Tradeoffs between Vegetation Management and Livestock Production under Adaptive Grazing Management

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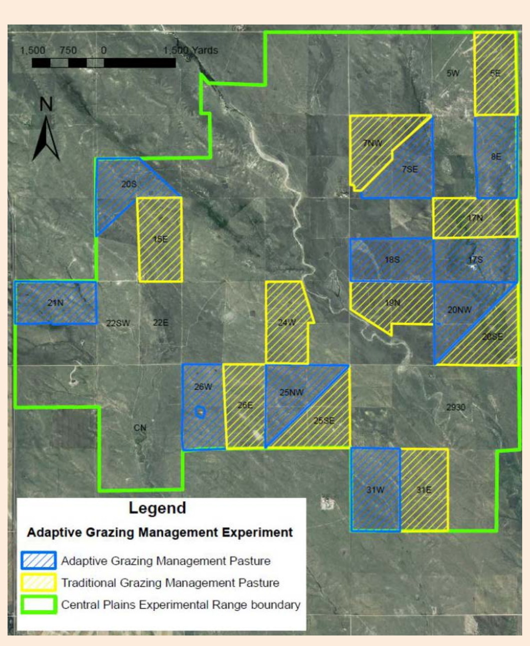
Introduction

Rangelands are characterized by temporal variability in weather overlaid on spatial topoedaphic variability (Fuhlendorf et al. 2012). In semiarid rangelands in particular, droughts create major financial hardship for livestock producers around the world. Strategies for coping with drought include reducing livestock numbers, leasing forage, temporarily grazing rangeland beyond its capacity, and increasing supplemental feed, but these involve economic or ecological costs. Alternative approaches to increase enterprise flexibility in responding to drought are clearly needed (Kachergis et al. 2014). Managing the spatial distribution of livestock during wet periods in order to enhance future production potential could improve ranch-scale resilience during droughts, but has not been evaluated at scales relevant to livestock producers.

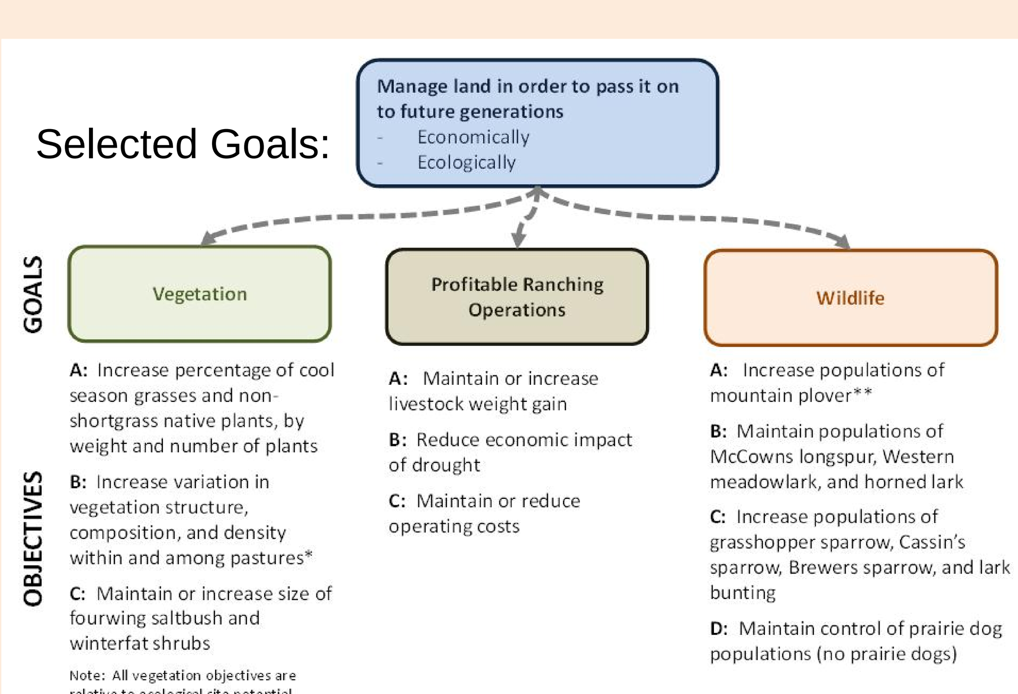
Adaptive Grazing Management Experiment

In 2012, we initiated an adaptive grazing management experiment in the shortgrass steppe of northeastern Colorado, USA, where 11 stakeholders representing ranchers, state and federal land management agencies, and non-governmental conservation organizations met to develop and implement an adaptive grazing management plan for ten 130-ha pastures.



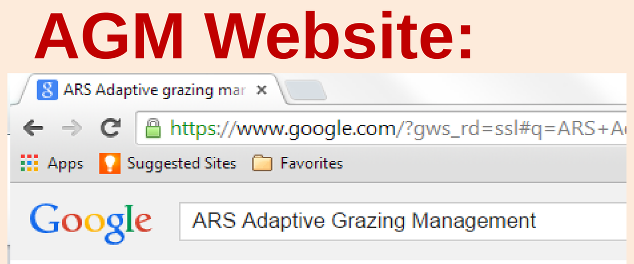
Stakeholder Group members determined:

1) Overall management goals, and specific objectives related to each goal.
2) Grazing management strategies that would be implemented to achieve the objectives
3) Types of monitoring data to inform adaptive management
4) Triggers for cattle movement among pastures



- **Cattle in the Traditional Grazing Management (TGM) treatment are distributed evenly among 10 pastures**, and graze them continuously during May – Oct.
- **Cattle in the Adaptive Grazing Management (AGM) treatment are managed as a single herd rotated among pastures**, with the objective of grazing 8 of 10 pastures (and resting the remaining 2 pastures) given average precipitation, and adjusting this grazing plan in response to intrannual precipitation variability.
- AGM and TGM pastures have the same overall stocking rate, but **stock density is 10-fold greater in the AGM treatment**.

AGM Website:

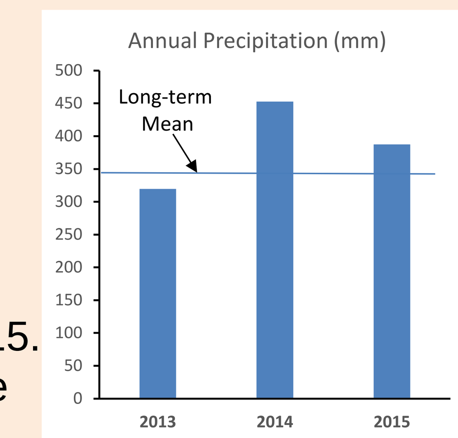


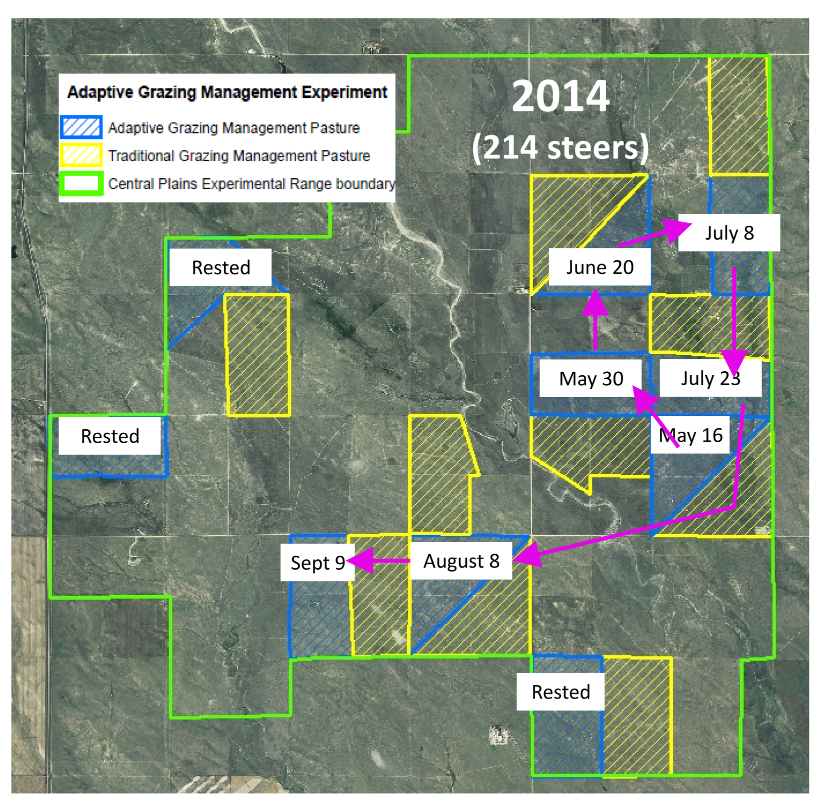
Grazing Plan Implementation

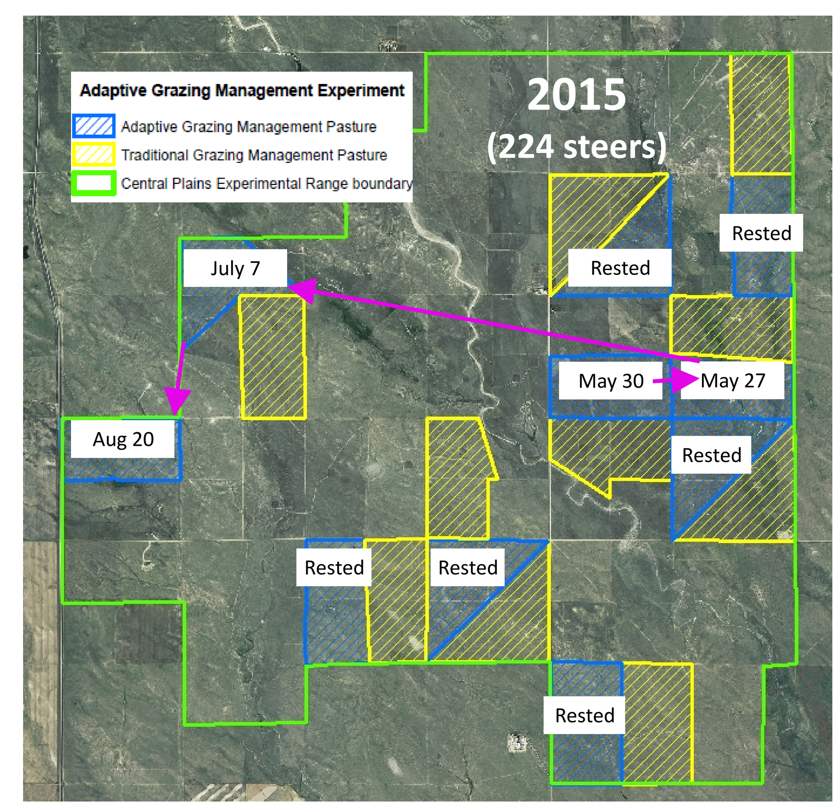
In 2014, cattle were moved among pastures when one of three triggers – residual forage biomass, cattle behavior, or maximum number of grazing days - was achieved in the currently grazed pasture.

In 2015, the maximum days threshold was removed such that moves among pastures were only based on forage biomass and cattle behavior.

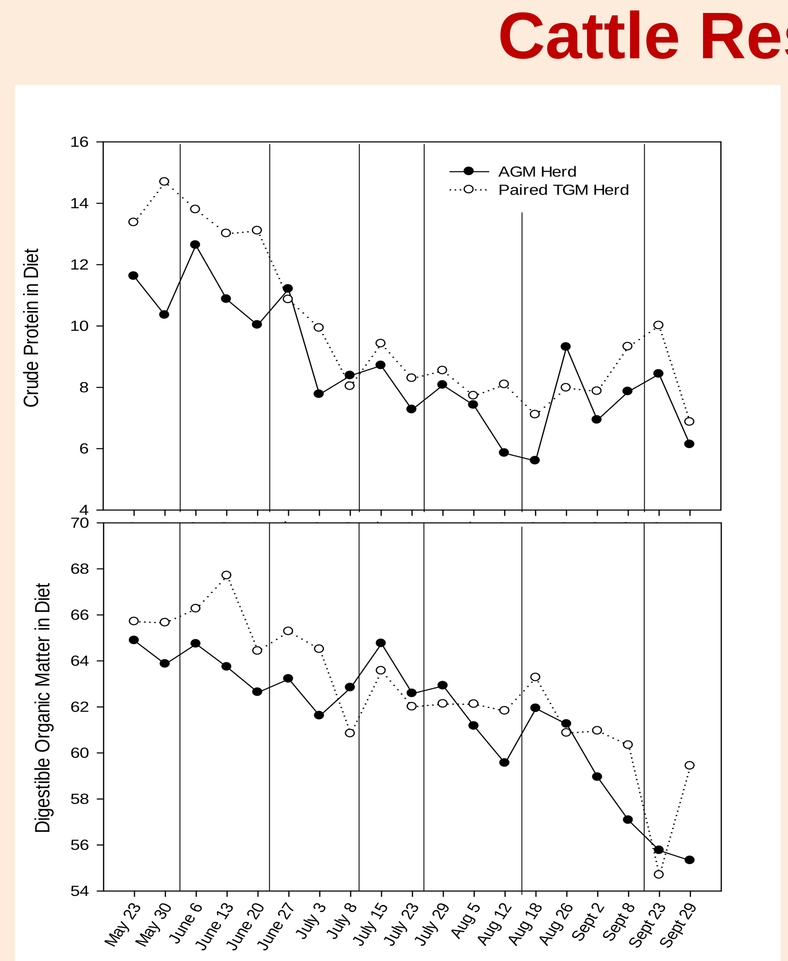
Due to 2 consecutive years of above-average spring precipitation and forage production rates, the AGM herd grazed 7 of 10 pastures in 2014 and 4 of 10 pastures in 2015. Thus, a substantial portion of the landscape under adaptive grazing management was rested in 2014 and/or 2015.

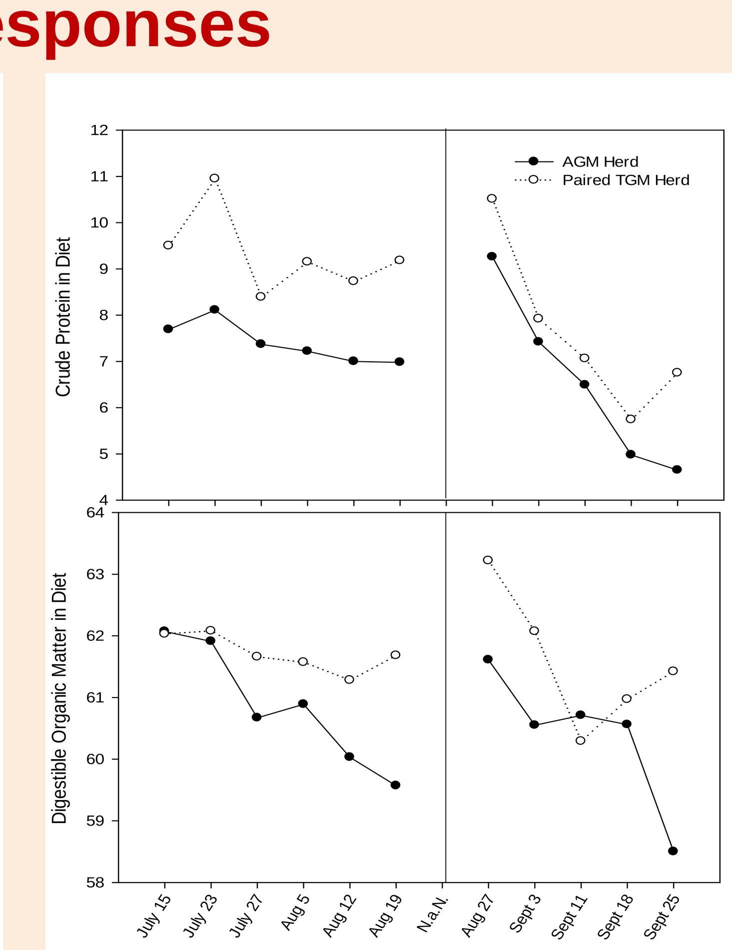


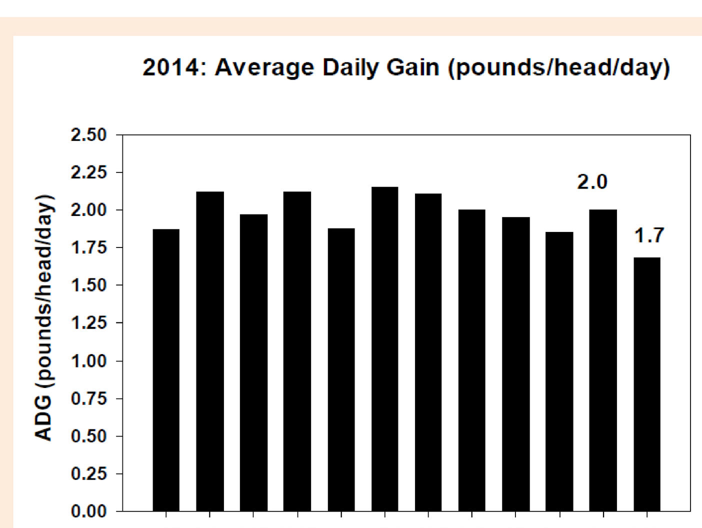




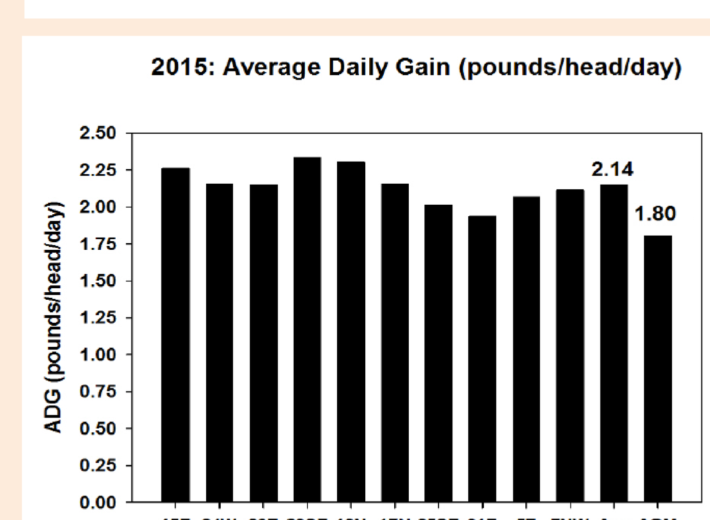
Cattle Responses







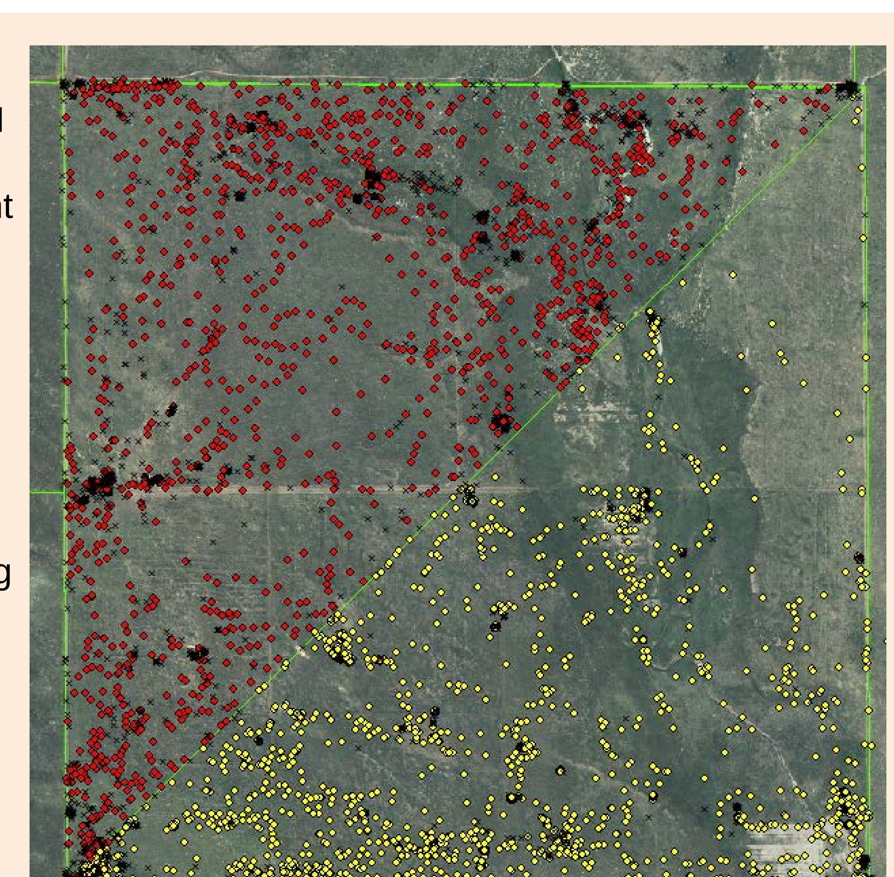
2014: 2-4 week rotations

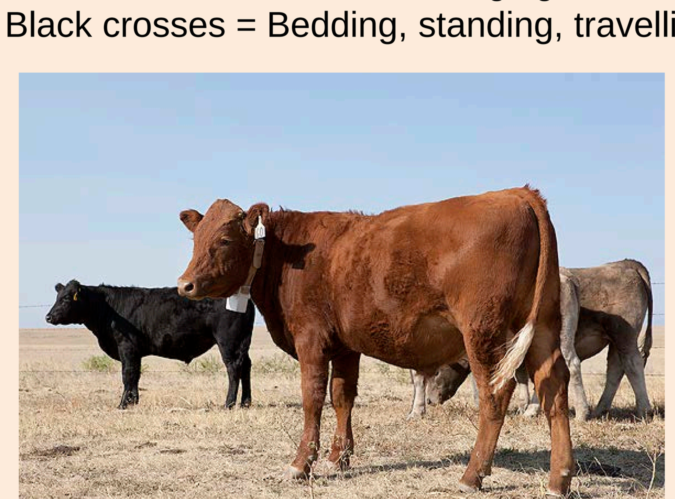


2015: 5-6 week rotations

Example of cattle foraging behavior in the AGM herd (red circles) versus a paired TGM herd (yellow circles). The example shows GPS collar fixes for 1 steer in each treatment collected every 5 minutes over a 13-day period in 2014. AGM cattle grazed in more linear pathways, moved longer distances while grazing, and spent less time per day engaged in grazing behaviors.

Red Circles: AGM steer foraging locations
Yellow Circles: TGM steer foraging locations
Black crosses = Bedding, standing, travelling

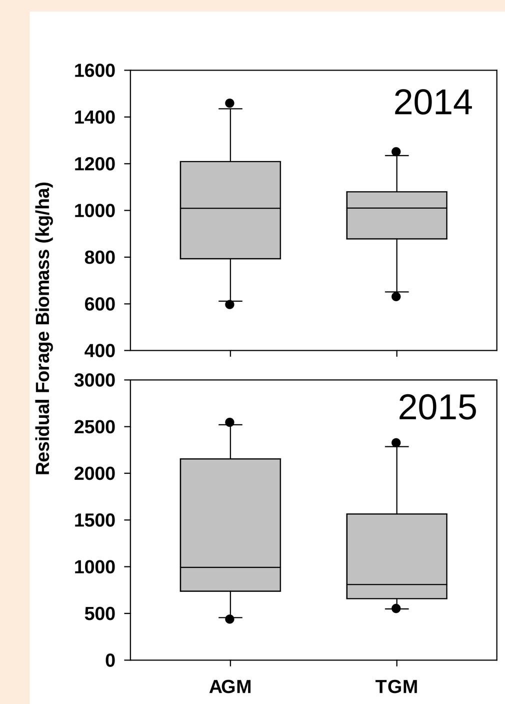




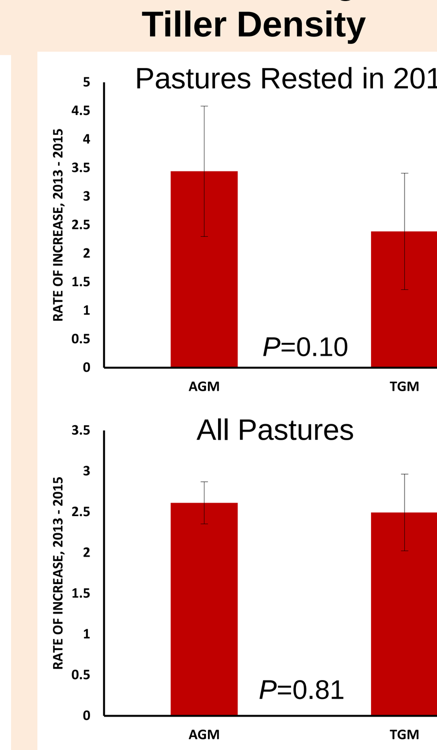
	AGM	TGM
Percent time foraging (grazing fixes/total fixes)	35.1	51.7
Mean foraging angle (degrees per 5 min)	146.3	134.8
Mean foraging distance (meters per 5 min)	43.6	40.9

Vegetation Responses

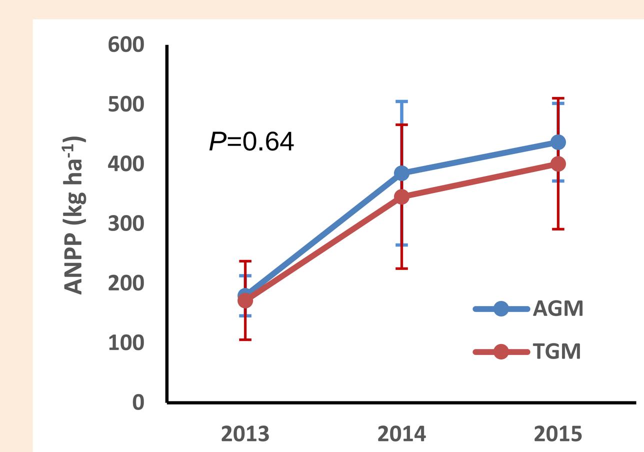
Residual Biomass after Grazing Season



Rate of Increase in Western Wheatgrass Tiller Density



Aboveground Production by C3 Perennial Gramminoids



Conclusions

Managing cattle as a single large herd rotated among many pastures instead of many small herds distributed evenly among pastures resulted in **an economically significant loss in livestock weight gains** (15-16% over 2 above-average precipitation years).

Large reductions in weight gain occurred in spite of adaptive selection of pasture sequences based on temporal patterns of forage production and availability (i.e. initiating grazing season in C3-dominated pastures, followed by rotation to C4-dominated pastures later in grazing season).

Reduced livestock gains with increased stock density are consistent with measured changes in diet selection and animal foraging behavior. **High-stock-density steers foraged in more linear pathways and consumed diets with reduced crude protein content** throughout both growing seasons, as compared to low-stock-density steers.

Reduced diet quality occurred during the first week after steers were rotated into a new pasture. These results indicate a **strong effect of herd size, regardless of how quickly animals move among pastures**.

Benefits of resting pastures for a full growing season were not readily measureable after 2 years of treatments. One C_3 perennial grass increased in density 44% more rapidly in rested compared to moderately grazed pastures, but this species increased in both treatments. We have not yet detected an increase in C_3 gramminoids production.

A unresolved question is whether future enhancements in forage production and residual biomass due to AGM could enhance livestock production during drought.

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Affiliation	Name
Crow Valley Livestock Cooperative	Steve Anderson, Leonard Ball, Dana Bowman, Jason Kern, Andy Lawrence, Scott Timm
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Bird Conservancy of the Rockies	Seth Gallagher, Angela Dwyer
Environmental Defense Fund	Ted Toombs
Colorado State University Extn	Casey Matney
USDA - NRCS	Rachel Murph
USDA - FS	Kim Obele
CO State Land Board	Matt Pollart

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