



**APPLIED PLANT SYSTEMS
EXPERIENTIAL LEARNING PROGRAM**

Juniper recovery following initial restoration with extreme fire

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Introduction



Tallgrass Prairie

Eastern redcedar (*Juniperus virginiana*) is a native tree that is invading the Great Plains ecosystem¹



Invasion

Wildfire suppression and widespread distribution of seed sources has altered ecosystem services across the central and southern Great Plains^{2,3}



Intervention

As a result of invasion and loss of ecosystem services, private landowners in Nebraska are using extreme prescribed fire to collapse juniper woodlands and restore grasslands³



Restoration

Research Questions:

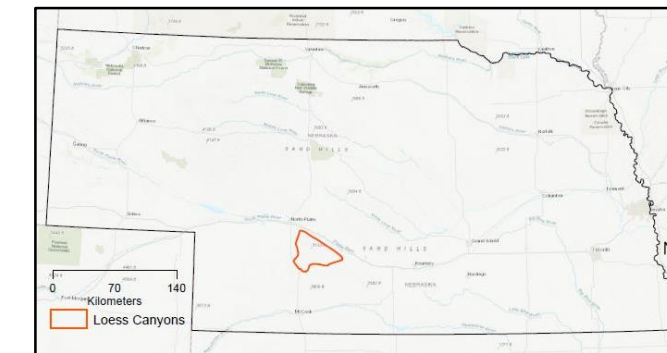
- 1) What is the rate of juniper recovery following initial restoration with extreme prescribed fire?
- 2) How can intervention strategies be used to maintain grasslands after initial intervention?

Methods

Study Site:

Loess Canyons Experimental Landscape

- 180,000 acre experimental landscape within the Loess Canyons



Experimental Design and Sampling:

- 22 burn units (range from 0-16 years since fire)
- 1 collapsed woodland patch sampled from each burn unit
- 3 unburned juniper woodland patches sampled for comparison
- In each patch, juniper canopy cover, height, and density sampled

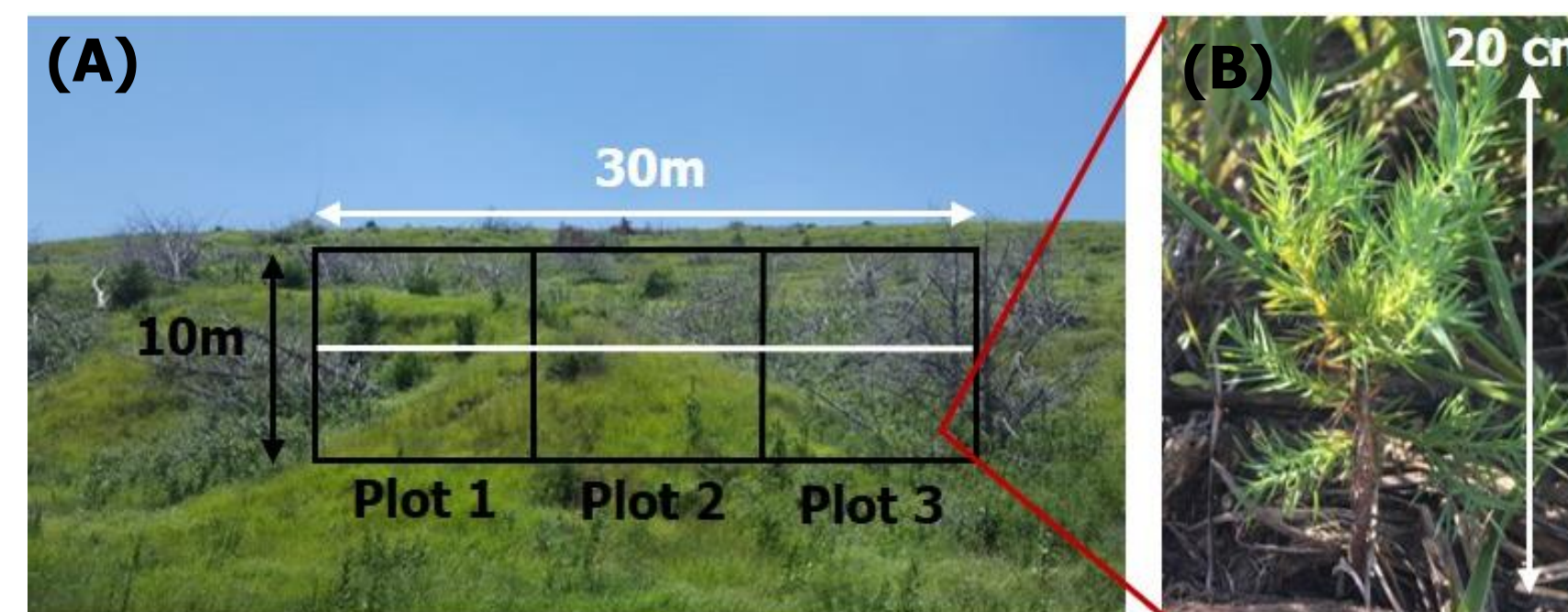


Figure 1. (A) White line represents line intercept, and 3 10x10 m plots used for height and density calculation (B) Juniper seedling found during surveys

Results

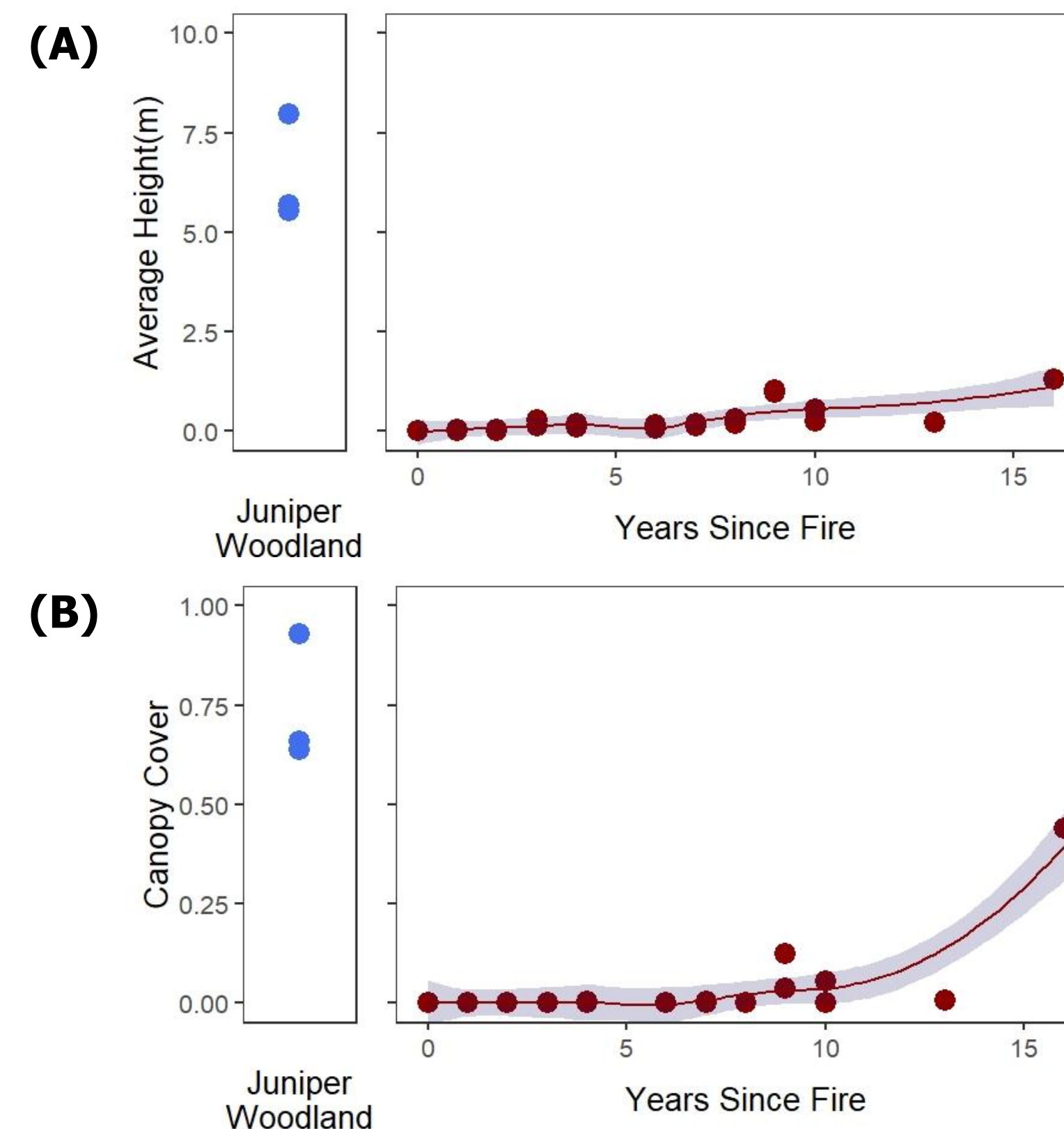


Figure 2. (A) Plots showing height and (B) canopy cover in unburned juniper woodland patches (left) vs. burned patches (right)

Acknowledgements

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References

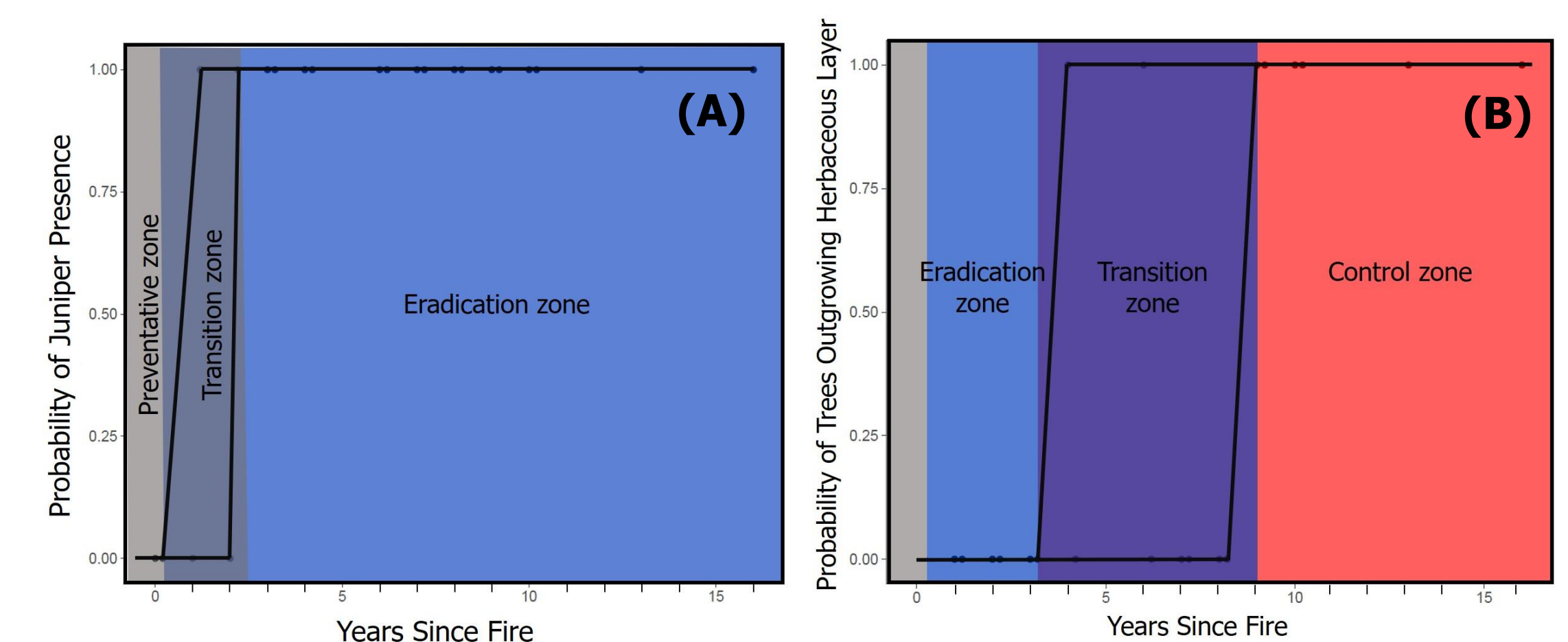
1. Briggs JM, Hoch GA, Johnson LC: *Ecosystems* **5**, 578 (2002)
2. Fuhlendorf SD, Archer SR, Smeins FE, et al: *Ecol. Stud.* **196**, 219 (2008)
3. Twidwell DT, Rogers WE, Fuhlendorf SD, Wonkka CL, Engle DM, Weir JR, Kreuter UP, Taylor CA: *Front. Ecol. Environ.* **11**, e64 (2013)



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Discussion and Implications

- Seedlings occurred within 1 year after initial restoration, creating a short window for prevention
- Juniper recovery was readily visible 4 years after initial restoration, when trees outgrew the herbaceous layer
- Juniper recovery surpassed the 6 foot (1.8m) fire-kill mortality threshold 9 years after initial restoration
- Guidance on adaptive juniper management based on juniper recovery provided below



(C) Management Phase	Description	Intervention Guidelines	Management Options
0) Endemic	No individuals present	Prevent occurrence of new individuals	Goats Haying
1) Propagule	Seeds entering site		
2) Incipient	Seeds become seedlings within herbaceous layer	Eradication of incipients, removal of seed sources	Fire
3) Escape/rapid growth	Seedlings escape herbaceous layer, growth rate accelerates	Control infestations Bottom-up: remove trees from herbaceous layer Top-down: Remove trees that have escaped herbaceous layer	
4) Exponential spread and recruitment	Propagule pressure, incipient establishment and spread, escape and rapid growth occur at an accelerated rate		
5) Landscape transition	Transition from grassland to woodland; invasion rate reduced	1. Adapt to new conditions / Long term management OR when capacity exists to sustain grassland 2. Restore grassland by removing all trees	Hand Cutting Mechanical

Figure 3. Adaptive Juniper Management - (A) Presence/absence of seedlings and (B) trees taller than the herbaceous layer (>0.5 m) in relation to intervention strategies. (C) Table describing management phases and intervention guidelines