

Tallgrass Prairie Storyline

Lesson 4: Keystone Species

Driving question: **How do ecosystems maintain their health?**

Lesson 4 question: **What is a keystone species of the tallgrass prairie?**

Terminology & Concepts

- **Biodiversity** = a broad term that includes not only species richness (number of different species) but also the genetic variation between organisms of the same species.
- **Biomass** = the sum of the mass of living organisms – or the mass of a living organism. It is typically measured dry – with the water removed/dried out.
- **Disturbance** = any specific event that affects the availability of resources or impacts the life of organisms living in an ecosystem. E.g., fire.
- **Drivers** = any event – natural or man-made – that directly or indirectly causes change in an ecosystem. E.g., fire.
- **Fauna** = Animals
- **Flora** = Plants
- **Forbs** = Plants with broad leaves and taproots. Also known as wildflowers. Dicots.
- **Grasses** = Plants with long linear leaves and fibrous roots. Monocots.
- **Grazers** = Animals that continuously feed on grasses (and not forbs, typically). The grass plant is not harmed by the grazing since it grows from the base of the grass blade upwards; grazing (like mowing the lawn) stimulates new grass blade growth.
- **Herbivory** = The ingestion of plants by animals – herbivores.
- **Keystone Species** = Is a species upon which other species in an ecosystem large depend, so much so that if it were to be removed the ecosystem would change drastically. .
- **Megafauna** = large animals.
- **Species Richness** = a measure of biodiversity – it is the number of different species that occur within a defined region.

1. Back to the Tallgrass Prairie

We'll watch some videos of researchers at the Konza Prairie Biological Station speaking about their work. One is a graduate student (Bess Bookout – who is working on her Ph.D.) and the other is a young professor (Dr. Zak Ratajczak).

Now might be a great time to speak with your students about what it means to be a “graduate student” and what the different degree programs mean – Master’s degree vs. Ph.D./doctorate program.

Bess Bookout – KSU Graduate Student – pursuing a Ph.D. in Grassland Ecology.



(PowerPoint - from beginning to 9:02 minutes)

Dr. Zak Ratajczak – KSU Assistant Professor – specializes in Community Ecology, Fire – Grasslands – Savannas, and Resilience Theory.



(PowerPoint - beginning at 9:02 minutes to the end)

2. Remember our Anchoring Phenomenon...



Look at the Konza Prairie Experimental Design map again. Your teacher will share with you exactly where this drone footage was taken.

1. Where do you think this footage was taken?
2. What can explain the difference in appearance?
3. What's happening in the left watershed vs. the right?
4. Which one is maintaining homeostasis better

3. Gather information.

Zak Ratajczak and other scientists recently published a scientific paper that may shed some light on the role that grazers, like bison and cattle, play in the Tallgrass Prairie. Here is an excerpt from the abstract of that paper:

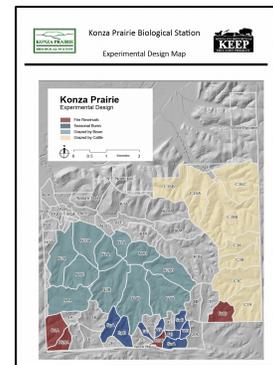
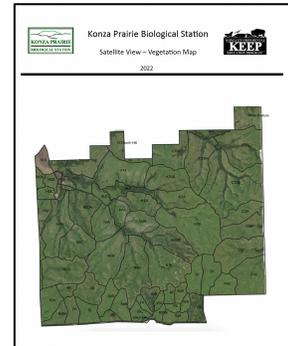
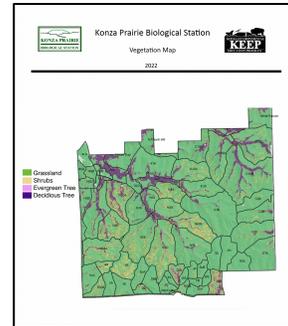
*The widespread **extirpation** of **megafauna** may have **destabilized** ecosystems and altered **biodiversity** globally. Most megafauna **extinctions** occurred before the modern record, leaving it unclear how their loss impacts current **biodiversity**. We report the long-term effects of **reintroducing** plains bison (*Bison bison*) in a tallgrass prairie versus two land uses that commonly occur in many North American grasslands: 1) no grazing and 2) intensive growing-season grazing by **domesticated** cattle (*Bos taurus*).*

Your teacher has broken that article into smaller bits of information and created **stations around the classroom** to allow you to explore this idea further.

Station 1: VEGETATION MAPS

In your notebook:

- 1) Looking at the Konza Vegetation Map, look for evidence of grazing. Describe that pattern.
- 2) Describe two ways that the information provided by the Vegetation Map could potentially assist prairie management decisions.
- 3) Based on all the maps, which factor do you feel plays a greater role in prairie health: grazing or burning? Use at least two examples from the map to explain your choice.
- 4) Develop a question that could be answered by the maps provided – it cannot be a “yes or no”, or an opinion question.



Click on maps to access larger versions at bottom of document.

They are also presented in the PowerPoint version - one map per page.

Station 2: INTERVIEW WITH BESS BOOKOUT

In your notebook:

- 1) Explain how the bison wallows in the grazed area of the Prairie a) benefit or, b) harm the health of the prairie. Explain your reasoning.
- 2) What observations did you make about how the bison interact with the Prairie? Are these interactions positive or negative towards the health of the Prairie?
- 3) How do bison and cattle interact with the Tallgrass Prairie differently? How do they interact in a similar fashion with the Prairie?
- 4) Describe one way in which the ungrazed Prairie is similar to the Kelp Forest after the loss of the Sea Otters. Then, describe one way in which those two ecosystems differ.

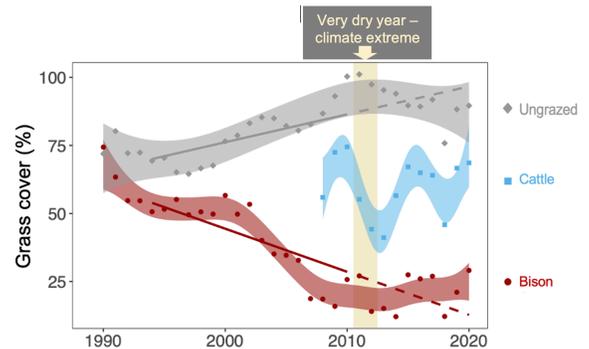


Start at 4:19

Station 3: PERCENTAGE COVER OF GRASSES VS. FORBS

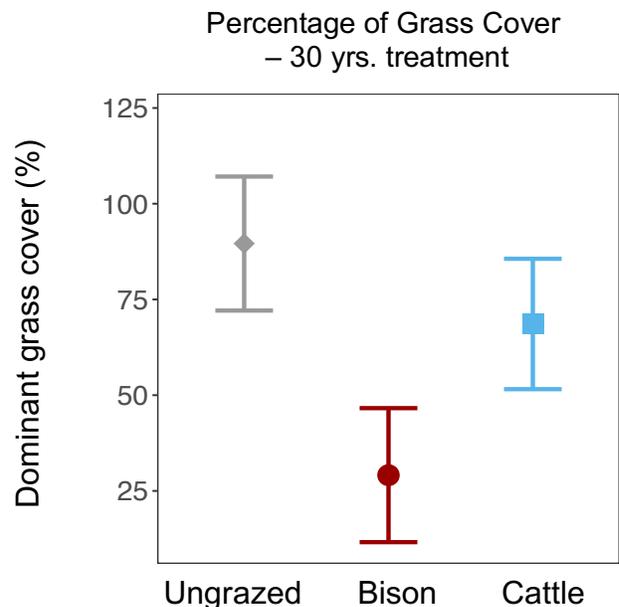
In your notebook:

- 1) Look at these graphs. Can you think of one question that this experiment may have been trying to answer? Write that question down.
- 2) What general trend exists for percentage of land covered by grasses in areas grazed by bison?
- 3) What general trend exists for percentage of land covered by grasses in areas that were ungrazed?
- 4) How does the percentage of land covered by grasses in bison-grazed areas compare to grass coverage in cattle-grazed areas?
- 5) Provide a potential explanation for the differences between grass coverage in bison grazed areas vs. cattle grazed areas (be specific).



[Click on graphs to access larger versions at bottom of document.](#)

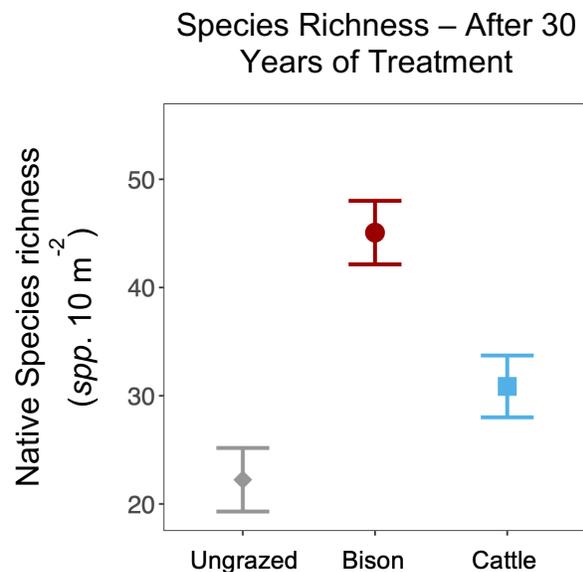
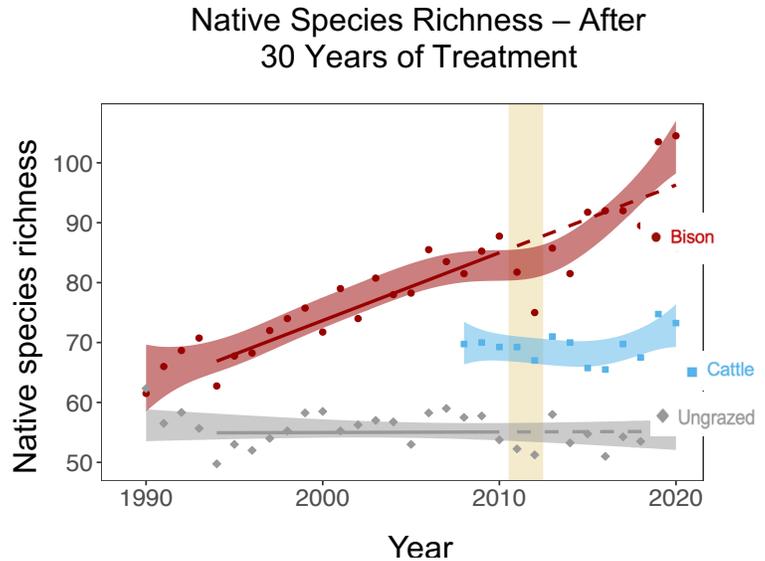
[They are also presented in the PowerPoint version - one graph per page.](#)



Station 4: NATIVE SPECIES RICHNESS

In your notebook:

- 1) What do you think is meant by the phrase “species richness”? (HINT: Is there a term that could be a synonym for ‘species richness’?)
- 2) Provide a question that this experiment may have been trying to answer.
- 3) 3) In general – is biodiversity higher in areas that are grazed or areas that are ungrazed?
- 4) 4) Which of the 3 areas showed more resiliency in bouncing back from drought? (Which one increased in biodiversity faster after the drought?)
- 5) How does biodiversity in bison grazed areas compare to biodiversity in cattle grazed areas?
- 6) Provide one explanation for why there are differences in biodiversity between bison grazed and cattle grazed areas.



Click on graphs to access larger versions at bottom of document.

They are also presented in the PowerPoint version - one graph per page.

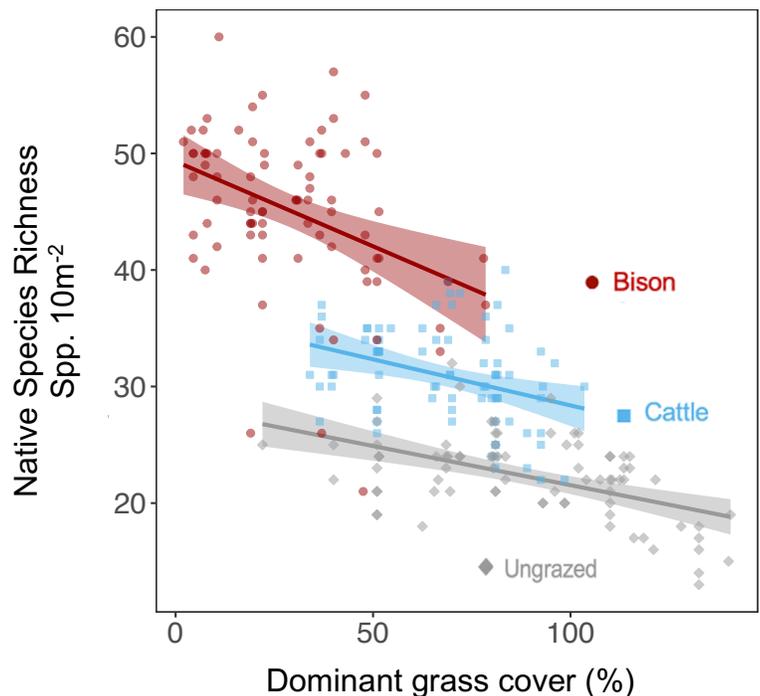
Station 5: NATIVE SPECIES RICHNESS vs. % of GRASS COVER (NOTE: this graph represents data from 2020 only)

In your notebook:

- 1) What general trend does this graph show that holds true for all 3 experiments?
- 2) Correct the false statement:

“As more of the prairie land is covered by dominant grass, then biodiversity of the prairie increases.”

- 3) In 2020, which of the three treatment areas had the highest biodiversity?
- 4) Provide an idea that explains why areas with less grass coverage have higher biodiversity?
- 5) Which of the 3 plot lines represents a healthier environment? Justify your choice by using specific data from the graph.
- 6) Which of the 3 lines could potentially include data taken from experiments conducted in the “right-side prairie”? Explain your choice.
- 7) Which of the 3 lines could potentially include data taken from experiments conducted in the “left-side prairie”? Explain your choice.



Click on graphs to access larger versions at bottom of document.

They are also presented in the PowerPoint version - one graph per page.

Station 6: BISON FACTS AND HISTORICAL INFORMATION

Watch the video on the American Bison

In your notebook:

- 1) What do bison eat? How often do they eat? What kind of impact might this have on the landscape?
- 2) During the spring and summer months bison get together in larger herds. How big are these herds? How would this impact the prairie?
- 3) Why don't bison stay in large herds during the winter?
- 4) How many bison were there in the Great Plains before 1800? How would this large number have impacted the prairie?
- 5) How many bison were there in the United States by 1900?

This video is viewable in the PowerPoint version.



4. Bringing it all together.

A. Keystone Species

1. Starfish are considered to be keystone predators. What impact did they have on the ecosystem?
2. Now, let's think about the bison. How is the relationship between bison and the Tallgrass Prairie similar to that of the starfish and the Rocky Intertidal System?
3. But consider: bison are herbivores and starfish are carnivores. How might an herbivore be the keystone species on the Tallgrass Prairie?
4. What is the difference between keystone predation and keystone herbivory?
5. Here is the title of the paper that was used to create the stations you just went through... **"Reintroducing bison results in long-running and resilient increases in grassland diversity."** Write it down in your notebook.
6. Now, as a group, have a discussion, and put a star by the THREE stations you feel really provide SOLID evidence to support this claim. Share your favorite one with the class.

Now, watch this video clip...



This video is viewable in the PowerPoint version.



This video is viewable in the PowerPoint version.

B. Bison on the Prairie

1. How important are the bison towards maintaining the health of the Tallgrass Prairie?
2. Since 1850 the prairie has undergone a huge change. What has happened to the prairie?
3. What are some challenges in protecting the Tallgrass Prairie in the future?

C. Re-visiting our initial question:

1. What are we seeing in this photo?



2. Take a look at the [Konza Prairie Experimental Design](#) map again. As a group, select a spot on the map that could have been the location of the photo. Justify your selection using 3 pieces of evidence from this activity.
3. The experimental data showed us the percentage of grass cover and relative abundance of native species diversity across 3 experimental treatments (bison, cattle, and ungrazed). Provide two more questions for Ms. Bookout and/or Dr. Rataczjak that you would be curious to test regarding bison wallows OR bison vs cattle vs ungrazed areas. (Pretend you are interviewing them and have 2 questions to ask as a follow up to these experiments)

4. MODEL TRACKER

As we try to figure out more about healthy environments, it is going to be really important to keep track of our discoveries and ideas. I imagine we will be figuring out a LOT of different things. Some things might be important in our models and others may be less important. To help us keep track of these ideas, we are going to use an **Incremental Modeling Tracker (IMT)**. The IMT will help us keep track of important discoveries and think through how we can prioritize our ideas and discoveries to revise or build on our model of healthy environments.

What did we figure out? Which parts of what we figured out (if any) can help us with our model? How can we add to or revise our models? *Record your current thinking about these questions on your IMT*

LESSON QUESTION (What Question Are We Trying to Answer?) & LESSON NICKNAME	WHAT DID WE FIGURE OUT? Which parts of what we figured out (if any) can help us with our model? (Highlight them!)	BASED ON OUR PROGRESS THIS LESSON, HOW CAN WE ADD TO OR REVISE OUR MODEL? How should we represent our ideas in our model? (Use pictures, words, or symbols)
Lesson 5 - Is there a keystone species on the Tallgrass Prairie?		

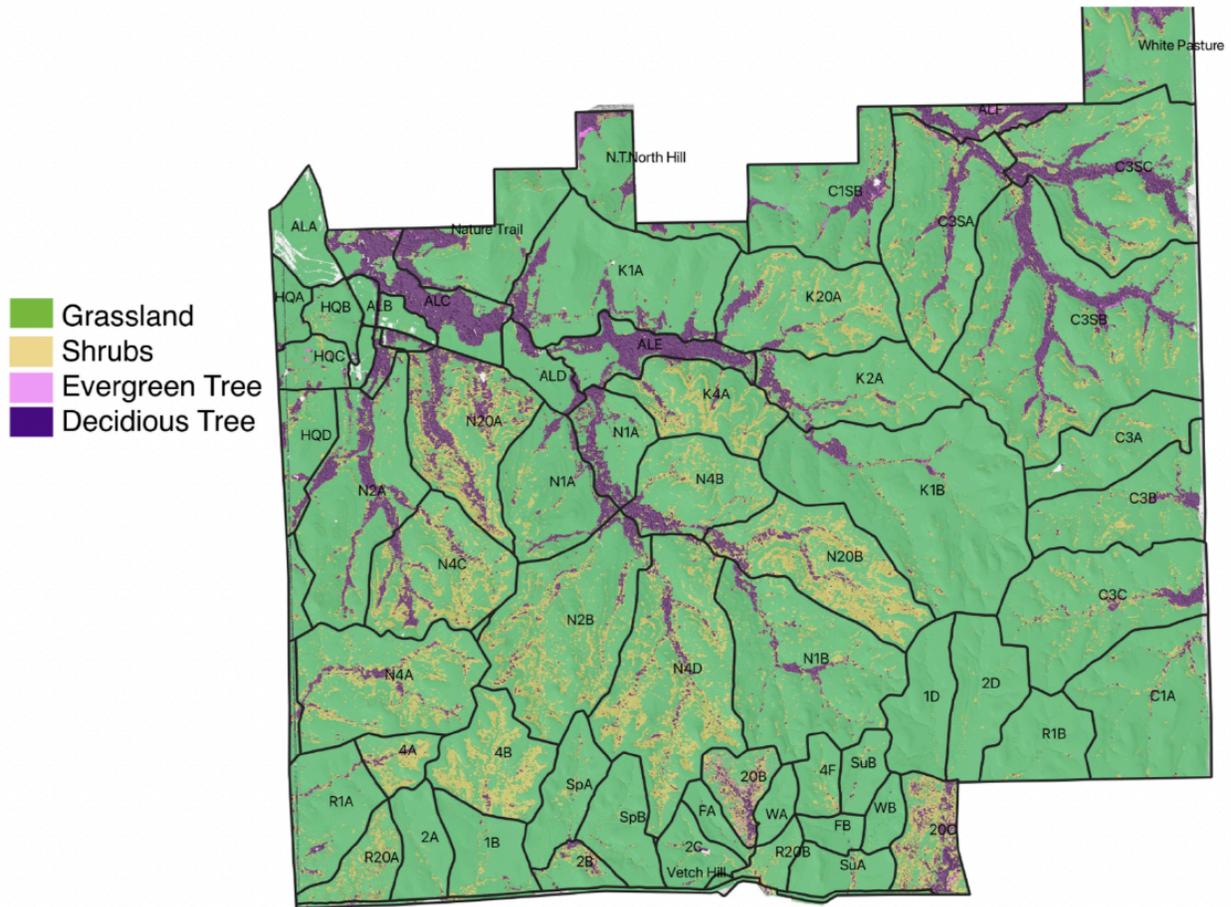


Konza Prairie Biological Station



Vegetation Map

2022

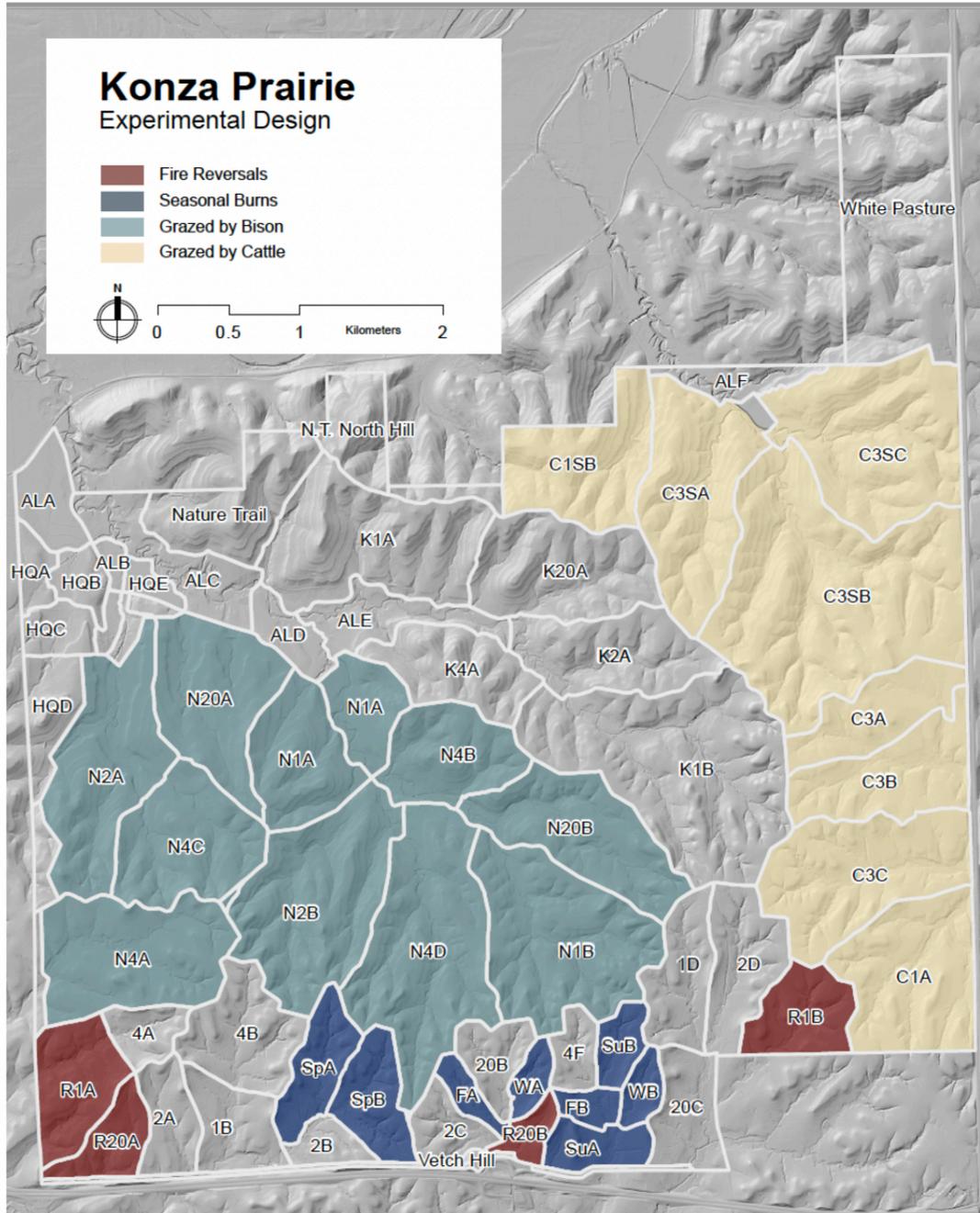


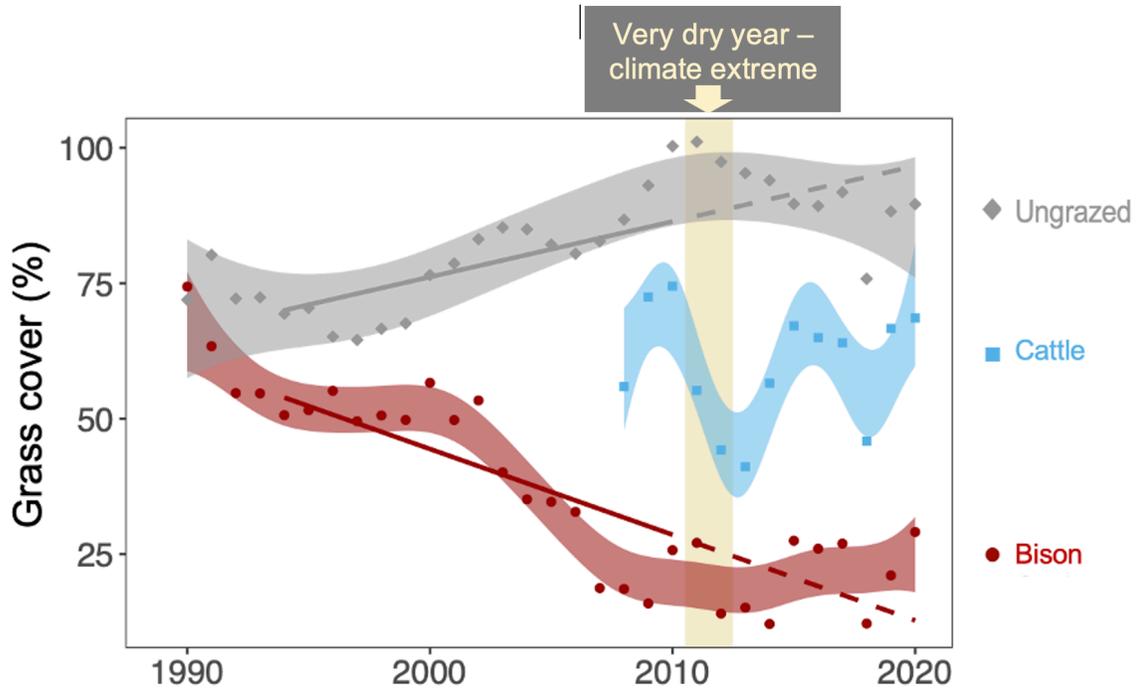


Konza Prairie Biological Station



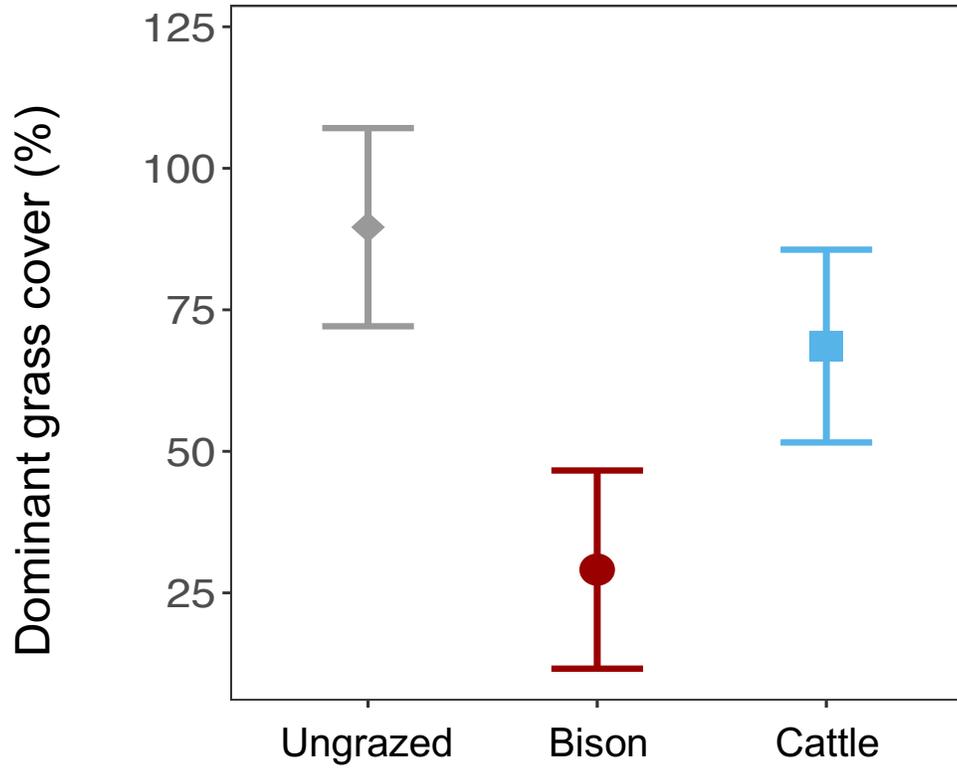
Experimental Design Map



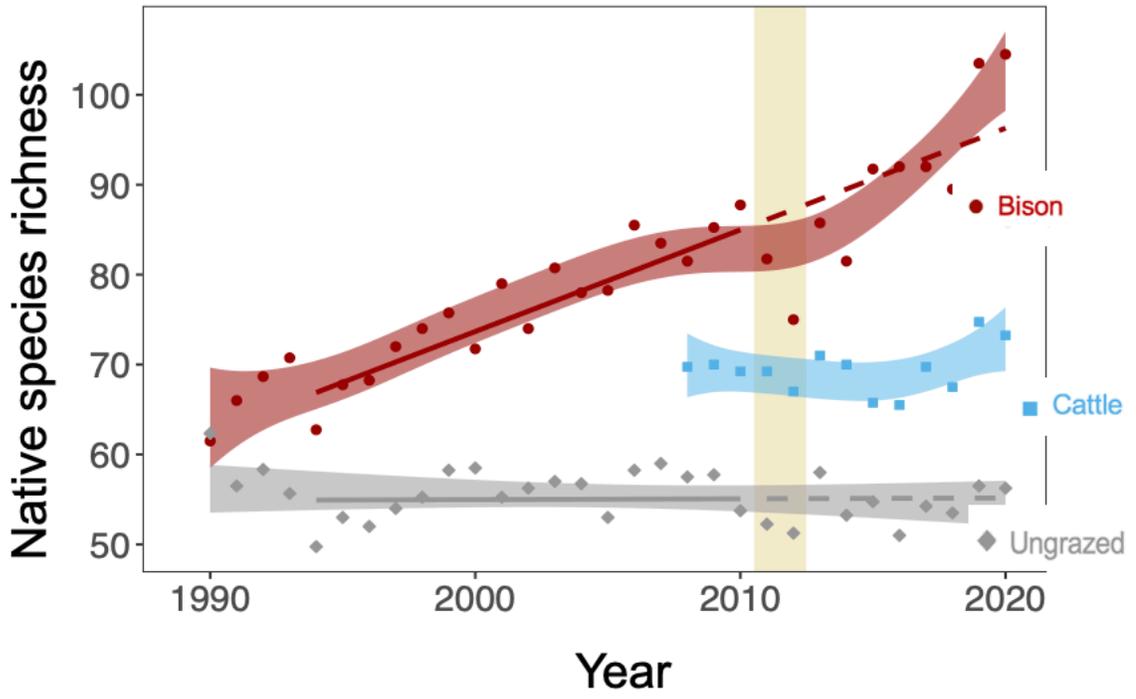


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Percentage of Grass Cover
– 30 yrs. treatment

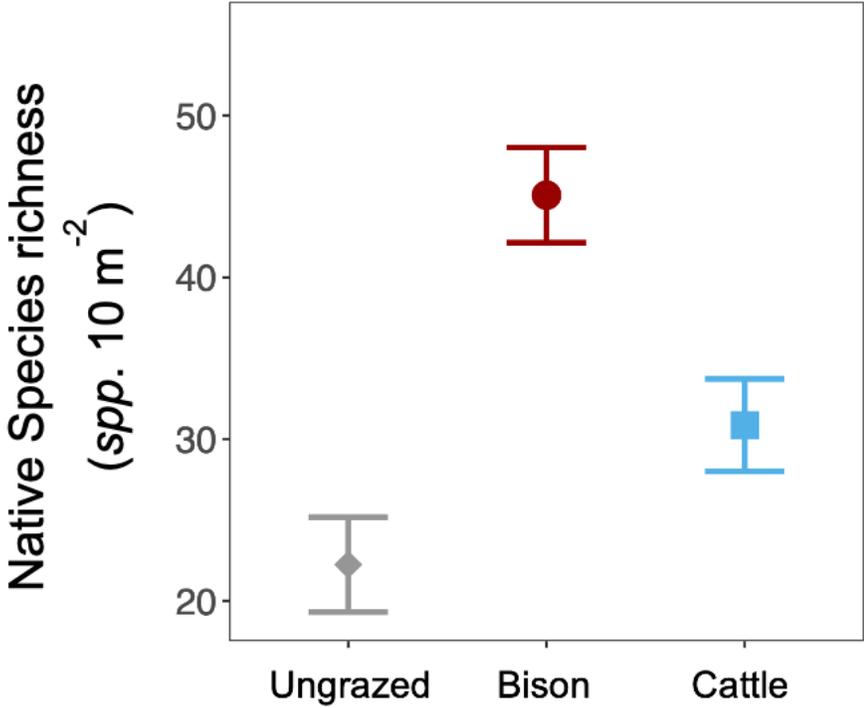


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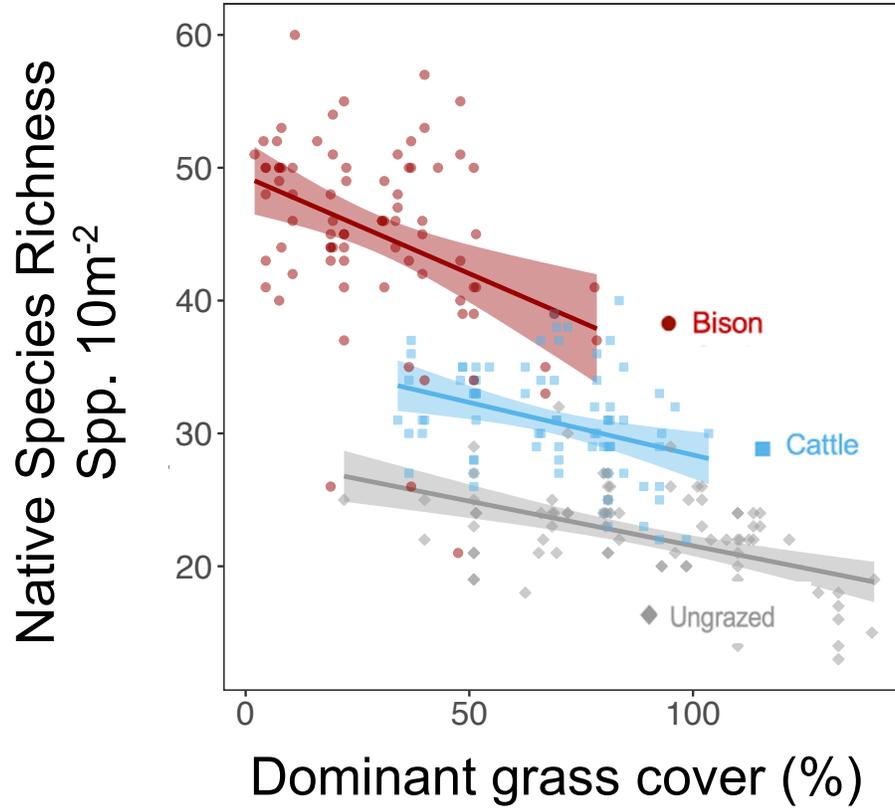
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Species Richness – After 30 Years of Treatment



[Return](#)

Grazer treatment



[Return](#)



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