Influence of Bison on Rock Movement at Konza Prairie

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Introduction

Aside from the keystone role they play by grazing in tallgrass prairie ecosystems, it has been questioned whether bison play a role in rock movement and geomorphic processes, specifically at Konza Prairie.

This was answered by an undergraduate research team at Kansas State University. They conducted a study in which rocks on a hillslope where bison freely roam, were measured, recorded, and monitored over a four week period. By the end of their study, they found that bison do in fact have numerous interactions with rocks on the Konza Prairie and are very likely geomorphic agents of the prairie landscape (Barrios et al, 2022).

To expand on their findings, our research team continued to monitor the previous team's study site for additional time and chose a second study site on a neighboring hillslope with numerous differences. This allowed us to determine to what extent bison interact with rocks on the Konza Prairie and how varying conditions and differences can impact the magnitude of the interactions. As proven in the previous study, bison do in fact have an impact on rock movement on the Konza Prairie, so, our group set out to determine the significance of this impact.

To what extent do bison have an impact on the movement of rocks on the Konza Prairie?

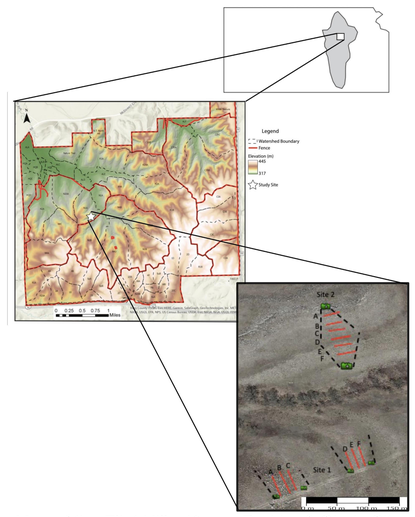
Bison kicking up dust

Background

The Konza Prairie is mostly made up of chert and flint-bearing limestone layers embedded with shale. The ridges of these hills are flat with shallow, rocky soils which makes them an excellent area to study rock movement on hillslopes. Factors such as wind and water as well as the biodiversity like the tallgrasses and the animals like the bison have impacted Konza's geomorphology. The rocks littered throughout the Konza create a natural armoring for the hillslopes which help contain the topsoil allowing for plant species to grow and for animals to thrive. Erosion of the geologic layers is caused by tributaries of the Kansas River, creating a landscape of dissected hills. The Konza Prairie is also currently home to over 200 bison.

Rock Movement on Slopes:
Rocks move downslope from stress from many factors including, shape, size, animal activity, gravity, weather, angle of slope, type of soil, and many others.

Previous Work:
In a previous study conducted at Konza Prairie, students from Kansas State University chose a hillslope in which bison were able to roam freely and placed marked rocks on 6 transects. They determined a 54% rate of bison-rock interaction and concluded that bison act as geomorphic agents on the Konza Prairie (Barrios et al, 2022).



Map of the Flint Hills, Konza Prairie, & Study Site

Methods

Selecting a Second Site: We decided on selecting an area that was away from the fence line and had a different facing slope than the original site.

Setting up the Second Site: We placed randomly selected rocks every 1 m along six different transects. Each transect had 20 rocks and the tops were painted with a red stripe and bottoms were painted green.

Placing Cameras: We chose to aim our cameras from the top-down and from the bottom-up. This decision was made so that we would be able to observe our entire site without need to move the cameras around. A total of 6 cameras were used to observe both sites.

Recording Rock Size and Shape: Rock sizes were measured on three separate axes to determine their length, width, and depth and then classified based on axes ratios.

Recording Rock Movement: Recorded rock movement based on how much they traveled downslope and upslope, how many degrees did they rotate, and whether or not they flipped over.

Recording rock movement

Bison activity on both sites

Results

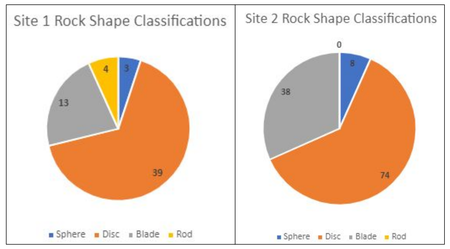
Site 1 Rock Movement
(Over a nine-week period)

Rock Name	Rock Movement	Shape
A5	Shifted 50cm horizontally	Blade
A7	Shifted 95cm horizontally	Disc
A8	Rotated 47°	Disc
A9	Flipped, Rotated 87°, 36cm Downslope Shift	Blade
C3	Rotated 79°	
C6	Rotated 87°	Disc
D3	10cm Downslope Shift	Disc
D7	Flipped	Rod
D8	Rotated 26°	Blade

Site 2 Rock Movement
(Over a seven-week period)

Rock Name	Rock Movement	Rock Shape
A6	Rotated 98°	Disc
A7	Rotated 49°	Blade
A11	Rotated 21°	Disc
A13	Flipped & Rotated (46°,72°)	Disc
B3	Rotated 28°	Disc
B15	8cm Downslope Shift	Disc
B17	Rotated 15°	Disc
C5	Rotated 37°	Disc
C9	Rotated 44°	Disc
C10	Rotated 76°	Blade
C13	Flipped & Rotated 68°	Blade
D1	16cm Upslope Shift	Sphere
D5	Rotated 19°	Disc
D8	Rotated 38°	Disc
D11	Flipped & Rotated 41°	Disc
D14	Half Flipped	Disc
F3	Half Flipped	Disc
F11	Flipped	Blade
F14	Rotated 40°	Blade

- Rock size did not have a major impact in rock movement according to our findings.
- A majority of rocks that moved were a shaped as discs.
- We only observed 15 percent rock movement on site one while previously 54 percent rock movement was recorded.
- Site two experienced 16 percent rock movement which is very similar to site 1.
- Bison are not always present on our cameras when rock movement is recorded.
- A large majority of our movement we observed was block rotation.
- A very slim majority of rocks moved had been altered in multiple ways.



Pie charts represents the classifications of shapes from site 1 and site 2.

Bison approaching marked rock

Rotated

Flipped

Discussion

Activity
Our research suggests little to no correlation between Bison activity and rock movement. It also suggested that Deer, Elk, and other animals could add to rock movement.

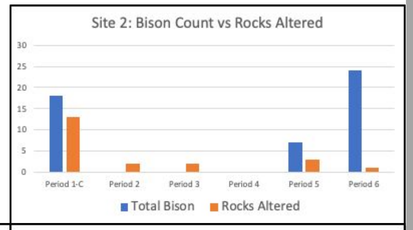
Results:
Among the 60 chosen rocks from the first site, 9 of them exhibited movement, giving a 15% rate of rock movement. As for the second site, among the 120 chosen rocks 19 of them exhibited movement of some kind, giving an 16.7% rate of rock movement.

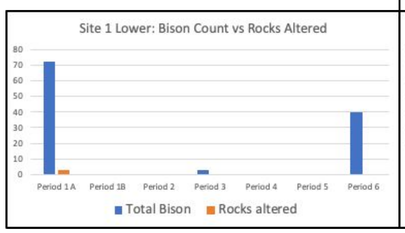
Differences:
When selecting another site we included differences between the original site and the new one. We chose to put the new site on a different facing hill slope that had a game trail located nearby. We also noticed a fresh spring that could provide fresh water making the activity potentially higher. One big difference is that our study area was not freshly burned unlike the original experiment, meaning there was more vegetation for bison to graze on. Compared to the previous study, we were very particular when observing which rocks had moved rather than recording movements due to negligible shifts in the baseline measurement. This explains the large difference in our final rock movement rate and the rock movement rate of the previous study.

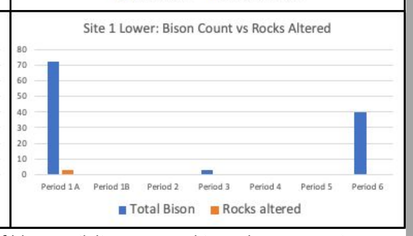
Elk

Bison Numbers Compared to Rocks Being Altered

When deciphering through the data we became aware of rocks showing noticeable movement even while bison were not observed. One way that the rocks could have moved are from weather related activity like heavy winds and rain. Another way the rocks could have moved is from the vegetation, the second site had areas of high and low amounts of vegetation which are a factor in how rocks are impacted on hillslopes.







All three Graphs represent the amount of bison activity compared to rock movement between our data collection periods across our study area.

Conclusion

Although there was a similar amount of bison activity throughout the duration of this study, there was a lower rate of rock movement when compared to the previous study. This indicates that despite there being evidence that bison do in fact move rocks, the significance of their impact on rock movement at Konza Prairie is not as substantial as previously believed.

Acknowledgements

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Barrios, K., Hoefgen, G., Parmenter, H., Ramos, R., & Rockers G. (2022). Rock Movement on the Konza Prairie: Bison acting as Geomorphic Agents.