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Extreme Fire as a Management Tool to Combat Regime Shifts in the Range of the Endangered American Burying Beetle

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Abstract

The American burying beetle (*Nicrophorus americanus*) is a federally-endangered species of carrion beetle found in Nebraska. In the Loess Canyons, woody encroachment is replacing the grasslands this species prefers. Prescribed fire has been used to stop the spread of woody species, but its impacts on the beetle are unknown.

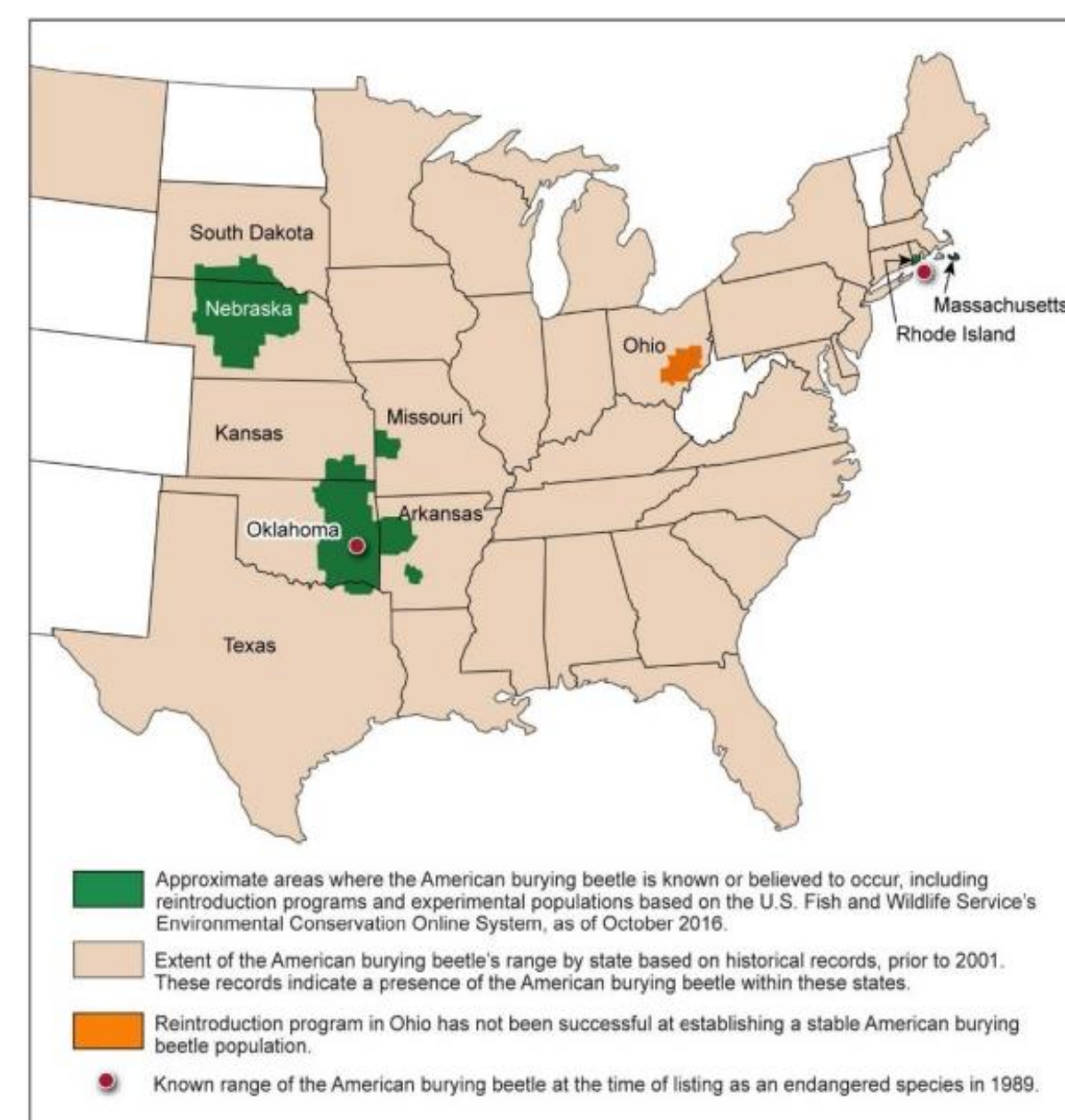
Introduction

Study Site: The Loess Canyons



- Very steep silt-loam hills¹
- Heavily eroded¹
- Mixed-grass prairie²
- Shifting from a grassland to woodland¹
- Extreme prescribed fire to halt woodland spread, restore grasslands³
- Above map adapted from: U.S. Fish and Wildlife Service. "Partners for Fish and Wildlife Program: Mountain-Prairie Strategic Plan." Report. 2012. Pg 71.

Beetle Background



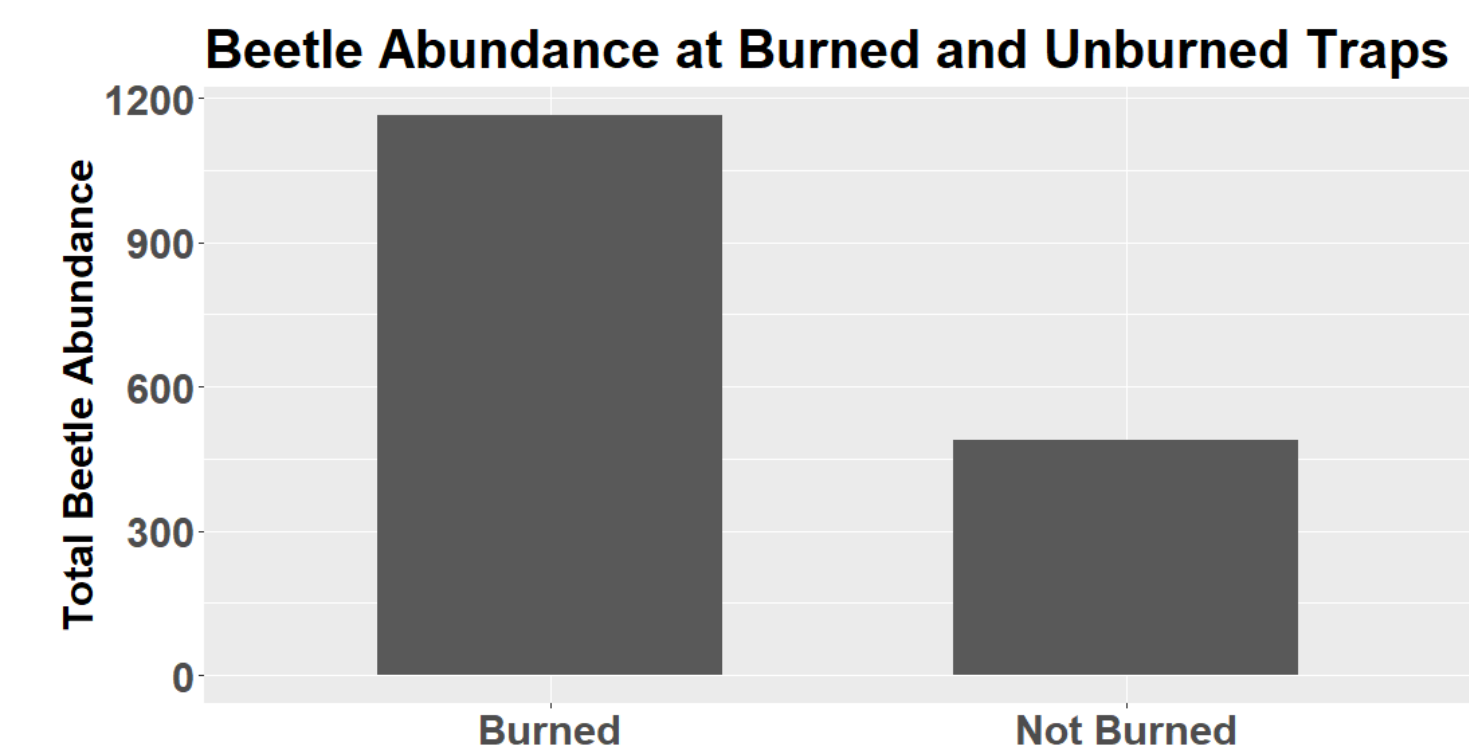
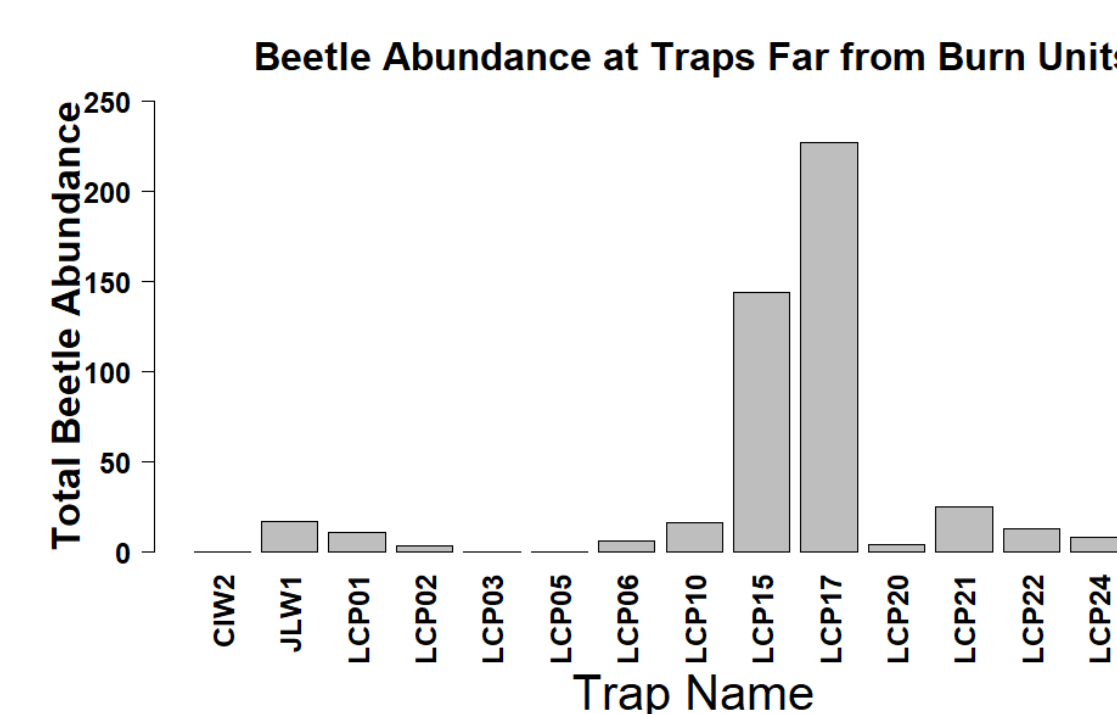
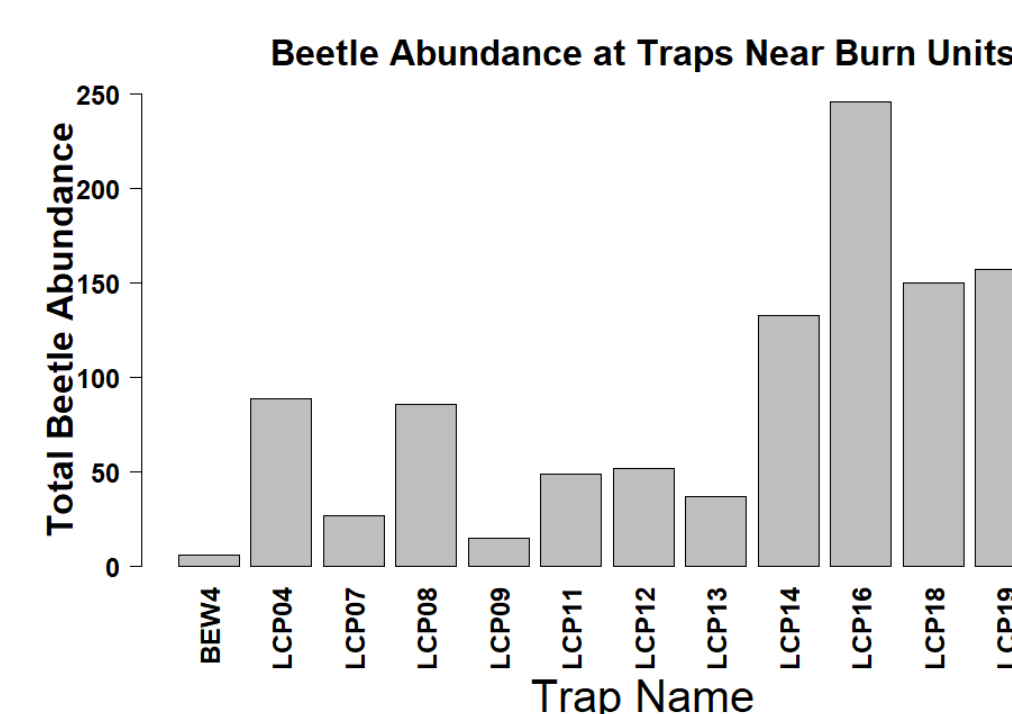
- Habitat generalist/scavenger/decomposer³
- Listed as federally-endangered in 1989³
- Found in < 10% of historical range³
- Low, dense *Juniperus* forest is detrimental³

Above map adapted from: Government Accountability Office. "Endangered Species Act: U.S. Fish and Wildlife Service's American Burying Beetle Conservation Efforts." Report. Dec 2016. Pg 37.

Results

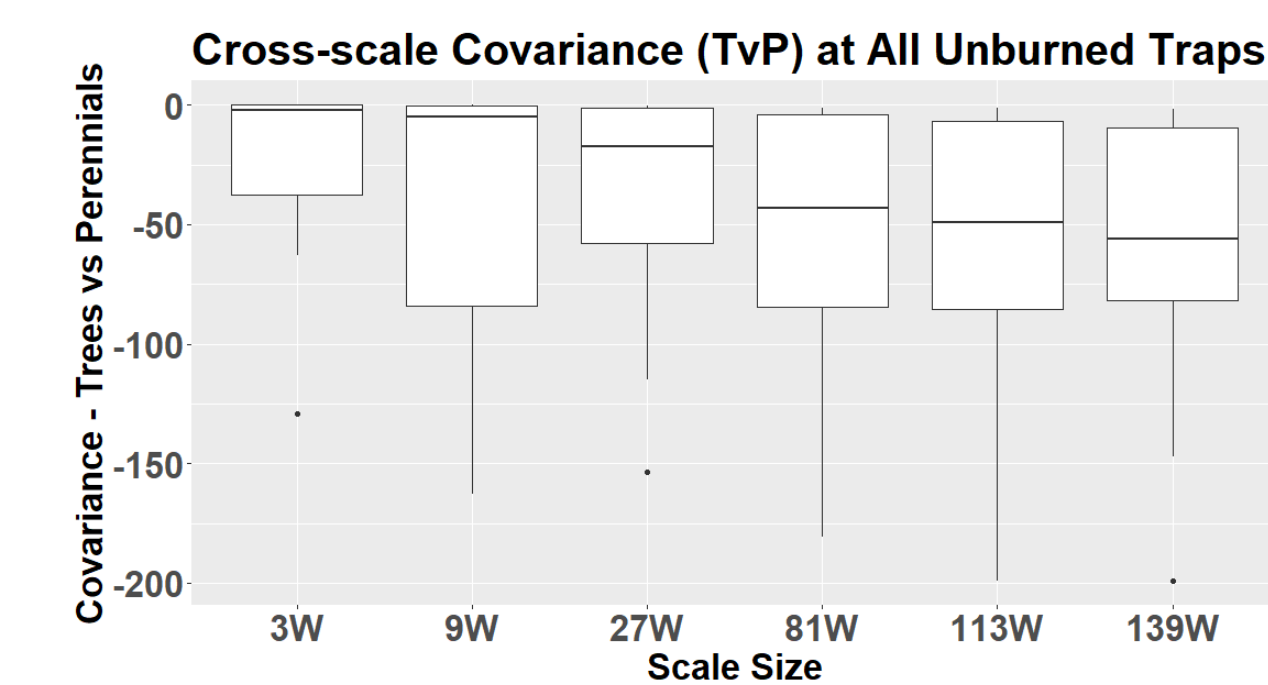
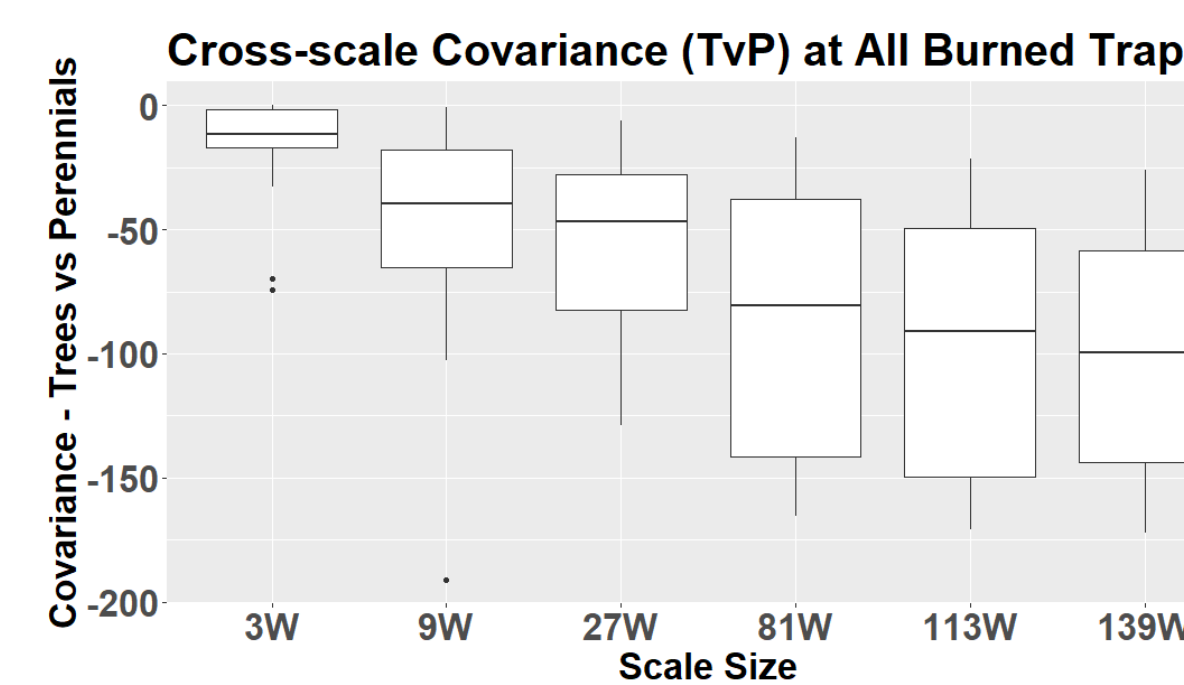
Beetle Trapping

- Beetle abundance greater at traps near burn units (within 1.2 km)
- Significant difference between beetle abundance at traps near and far from burn units (p-value < 0.0001)



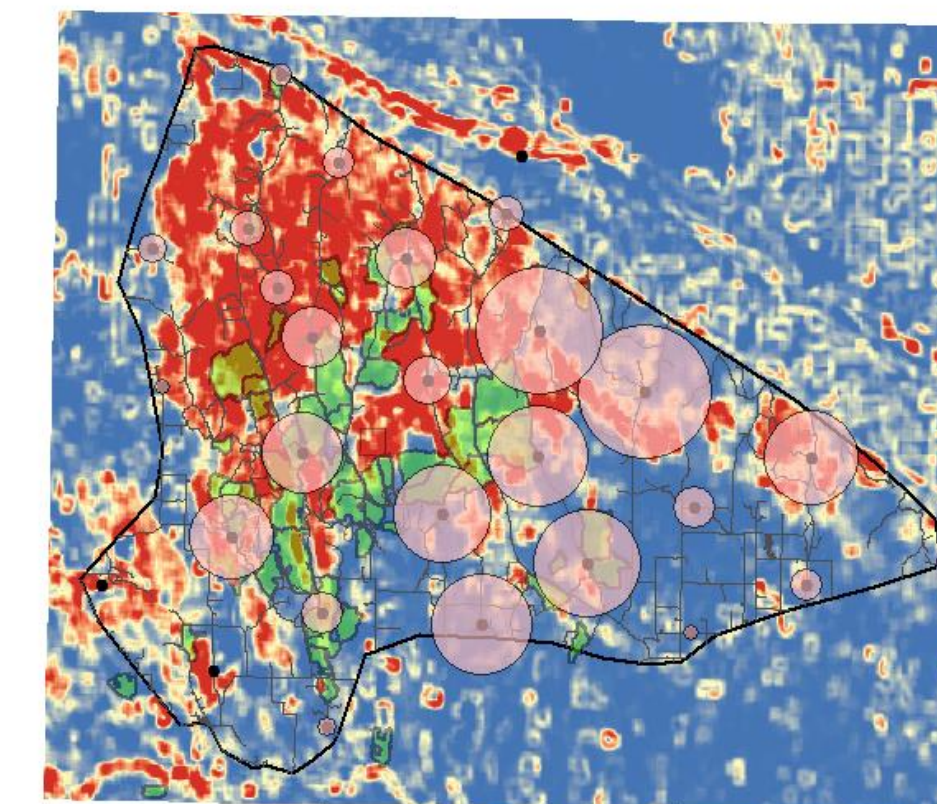
Covariance Dataset

- Traps near burn units (within 1.2 km) have more negative covariance values at larger spatial scales
- Indicates more border clashes between trees and perennials at larger scales



Landscape Map

- Pink circles indicate trap locations
- Circle size indicates total beetle abundance
- Green polygons indicate burn units
- Red areas denote more negative covariance values (max -100), while blue areas show less negative covariance values (min 0)
- **Map Result:** Areas in the central Canyons have higher beetle abundances. This is also close to the majority of prescribed fires.



The largest circle has a total abundance of ~230 ABB caught across all years.



Conclusions

- Endangered beetle more abundant at traps near burn units, therefore extreme prescribed fire not having a negative effect on the beetle
- Covariance at small scales, less negative at both burned and unburned traps
- Covariance at large scales, more negative near burned traps
- At large scales, there are more clashes between grassland and woodland near burn traps

References

- 1 McPherron et al (2012) *Trends in Entomology* 8:27–36.
- 2 Roos et al (2018) *PNAS* 115(32):8143–8148.
- 3 Twidwell et al (2013) *Frontiers in Ecology and the Environment* 11(s1):e64–e71.
- 4 Walker & Hoback (2007) *Environmental Entomology* 36(2):297–307.

Acknowledgements

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- Dr. Dan Uden and Dr. Dirac Twidwell, and the entire Twidwell Lab

Research Questions

- Is extreme prescribed fire having an impact on the endangered beetle?
- What is the covariance between trees and perennial forbs/grasses around burned and unburned traps?

Methods

Beetle Trapping

- 28 permanent trap locations, sampled since 2007
- Annual trapping, ~5 days in August
- Traps baited with carrion and checked every morning
- All American burying beetles are counted, measured, and tagged before release



Covariance Dataset

- Covariance of trees vs. perennial forbs/grasses
- Covariance values range between 0 and -200
- More negative values indicate higher incidences of clashes between tree-perennial borders
- Covariance values are calculated at six levels of spatial scale (simplified diagram shown below)

