Prairie restoration using extreme fires & spatial regime monitoring in the Great Plains

Phoebe Hartvigsen[1], Christine Bielski[2], and Dirac Twidwell[2]
State University of New York College at Geneseo[1], University of Nebraska-Lincoln[2]

INTRODUCTION

Eastern redcedar (*Juniperus virginiana*) is a native invasive species in the Great Plains where it has spread into grasslands, decreasing biodiversity, reducing valuable rangeland forage for livestock, and increasing wildfire risk. Historically, natural processes such as fire would maintain these prairie ecosystems and keep cedar trees scarce. However, wildfire suppression and the planting of Eastern redcedar for windbreaks have resulted in its rapid expansion. Extreme or high-intensity fire is able to kill adult cedar trees which is why it has been applied to invaded rangeland systems in order to restore grassland.

I was a involved in 4 research projects this summer and gained a significant amount of hands-on experience both in the lab and in the field. We focused our studies mainly on burn sites, treating these areas as complex adaptive systems—systems with individual components that adapt based on their interactions.

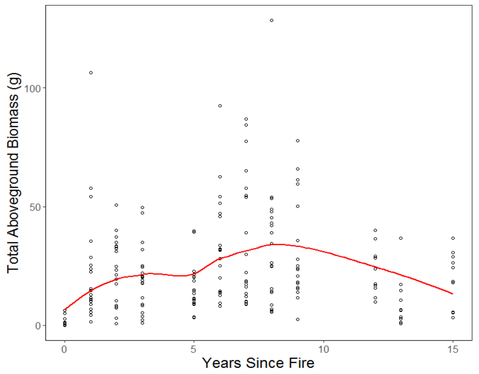
#1 HERBACEOUS BIOMASS AFTER FIRE

Fire causes an ecosystem to collapse after which—in grassland areas with invasive Eastern redcedar—herbaceous grasses and forbs should form beneath the dead trees. This study addresses this regrowth in the Loess Canyons Biologically Unique Landscape (BUL) of western Nebraska.

This project aims to quantify the biomass that grows back after a prescribed burn. The **method** included:

- 20 burn sites ranging from burned in 2002 to 2017
- 5 unburned sites
- 10 quadrats per site
- Visual estimations of % live/dead vegetation
- Clippings of aboveground grasses & forbs
- Vegetation weights together, then grasses only

Results:



Herbaceous biomass increases with the time since collapse.

The data suggest that biomass begins to decrease roughly 8 years after fire.

Key Findings:

- Herbaceous vegetation grows back after fire beneath cedar skeletons.
- Vegetation growing back immediately after fire had higher percent live than areas farther from time of collapse.
- This regrowth is important for ranchers because it shows that extreme fires can provide more forage for cattle.

#2 SPATIAL REGIME MONITORING

The mission of the Nature Conservancy is to keep ecosystems stable and maintain biodiversity. The aim of this study is to create a method for predicting unfavorable regime shifts. The study location was the Niobrara Valley Preserve.

The **method** involved making measurements along **one 4 km transect** through different types of terrain. These measurements were made **every 10m** along the transect.

Measurements included:

- DBH of nearest tree in each quarter
- Distance to nearest tree in each quarter
- Height of "canopy" at each point & plant species represented

Results:

- When completed, this study will yield a monitoring system that allows the conservancy to prioritize their efforts by identifying areas at risk of shifting to "undesirable" regimes.


PHOTO CREDIT: COURTNEY EVERHART

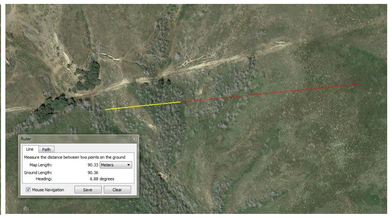
#3 BURN SEVERITY

Prescribed burning by the Loess Canyon Rangeland Alliance (LCRA) started in 2002. This study is meant to determine 1) how much live cedar cover is altered by fire for each prescribed burn and 2) if the severity of the LCRA burns has increased over time.

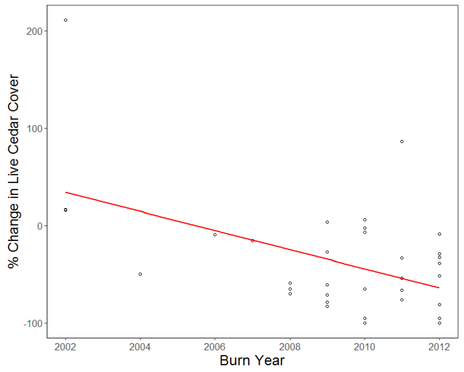
The **method** included **five 300m transects** in a total of **35 burn areas** drawn using Google Earth satellite imagery. The total distance of live and dead trees directly before and after the burn were measured using line-intercept sampling.

Measurement parameters:

- Gap size: 5m
- Measurement resolution: 5m
- Patch resolution: 10m



Results:



Percent change in live cedar cover caused by each burn decreased over time since 2002 as a higher percent of cedars were killed per burn.

Key Findings:

- As the LCRA becomes more experienced, the severity of the burns increases as indicated by the reduction in live cedar coverage post-fire.
- This suggests an increased knowledge base regarding burn conditions for making truly extreme fires.

#4 BATS IN BURNED AREAS

Bats are important for the agriculture industry because they consume pest insects that threaten crops. Nebraska being an agriculturally-inclined state makes studying bats extremely valuable. The aim of this study is to identify the distribution of bat species in a landscape with a history of extreme fires in order to better understand their distribution. The location used was the Loess Canyons BUL.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The **method** included **15 acoustic detectors** in 5 different prescribed burn sites.

Detector locations included:

- 5 in areas with primarily live cedars
- 5 in areas with primarily dead cedars
- 5 in areas with both live and dead cedars


PHOTO CREDIT: CHRISTINE BIELSKI

DISCOVERIES & IMPLICATIONS

- Rangelands represent complex systems unlike crop agriculture such that the factors affecting them are not controlled but rather natural processes that work to maintain themselves.
- In these systems, prescribed fire is able to act as a historical process to restore grasslands and provide the disturbance necessary to stabilize these ecosystems.
- Restoration can be achieved with intense fire and careful monitoring of ecosystem stability in order to reverse invasion and prevent further transformation.
- Nebraska is just a piece of the Great Plains and demonstrates both how the Plains could be transformed into a less stable, undesirable state as well as the effects of one of the most effective methods of prevention: extreme fire.


PHOTO CREDIT: CHRISTINE BIELSKI

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