Adaptive Grazing Management for Multiple Ecosystem Goods and Services: Does it Enhance Effective Decision-Making?**

Hailey Wilmer[12,] Maria E. Fernandez-Gimenez[1], Justin D. Derner[2], David D. Briske[3], David J. Augustine[2], Lauren M. Porensky[2], Kenneth W. Tate[4], Leslie M. Roche[4]

[1]Department of Forest and Rangeland Stewardship, Colorado State University, Fort Collins, CO, 80253, 2USDA-Agricultural Research Service, Rangeland Resources Research Unit, Fort Collins, CO 80256 / Cheyenne, WY 82009, [3]Ecosystem Science and Management Department, Texas A&M University, College Station, TX 77843, [4]Department of Plant Sciences, University of California-Davis, Davis, CA 95616 Correspondence: hailey.wilmer@ars.usda.gov

Introduction

Study Justification

The shortgrass steppe of Eastern Colorado, USA is a complex social-ecological system where multiple production and conservation management objectives converge. The concerns of rangeland stakeholders include the desire to support diverse native plant communities, economically viable cattle ranches, and grassland bird habitat. Conventional rangeland experiments have traditionally excluded the decision-making aspects of grazing management.

Collaborative Approach

The project aims to foster partnerships and data-driven rangeland management through active engagement of stakeholders in the research process. The collaborative adaptive management (CAM) framework connects multiple forms of knowledge via structured decision-making where the outcomes of management decisions are used to inform future actions. Social learning theoretically enables collaborative decision makers to use new knowledge to improve management.

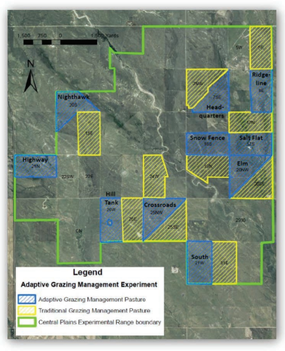
Social Research Objectives

Identify how the AGM stakeholder group:
1) negotiated management objectives for multiple ecosystem services,
2) experienced social learning, and
3) perceived the effectiveness of the CAM process in using new information to adjust management (close the adaptive management loop).

Methods and Participants

Adaptive Grazing Management Experiment

Adaptive Grazing Management (AGM) treatment: 10, 130 ha pastures, ~220 steers, managed by stakeholders.
Traditional Grazing Management (TGM) treatment: 10 paired pastures, season long, continuous grazing, same stocking rate.



Qualitative Data Collection and Analysis

Iterative data collection and analysis following case study and grounded theory methods. Stakeholder meetings, interviews and participatory focus group audio recorded, transcribed and coded to trace process of loop learning and use of new knowledge. Findings peer and member checked, triangulated against participant observation, and subject to negative case analysis.

AGM Stakeholders

Conservation NGOs
The Nature Conservancy
Environmental Defense Fund
Bird Conservancy of the Rockies

Government Agencies
Natural Resources Conservation Service
Colorado State Land Board
Colorado State University Extension
USDA-Forest Service

Ranchers
Crow Valley Livestock Cooperative (4 Seats)

Results

Stakeholders brought diverse **systems of knowledge** and contributions to management for multiple objectives. These systems of knowledge framed loop-learning and decision-making.

Ranchers: Gatekeepers of financial risk. Multi-generational experience with local drought impacts, animal husbandry, and short-grass ecosystem thresholds.
NGOs: Trained as scientists and have knowledge of other collaborative processes. Knowledge of wildlife, rangeland management, and human dimensions of natural resources in multiple ecosystems.
Government Agencies: Knowledge brokers in public lands management, trained as scientists and managers, and have some ranching experience.

Stakeholders reported **growing trust and motivation to learn** through collaborative adaptive management.

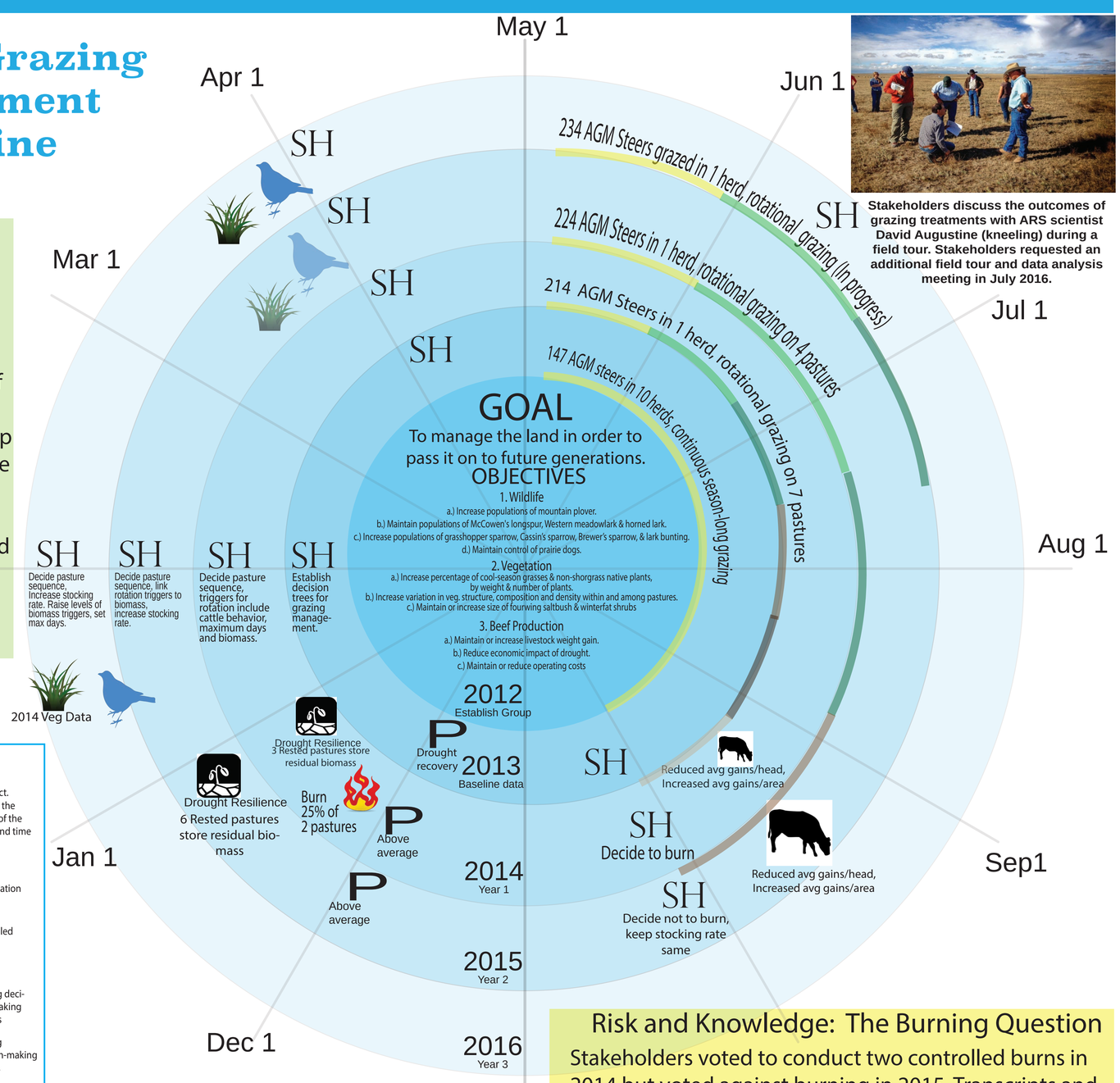
"I hope the major lesson that comes out of it is that collaborative, multi-stakeholder processes actually work. That you can have your cake and eat it too. You can have three different parties with three different objectives sit down and manage something and everybody at the end of 10 years can be happy." -Gov't Agency Stakeholder

Participation in experimental grazing management research had **real-life implications for public lands stakeholders** interested in finding **collaborative, science-based** management approaches that promote the provision of multiple rangeland goods and services.

Trade-offs exist between learning opportunities and outcomes for multiple objectives across spatial and temporal scales.

Adaptive Grazing Management Timeline

Grazing Rotations: Double-Loop Learning?
Stakeholders adjusted triggers for grazing rotation using co-produced knowledge and reconsideration of guiding assumptions about the ecosystem, but their loop learning was incomplete due to path dependency, time lags between decisions and outcomes, and existing systems of stakeholder knowledge.



Stakeholders discuss the outcomes of grazing treatments with ARS scientist David Augustine (kneeling) during a field tour. Stakeholders requested an additional field tour and data analysis meeting in July 2016.

Legend

Each circle represents a year in the AGM project. Nested circles (analogous to tree rings) reflect the complex, path dependent and nested nature of the adaptive management process across space and time for both the social and ecological processes.

- Grazing rotation
- Precipitation Data
- Outcomes related to beef production management objectives
- Controlled Burn
- Outcomes related to grassland bird management objectives
- Grazing decision-making process
- Outcomes related to vegetation management objectives
- Burning decision-making process
- Outcomes related to drought resilience objectives
- SH Stakeholder group meeting

Risk and Knowledge: The Burning Question

Stakeholders voted to conduct two controlled burns in 2014 but voted against burning in 2015. Transcripts and interviews suggest subgroups of stakeholders had different risk perceptions related to vegetation management. Rangeland management knowledge is context specific and co-produced knowledge does not replace existing systems of knowledge in the short term.

Discussion

In this study, the collaborative adaptive management process provided opportunities for stakeholders to negotiate multiple management objectives, create spaces for social learning, and close the adaptive management loop. However, this loop learning was sometimes incomplete and constrained by path dependency, gaps in time between decisions and outcomes, and different knowledge systems. Long-term commitment from stakeholders and scientists is key to building norms of trust and respect, which in turn foster social learning that enables adaptive management for multiple ecosystem services. Early experiences suggest that social learning is a key process for successful adaptive grazing management.

*****This research sponsored by grants from USDA AFRI award 2009-04442; USDA ARFI award 2012-38415- 20328; Colorado Agricultural Experiment Station project COLO0698; and the Center for Collaborative Conservation.**

Acknowledgments:

Stakeholder participants, Emily Kachergis, Nick Dufek, Jeff Thomas, Jake Thomas, Craig Lawrence, Billy Armstrong, John Wendt.

Use your smart phone to scan this QR Code and learn more at the AGM project website.