Developing and Integrating Science for Decision Support Tools to Inform Bison and Ecosystem Management at Badlands National Park

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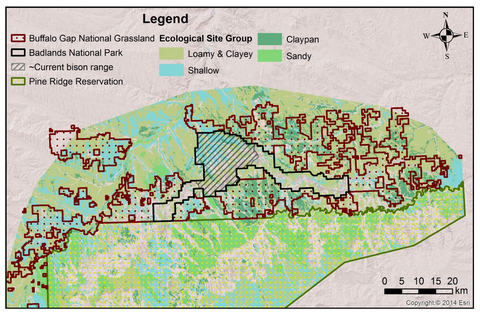
Background

Together with fire and a highly variable climate, bison have played a key role in shaping the grasslands of the Great Plains for millennia. Today, however, most fires are suppressed, some aspects of climate will soon exceed the bounds of their historic variability, and bison are confined to ranges far smaller than their innate roaming capabilities and tendencies. Consequently, even agencies and organizations aiming to maintain "natural" conditions must carefully manage their lands and wildlife to achieve and sustain healthy plant and animal populations and communities. Badlands National Park, home of more than 900 bison that range widely in, but are still confined to, one of the largest open ranges in the Great Plains (>64,000 acres), faces this dilemma. The National Park Service (NPS) relies on science to guide its decision making in this context at Badlands and other Great Plains parks. Here we describe two relevant efforts that we anticipate will be integrated with other science into a dynamic decision making tool and a regional NPS bison management strategy for Badlands and other park managers.

Co-produced, quantitative state-and-transition simulation model in a climate change scenario planning framework

Miller et al. 2017

Southwest South Dakota Study Area



Simulation Modeling

- Spatially explicit, state-and-transition simulation model of grazing, fire, and climate effects on vegetation production and composition in four climate scenarios (below) and four management alternatives (right) for Badlands National Park and the surrounding Buffalo Gap National Grassland (US Forest Service)
- Co-produced by researchers, resource managers, & climate adaptation specialists

Simulated management alternatives: A storyline approach

	Buffalo Gap National Grassland (BGNG)	Badlands National Park (BNP)
Current Practice		
Grazing	season-long, 35% of initial-condition, average-year production, less in dry yrs	year-round, 5% of initial-condition, average-year production in current range
Fire	0.5% of area each year	0.8% of area each year
Thistle	33% search, 33% of found treat (big 1st)	3% search, 0.2% of area treated (big 1st)
Presently Preferred		
Grazing	35%, varies both directions with weather	8% all the time throughout park
Fire	7% of area each year	10% of area each year
Thistle	33% search, 33% found treat (small 1st)	20% search, all found treated
Planning for Good Conditions		
Grazing	42% higher than Presently Preferred	25% higher than Presently Preferred
Fire	7% of area each year	6.5% of area each year
Thistle	33% search, 33% found treat (small 1st)	6% search, 0.4% of area treated (small 1st)
Planning for Poor Conditions		
Grazing	57% of Current Practice	67% of Current Practice
Fire	0.5% of area each year	1.7% of area each year
Thistle	33% search, 33% of found treat (big 1st)	3% search, 0.2% of area treated (big 1st)

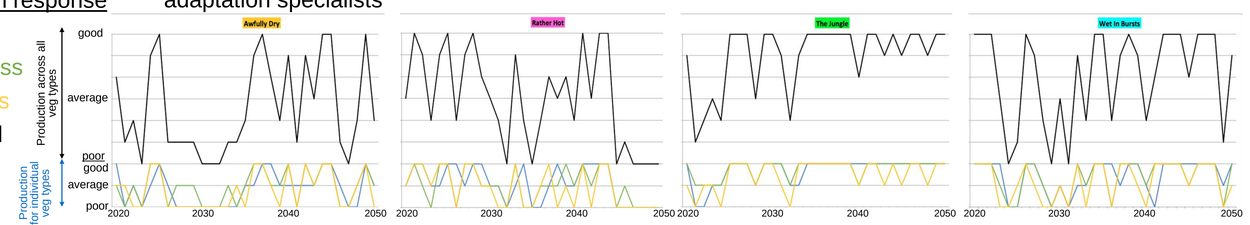
Climate scenarios

- *Awfully Dry*
- *Rather Hot*
- *The Jungle*
- *Wet in Bursts*

Smart et al. 2007

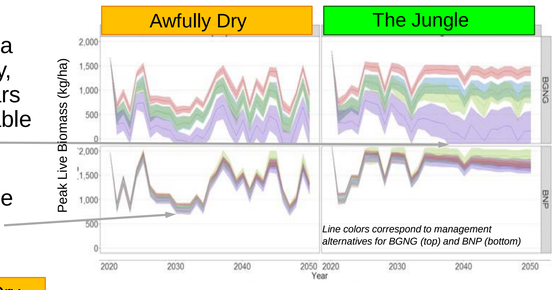
Vegetation response

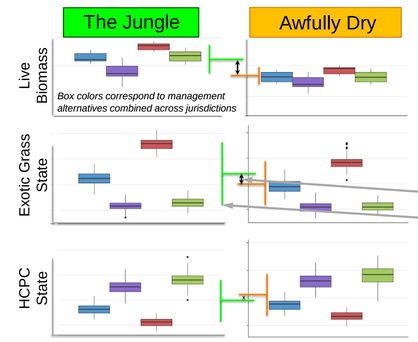
- Midgrass
- Mixed-grass
- Shortgrass
- Combined



Results: Forage Availability

- In the BGNG storyline illustrating a less conservative grazing strategy, higher consumption in "good" years put forage at risk even in a favorable climate scenario
- Conservative herd sizes in the Badlands storyline maintain forage availability even in a challenging climate scenario





Climate vs. Management, Composition

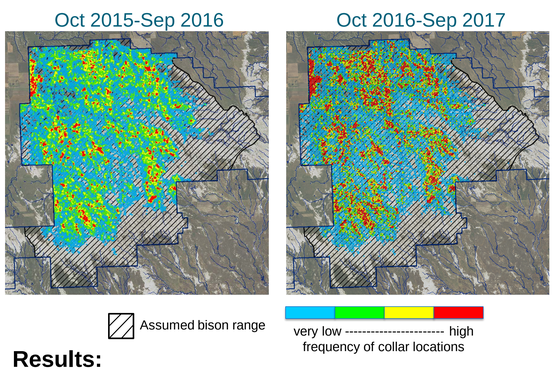
Combining over all management jurisdictions

- Long-term management alternatives produced stronger differences than climate scenarios, especially for composition
  - *Difference between horizontal lines (means for climate over all management alternatives) is less than length of vertical lines (range of management alternatives)*
- Less conservative grazing rates (purple & green) favored "Historic Climax Plant Community" states over states with a high cool-season exotic grass component

Field data on bison distribution, resources, and diet

Are bison accessing the full range?

Methods: GPS collars deployed on 30 cows in October 2015; location recorded hourly

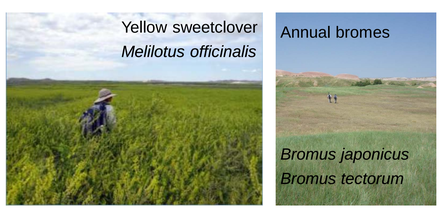


Results:

Note: Cell size and frequency categories differ between years.

- Some small areas are inaccessible.
- Much of the area is visited infrequently.
- Will analyze with respect to landscape features, proximity to water, and vegetation.

Are bison consuming sometimes-abundant invasives?



Methods: Chloroplast DNA meta-barcoding on spatially and temporally extensively collected fecal material

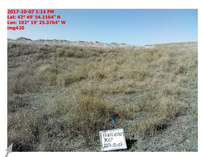
Results:

- Sweetclover and annual bromes detected in diet, even though both were not abundant on the landscape
- Mild surprises: bindweed, juniper; dandelion and salsify in August; willow family in winter; not much warm-season grass

Is the current forage production estimate reasonable? What is the vegetation "condition" in areas where bison spend more and less time?

Methods: Modified NRCS double sampling method, with at least one sample per 640 acres of ecological sites comprising at least 1000 acres in the park, and distributed among bison frequency categories

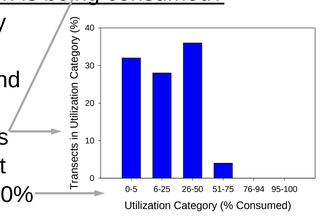
Results: Data not yet analyzed.



How much vegetation is being consumed?

Methods: Cages by bison frequency category (didn't work) and visual estimation in high frequency areas

Results: Even most frequented areas <50%



End Goal: A Regional Bison Strategy

The National Park Service is developing a Midwest Region Bison Management Strategy to achieve six objectives:

- Restore and maintain ecological communities and processes
- Maintain and improve cultural aspects of bison management
- Maintain a healthy (genetics, health, wildness) bison herd
- Engage partners
- Engage and inspire the public
- Increase inter-park collaboration and efficiency

We will continue to work with the managers and other researchers to incorporate the results from the two projects described here into this strategy and its accompanying decision-support tool.

Acknowledgments and References Cited

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