2013-2014 Webinar Series

January 30, 2014 2:00 PM Eastern, 1:00 PM Central

When is a Grassland Restoration Truly Restored?

Examining Microbial Community Responses to Fire in Remnant and Restored Grasslands

Kathryn Docherty (Western Michigan University)

Ryan Koziatek (Kalamazoo Nature Center)

Ashley Anne Wick (Kalamazoo Nature Center)

When is a Grassland Restoration Truly Restored?

Examining Microbial Community Responses to Fire in Remnant and Restored Grasslands. A Manager-Scientist Lessons-Learned Webinar

Presenters:

Ryan Koziatek, Stewardship Field Director – Kalamazoo Nature Center

Kathryn M. Docherty, Assistant Professor – Western Michigan University, Department of Biological Sciences

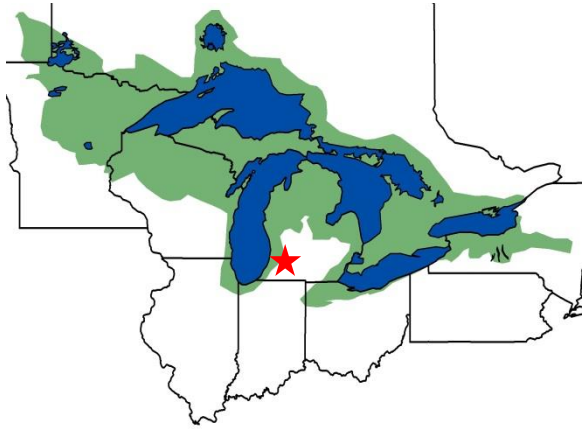
Ashley Anne Wick, Biological Research Director – Kalamazoo Nature Center

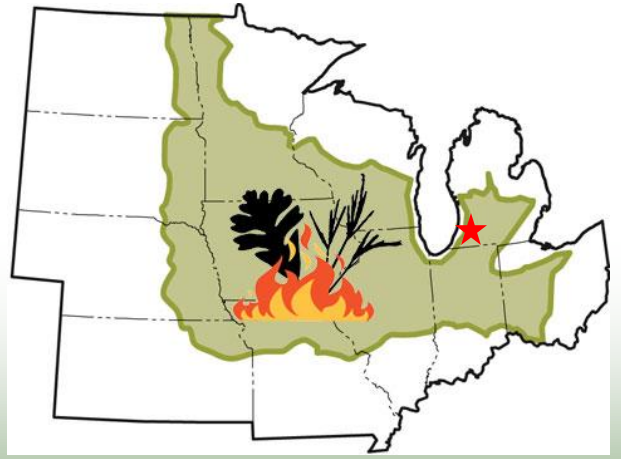
Outline: Three perspectives

- Land manager (Ryan)
  - KNC and site history
- Academic researcher (Kathryn)
  - Research questions
- Research director (Ashley)
  - Her role
  - Facilitated discussion

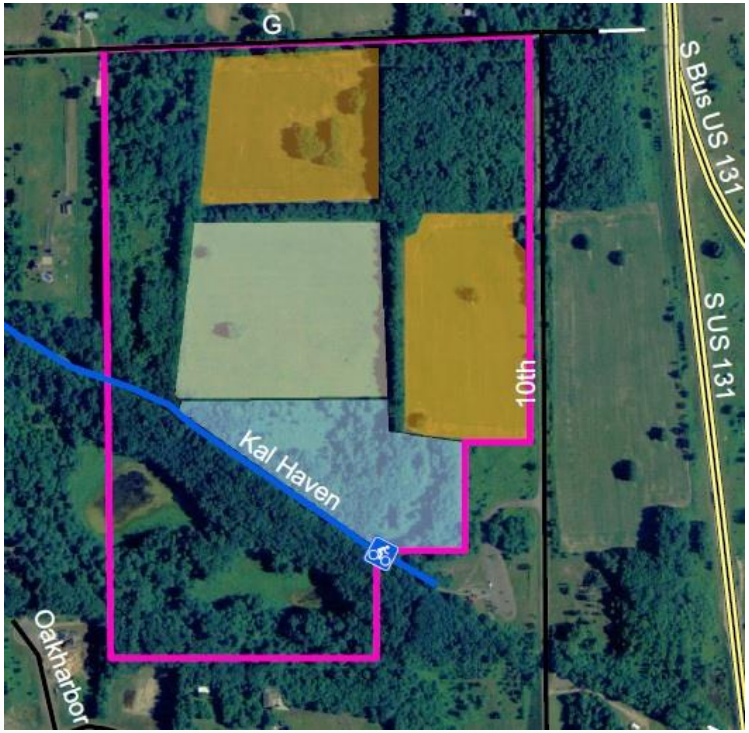
Kalamazoo Nature Center (KNC) History (Ryan)

- Est. 1960
  - Education
  - Development
  - Conservation Stewardship
- 1100 acres
- Diverse habitat





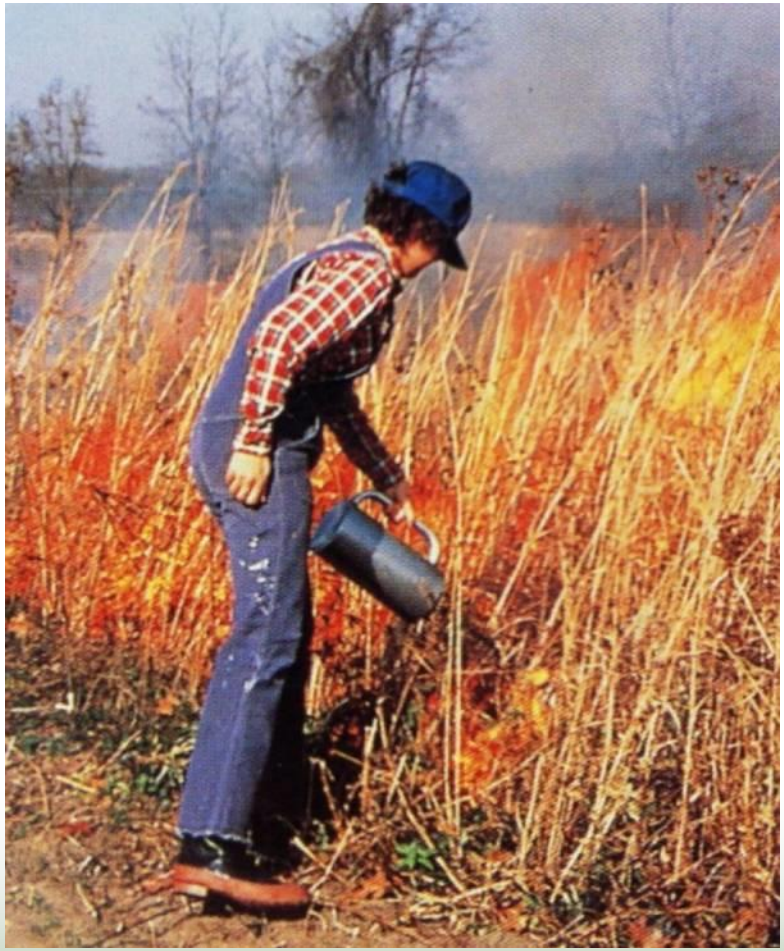
Kalamazoo Nature Center
Harris Prairie, Oshtemo, MI



- Remnant - 1993 - 2010 - 2015

Land management at KNC

- History
  - 1974 Volunteer Prairie Planting
  - 1993 CRP Planting
  - 1994 Land Use Plan
    - Not Land Management Plan
  - 2003/2004 Bioinventory
  - 2005 Land Management Plan
- Invasive species management
- Restoration
- Fire



Controlled fire at KNC in the 1970s

Adaptive Land Management

Source : https://miradi.org/openstandards

Limitations as a land manager

- Is management working?
- Not enough resources for monitoring
- Lacking meaningful metrics or protocols
- Time

Bring in the researchers

- Ashley and Kathryn do initial site visits
- Research needs
  - Fire
  - Control plots in management units
- Collaboration began
  - Applied research

Visible Measures of Restoration (Kathryn)

- Biodiversity
- Floristic Quality Assessment
- Presence of Indicator Species
- Recovery of Aboveground Ecosystem Services

What's going on below the restored prairie surface?

O – loose organic matter

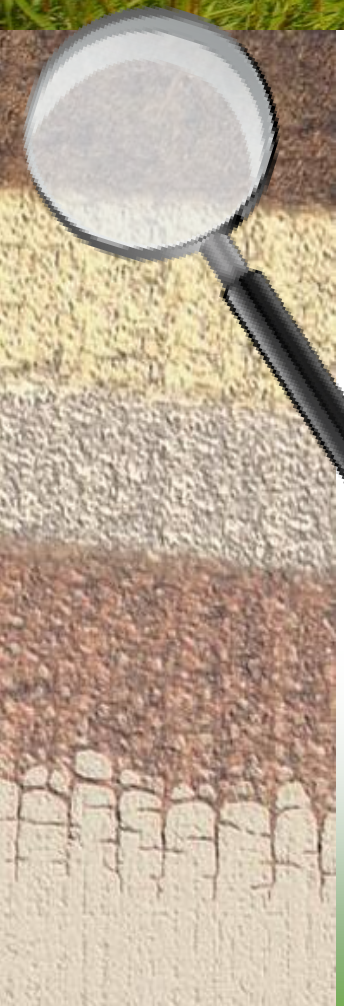
A – mineral matter and humus

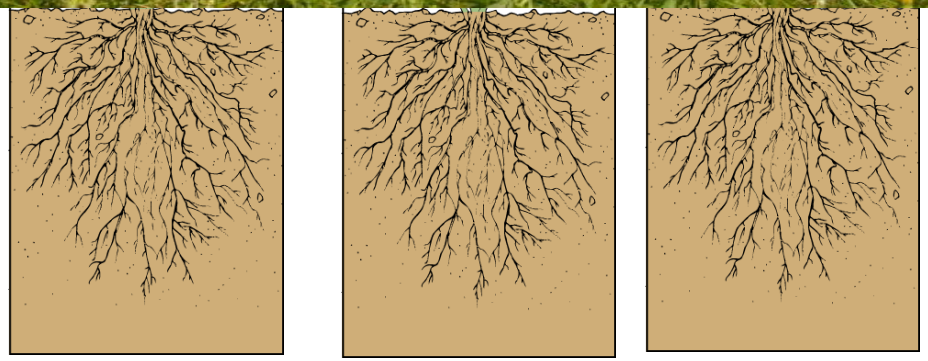
E – Zone of eluvation and leaching

C – Partially altered parent material

Unweathered parent material

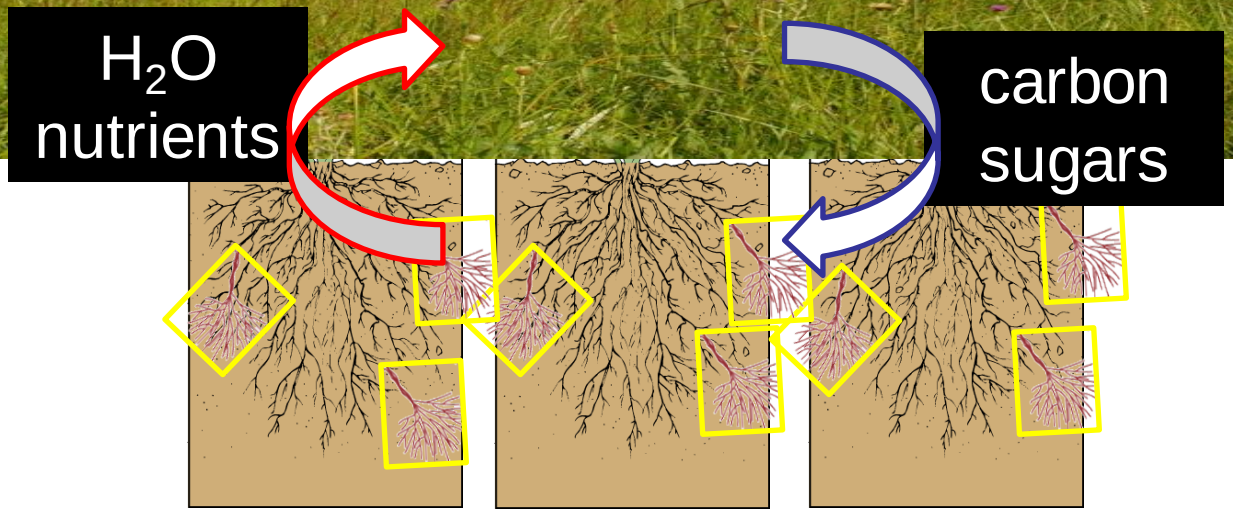
What's going on below the restored prairie surface?





1) Extensive tilling has reduced the amount of **arbuscular mycorrhizal fungi** in the soil

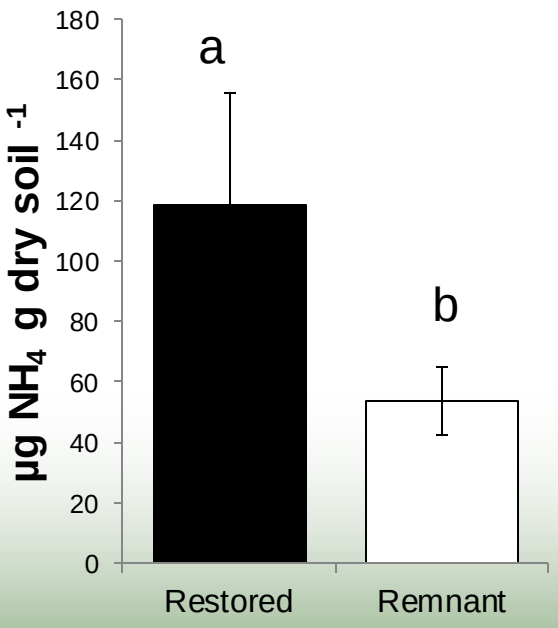
What's going on below the restored prairie surface?

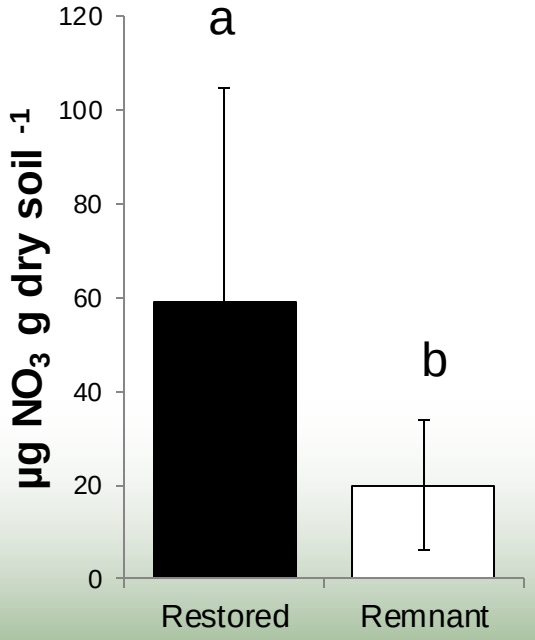


1) Extensive tilling has reduced the amount of **arbuscular mycorrhizal fungi** in the soil

What's going on below the restored prairie surface?

2) Fertilization causes **soil nitrogen levels** remain high decades following restoration.





What's going on below the restored prairie surface?

Never Fertilized

- More *Verrucomicrobia*
- Less cell division pathways
- More recalcitrant carbon degradation pathways
- Generally "oligotrophic"

Fierer et al. 2013 Science

3) Fertilization has changed the **soil bacterial community**

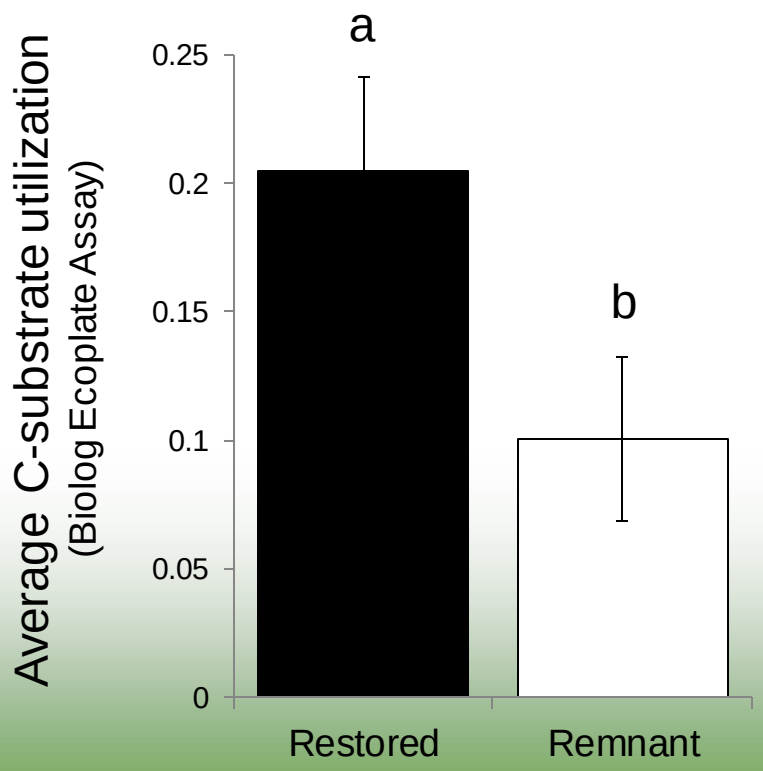
What's going on below the restored prairie surface?

Never Fertilized	Past Fertilization
• More *Verrucomicrobia* • Less cell division pathways • More recalcitrant carbon degradation pathways • Generally "oligotrophic" Fierer et al. 2013 Science	• More *Actinobacteria* & *Firmicutes* • More labile carbon degradation pathways • Generally "copiotrophic" Ramirez et al. 2012 Global Change Biology

3) Fertilization has changed the **soil bacterial community**

What's going on below the restored prairie surface?

4) Restored prairie microbial communities **use carbon more quickly** than remnant prairie communities.



What's going on below the restored prairie surface?

1) Arbuscular Mycorrhizal Fungi
2) Nitrogen
3) Soil Bacterial Community
4) Carbon Utilization

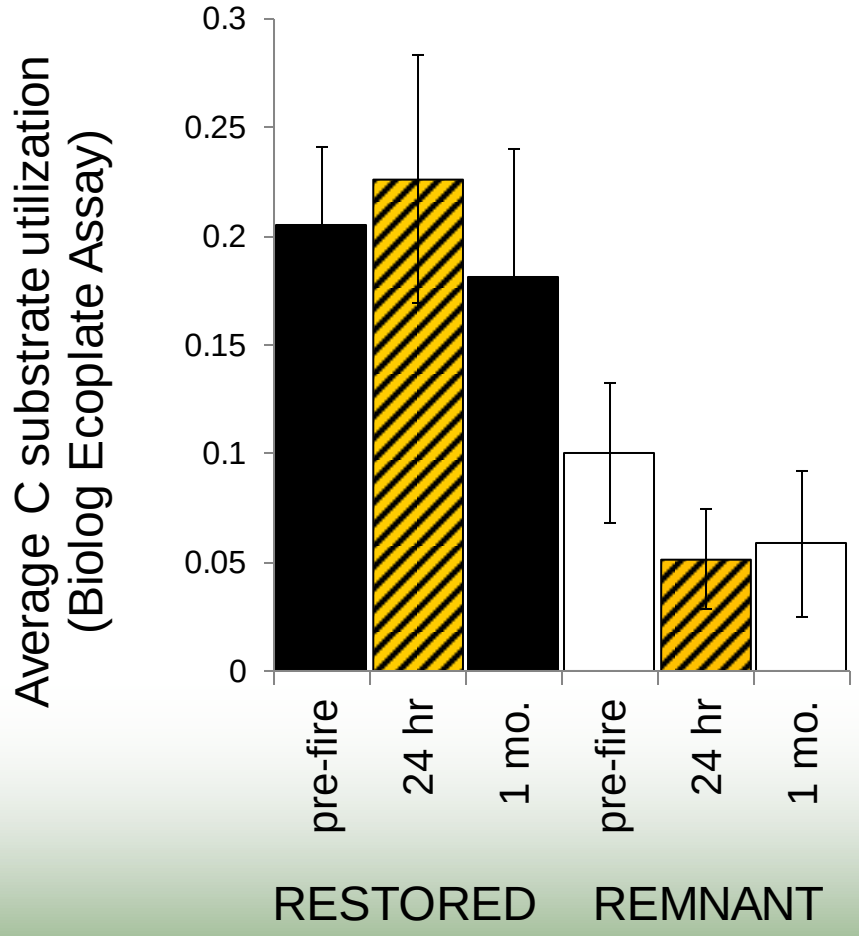
Less belowground carbon storage in restored prairies than remnants, even **7 decades** after restoration.

Kucharik et al. 2006 Soil Biology & Biochemistry

What does prescribed burning do?

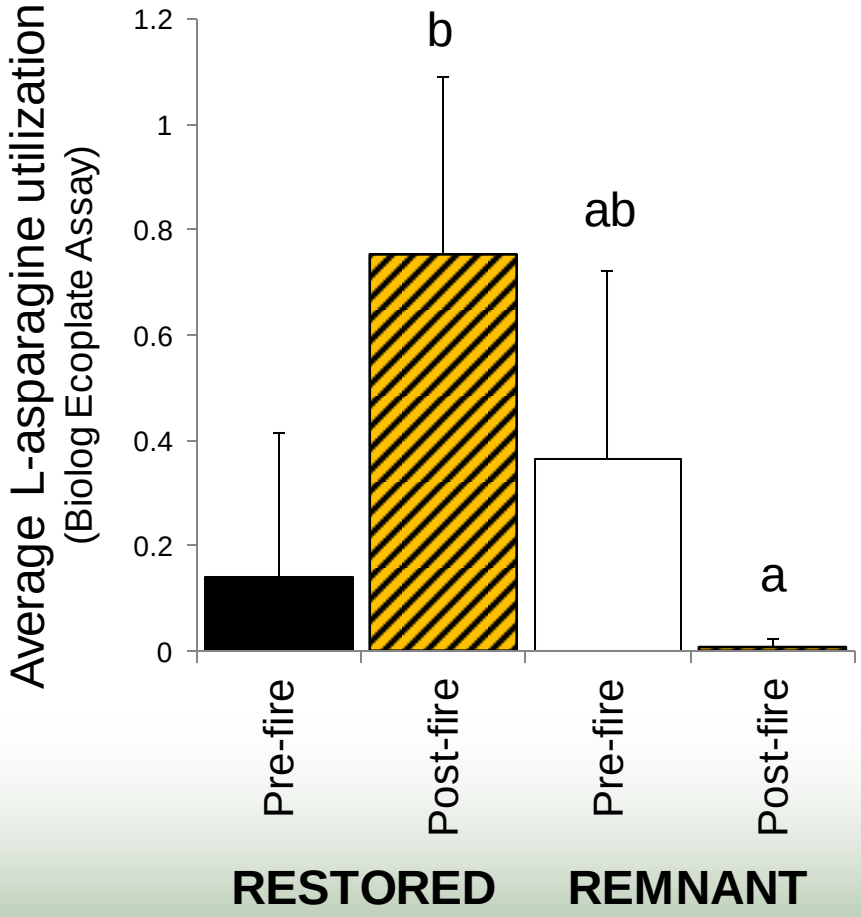
Increases soil pH, NH_4^+, NO_3^-

Overall carbon utilization remains the same



What does prescribed burning do?

Increased metabolism of **N-containing carbon substrates** in restored prairie immediately following a burn



L-asparagine
putrescine
L-serine
L-arginine

Take Home Points

- Soil microbial communities in restored prairie soils perform **fundamentally different ecosystem functions** than those in remnants.
- As a result, they respond differently to prescribed burning and provide different services to the aboveground community.
- Belowground restoration tactics are necessary to restore historical microbial biodiversity and function.
- Collaborating with land managers long-term is necessary to achieve goals.

Wearing both hats (Ashley)

- Practitioner & researcher
- At KNC
  - Grant permission to researchers
  - Microbe x fire research
  - Michigan Butterfly Network
  - Kalamazoo Climate Change Coalition
  - Developing new monitoring metrics with drones
  - At-risk butterfly work in Michigan (Mitchell's Satyr and Karner Blue)
  - COSEWIC butterfly consultant

Limitations of researchers & land managers

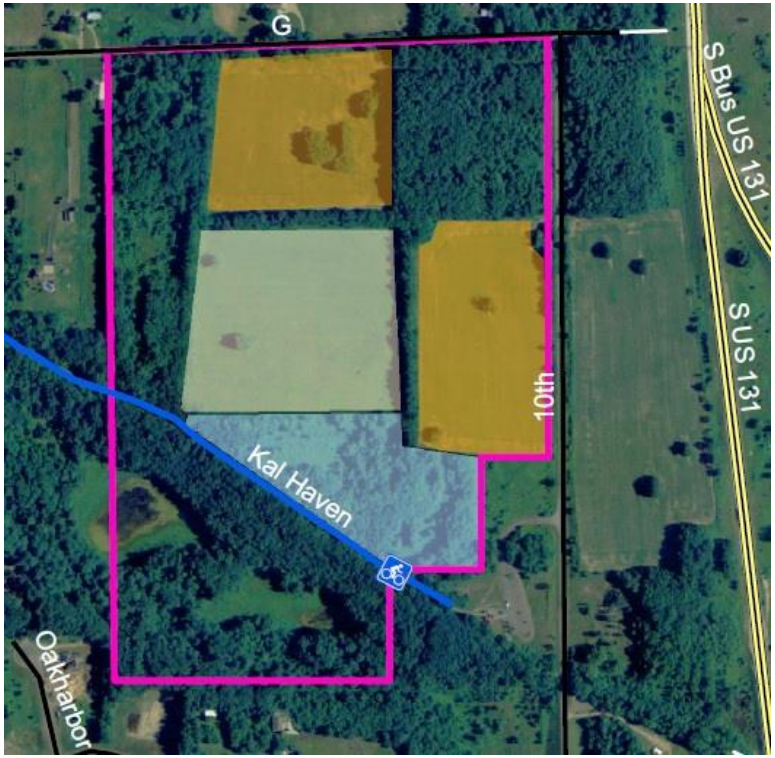
- **Land managers**
  - Busy managing land!
  - Geographically limited
  - Holistic view
- **Researchers**
  - Tend to use many systems
  - Specific hypotheses
  - Short term projects
- **Both**
  - Boots-on-the-ground land management is resource intensive
  - Rare species awareness
  - Funding

Learning from each other

- Open communication
- Hypothesis brainstorming sessions
- Literature reading groups
- Debating methodology

Hurdles in collaborative research

Winds are right… Let's light the fire!



So far… It's working!

- One season of preliminary data
- New relationships established
- 2015 planting
- Community outreach class through WMU and KNC

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Next Co-sponsored Webinar:

February 13, 2014 at 2:00 PM Eastern, 1:00 PM Central

Multi-scale Responses of Eastern Massasauga Rattlesnakes (Sistrurus catenatus) to Prescribed Fire

Matthew D. Cross

(Bowling Green State University)

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LakeStatesFireSci.net

@prairiefiresci

tposfirescience.org

Tallgrass Prairie and Oak Savanna Fire Science Consortium

A JFSP KNOWLEDGE EXCHANGE CONSORTIUM

Next TPOS Webinar:

February 11, 2014 at 12:00 PM Central, 1:00 PM Eastern

An Adaptive Framework for Management of Invasive Forest Plants: Integrating Prescribed Fire, Mechanical, Chemical, and Biological Techniques

Sean Blomquist

(U.S. Fish and Wildlife Service-Ottawa National Wildlife Refuge)

Next LSFSC Webinar:

February 20, 2014 at 2:00 PM Eastern, 1:00 PM Central

Assessing the Drivers of the 'Spring Dip' in Foliar Moisture Content and their Potential Impact on Forest Fire Behavior

W. Matt Jolly, PhD

(Research Ecologist with USFS, RMRS, Fire Sciences Laboratory)