

Water Soluble Nutrient Efflux in Tallgrass Prairie in Response to Pyric Herbivory

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Acknowledgements

- Oklahoma State University
- The Nature Conservancy
- Assistants:
 - Elaine Stebler & Andrew West
 - Keith, Greg, Randy, Micah, Bharat, Joe & Rodrigo

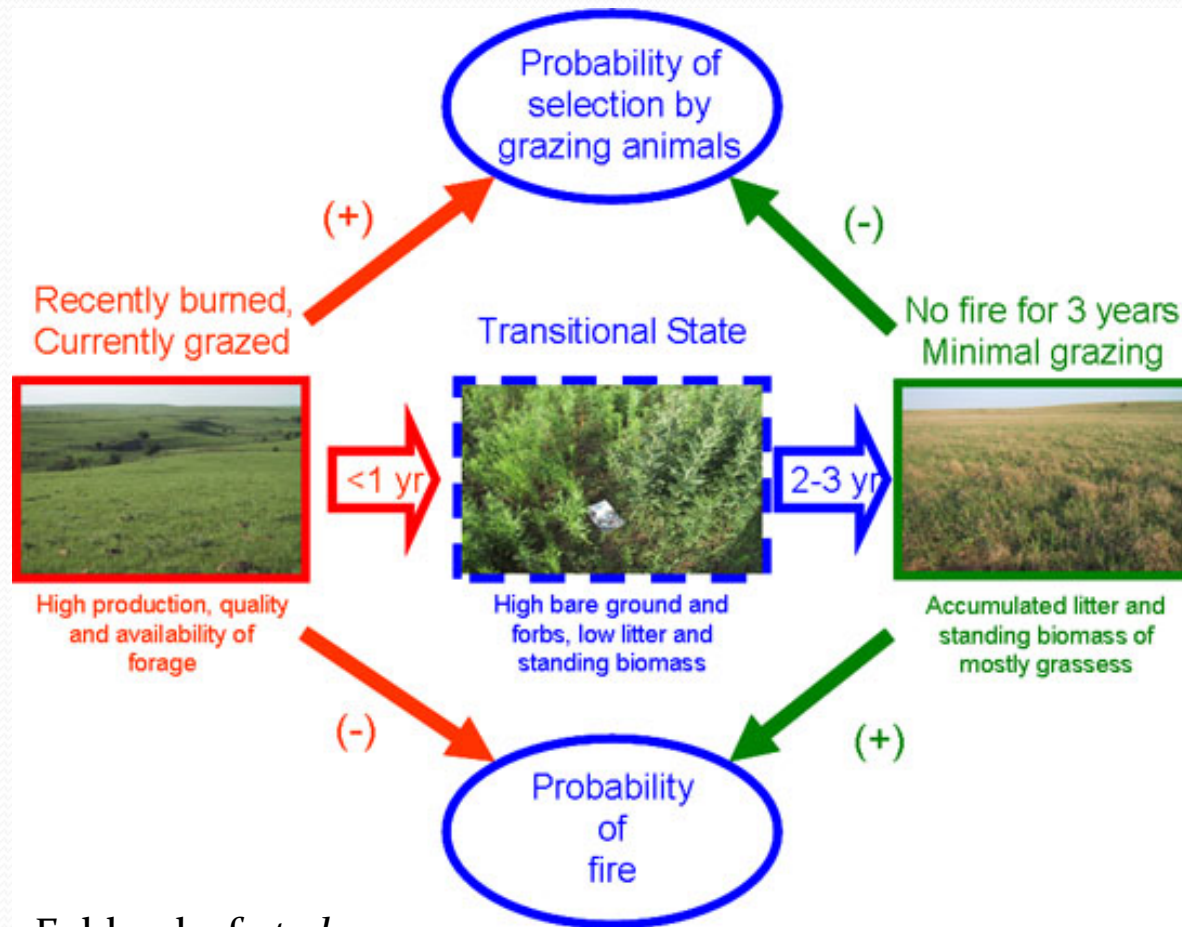


Introduction

- In the US, almost 50% of land is managed for grazing
- Conservation of many ecosystems
- Fire and grazing are the primary disturbances in rangelands
 - Studies on wildfires
 - High erosion & nutrient loss up to 2 years
 - Studies on steep rangelands
 - Erosion tied to bare ground from grazing intensity
 - Nutrient efflux tied to congregation areas



Pyric-herbivory



Fuhlendorf *et al.* 2004

Patch Burn Grazing





Studies using Patch Burn Grazing

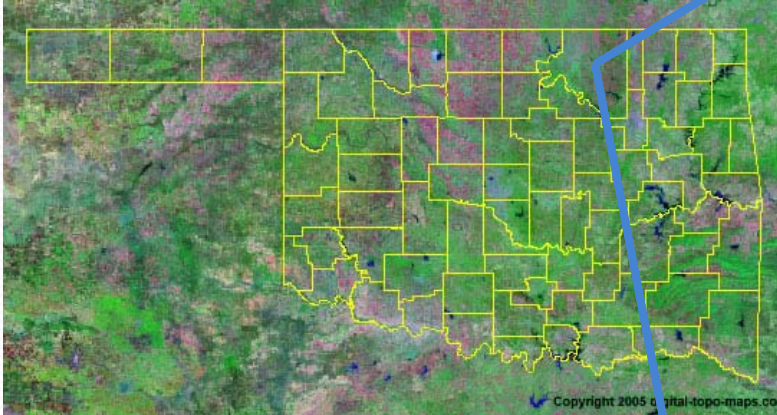
- Studies on vegetative response
 - Recovers 2-3 years post fire and grazing
- Studies on biodiversity
- Prairie studies on hydrology with grazing and fire separate
 - Fire creates bare ground & ash.
 - Recover from fire 6-12 months
 - Grazing creates bare ground & high bulk density
 - Recovery from grazing 1-2 years

Goals

- Objective 1: Effect of pyric herbivory on runoff, and sediment transport in a native tallgrass prairie
- Objective 2: Potential nutrient loss under patch burn grazing and annual burn managements



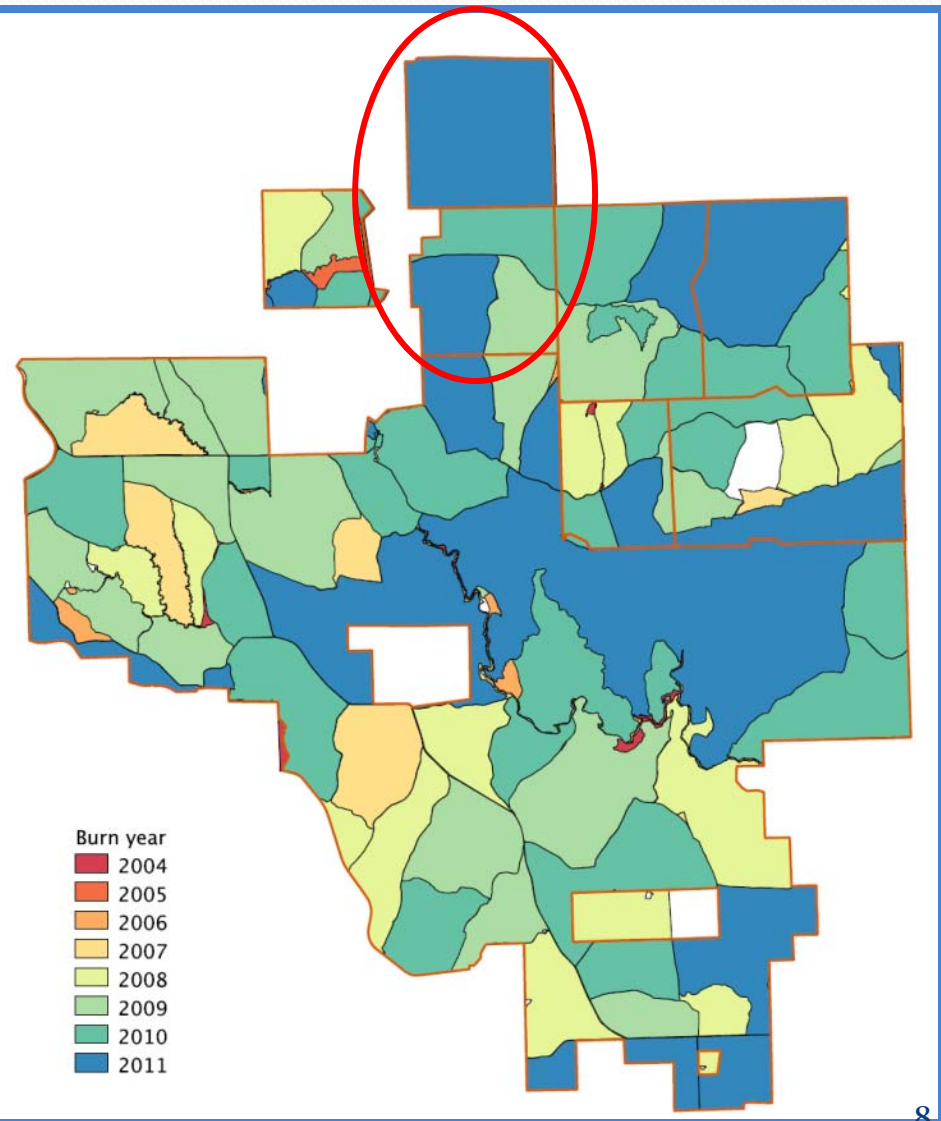
Study Site



Wanted to isolate treatment effect.

Sites were selected for:

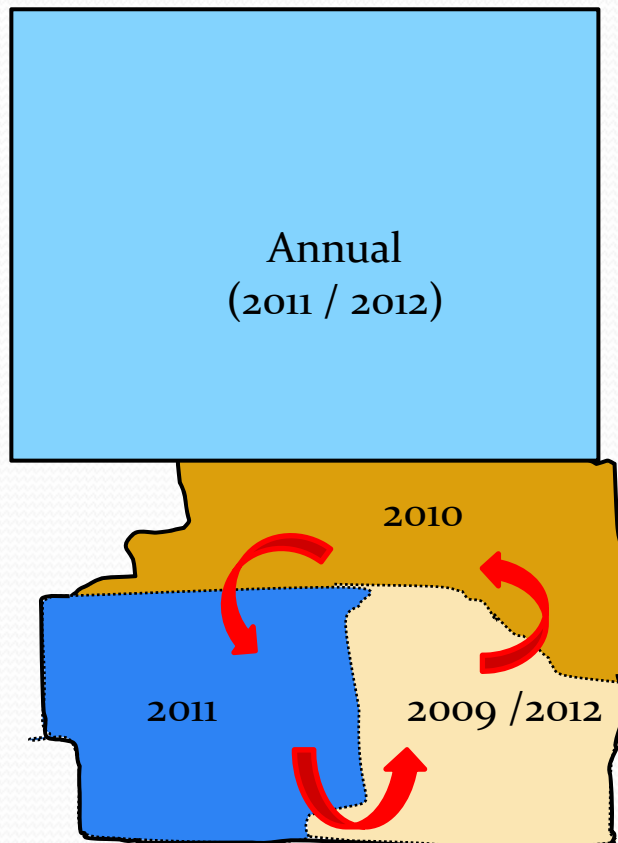
- 3-8% slope
- 2-5% rock outcropping
- Lucien-Coyle Complex
- Sandy-loam soils





Methods

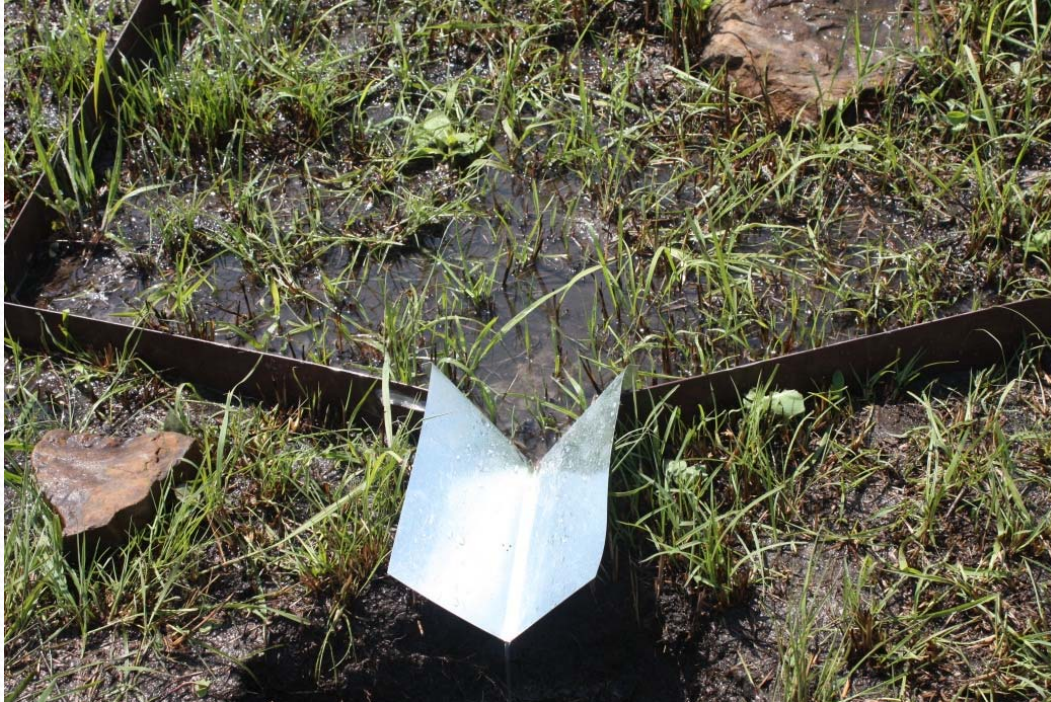
Sampled:
October 2011
April 2012
October 2012



	Month Since Fire	Simulation Oct 2011	Simulation April 2012	Simulation Oct 2012	
soil condition		Dry	Wet	Dry	Wet
Annual Burn	0 (2 weeks)	-	AB-0	-	-
	6	AB-6	-	AB-6	AB-6
Patch Burn Grazing	0 (2 weeks)	-	PB-0	-	-
	6	PB-6	-	PB-6	PB-6
	12	-	PB-12	-	-
	18	PB-18	-	PB-18	PB-18
	24	-	PB-24	-	-
	30	PB-30	-	PB-30	PB-30

Methods

- 10-year storm intensity applied (68 mm hr⁻¹)
- 30 minute runs
- Runoff collected every 2 minutes
- Nutrient samples every 8 minutes

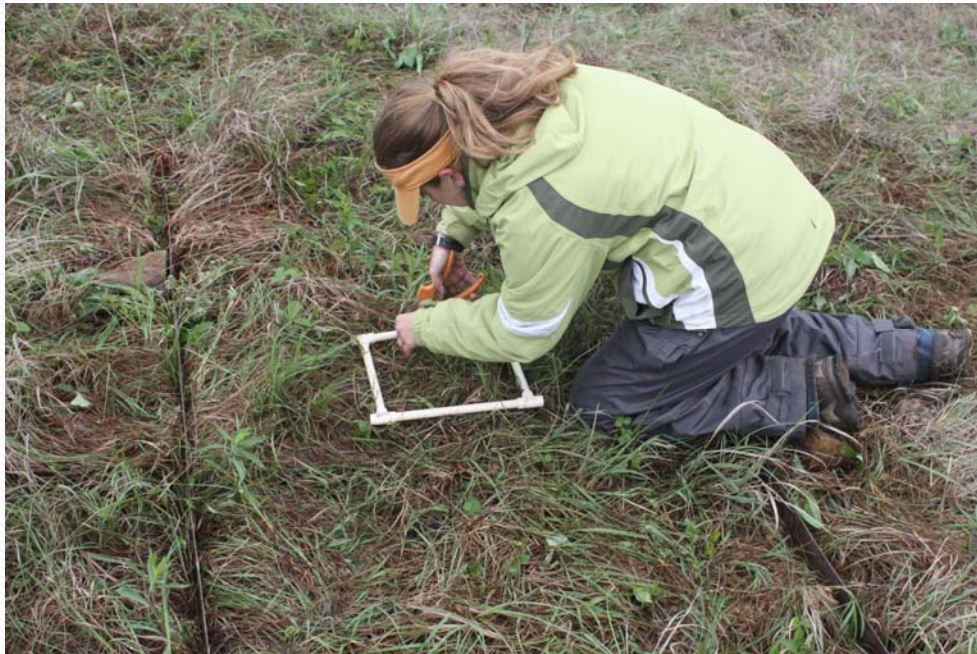


Methods

- Ground cover calculated with Daubenmire Index
 - Vegetative cover (forb & grass)
 - Basal Area
 - Rock
 - Bare
 - Litter
 - Dung
- GPS collars placed on 1 cow per treatment (Brady Allred composited data)



- Aboveground Biomass
 - 0.25 m² clipped after simulation
- Soil Moisture
 - Pre and post simulation
 - Hydrosence II 10cm depth

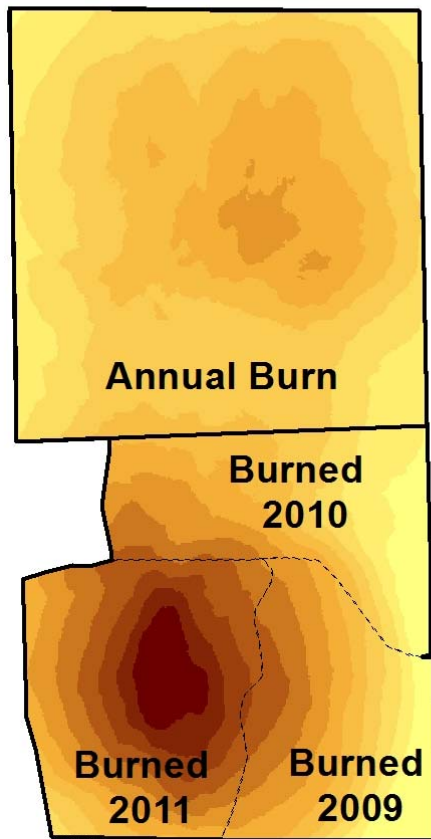


Back in the Lab..

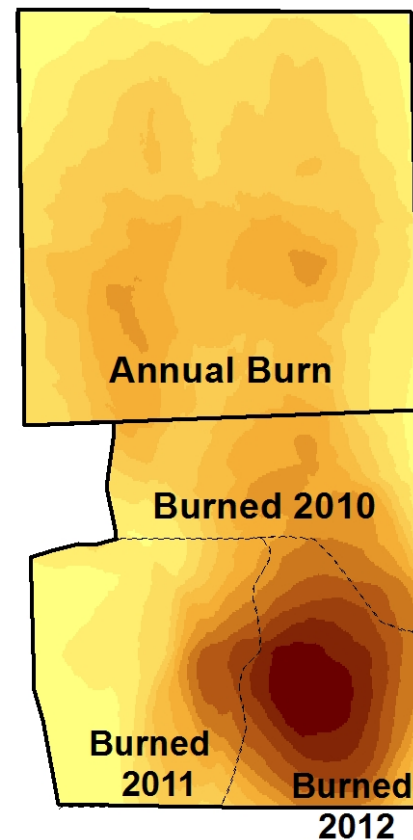
- Grab samples filtered
- Weighed & burned at 550 C to get organic & inorganic composition
- Water samples analyzed for:
 - K
 - P
 - $\text{NH}_4\text{-N}$
 - $\text{NO}_3\text{-N}$



Results: grazing intensity



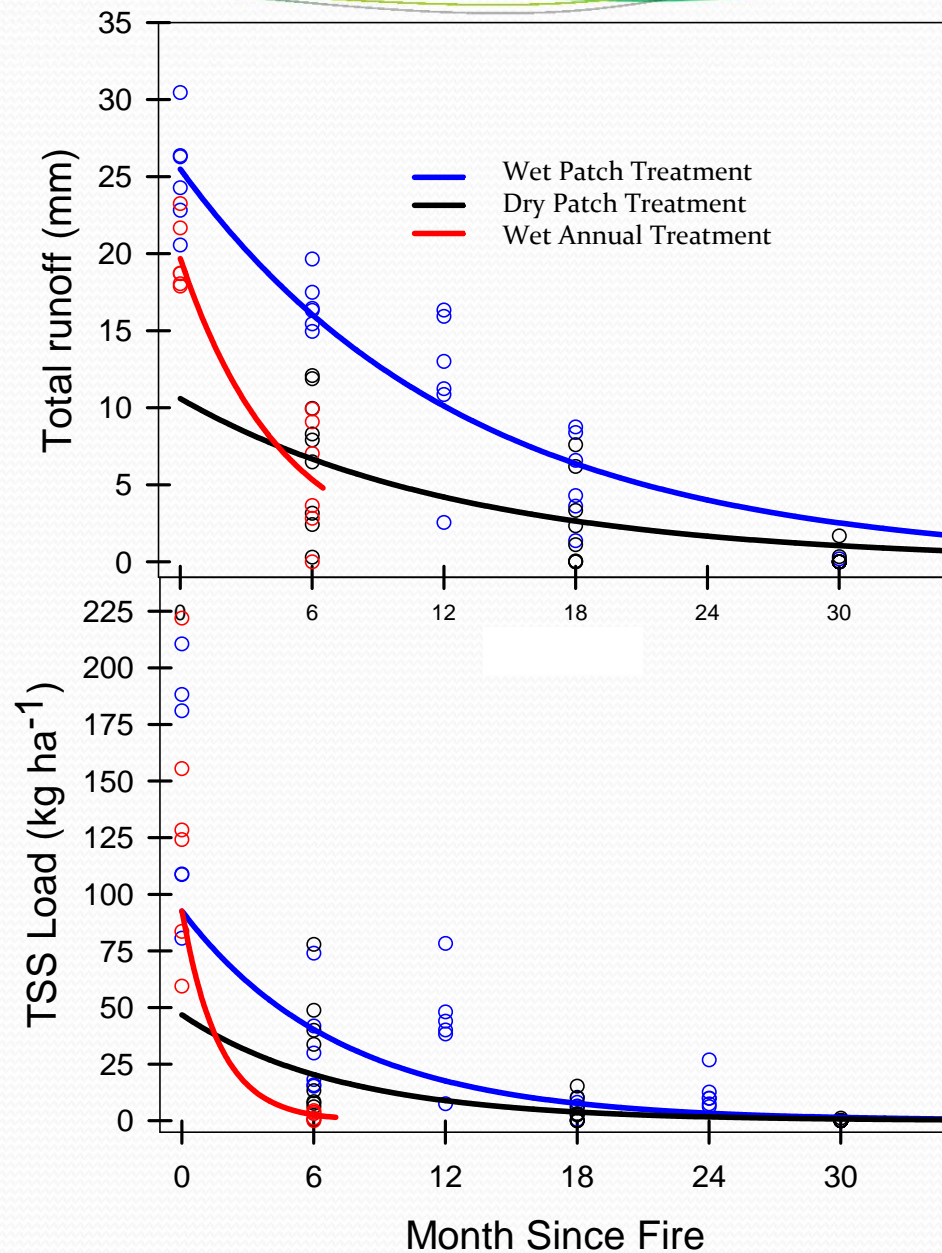
A) 2011



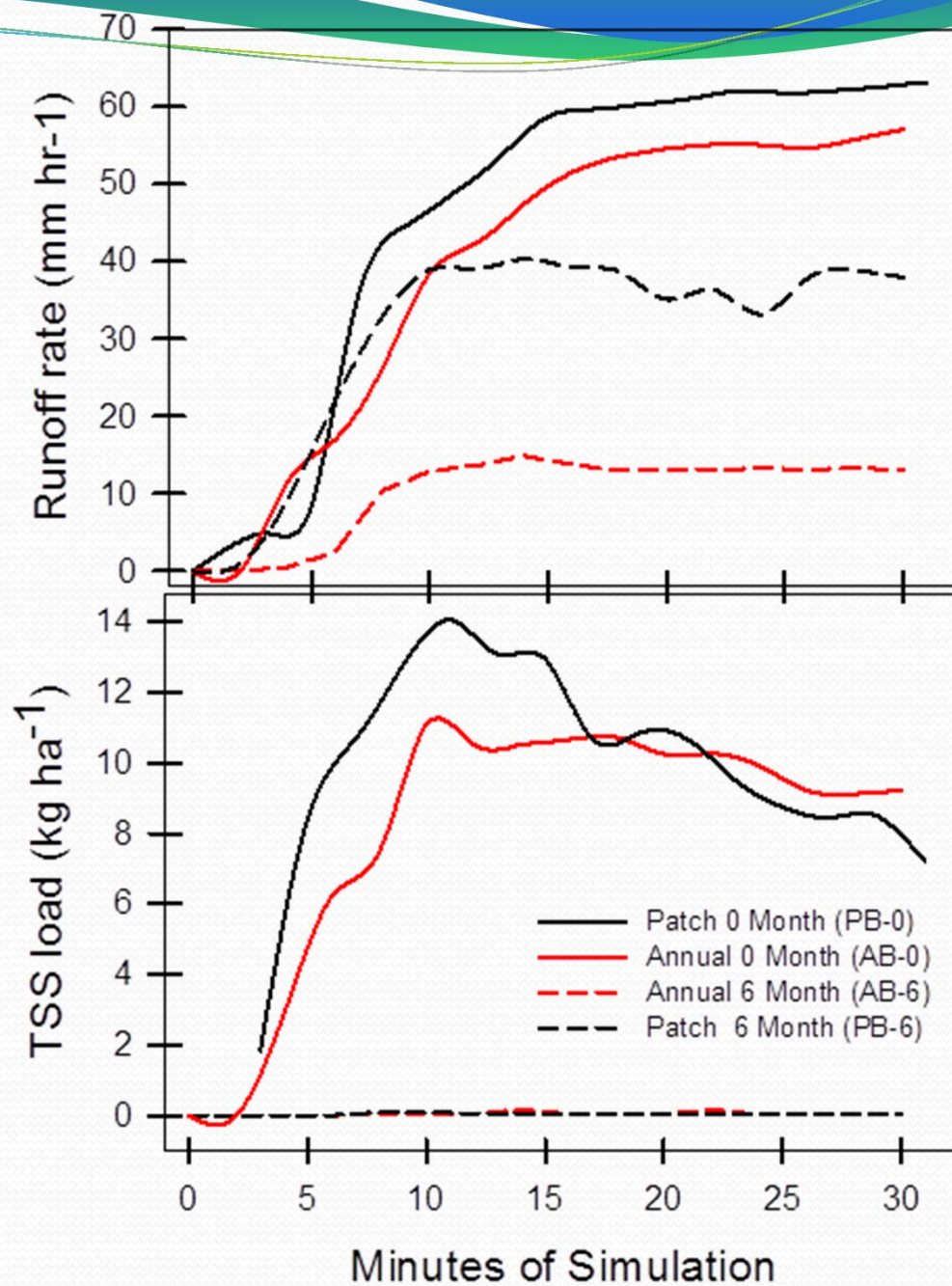
B) 2012

Results

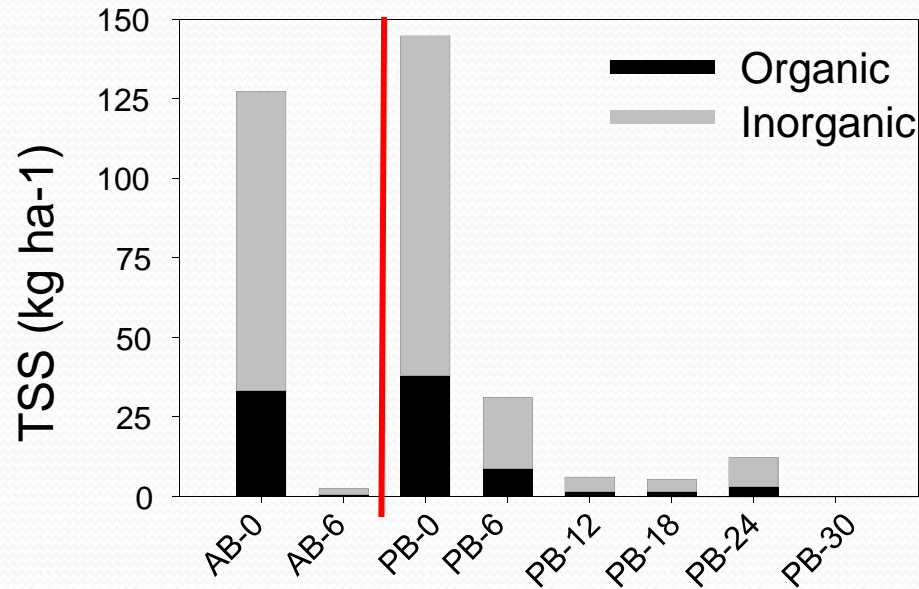
- Annual treatment had greater reduction runoff & TSS in 6 months than patch treatment
- Dry had lower runoff and TSS loads overall



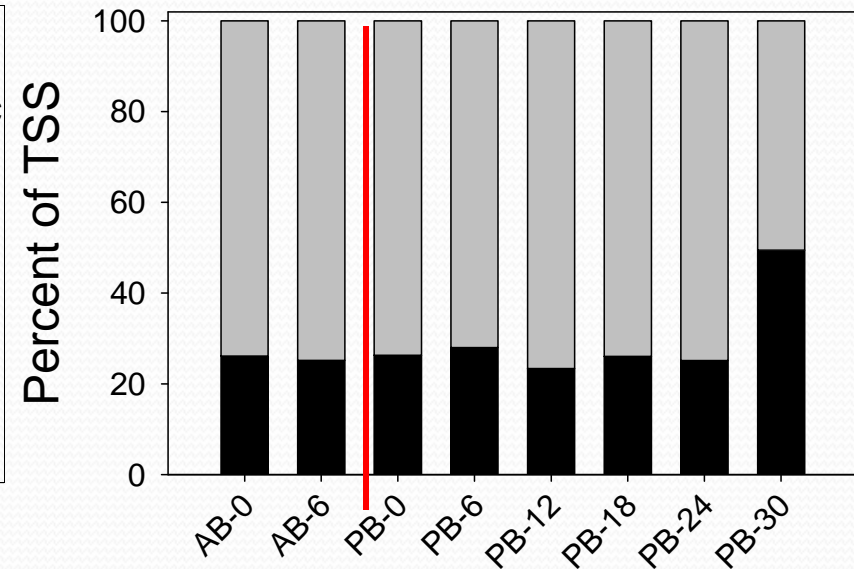
Recovery Rates



Results: composition



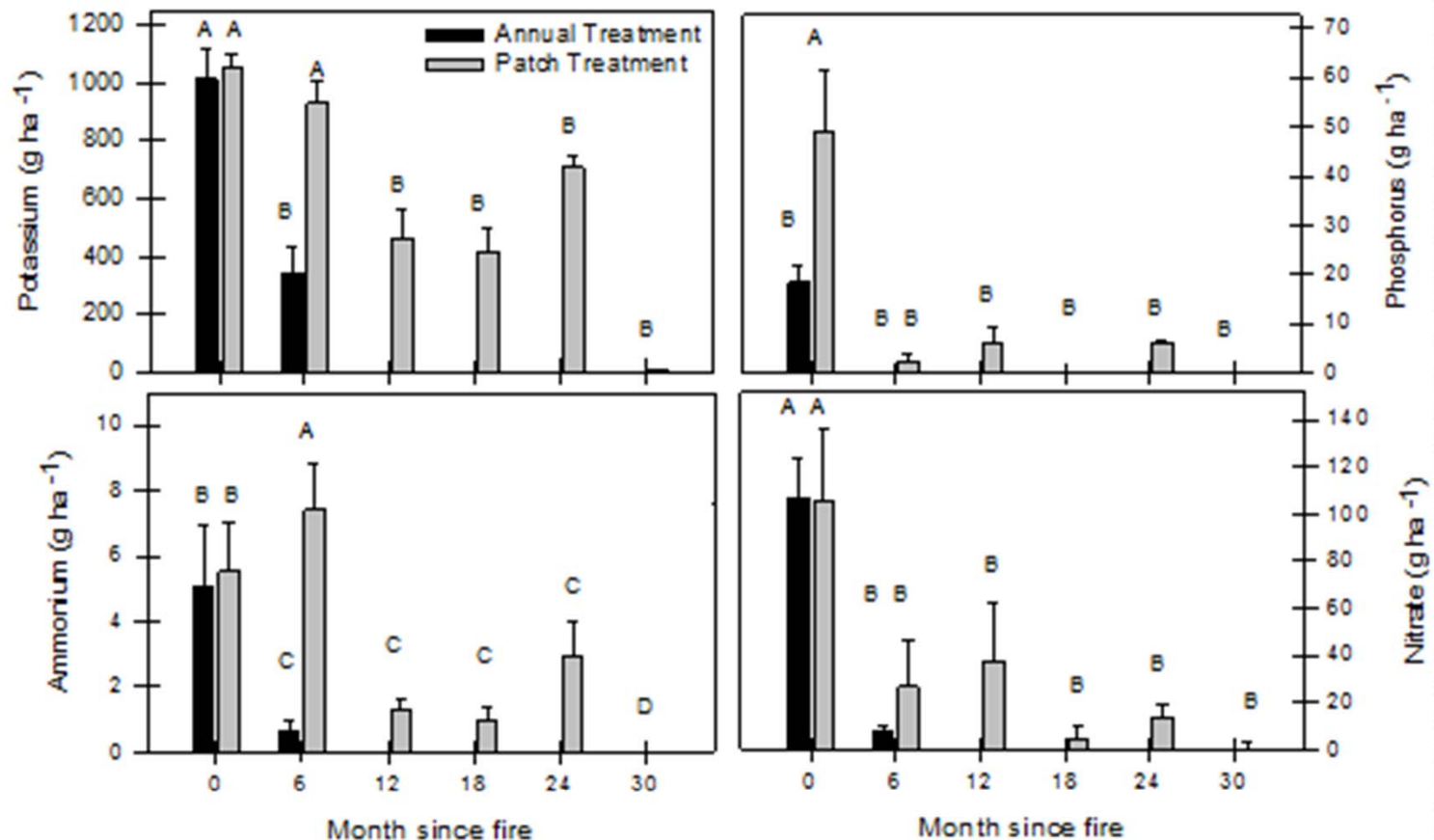
Month Since Fire



Month Since Fire

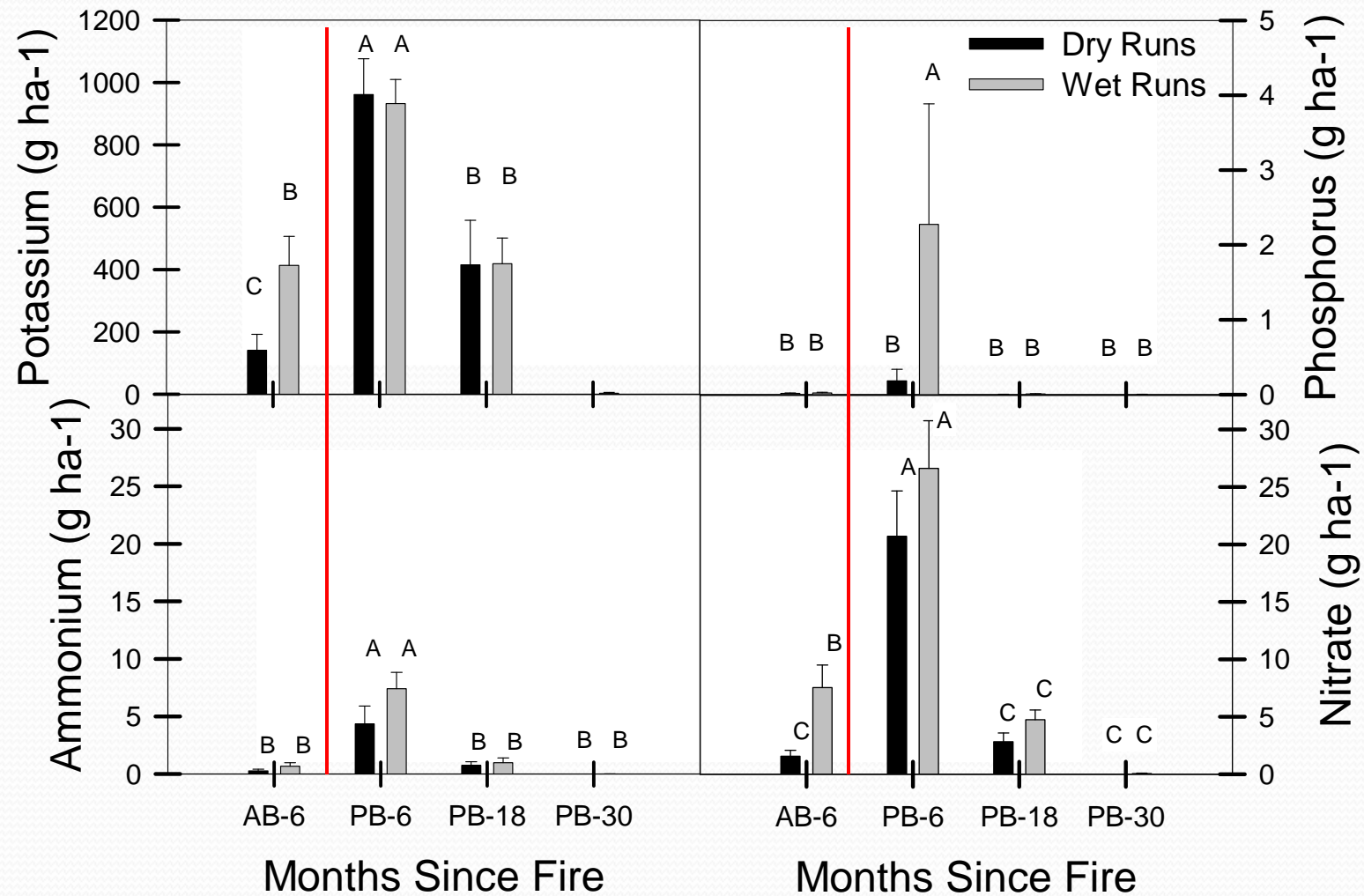
- Inorganic Sediment comprised ~60% of TSS

Results: total nutrients



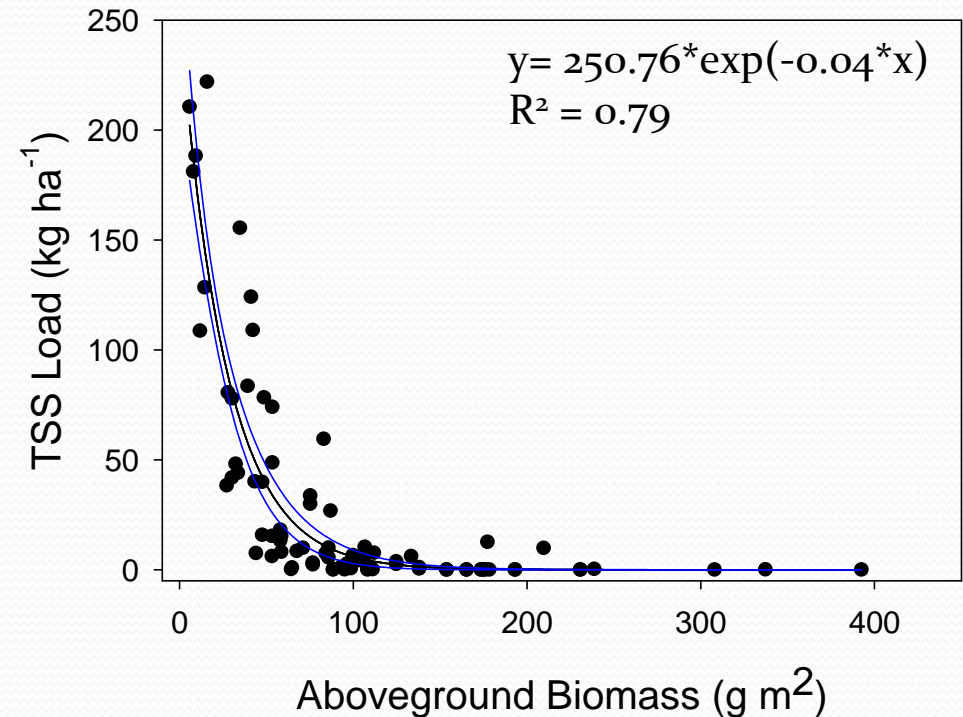
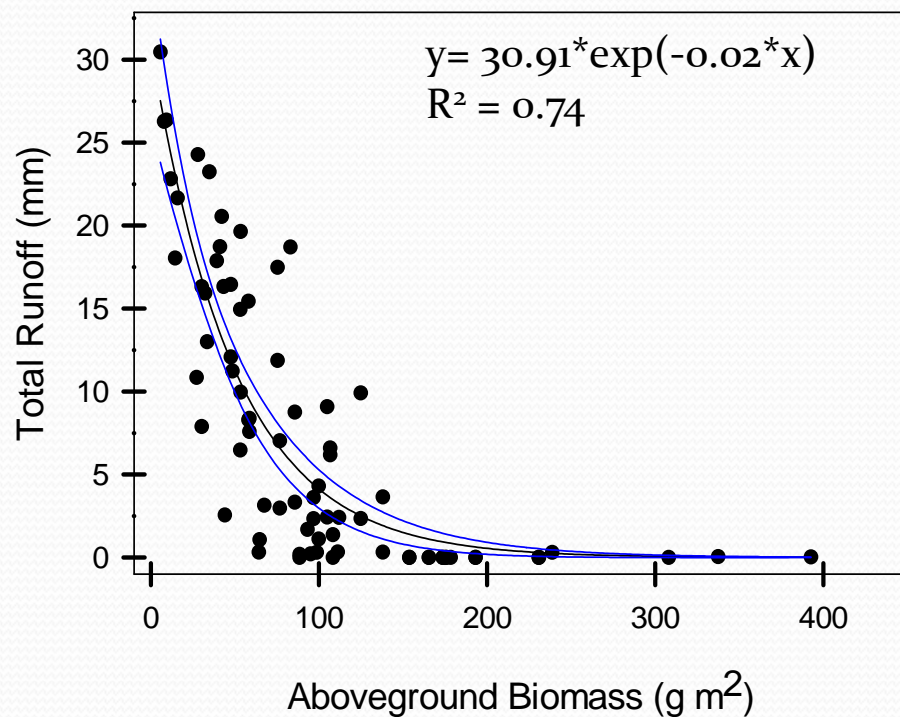
- Total nutrient loss was greatest after fire
- Annual treatment had greater decrease

Results



- Comparing dry and wet runs, nutrients were very similar – except P

Results: aboveground biomass

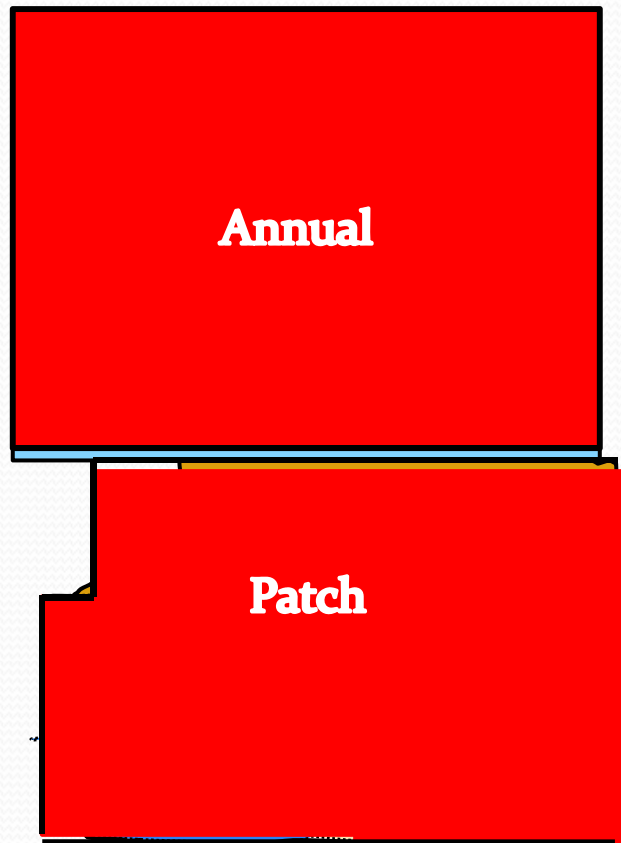




Conclusion

- Heavy grazing after fire will result in increased disturbance and slower recovery rates
- Patch Burn grazing does increase sediment and nutrient transport after fire compared with the annual burn but reaches lower rates by 30 months since fire .
- However, Patch Burn Grazing limits disturbance to smaller areas while traditional management has uniform disturbance across landscape.

Extrapolation to landscape



Loss for 6 months (April – October)
for 2012

kg ha ⁻¹	Annual Treatment (AB)	Patch Treatment (PB)	Difference (AB-PB)
TSS	52.66	45.48	7.179
K	1.020	0.720	0.300
P	0.018	0.019	-0.001
NH ₄	0.005	0.003	0.002
NO ₃	0.012	0.005	0.007

Management Application

- 3-year fire return works in Tallgrass Prairie.
- Management application of Patch Burn Grazing should allow landscape to reach biomass levels that maximize infiltration and minimize runoff

