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Cattle as Partners in Conservation: Collaborative Management of Public Lands

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Background

Over 30% of land in **Colorado** is owned and managed by the federal government, 95% of which is used for domestic **livestock grazing** and only 10% of which is classified as "protected" [1]. Local governments along the Front Range are making large investments to protect remaining open space, offset conversion to urban development, and maintain natural **working lands** for local agriculture.

Colorado's **Northern Front Range** is a sensitive transitional landscape forming a patchwork of mixed and shortgrass prairie that lie wedged between 2 ecoregions, the Southern Rocky Mountain Steppe to the west, and the Great Plains to the east[2]. Rich in natural resources, these lands are highly desirable and **support many uses** including, food, feed, and bioenergy production, recreation, and conservation.

Herbivory by **cattle** contributes to the maintenance of these grassland ecosystems while producing food for growing global populations[3]. Today, **food production** and **natural resource** management objectives, especially on government-owned lands, are often paradoxical.

Complexities in social-ecological systems compounded by economic pressures make **value-based decision-making** among diverse stakeholder groups difficult[4].

Partnerships between government land agencies and private ranchers aim to meet **pluristic objectives** of protecting natural open spaces, producing local food, supporting community livelihoods, and managing natural resources.

However, research engaging **social**, **ecological**, and **economic** elements of collaborative grazing systems is lacking[5]. In response, our study uses a holistic framework incorporating these 3 pillars of sustainability (Figure 1).

Partnerships were established with **placed-based stakeholder assemblages** that include land agencies, rancher lessees, and community members associated with 4 Colorado Front Range public lands areas (Figure 2, 3).

Could conceptualizing cattle as partners in conservation be a win-win for both ranching livelihoods and rangeland conservation?

Conducting soil analysis to verify biological consistency among transect locations.

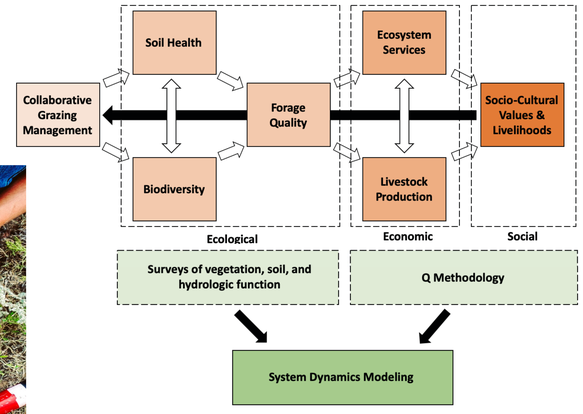


Figure 1. Conceptual diagram of study components associated with 3 pillars of sustainability (ecological, economic, and social) *and their associated methods, the quantitative and qualitative results of which will be integrated in a system dynamics model[6].*

Collecting plant species data along linear transects

Goals

❖ To engage with local management of Colorado's Front Range working lands, where livestock production and natural resource conservation are bound together by a rich cultural history and progressive conservation efforts.

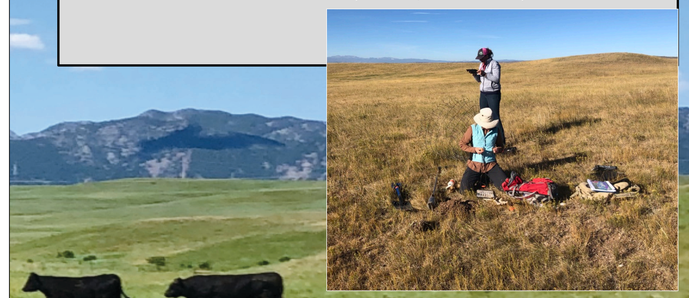
❖ To incorporate the social-ecological complexities in collaborative grazing systems and their influence on natural resource management and conservation.

❖ To develop an applied, context-specific, and dynamic tool (system dynamics model) with which to aid stakeholders in consensus-building, co-learning, and collaborative decision-making.

❖ To promote a unique interdisciplinary research model acknowledging the importance of various levels of expertise from diverse groups of stakeholders.

❖ To address current issues in science, including sustainable food systems (beef production) and climate change (ecosystem health and resilience).

Stakeholder partners perform soil and forage quality analyses on Soapstone Prairie study site.



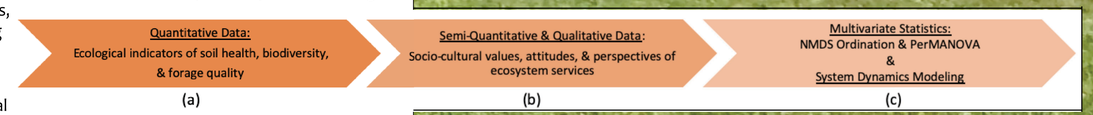
Methods

A sequence of methods, which are demonstrated in more detail below, is being applied to study this complex social-ecological system (Fig 1). All ecological field research will be conducted in 2 field seasons, one of which has already been completed. Socio-economic research is in-process.

(a) **Ecological (Su20, Su21)** – 6 x 50 m linear transects on each study site (Fig 3), 4 in grazed areas and 2 in historically ungrazed areas. ***Soil health*** (organic carbon (C), nitrogen (N) and hydrologic function): Soil cores with a 20 cm depth were extracted from within a 25x25 cm quadrat at 10 m intervals (n=10/transect). Each core was divided into 0-10 cm and 10-20 cm sub-cores, dried, finely ground, and analyzed for Total C (TC) and Total N (TN) via combustion analysis using LECO instrumentation. Inorganic C (TIC) was analyzed using gravimetric determination of calcium carbonate and subtracted from TC to determine Total Organic C (TOC). Soil hydrologic function was assessed via water infiltration rates (IR), using the single-ring infiltrometer method within the same quadrats used in soil core sampling (n=5/transect). ***Plant species richness, evenness, and composition*** by functional group was measured using the Daubenmire cover class method. 20x50 cm frames were placed at every 1 m interval (n=50/transect). Shannon's Diversity Index will be calculated for biodiversity and constrained ordination and PerMANOVA multivariate statistical methods will be used to explore differences in composition. ***Forage quality*** measures include crude protein, acid detergent fiber, and neutral detergent fiber. Forage samples were collected by clipping all standing biomass from within 25x25 cm frames at 8 m intervals (n=6/transect). Individual samples were dried, finely ground, and analyzed for nutrient content using Near Infrared Reflectance Spectroscopy.

(b) **Socio-Economic (Fa20-Fa21)** – Q-methodology is a semi-quantitative approach to socio-cultural studies which I will use to capture the dynamics of value-based decision-making from diverse perspectives for systems modeling. 3 groups of stakeholders, 12 minimum per study site, are being recruited using purposive sampling (Fig 2). ***Q-method process:*** 1. develop a concourse of values, attitudes and beliefs, 2. engage in ranking exercise of concourse statements, 3. clarify ranking choices in interviews with individual stakeholders, 3. perform factor analysis, 4. interpret and calibrate results with stakeholder experience.

(c) **System dynamics model (Fa21-Sp22)** will be created using Stella software to link the ecological system components with socio-economic system components to reflect stakeholder decision-making on land use. The synthesis of Q-methodology and systems modeling will exemplify a novel application of both methods, integrating the human dimension of natural resource management through the use of place-based ecological data, stakeholder-driven research and the creation of social-ecological narratives.



Research Questions

1. Does collaborative grazing management improve **soil health** as measured by levels of a) organic carbon, b) nitrogen, and c) water infiltration?
2. Does collaborative grazing management increase **above-ground biodiversity** as measured by a) plant species diversity (richness and evenness), and b) composition (functional groups)?
3. Does collaborative grazing management improve **forage nutritive quality** as measured by a) crude protein, b) acid detergent fiber, and c) neutral detergent fiber?
4. What are the unique sets of values and perspectives toward **ecosystem services** among collaborative grazing management stakeholders, and how does the prioritization of these values drive **dynamic decision-making**?

Figure 2. Diagram of collaborative research model, including 3 stakeholder participant groups for the Q-Methodology socio-economic component of the study: government land agency partner, rancher/producer, and community member/ recreationer[7].

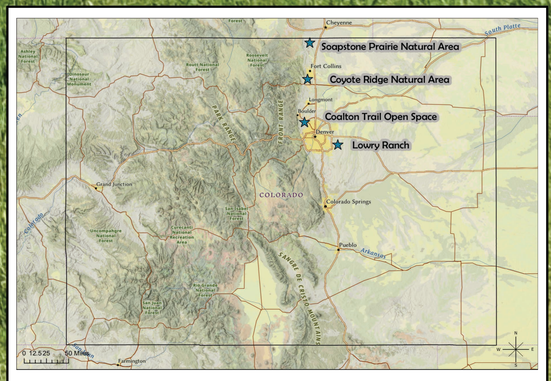


Figure 3. Locations of 4 Colorado Northern Front Range study sites located in Larimer, Boulder, and Arapaho counties.

Partners and Sponsors

References

1. Enviro CO Research & Policy. *Losing Ground.* **2006**.
2. City of Fort Collins. *Management Plan*. **2005**. 18-19.
3. Gibson, D.J. *Grasses and Grassland Ecology*. **2009**.
4. Jacobs, S. et al. *Ecosystem Services.* **2016**. 22:213-220.
5. Briske, et al. *Rangeland Ecol. & Mgt.* **2011**. 64(4), 325-334.
6. Rhoades, et al. *Rangelands.* **2014**. 36:2-6.
7. Webler, T. et al. *Social and Environ. Research Institute.* **2009**. 54:1-45.