Collaborative Adaptive Management at Barta Brothers Ranch

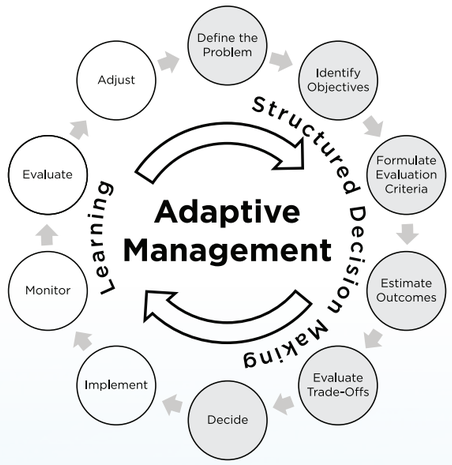
PRELIMINARY STUDY RESULTS– YEAR 1

In 2020, the University of Nebraska's Barta Brothers Ranch launched a collaborative adaptive management (CAM) project to address risks and uncertainties related to grassland management in the Sandhills. This project focuses on evaluating stakeholder-designed management plans in a collaborative research setting. This emphasis on co-producing science ensures CAM reflects real-world ranching conditions of the Sandhills and the north-central Great Plains.

What is CAM?

The foundation of the CAM Project at Barta Brothers Ranch comes from its linkage to the adaptive management framework. Adaptive management is an iterative process to increase understanding of a system through a structured decision-making process. This includes:

- Defining the problem
- Identifying objectives
- Formulating evaluation criteria, estimating outcomes
- Evaluating trade-offs
- Deciding on actions to be taken
- Implementing action plan
- Monitoring system behavior
- Evaluating management outcomes
- Adjusting management



Keys to the Success of CAM at Barta Brothers Ranch

- Emphasize collaboration to address management uncertainties over time
- Focus on stakeholder knowledge, experience and leadership
- Engage stakeholders represented across the region: Sandhills ranchers, Nebraska Game and Parks Commission, Nebraska Forest Service, Natural Resources Conservation Service, US Fish and Wildlife Service, The Nature Conservancy, and the Sandhills Task Force
- Support from USDA North Central SARE, Nebraska Environmental Trust, and the University of Nebraska

The CAM Process

PHASE 1: DEFINE PROBLEM	
Focus	**Objectives for Barta Brothers Ranch CAM**
Woody encroachment/ invasive species	Reduce woody encroachment
Heterogeneity/diversity	Increase landscape heterogeneity and species diversity
Economic and ecological trade-offs	Improve livestock performance
PHASE 2: DECIDE	
Management for grazing season (2022)	Modified patch-burn grazing system stocked at .65 AUMs. Standard deferred system established with similar stocking rate as control
PHASE 3: MONITOR	
Focus	**Approach**
Woody encroachment	Control of eastern redcedar via geospatial and ground monitoring
Heterogeneity/diversity	Vegetation cover, composition, and diversity; grassland bird abundance
Livestock performance	Weight gains, patch selectivity (GPS-tracked cattle), nutritional content of forage
Soils	Erosion (loss/gain), sampling of organic matter
PHASE 4: EVALUATE	
Results discussed on following pages	

Summary Of CAM Results

The CAM project at Barta Brothers Ranch adopted a burn/grazing strategy as its first management action. In the spring of 2022, pasture N-5 (<160 acres) was burned followed by open grazing with spayed heifers (.62 AUMs per acre) throughout the system (figure 1). Researchers monitored livestock performance and utilization, plant and animal heterogeneity and diversity, and soil nutrient composition and erosion at three periods during the year (pre-burn, post-turnout, and end of season). Below are the preliminary results from these experiments and discussions of the results.

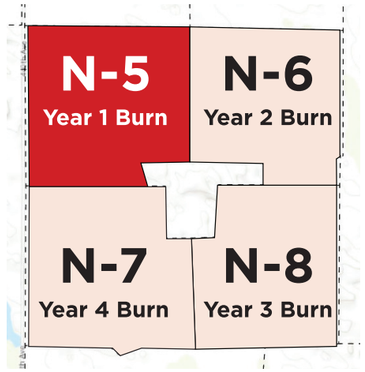


Figure 1. Map of experimental four-pasture system at Barta Brothers Ranch. Burns are conducted annually and rotated through the system.

LIVESTOCK BEHAVIOR

The boost in nutrient value of grasses and forbs due to prescribed burning is well documented in rangeland research. Fire helps remove standing dead plant material buildup, which increases access to a more nutritious diet for grazing animals. As a result, cattle will focus grazing on burned sites and reduce grazing pressure on unburned areas of the pastures. As the grazing season goes on, animals will spread out to other areas of the pasture but still return periodically to selectively graze certain species in the burned patches within the pasture. GPS tracking collars were placed on a portion of the study animals to evaluate shifts in cattle grazing behavior (i.e., grazing and resting times) and grazing distribution (i.e., where animals are grazing) in the study pastures. The first-year results aligned with previous studies showing cattle spent 1.5 - 2x more time in the burned patches compared to unburned areas within the pastures (figure 2).

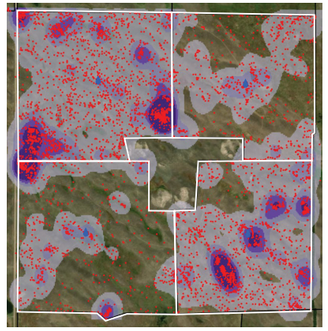


Figure 2. CAM's four-pasture system and movements of heifer #25 throughout the 2022 grazing season (mid-May to mid-September). The top left pasture (N5) was burned in March.

LIVESTOCK PERFORMANCE

Animals were weighed three times during the year, pre-turnout in May, mid-season in July, and before pull-off in late September. As a control, heifers grazing in the management pastures (N-5 through N-8) were compared to other spayed heifers stocked at a similar rate in a standard four-pasture deferred rotation system at the Barta Brothers Ranch. At the end of the grazing season in 2022, cattle in the burn/graze management system were 43 lbs. heavier than those in the standard deferred system (figure 3). These gains were not consistent throughout the grazing season. The cattle in the burn/graze system tended to gain more weight in June and July but later tracked closely with gains of the animals in the standard deferred rotation. At market, the heifers from the burned/grazed system returned an additional $86.96 per head. This is based on one year of data in a relatively high cattle price scenario.

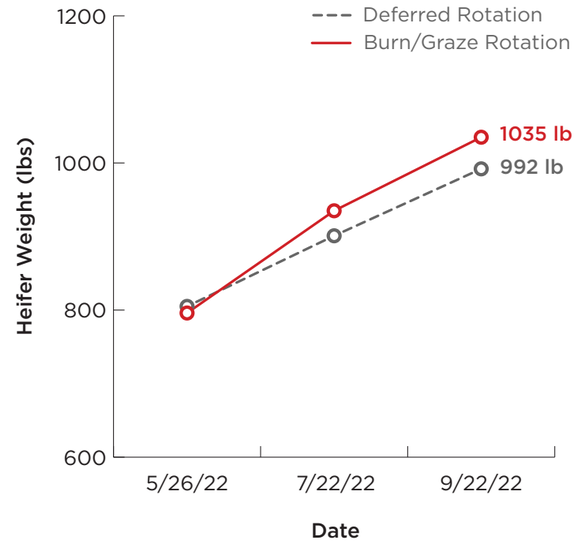


Figure 3. Animals in the burn/graze management system were 43lbs. heavier at the time of sale. Most of this difference in performance occurred during the first two months of the grazing season.

LANDCOVER MONITORING

Field observations were taken at Barta Brothers Ranch in mid-June. Sampling was carried out in three locations on the ranch: burned, unburned, and a neutral site formerly used to study biocomplexity at the ranch. Researchers detected an increase in the burned treatment's reflectance, likely arising from increased albedo affecting the surface energy balance. This team also found decreases in key energy absorption bands, likely resulting from the loss of standing biomass.

Figure 4. Photographs taken from identical locations in the burned pasture (N-5). Courtesy: Jess Milby, Research Technologist, University of Nebraska.

ANNUAL PLANT PRODUCTION

Developing a better understanding of how burning and grazing affect vegetation growth over time is a key outcome of the CAM project's research. In 2022, plant samples were collected in the burned area of the study and compared to Barta Brother's Ranch long-term grazing systems data which has evaluated plant production for over 20 years. At this point, data is still being analyzed and multiple years of data are needed to draw conclusions, but there was no difference in the total annual plant production on the burned compared to unburned pastures (figure 5). The main difference between the burned and unburned areas was the amount of standing dead and litter plant material. While seasonal conditions will vary production, year one suggests that burning and grazing can occur in the same season with minimal effects on the total forage produced.

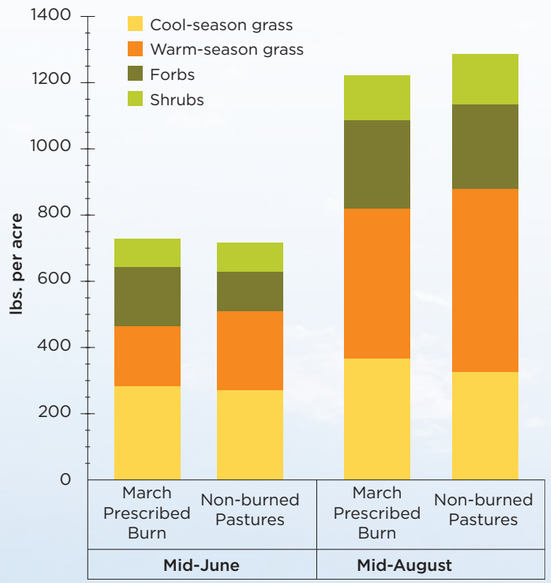


Figure 5. Minimal differences in forage production were observed among burned and non-burned pastures in 2022.

EROSION

Another key stakeholder concern in the use of prescribed burning is how exposed landscapes respond to wind-blown erosion. To monitor this effect, erosion measurements were taken at both burned and unburned pastures before and after the grazing season. On average, the unburned/grazed pasture lost 0.0986 cm of soil and the burned/grazed pastures lost 0.3595 cm. While more erosion was observed in the burned pasture, there was also more deposition compared to the unburned control pasture. These preliminary results suggest that while soil did move, it was not lost from the system. This aligns with previous research performed in the Sandhills which found 4-5 years of repeated vegetation suppression was needed before significant movement of soil occurred.

GRASSLAND BIRD DIVERSITY

Total number of observations for each bird species found during the birds' nesting season in the summer of 2022 can be seen in Table 1. Across most of the species observed, and in total, there were slightly more observations in the burned/grazed system compared to the standard deferred system. For species that prefer bare ground and less dense vegetation (e.g., Dickcissel, Horned Lark), observations were between 2 - 6x higher in the burned/grazed system. The burned/grazed system also had a more uniform distribution in total species present, likely reflecting the increased heterogeneity of the habitat created through the use of prescribed fire.

Burned / Grazed System	Standard / Deferred System	Total Observations	Species
225	265	490	Grasshopper Sparrow
207	192	399	Western Meadowlark
161	127	288	Red-winged Blackbird
138	145	283	Brown-headed Cowbird
95	54	149	Dickcissel
49	41	90	Upland Sandpiper
60	10	70	Horned Lark
25	7	32	Bobolink
17	14	31	Lark Sparrow
12	4	16	Mourning Dove
9	3	12	Common Nighthawk
6	5	11	Eastern Kingbird
1062	**899**	**1961**	

Table 1. Total number of observations for selected bird species found inside of designated point counts performed over two sampling periods during the nesting season in the summer of 2022.

MENTAL MODELING

The CAM approach is a participatory process by which management decisions are made collaboratively. The purpose of this social science research is to chronicle exercises, primarily through a focus on how stakeholders make initial decisions, learn from relevant data, and adapt their thinking about system dynamics. The significance of the research is both practical and theoretical because knowledge of the system is evaluated through hands-on experimentation and implementation of the adaptive management framework. A working "cognitive map" is in development that helps explore the ways knowledge is gained, how learning can be stimulated in collaborative settings, and how differences in understanding the system can be navigated to build consensus.

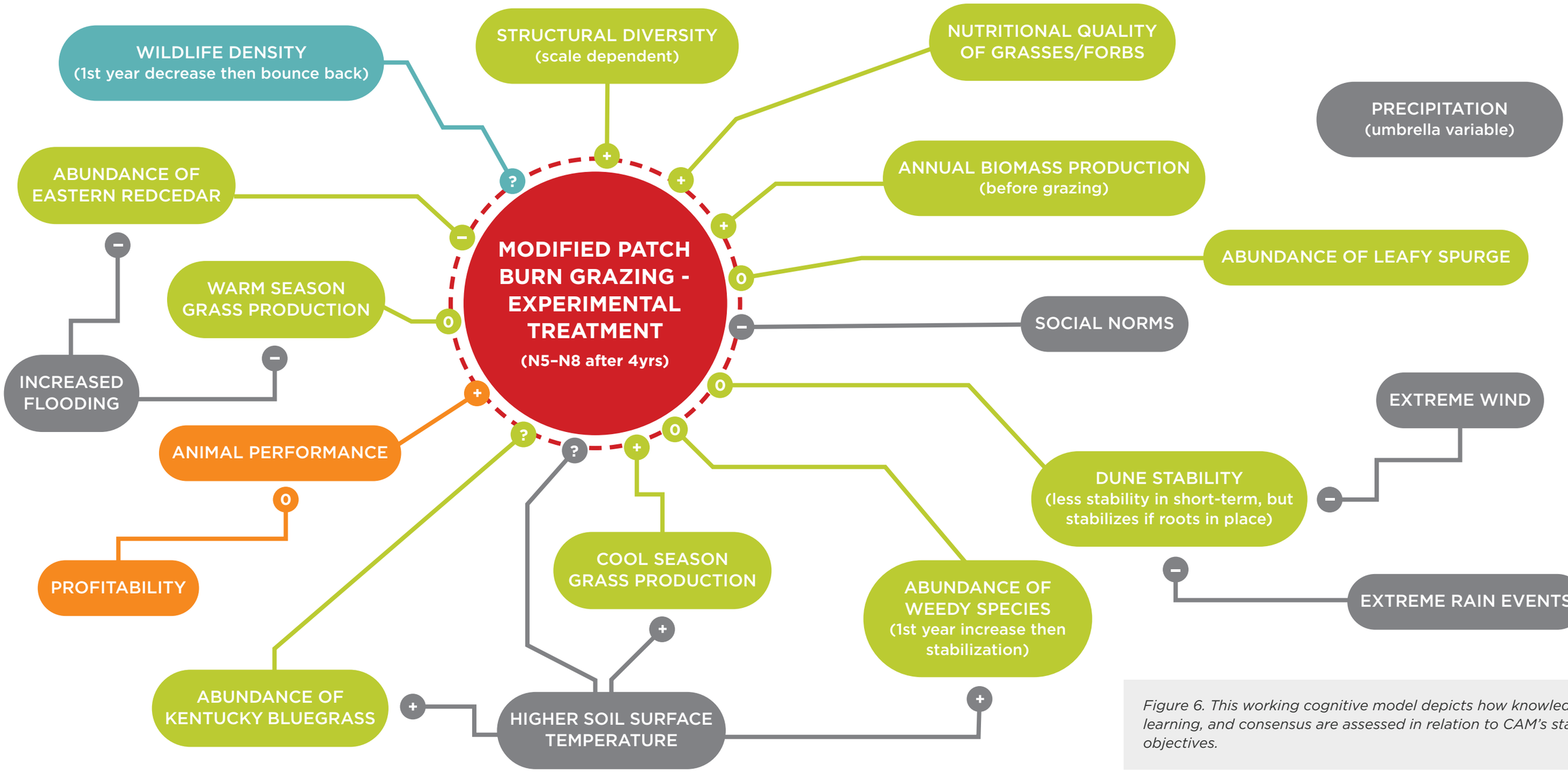


Figure 6. This working cognitive model depicts how knowledge, learning, and consensus are assessed in relation to CAM's stated objectives.

CAM Project Research Team

The CAM project brings together UNL faculty engaged in research, extension and teaching across multiple disciplines, departments and geographic locations. All three IANR District Research, Extension, and Education Centers are involved in the project (Eastern Nebraska, Panhandle, and West Central) along with three Lincoln-based centers: the Center for Grassland Studies, the Center for Resilience in Agricultural Working Landscapes, and the Center for Agricultural Profitability housed in the Department of Agricultural Economics. The CAM project also brings together four eastern Sandhills ranchers along with representatives from the Nebraska Game and Parks Commission, Nebraska Forest Service, Natural Resources Conservation Service, US Fish and Wildlife Service, The Nature Conservancy, and the Sandhills Task Force to form its stakeholder group.

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About Barta Brothers Ranch

The Barta Brothers Ranch is a 6,000-acre property donated to the University by Clifford and James Barta in 1996. It is utilized by scientists, extension educators and students to compare livestock grazing systems, study complex plant communities, and explore water interactions associated with grasslands. The ranch serves as a model ranch, providing the facilities and support needed to conduct research and demonstrations relevant to Sandhills ranchers. Educational programs from the ranch play an important role in training students and continuing education for ranchers, conservationists, and representatives of federal and state agencies.

FUNDING AND ACKNOWLEDGMENTS

The Barta Brothers Ranch Collaborative Adaptive Management project is partially funded through a grant from the Nebraska Environmental Trust. The Trust is funded by proceeds from the Nebraska Lottery and has awarded more than $178 million to more than 1,300 conservation projects across the state of Nebraska since 1994.

This material is also based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under agreement number 2019-38640-29879 through the North Central Region SARE program under project number GNC20-307, is an equal opportunity employer and service provider. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

For more information about the CAM Project at Barta Brothers Ranch please visit:

centerforresilience.unl.edu/collaborative-adaptive-management

The CAM Project is a partnership among the Center for Resilience in Agricultural Working Landscapes, Center for Grassland Studies, and the Center for Agricultural Profitability; the Eastern, West Central and Panhandle Research, Extension and Education Centers; Sandhills ranchers; Sand Hills Task Force, Natural Resource Conservation Service, US Fish and Wildlife Service, and The Nature Conservancy.