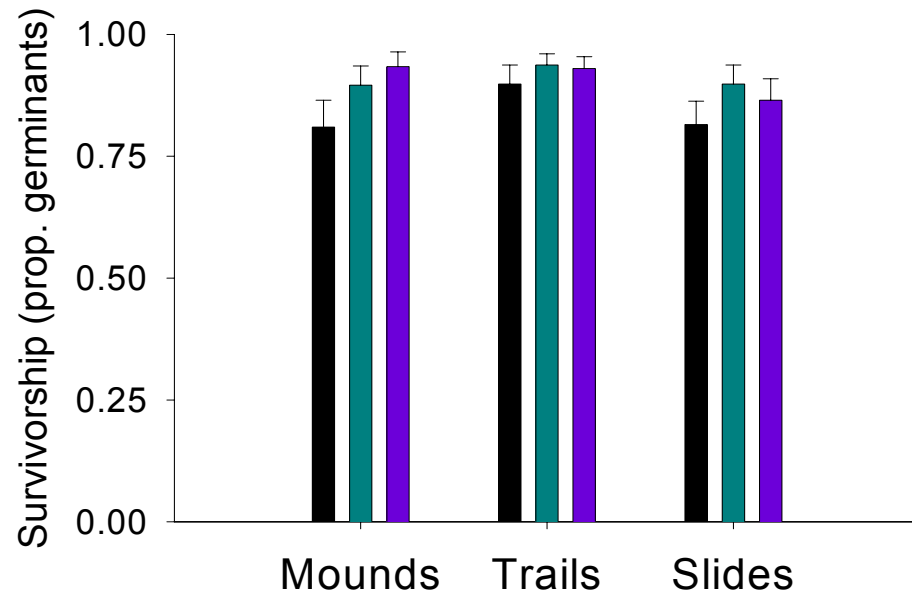


Chorizanthe Demography

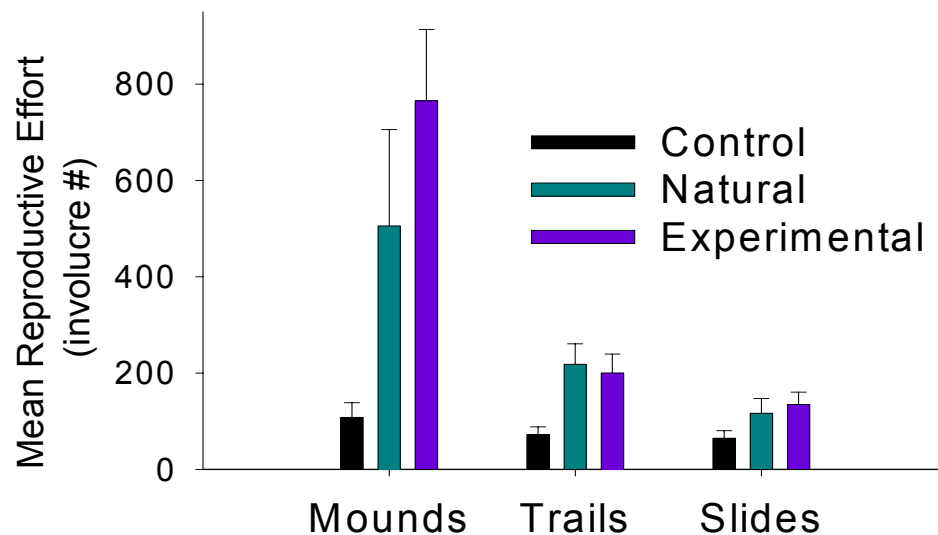
Germination



Survivorship

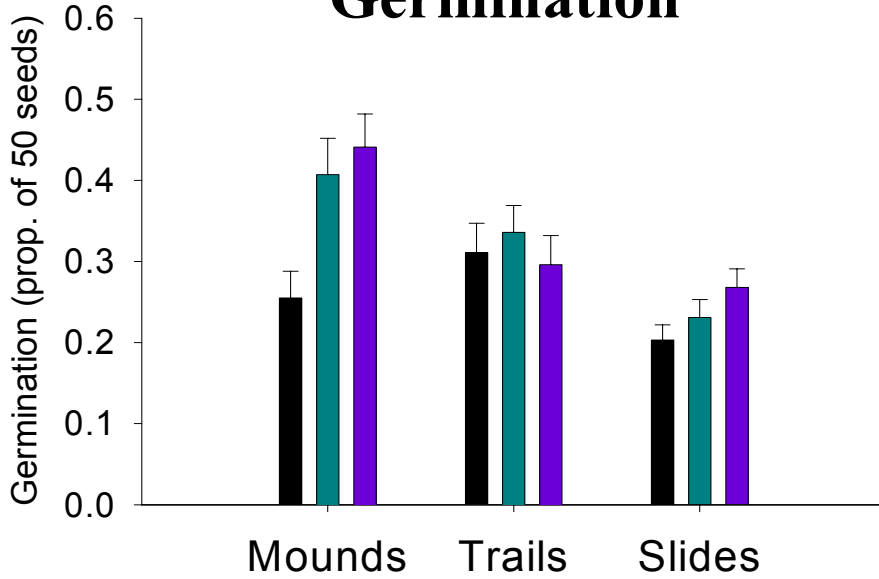


Reproductive Effort

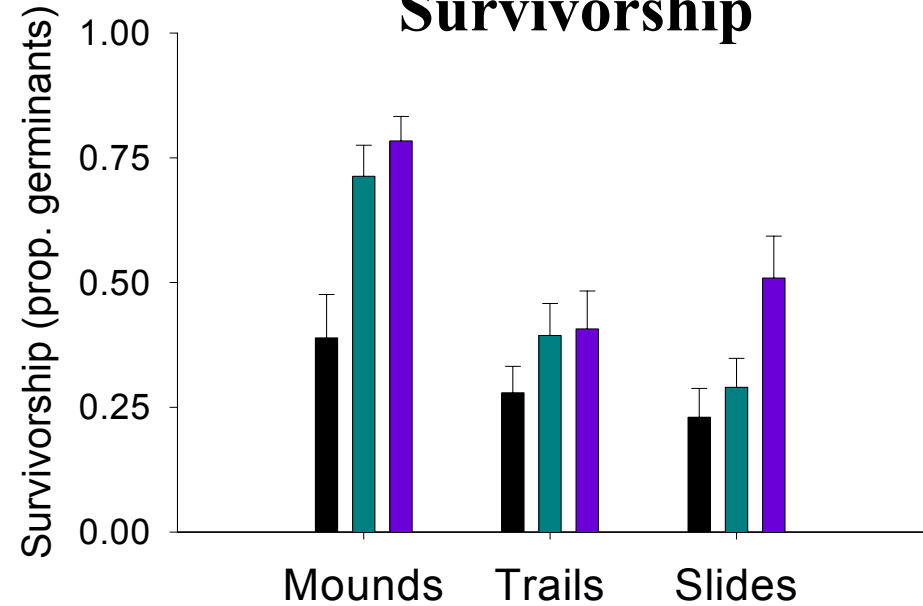


Erysimum Demography

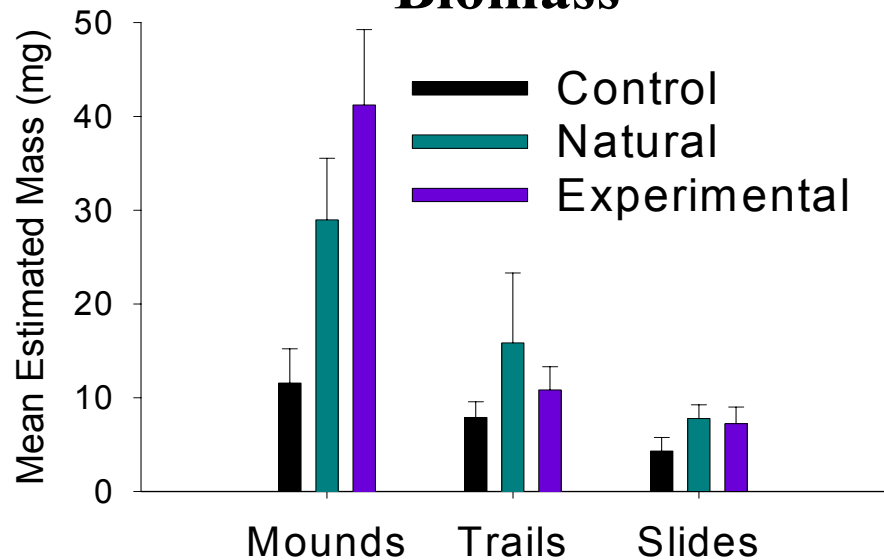
Germination



Survivorship

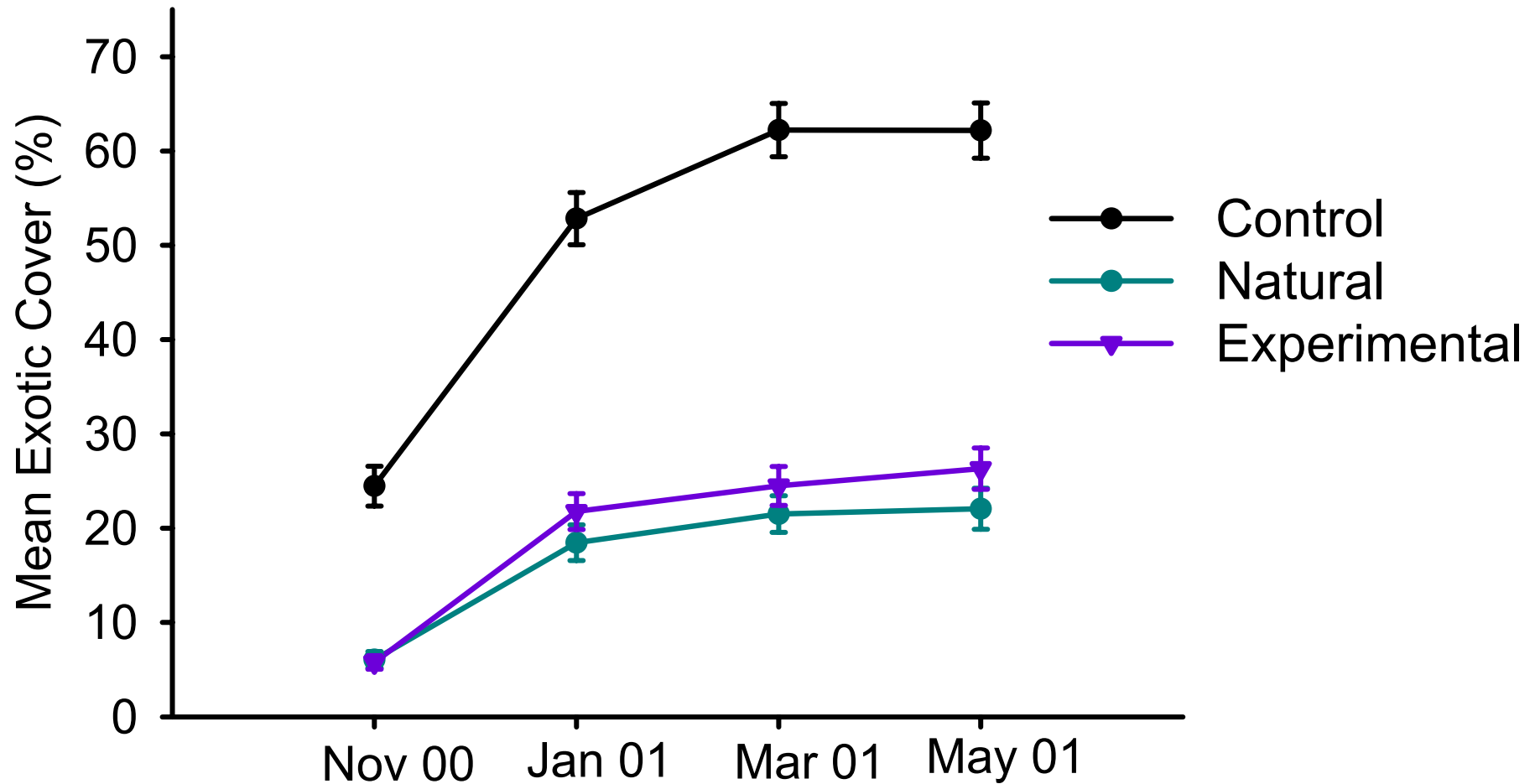


Biomass



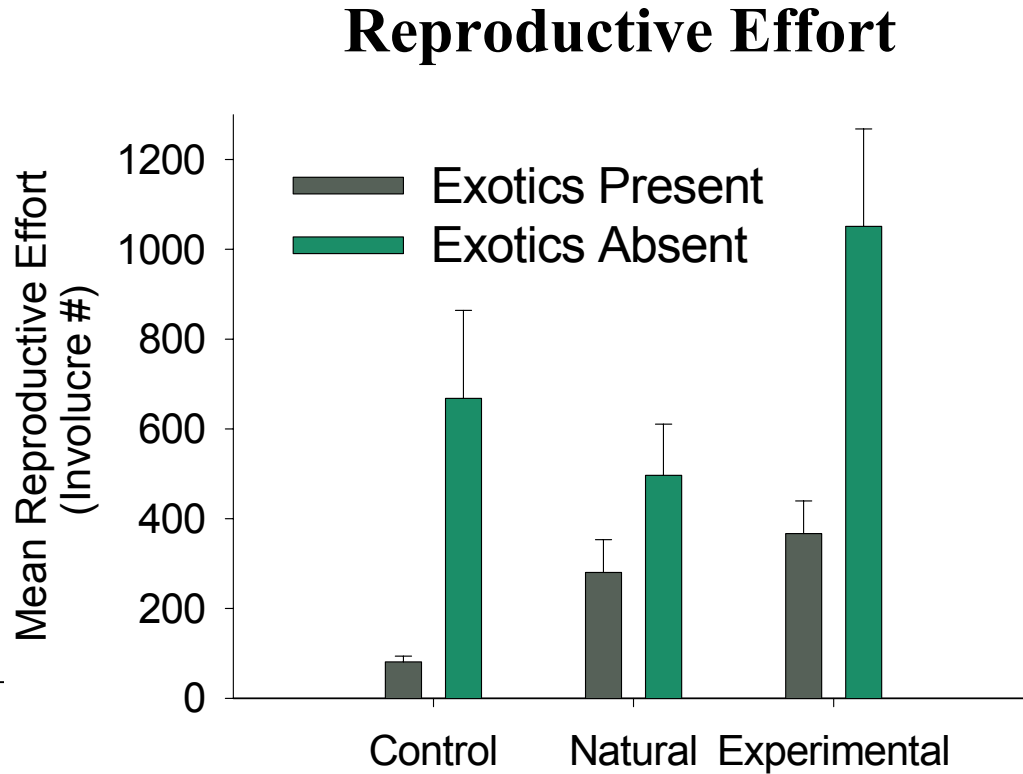
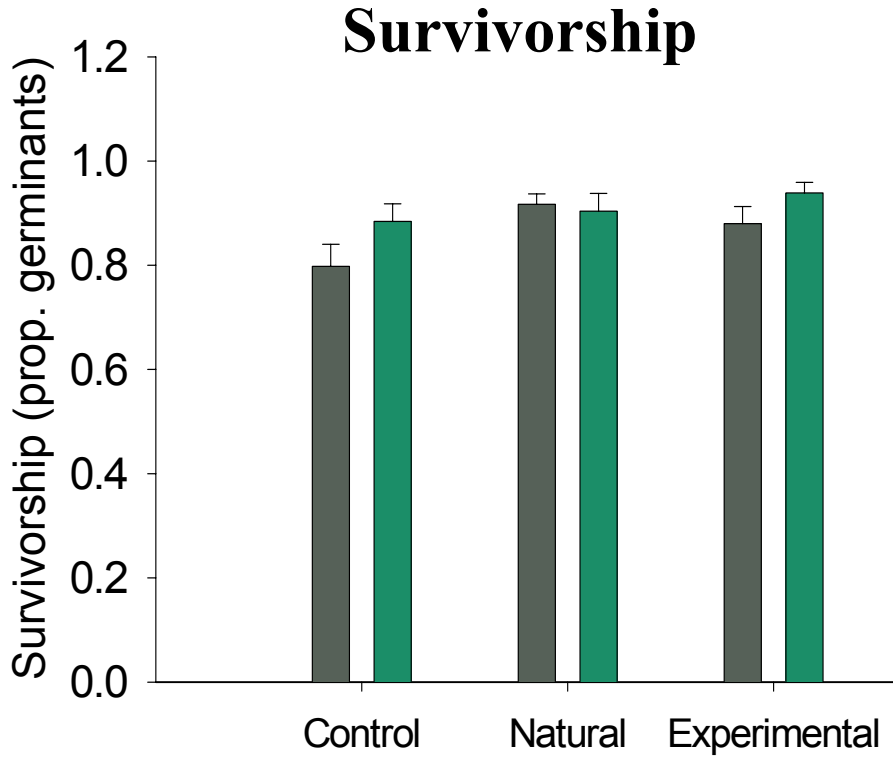
Disturbances Reduced Exotic Cover

All Disturbances Combined



Exotics Affect *Chorizanthe*

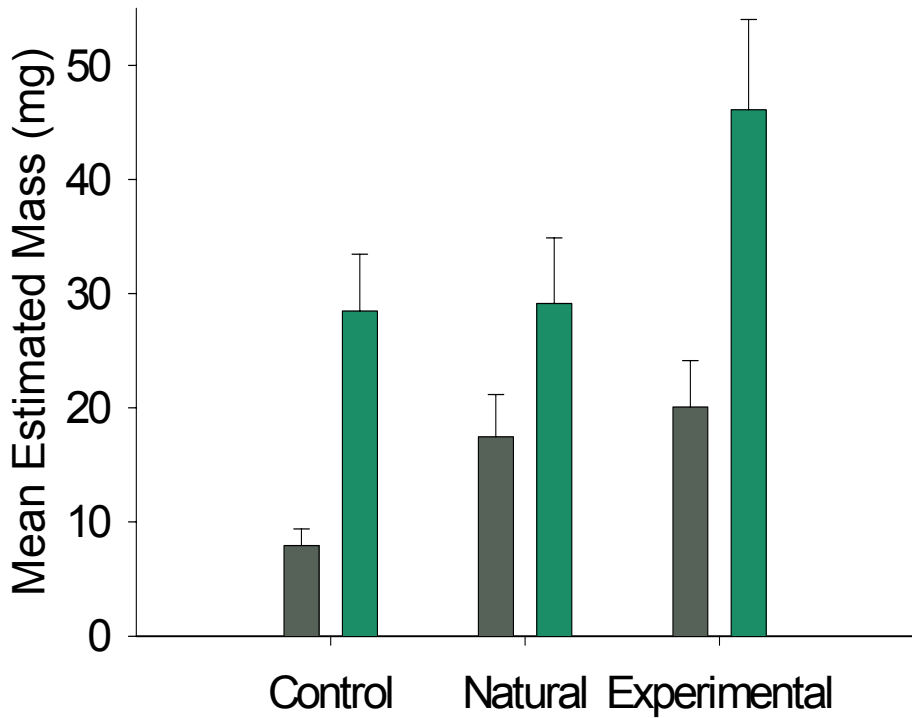
All Disturbances Combined



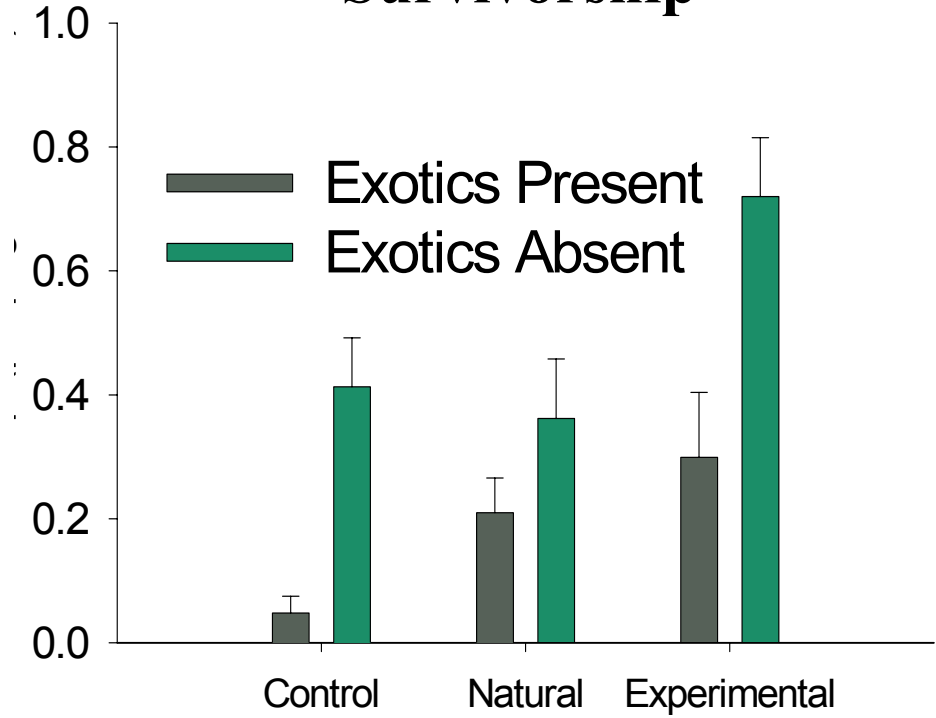
Exotics Affect *Erysimum*

All Disturbances Combined

Biomass



Survivorship



Summary of Results

Soil disturbances

- Removed accumulated litter
- Reduced exotic plant cover
- Enhanced native plant cover and richness
- Increased *Chorizanthe* germination and reproductive effort
- Increased *Erysimum* germination, survivorship, and biomass

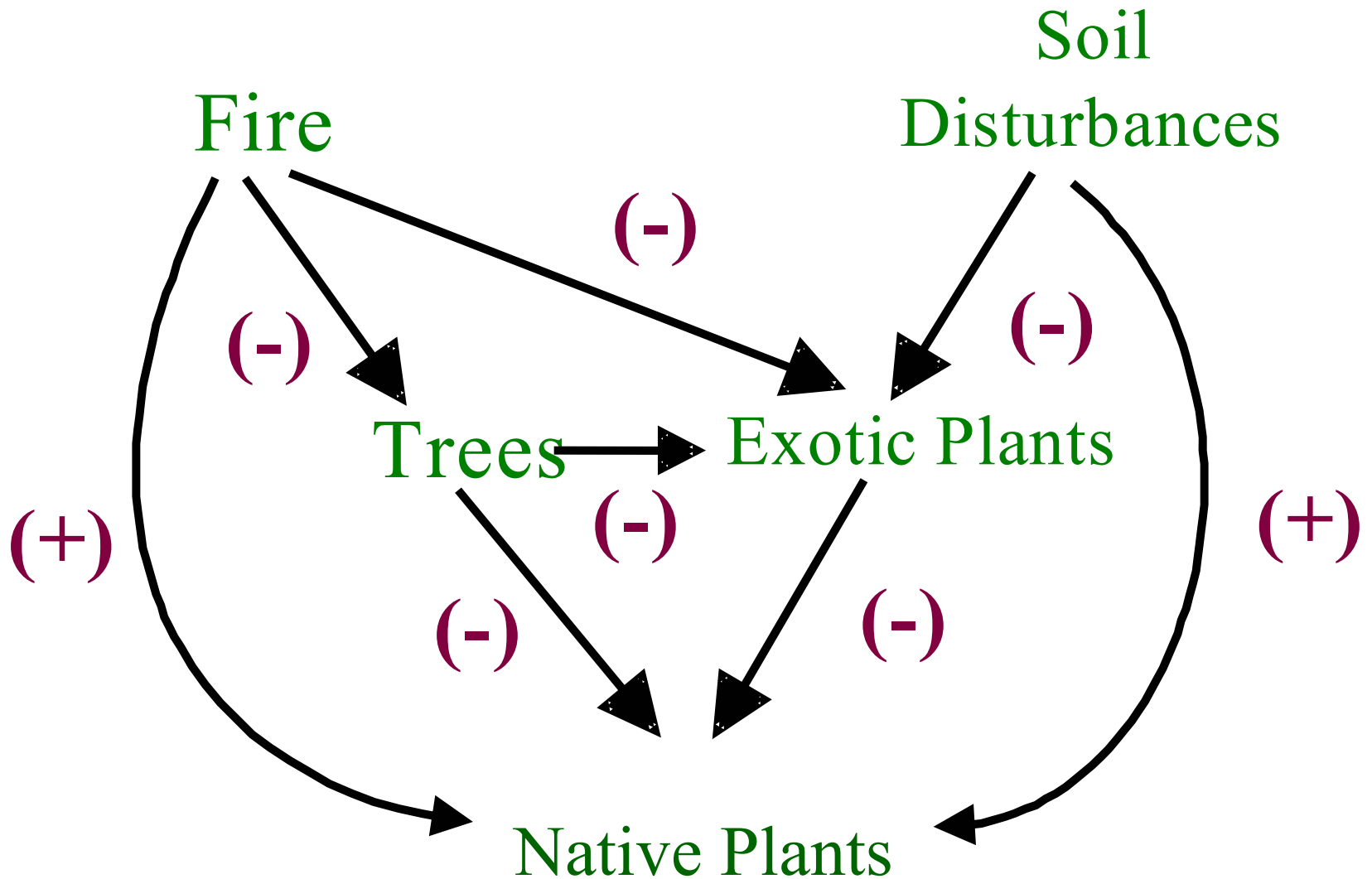
Management Implications

Soil disturbances increase endangered plant populations and enhance native community structure

Soil disturbance mimics can facilitate the native plant community and promote endangered species recovery

Soil disturbances do NOT present a conundrum for native plant management

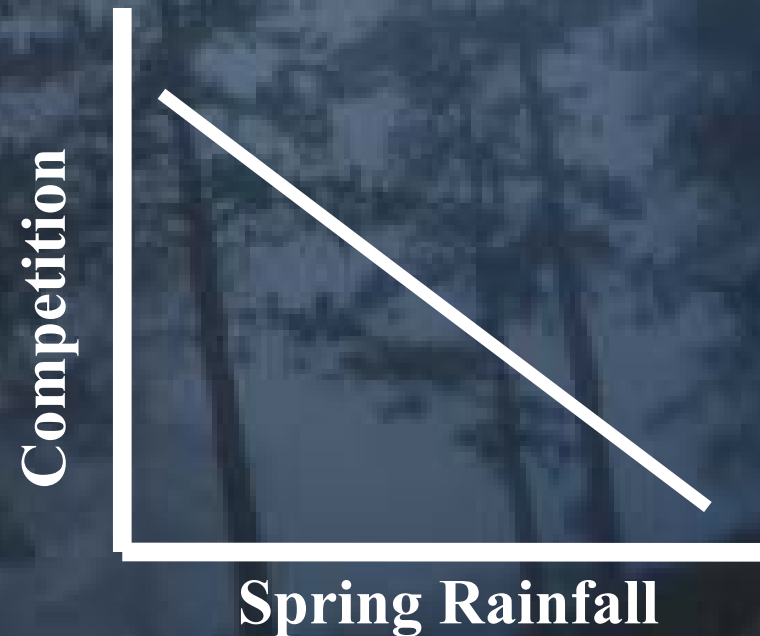
Summary of Results



Effects of Rainfall

Rainfall and exotic plants interact

Increased spring rainfall enhances endangered plants by reducing exotic plant competition



Long Term Management and Maintenance Plan

South Ridge



North Ridge



West Ridge



Sandhills Conservation and Management Plan

Olympia Well-field



Quail Hollow Ranch





Acknowledgements

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