Hope on the Hardgrass

Can community-engaged research build common ground for ranching and conservation in the Western Great Plains

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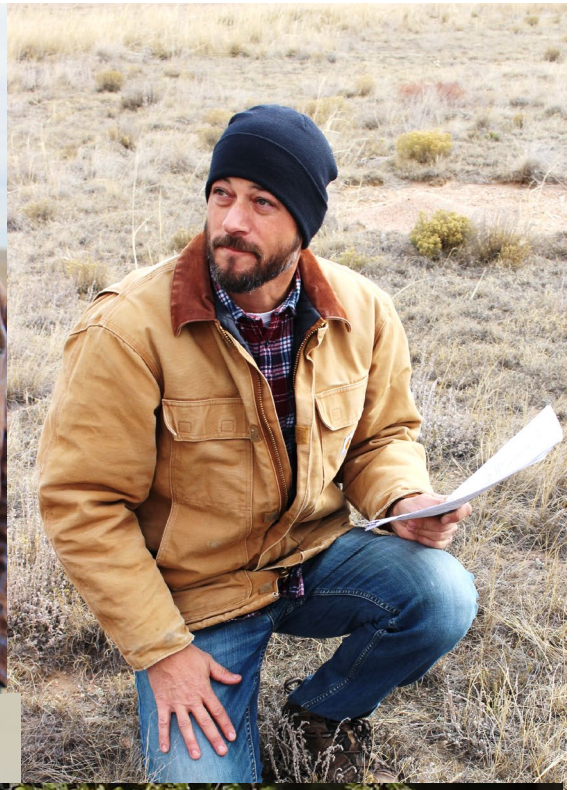
CARM
Collaborative Adaptive Rangeland Management
Central Plains Experimental Range,
Nunn, Coloraoo
Est. 2012

Melissa Johnston

Lauren M. Porensky
Maria E. Fernandez-Gimenez
Justin D. Derner
John P. Ritten
David D. Briske
Dannele E. Peck
Jessica Windh







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Finding the ways that work

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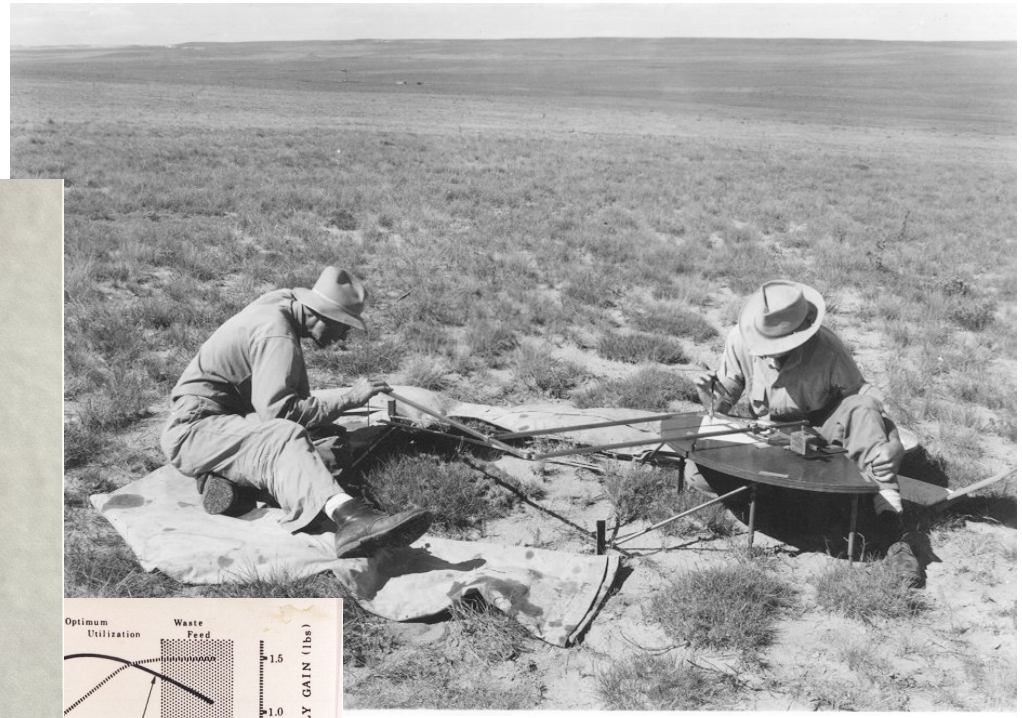
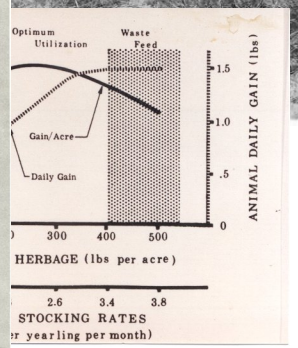
CARM
Collaborative Adaptive Rangeland Management

Central Plains Experimental Range,
Nunn, Colorado
Est. 2012

Melissa Johnston

Bob Bement

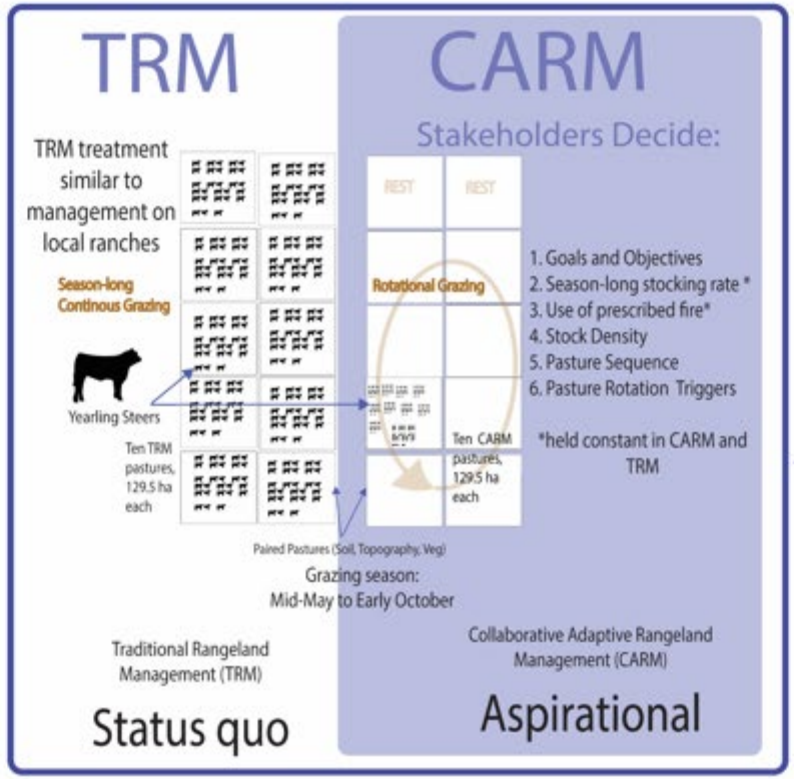




CPER Archives


CARM
Collaborative Adaptive
Rangeland Management
Central Plains Experimental Range,
Nunn, Coloraoo
Est. 2012

1. Stakeholder Group and Research Team



2. Ranch-Scale Study Design

3. Collaborative Adaptive Management (10 years)

CARM Goals and Objectives
Revised for 10-2018

Goal: Manage the land in order to pass it on to future generations
-Economically
-Ecologically

Vegetation

A) Attain and/or maintain abundances of cool-season perennial graminoids within 30% of targets for each plot. *

B) Maintain or increase plant compositional diversity both within and across pastures.*

C) Increase variation in vegetation structure, composition, and density within and among pastures **

D) In pastures that had stands of fourwing saltbush at the start of experiment, increase or maintain cover relative to baseline.*

Profitable ranching operations

A. Maintain or increase livestock weight gain †

B. Reduce economic impact of drought †

C. Maintain or reduce operating costs †

Wildlife

A. Increase populations of mountain plover. **

B. Maintain populations of McCown's longspur, Western meadowlark, and horned lark **

C. Increase populations of grasshopper sparrow, Cassin's sparrow, Brewers sparrow, and lark bunting **

D. Maintain control of prairie dog populations (No prairie dogs.) **

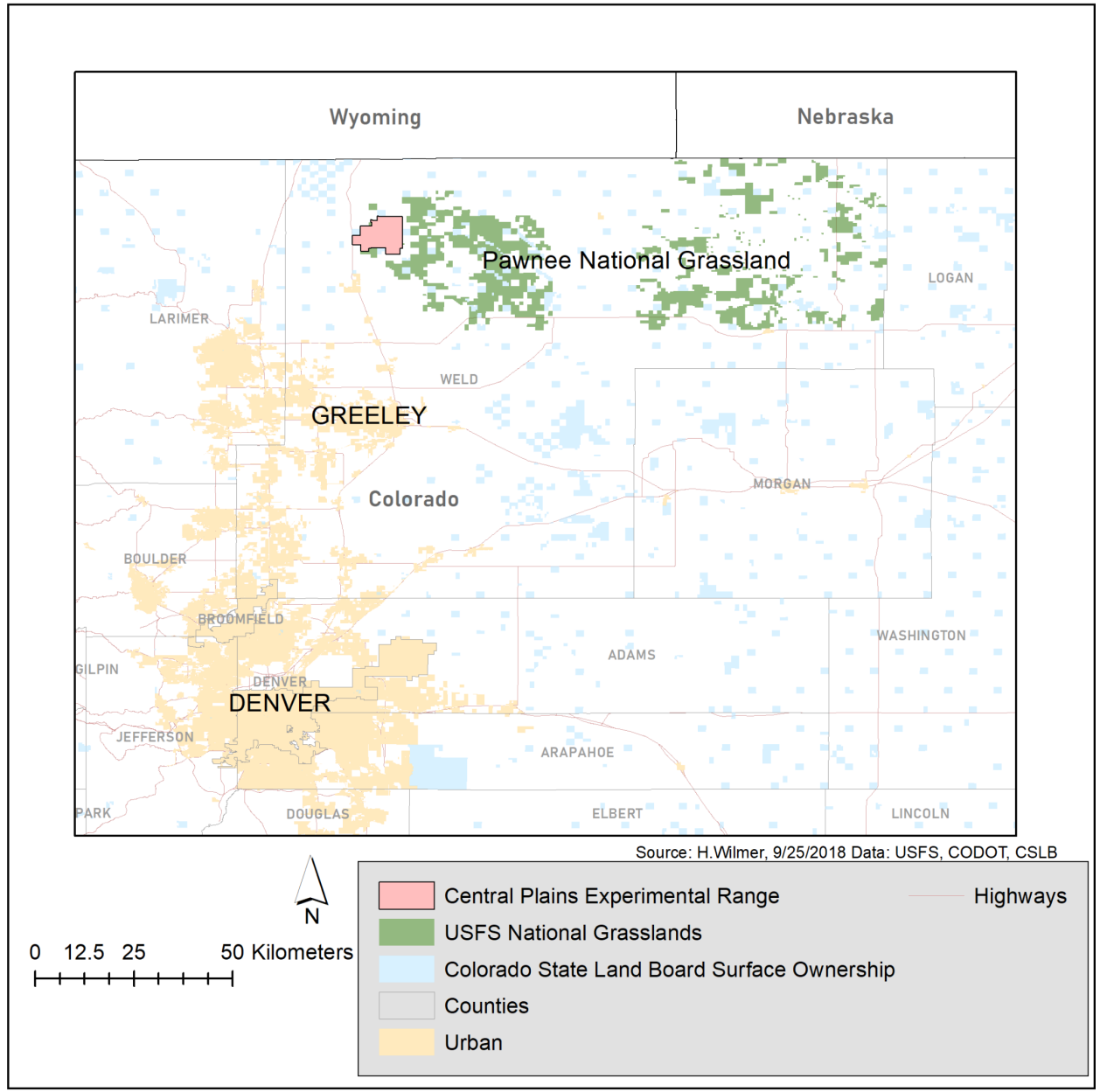
Collaborative Learning

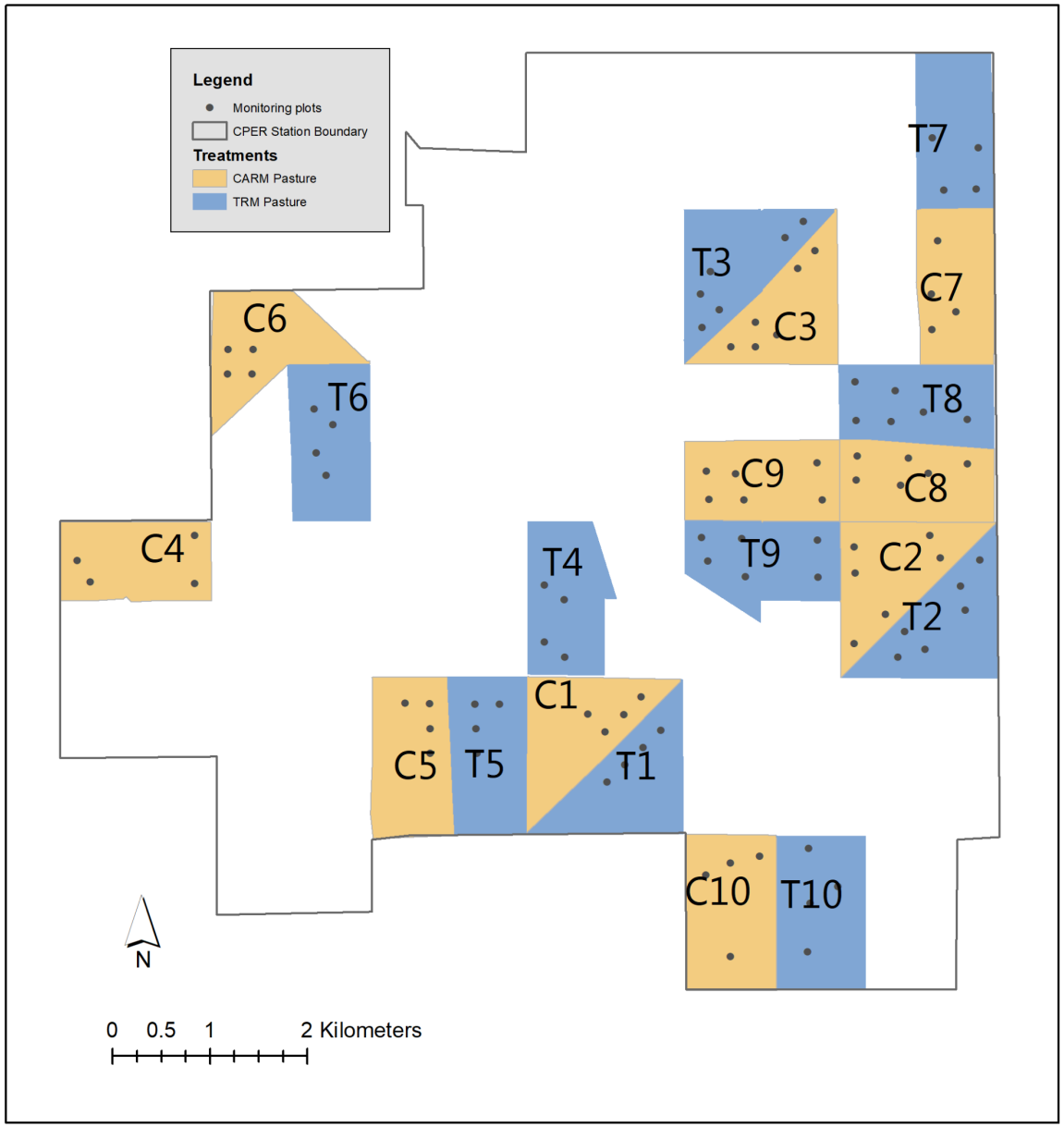
A. Apply new knowledge and CARM in new areas

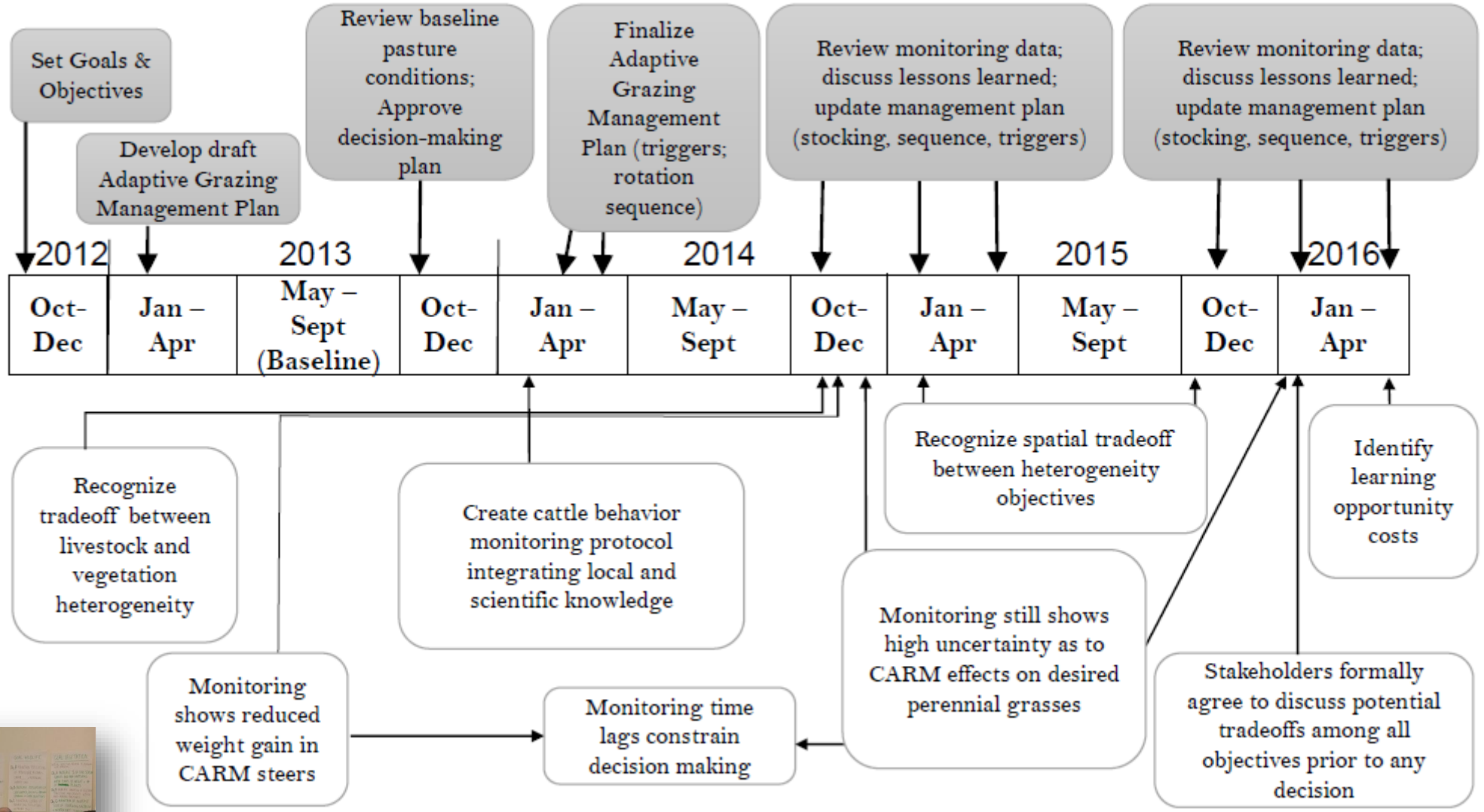
B. Respect, understanding and trust increases among stakeholders and researchers

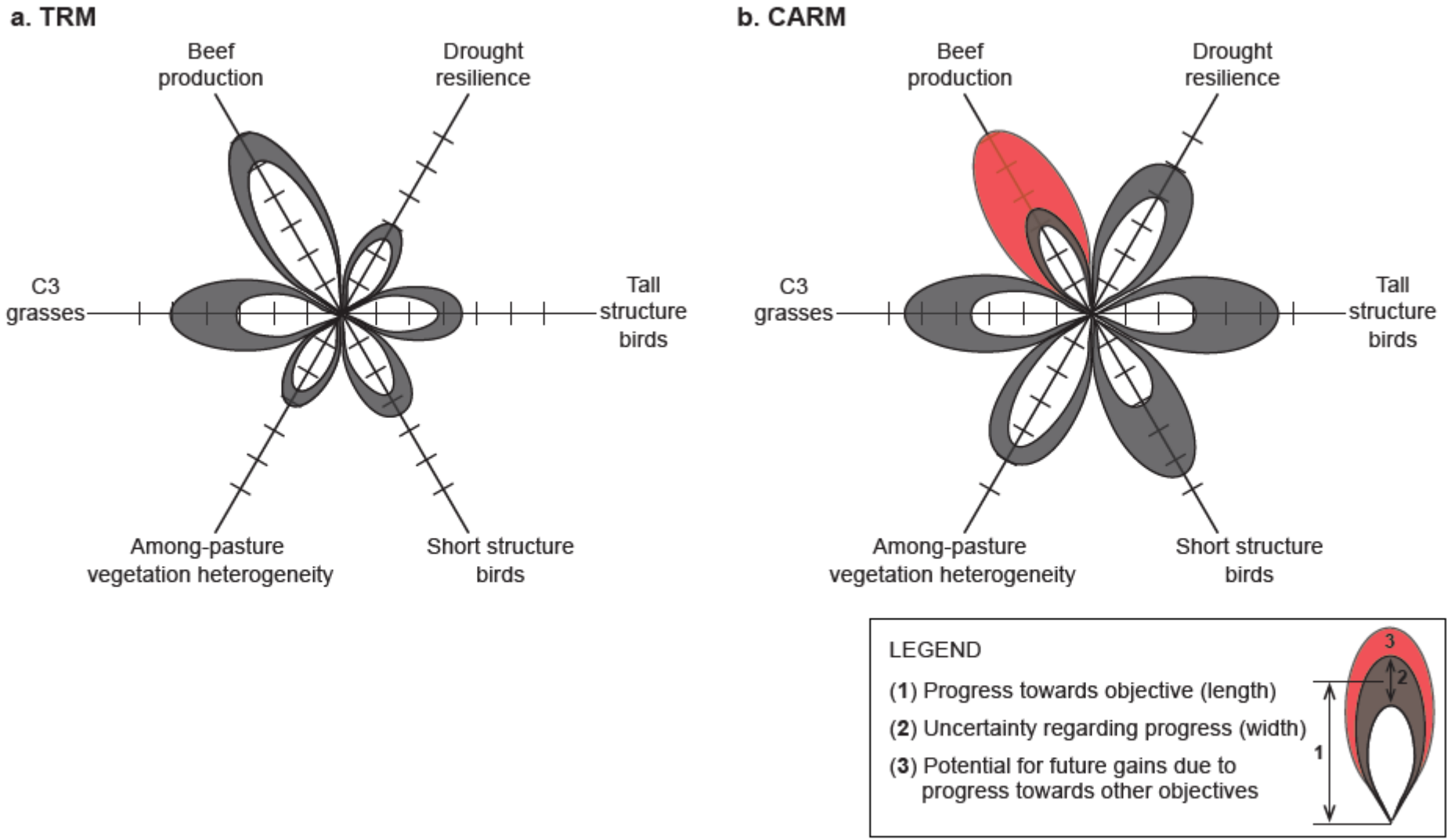
C. Stakeholders and researchers co-produce new knowledge

* Revised in April 2018. See Grazing Management Plan for additional metrics and rationales.
**Revised version has been drafted and is slated for vote January 2019.
† Revisions will begin fall/winter 2018.

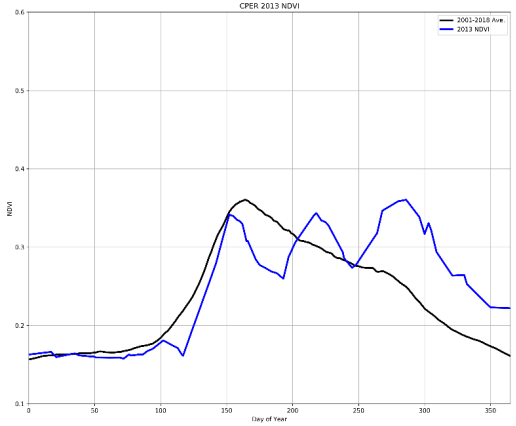

Wyoming
Nebraska
Pawnee National Grassland
LOGAN
LARIMER
WELD
GREELEY
Colorado
MORGAN
BOULDER
BROOMFIELD
WASHINGTON
ADAMS
GILPIN
DENVER
DENVER
JEFFERSON
ARAPAHOE
PARK
DOUGLAS
ELBERT
LINCOLN
Source: H.Wilmer, 9/25/2018 Data: USFS, CODOT, CSLB
N
0 12.5 25 50 Kilometers
Central Plains Experimental Range
USFS National Grasslands
Colorado State Land Board Surface Ownership
Counties
Urban
Highways


Legend
Monitoring plots
CPER Station Boundary
Treatments
CARM Pasture
TRM Pasture
T7
T3
C3
C7
C6
T6
T8
C9
C8
C4
T4
T9
C2
T2
C1
C5
T5
T1
C10
T10
N
0 0.5 1 2 Kilometers

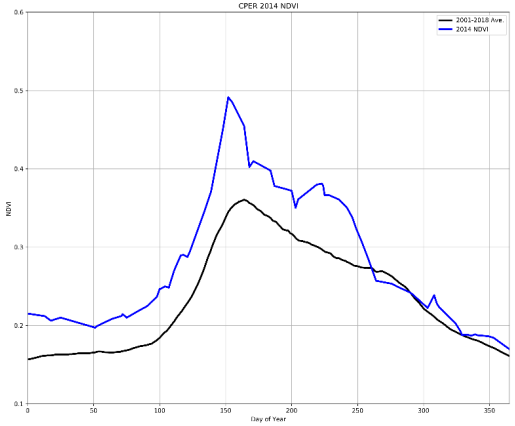

Set Goals & Objectives
Develop draft Adaptive Grazing Management Plan
Review baseline pasture conditions; Approve decision-making plan
Finalize Adaptive Grazing Management Plan (triggers; rotation sequence)
Review monitoring data; discuss lessons learned; update management plan (stocking, sequence, triggers)
Review monitoring data; discuss lessons learned; update management plan (stocking, sequence, triggers)
2012
2013
2014
2015
2016
Oct-Dec
Jan – Apr
May – Sept (Baseline)
Oct-Dec
Jan – Apr
May – Sept
Oct-Dec
Jan – Apr
May – Sept
Oct-Dec
Jan – Apr
Recognize tradeoff between livestock and vegetation heterogeneity
Create cattle behavior monitoring protocol integrating local and scientific knowledge
Recognize spatial tradeoff between heterogeneity objectives
Identify learning opportunity costs
Monitoring shows reduced weight gain in CARM steers
Monitoring time lags constrain decision making
Monitoring still shows high uncertainty as to CARM effects on desired perennial grasses
Stakeholders formally agree to discuss potential tradeoffs among all objectives prior to any decision


a. TRM
Beef production
Drought resilience
C3 grasses
Tall structure birds
Among-pasture vegetation heterogeneity
Short structure birds
b. CARM
Beef production
Drought resilience
C3 grasses
Tall structure birds
Among-pasture vegetation heterogeneity
Short structure birds
LEGEND
(1) Progress towards objective (length)
(2) Uncertainty regarding progress (width)
(3) Potential for future gains due to progress towards other objectives
3
2
1

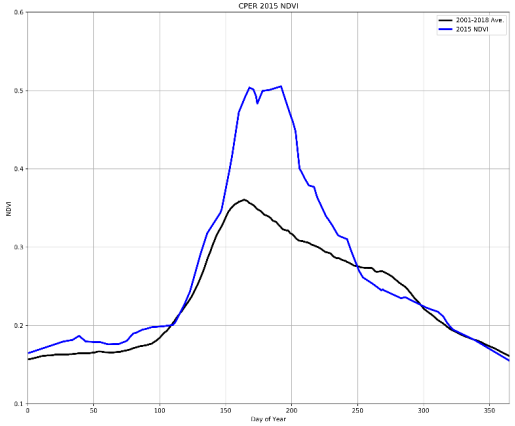
2013



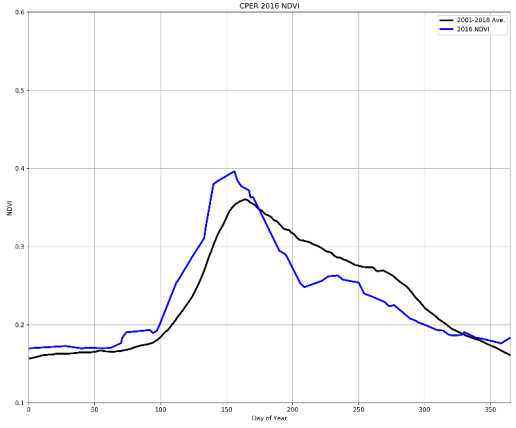
2014



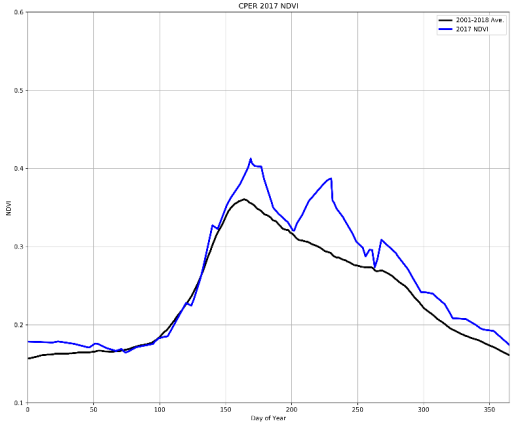
2015



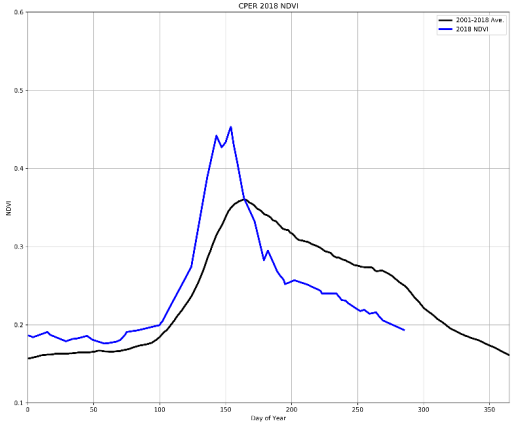
2016

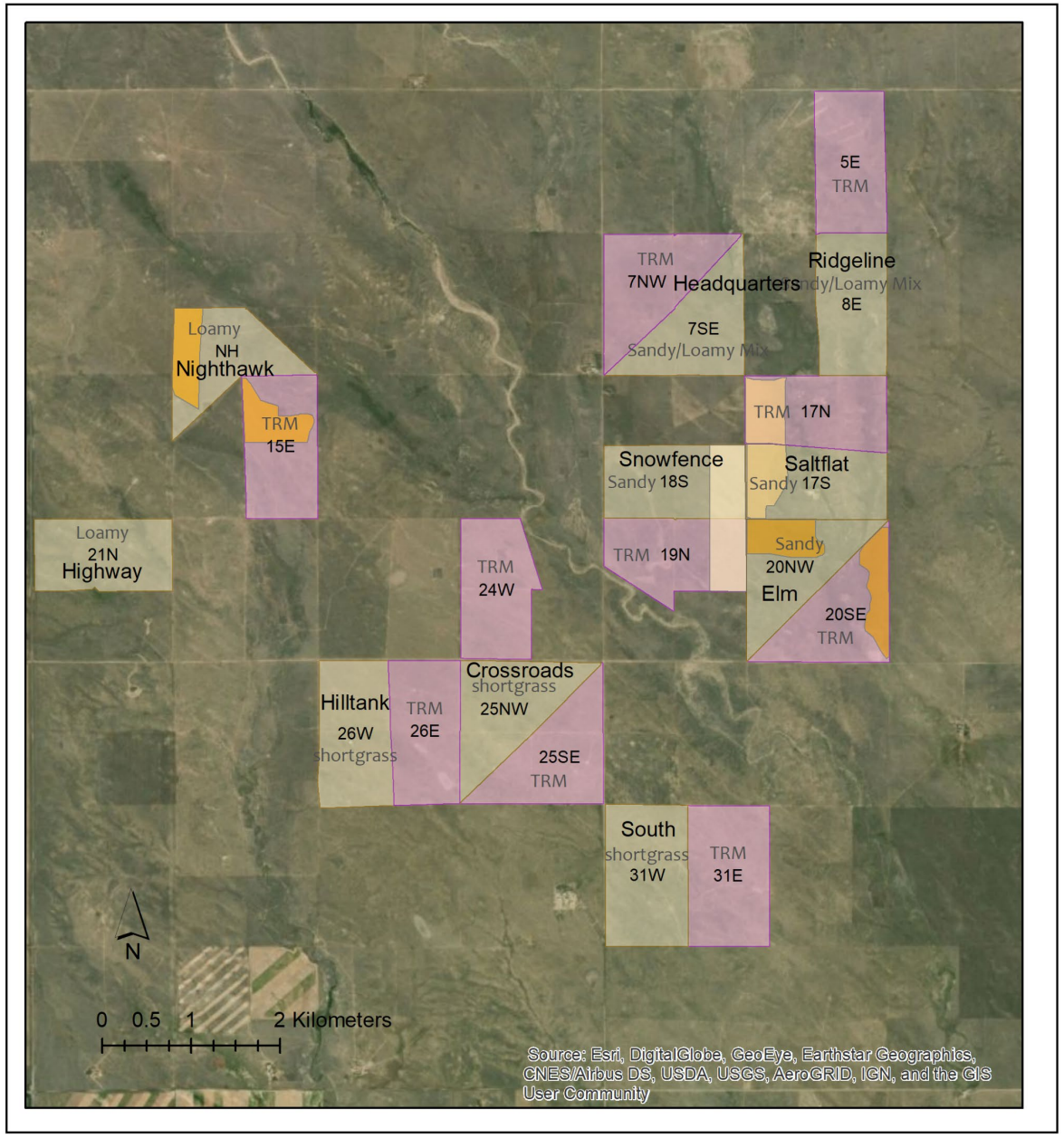


2017



2018





Legend

AGM_Pastures

- 2014 Burn 1
- 2014 Burn 2
- 2016 Burn
- 2017 Burn

Grazing

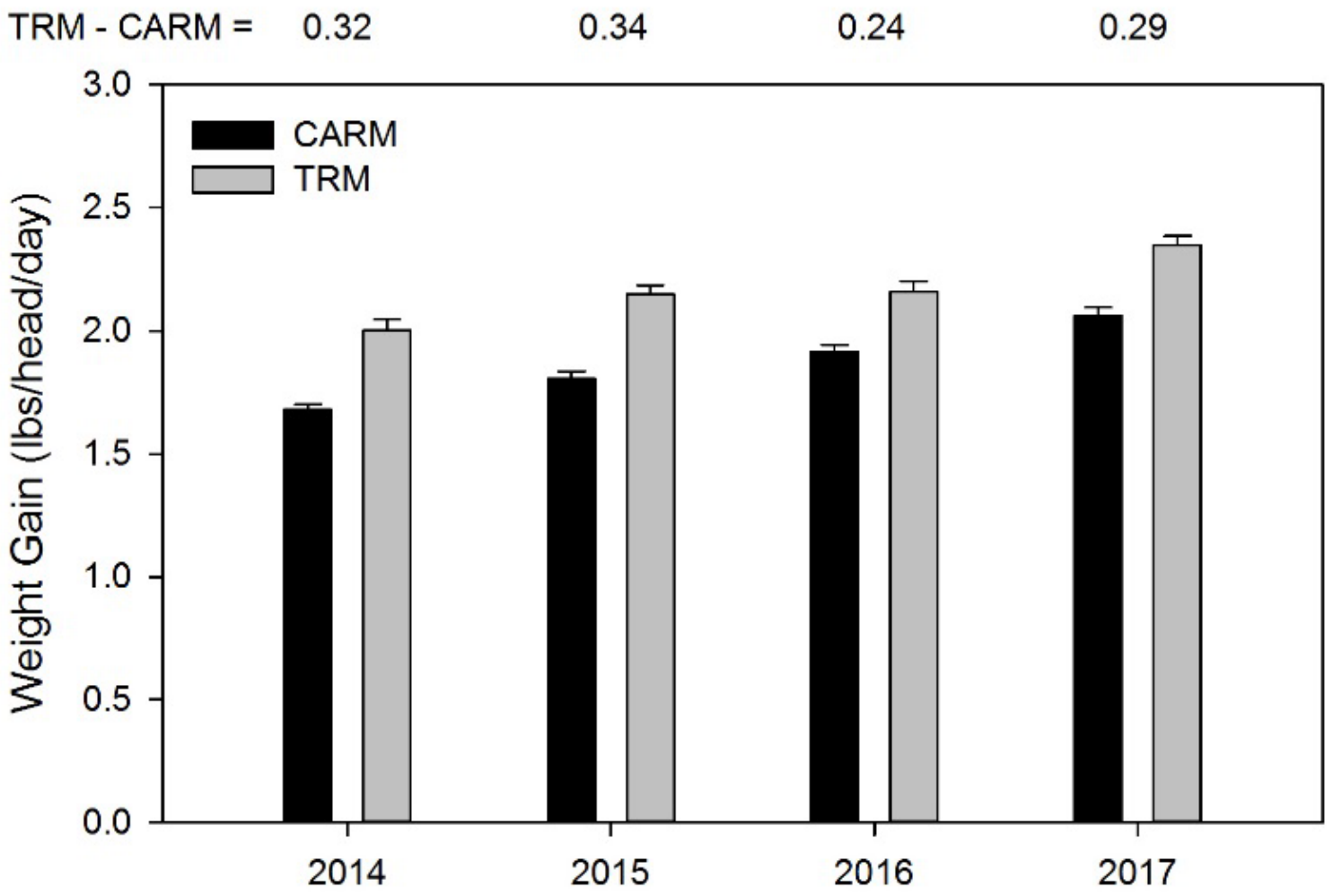
- CARM Pasture
- TRM Pasture

Historic stocking rates and pasture grazing

	2014	2015	2016	2017	2018
Stocking (# Steers)	214	224	234	244	280
CARM Pastures Grazed/Rested	7/3	4/6	7/3	9/1	9/1

Beef

Cattle Weight Gains: 2014 - 2017



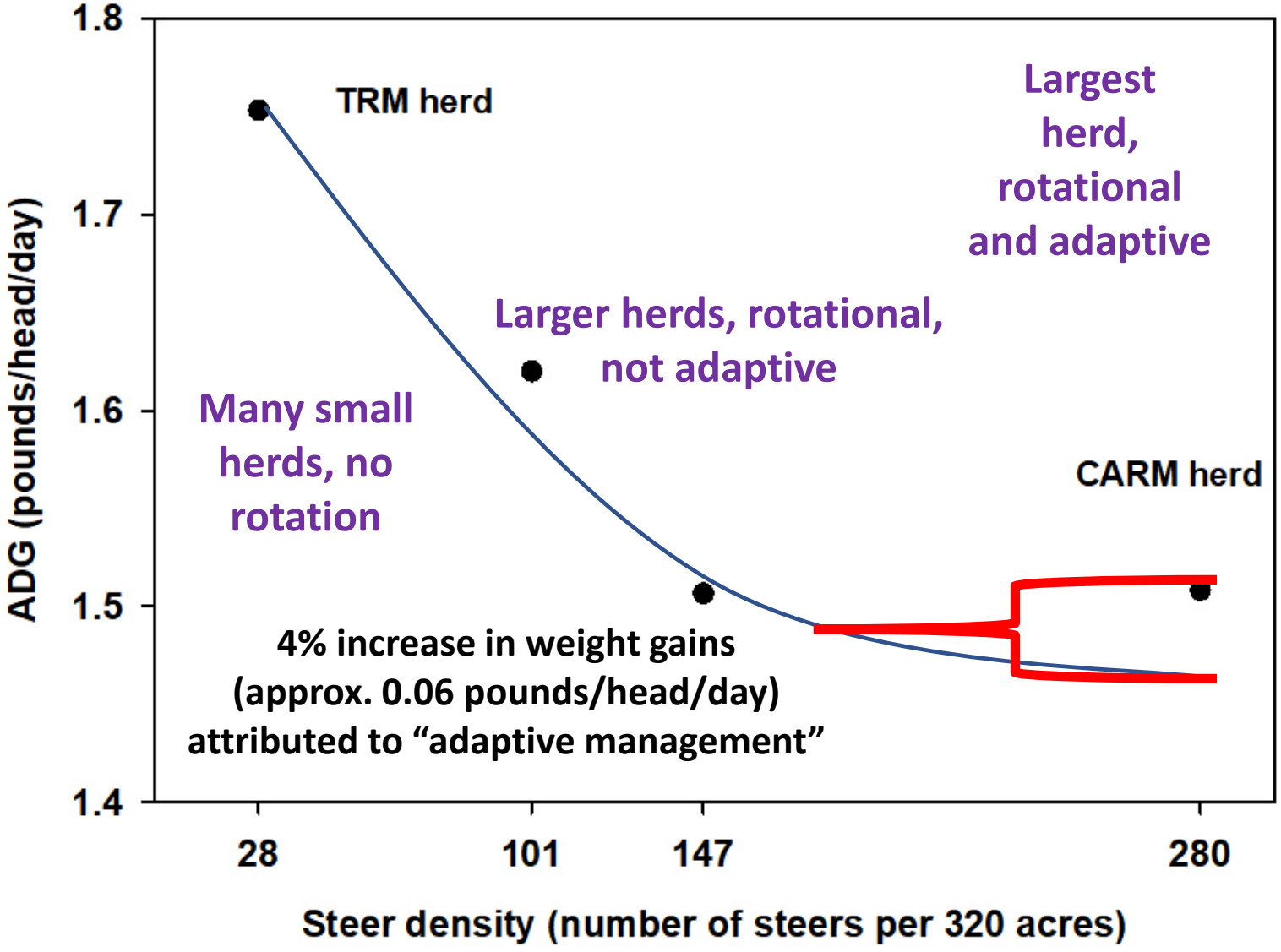
2018 Average Daily Gains (lbs/steer/day)

Treatment	ADG
TRM	1.75
CARM	1.51

- **15.9% advantage to TRM**
- **Within the 12-16% range for the difference over the past 4 years**
  - **Consistently lower in CARM across years with different environmental conditions, stocking rates, triggers for movement to next pastures, fall management practices, and pasture grazing sequences**


DEERE

Steer Density Effects on Weight Gains 2018



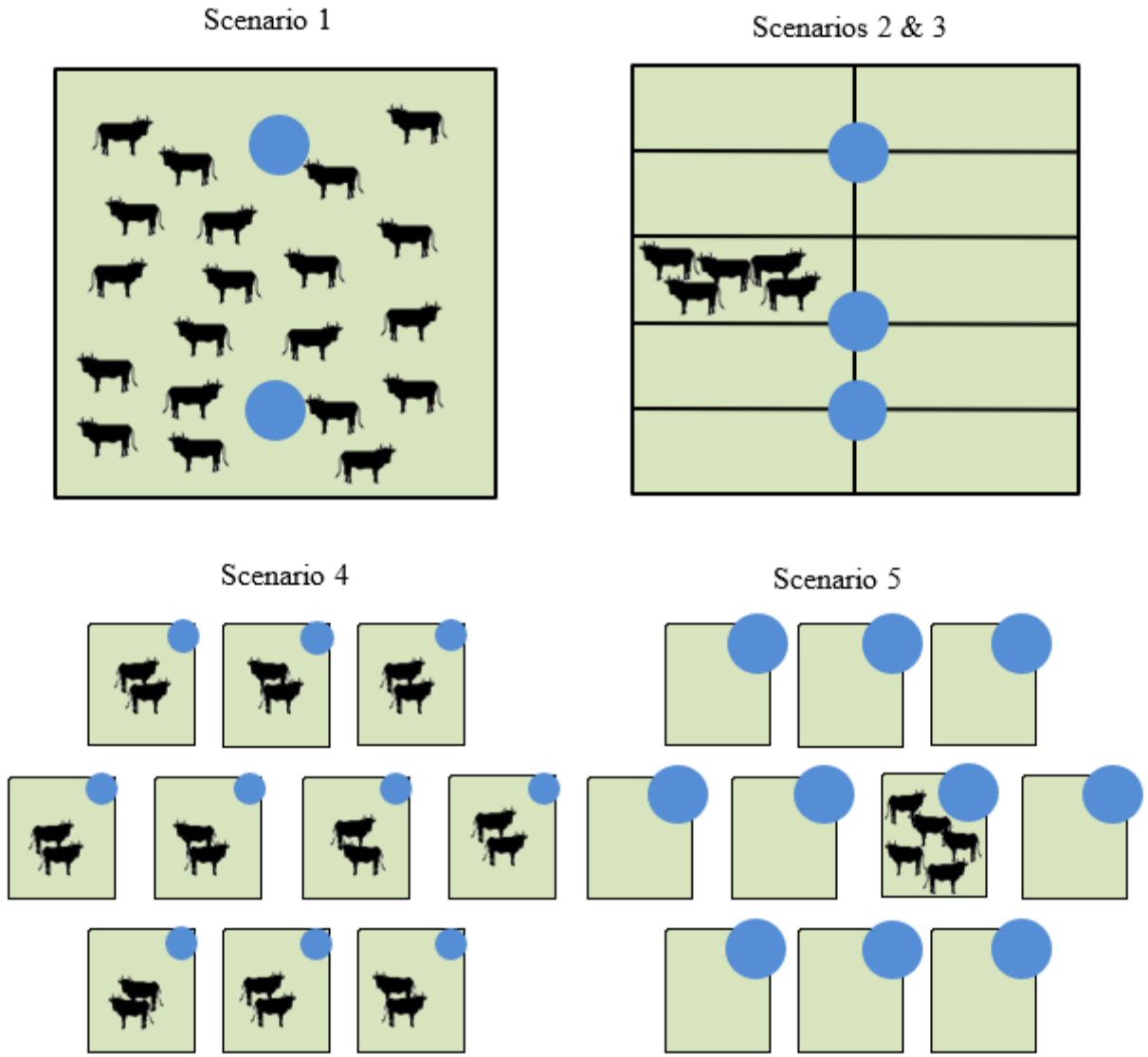


Figure 2.1. The five scenarios we use to model our costs are: 1) one large pasture, grazed continuously; 2) Scenario one, subdivided using permanent fencing, grazed rotationally; 3) Scenario one, subdivided using temporary fencing, grazed rotationally 4) ten non-contiguous pastures, grazed continuously, and 5) ten non-contiguous pastures, grazed rotationally.

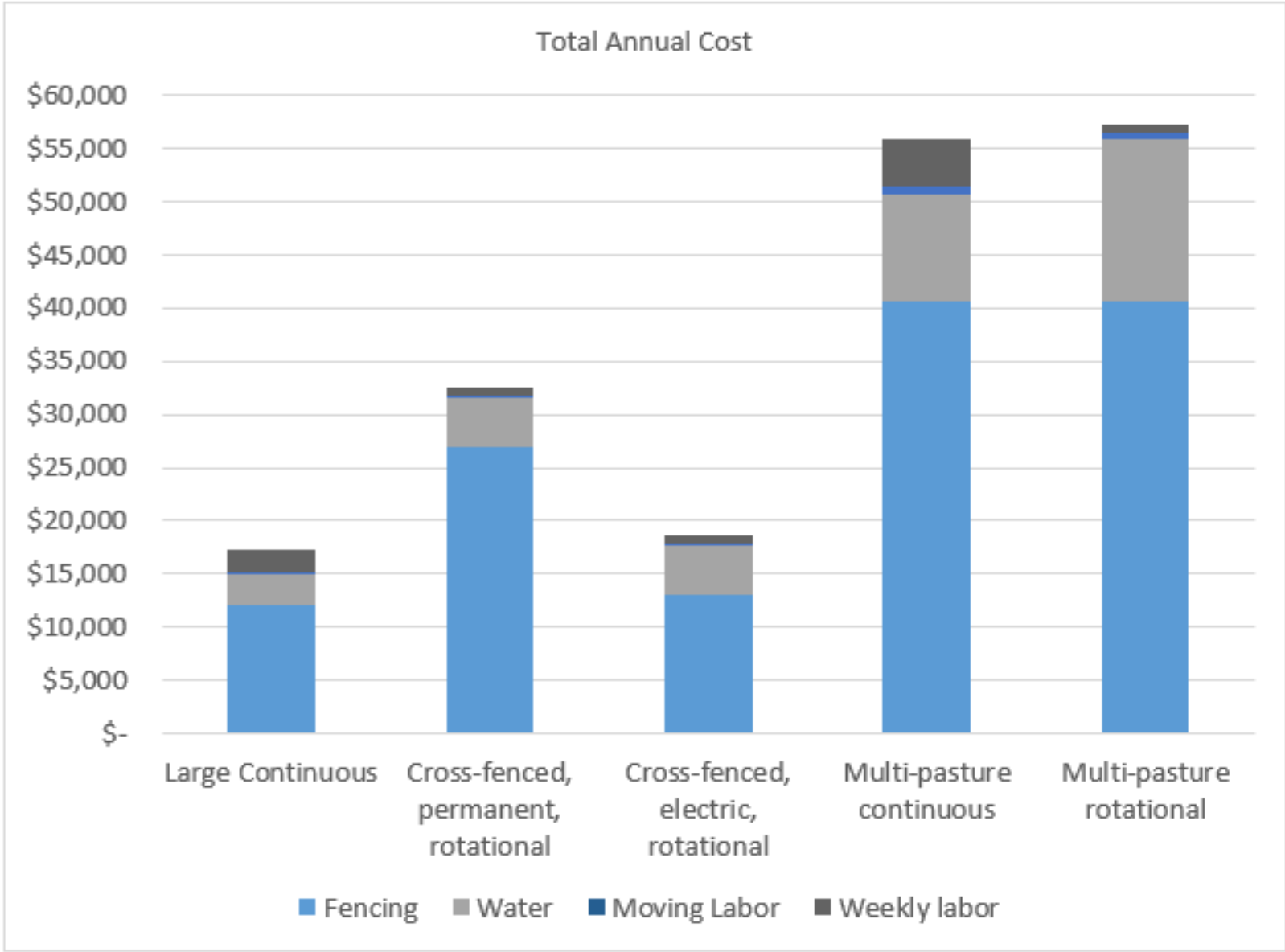


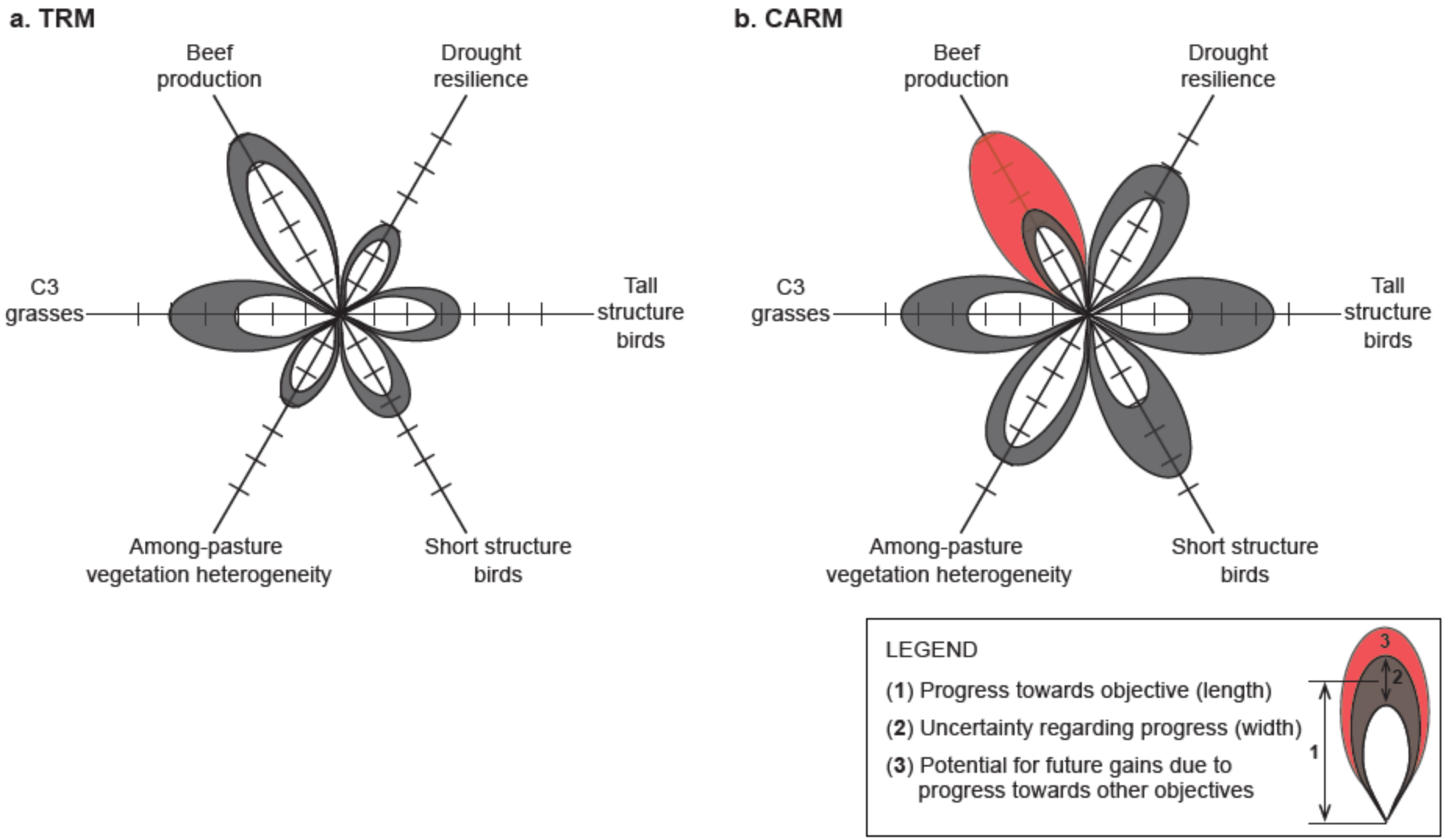
Figure 2. Total annual costs for fencing infrastructure, water infrastructure, and labor costs for each of the five scenarios.

Table 3.6 Average annual revenues by treatment

	Treatment	Net Revenue*	Total # of Steers	Total Revenue
2014	Continuous	$289.57	214	$61,969.03
	Rotational	$281.78		$60,301.98
2015	Continuous	$305.97	224	$68,536.27**
	Rotational	$302.88		$67,845.39**
2016	Continuous	$326.31	234	$76,355.83
	Rotational	$291.31		$68,100.37
2017	Continuous	$310.60	244	$75,785.22
	Rotational	$316.32		$77,181.26
2018	Continuous	$269.36	280	$75,422.17
	Rotational	$225.91		$63,254.04

*Prices used are the average estimated price based on the Monte Carlo price distributions.

**Not statistically significantly different at 95% CI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Beef production
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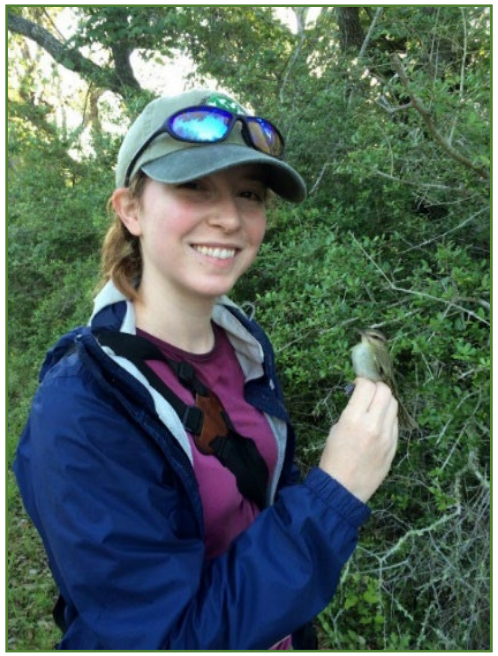
LEGEND
(1) Progress towards objective (length)
(2) Uncertainty regarding progress (width)
(3) Potential for future gains due to progress towards other objectives
1
2
3

Treatment	Pre-Drought Year	Drought Year	Post-Drought Year (Early)
Grass Banking (**managing for heterogeneity**)	**Promote cool-season perennials** **Grasshopper Sparrow** **McCown's Longspur**	**Grass Bank maintains stocking rate**	**H1: Early post-drought forage production not affected by history of grazing**
No Grass Banking (**managing for the middle**)	**Horned Lark**	**Reduce Stocking Rate (-$)**	

Treatment	Pre-Drought Year	Drought Year	Post-Drought Year (Early)
Grass Banking (**managing for heterogeneity**)	**Promote cool-season perennials** **Grasshopper Sparrow** **McCown's Longspur**	**Grass Bank maintains stocking rate**	**H2: Early post-drought forage production enhanced by grassbanking**
No Grass Banking (**managing for the middle**)	**Horned Lark**	**Reduce Stocking Rate (-$)**	

Birds

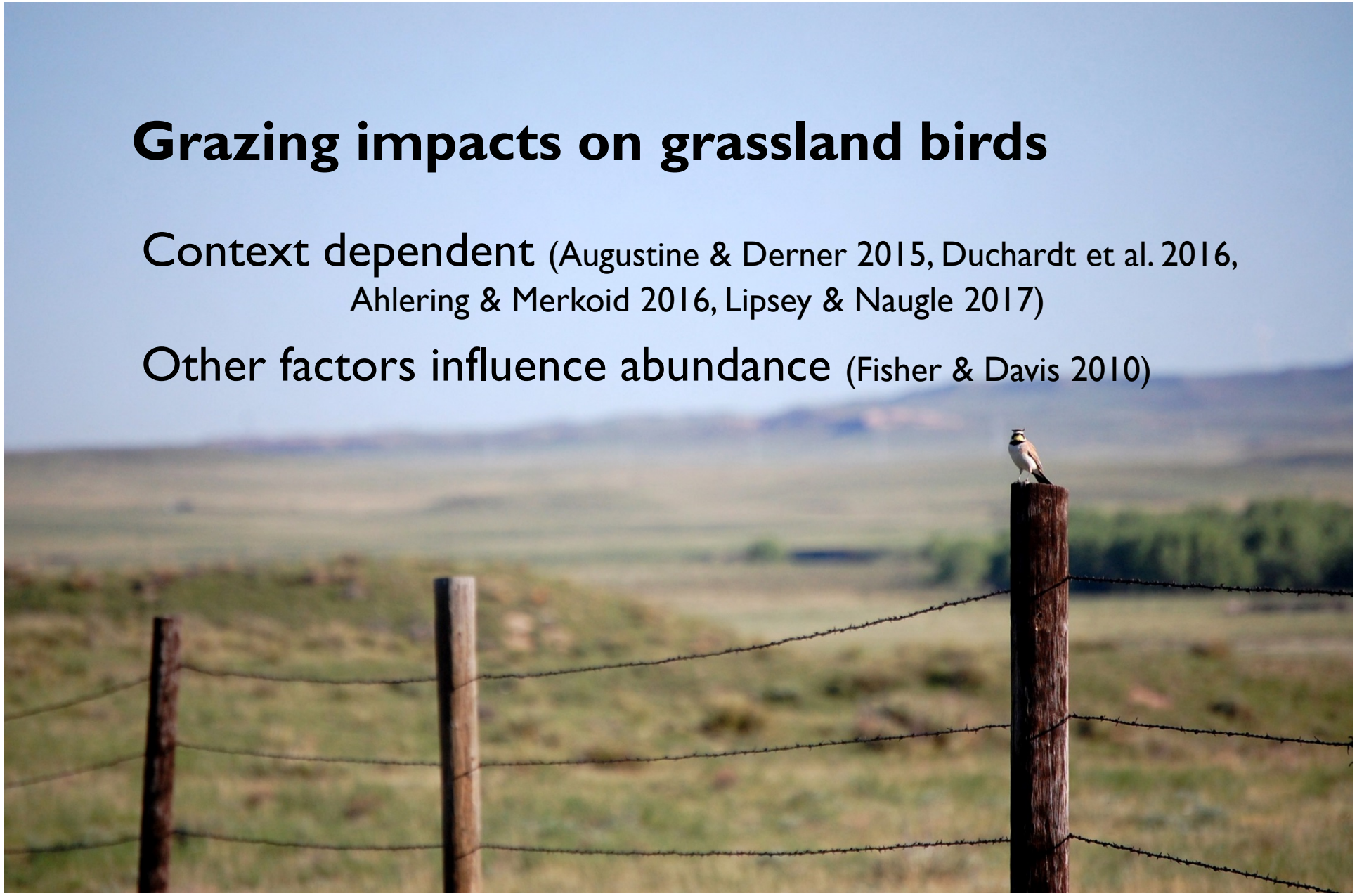


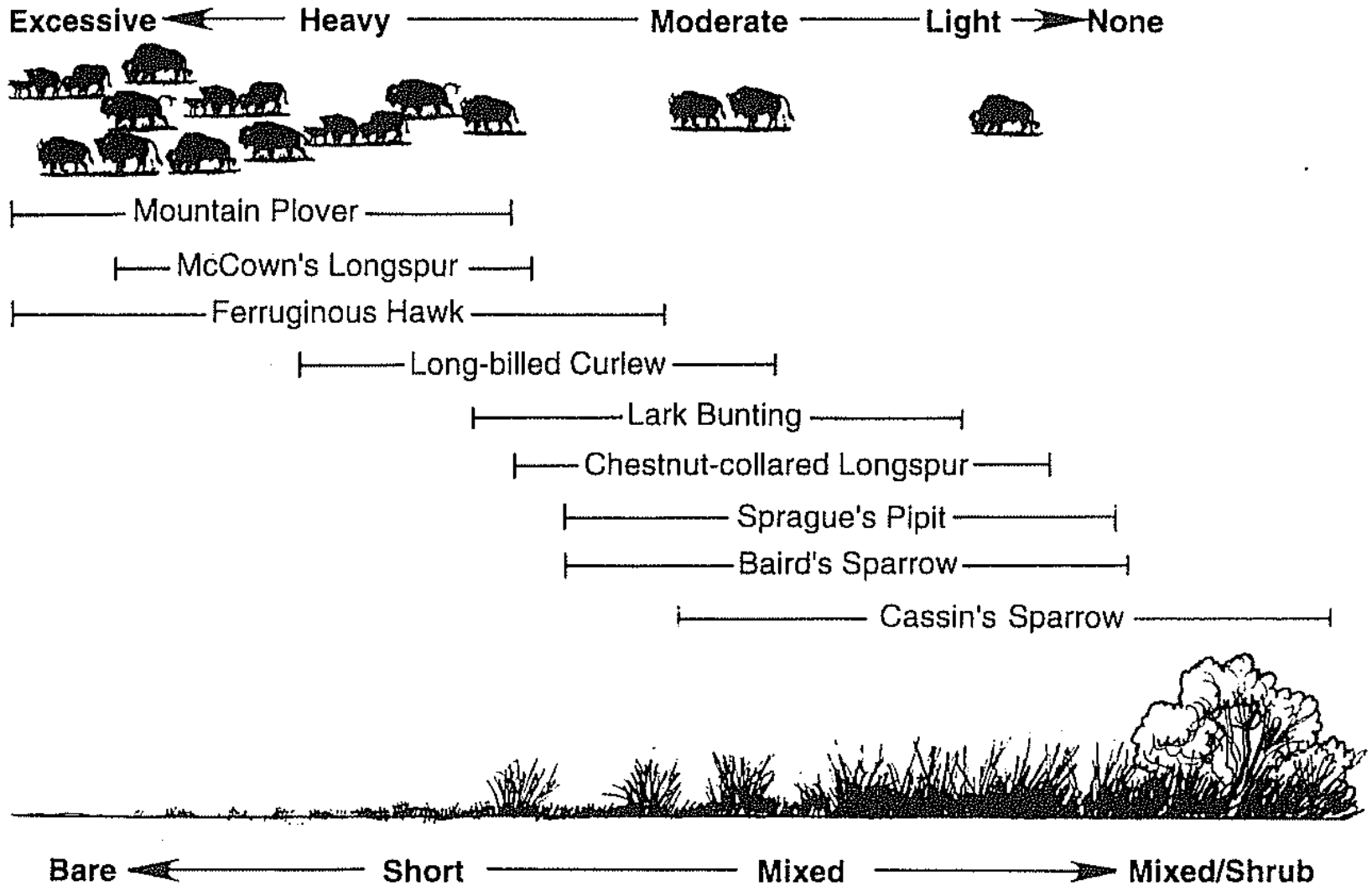
Running head: Grazing management and grassland birds

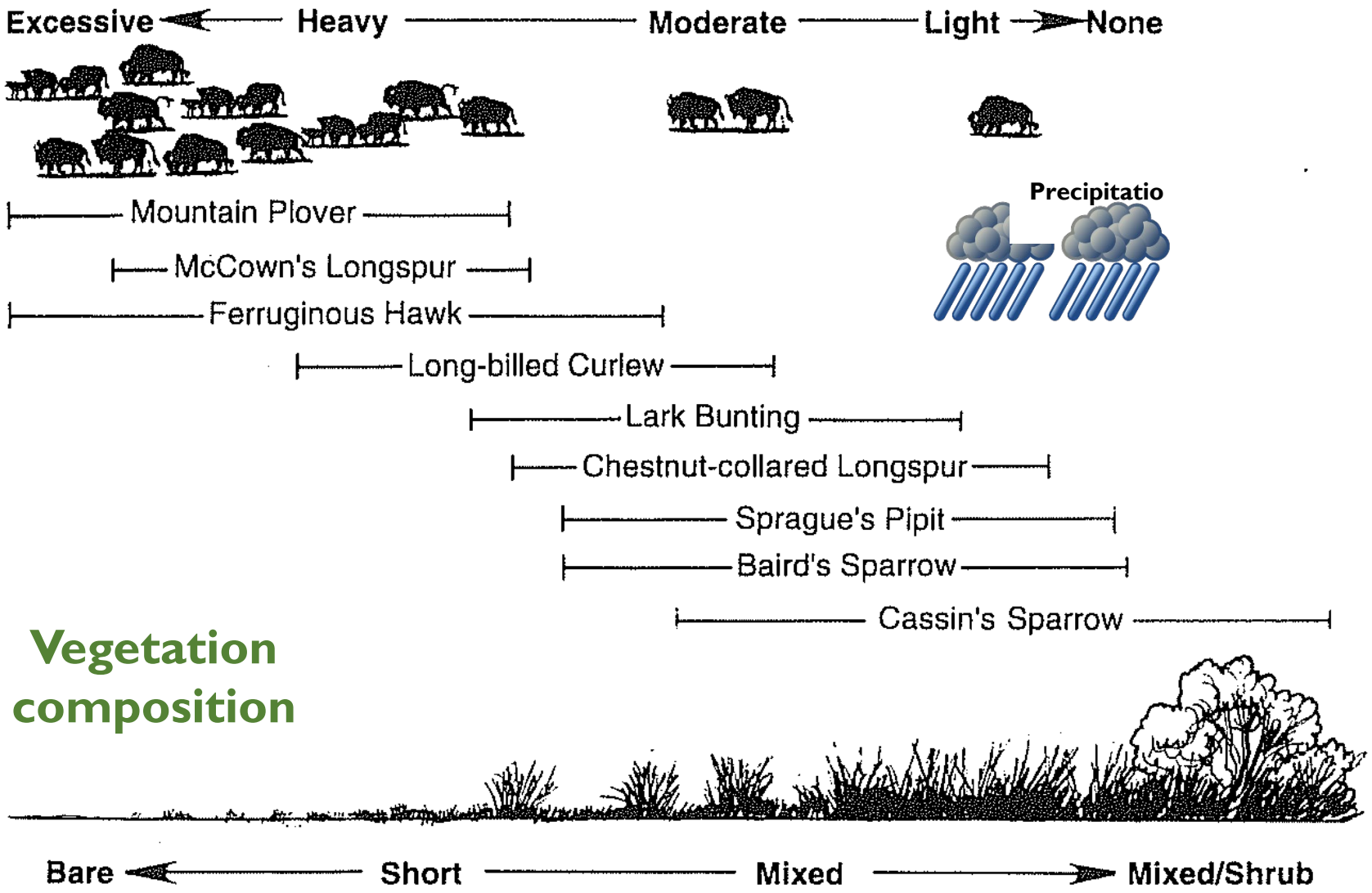
Title: Adaptive rangeland management benefits grassland birds utilizing opposing vegetation structure in the shortgrass steppe.

Authors:
Kristin P. Davis, Adrian P. Moore, and Cameron L. Aldridge:
Natural Resource Ecology Laboratory and Department of Ecosystem Science and Sustainability, Colorado State University, and USGS Fort Collins Science Center

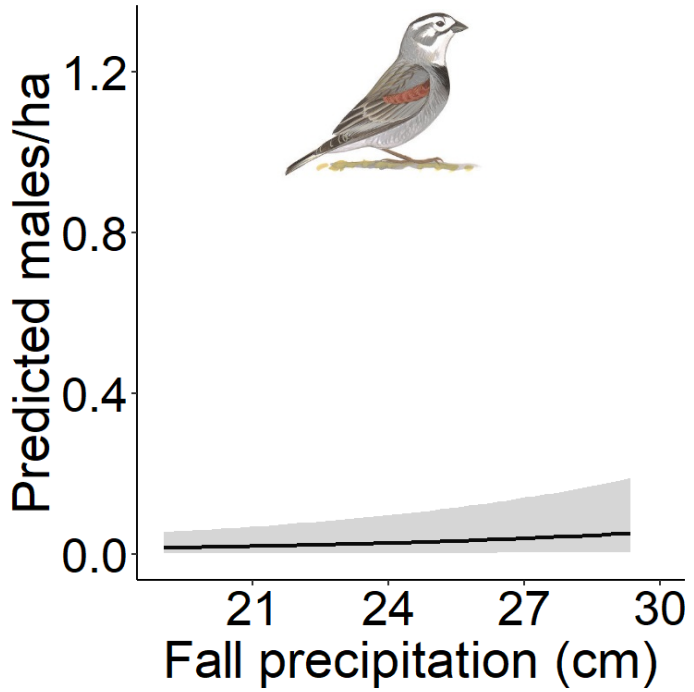
David J. Augustine and Justin D. Derner:
USDA-ARS Rangeland Resources and Systems Research Unit, Fort Collins CO/Cheyenne WY

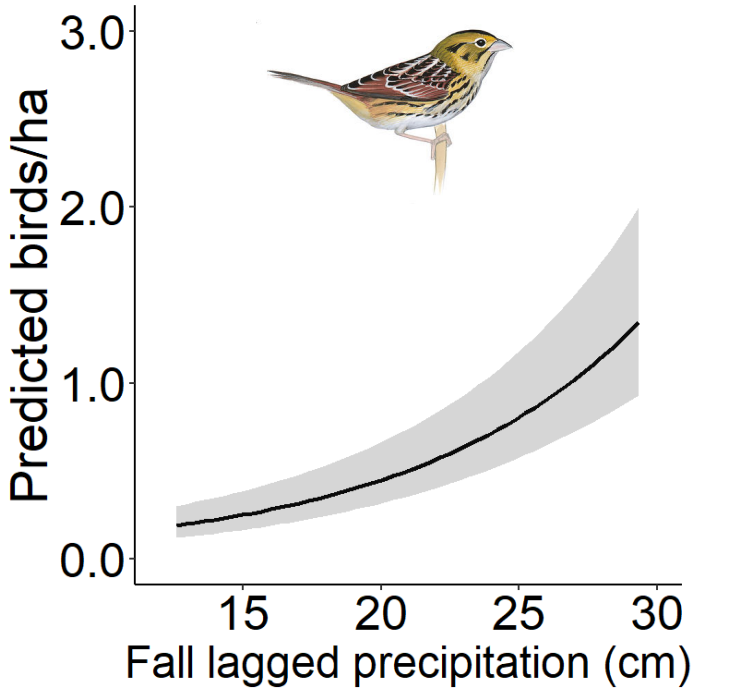

Grazing impacts on grassland birds
Context dependent (Augustine & Derner 2015, Duchardt et al. 2016, Ahlering & Merkoid 2016, Lipsey & Naugle 2017)
Other factors influence abundance (Fisher & Davis 2010)


Excessive
Heavy
Moderate
Light
None
Mountain Plover
McCown's Longspur
Ferruginous Hawk
Long-billed Curlew
Lark Bunting
Chestnut-collared Longspur
Sprague's Pipit
Baird's Sparrow
Cassin's Sparrow
Bare
Short
Mixed
Mixed/Shrub


Excessive
Heavy
Moderate
Light
None
Precipitatio
Mountain Plover
McCown's Longspur
Ferruginous Hawk
Long-billed Curlew
Lark Bunting
Chestnut-collared Longspur
Sprague's Pipit
Baird's Sparrow
Cassin's Sparrow
Vegetation composition
Bare
Short
Mixed
Mixed/Shrub

Responses to Year-to-year Variation in Rainfall

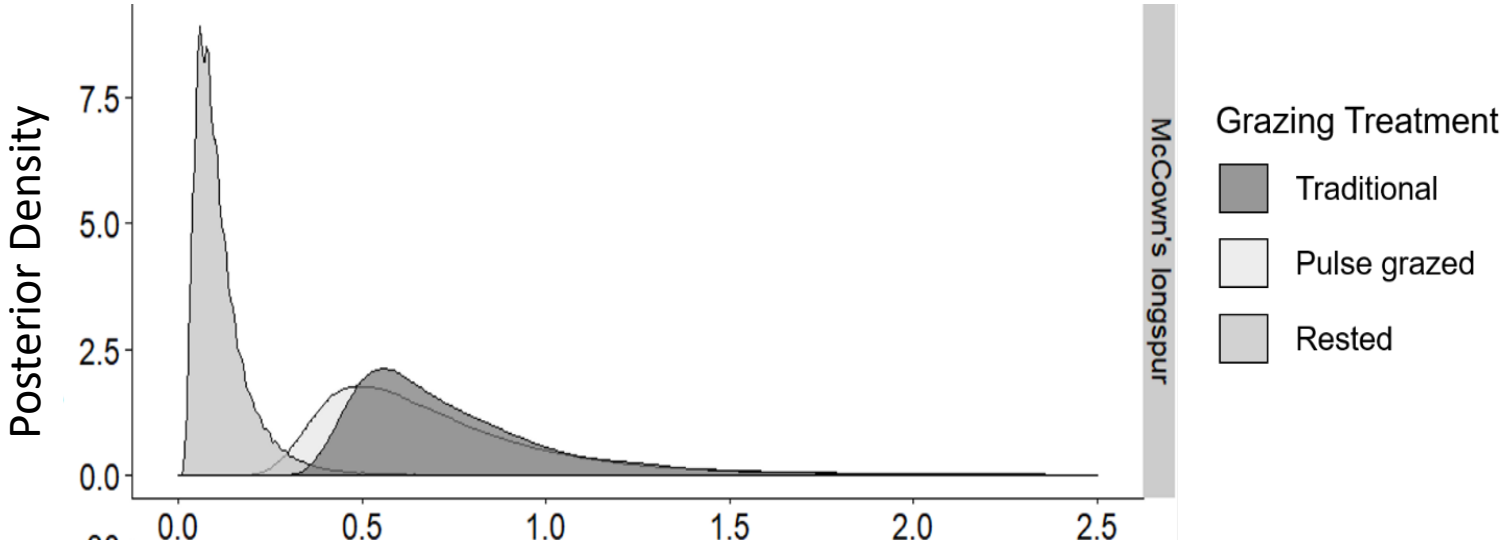




<u>McCown's Longspur:</u>
Nests in shortgrass;
Not much response to variation in rainfall

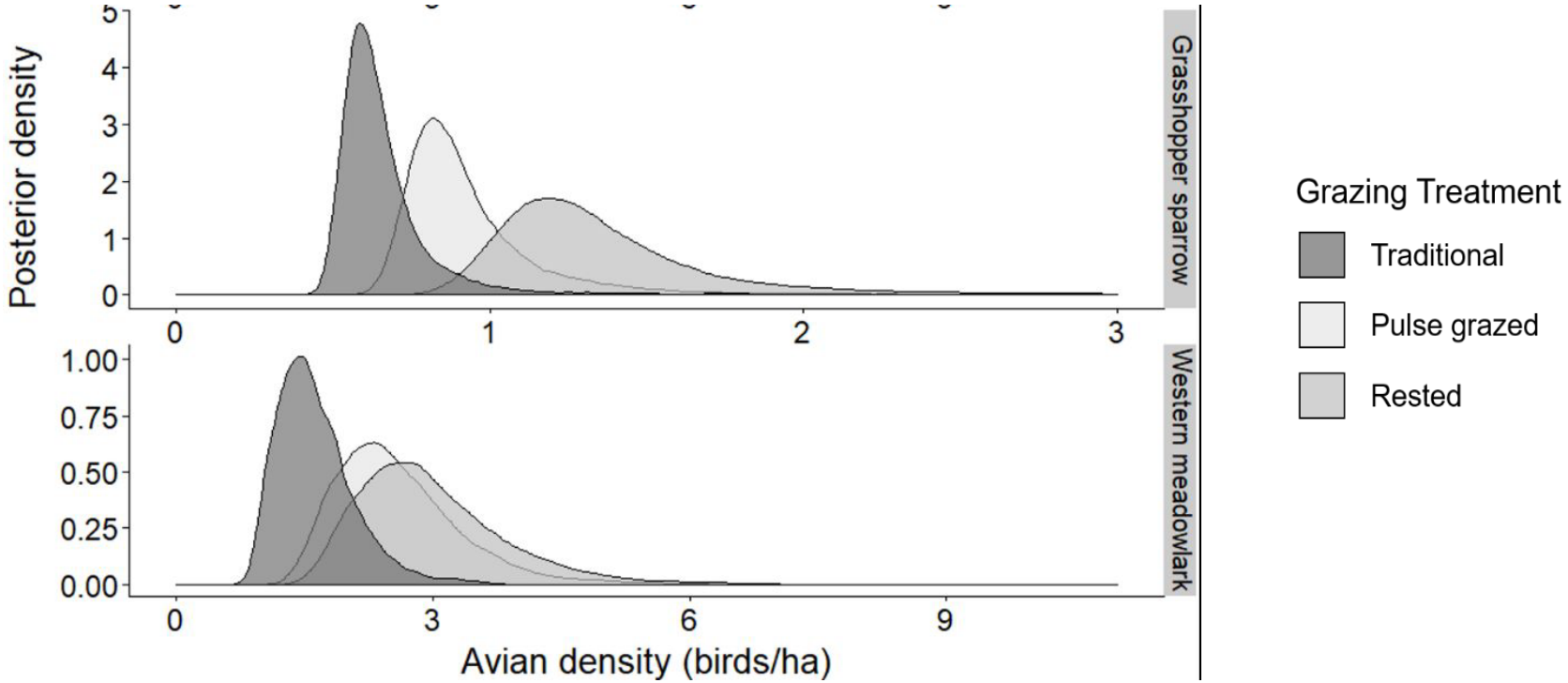
<u>Grasshopper Sparrow:</u>
Nests in midgrasses;
Large increase in abundance
Following wet years

Resting pastures (on loamy ecological site) results in significantly lower McCown's Longspur density in the next year



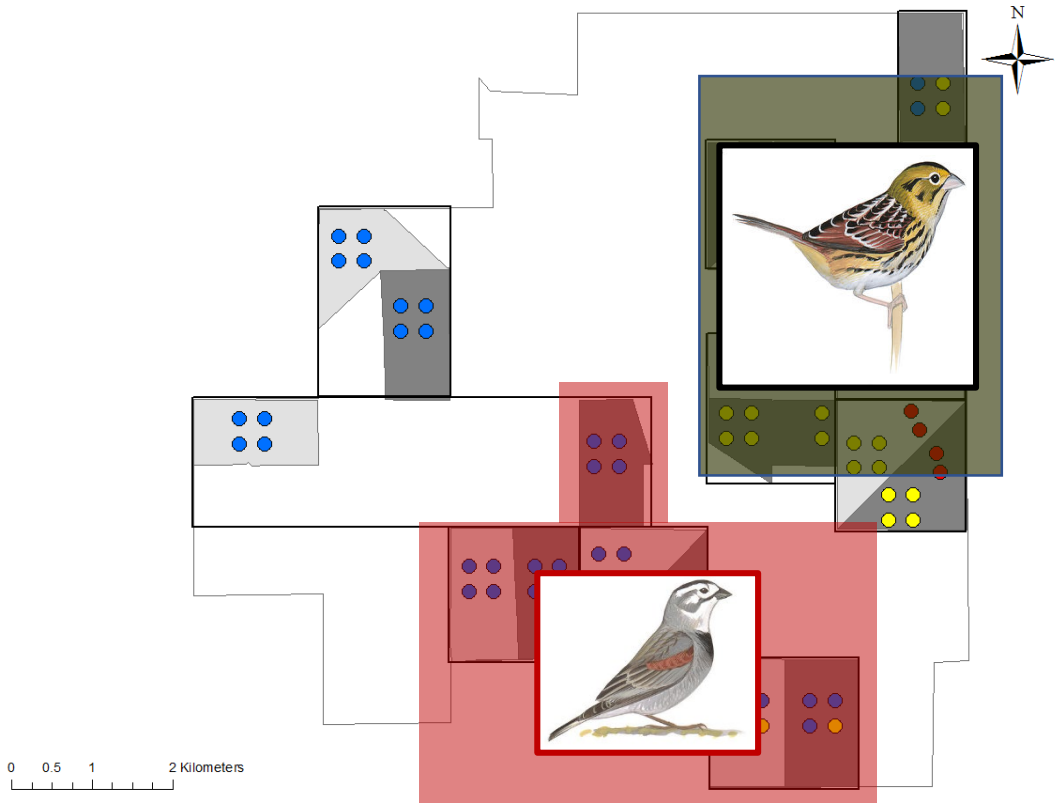
McCown's Longspur Density (Males/ha)

Resting pastures significantly increases grasshopper sparrow density




What have we learned?
1. Grazing management matters, but so does the environment.
2. Grazing impacts may be constrained, but this enables management tailored to site characteristics.
Nicole Kaplan

Spatial Prioritization




If you graze it
They MAY come

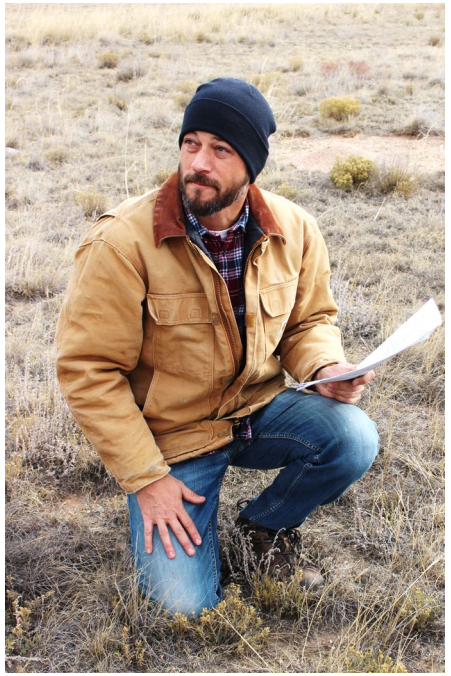
Hope

Nick Dufek

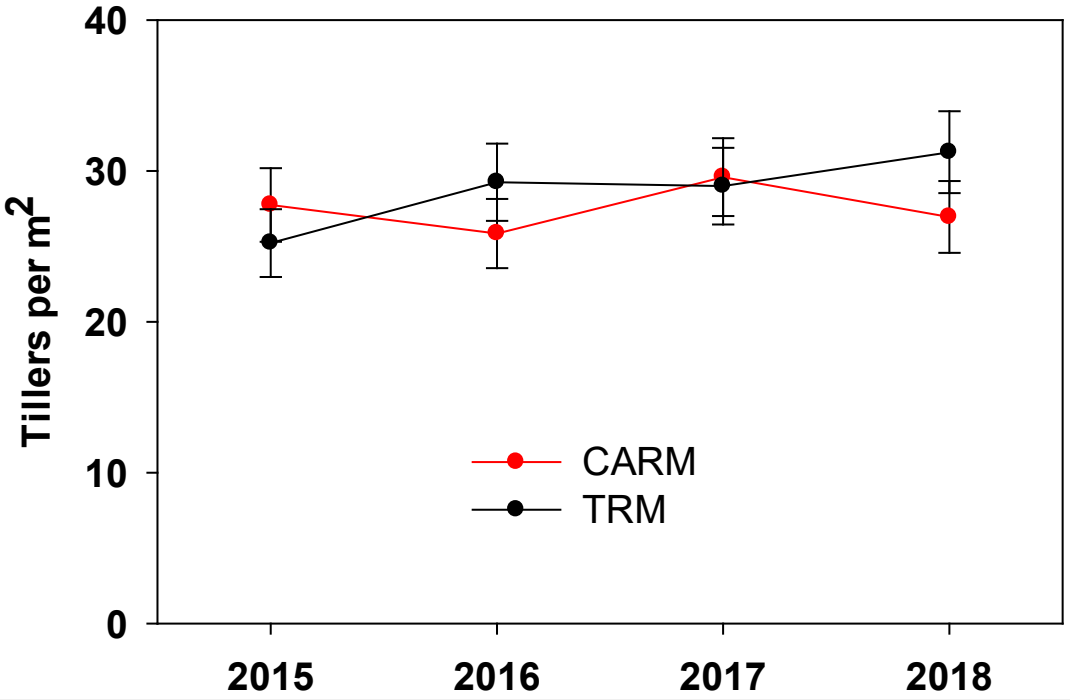
Vegetation

Responses of key plant species to CARM:

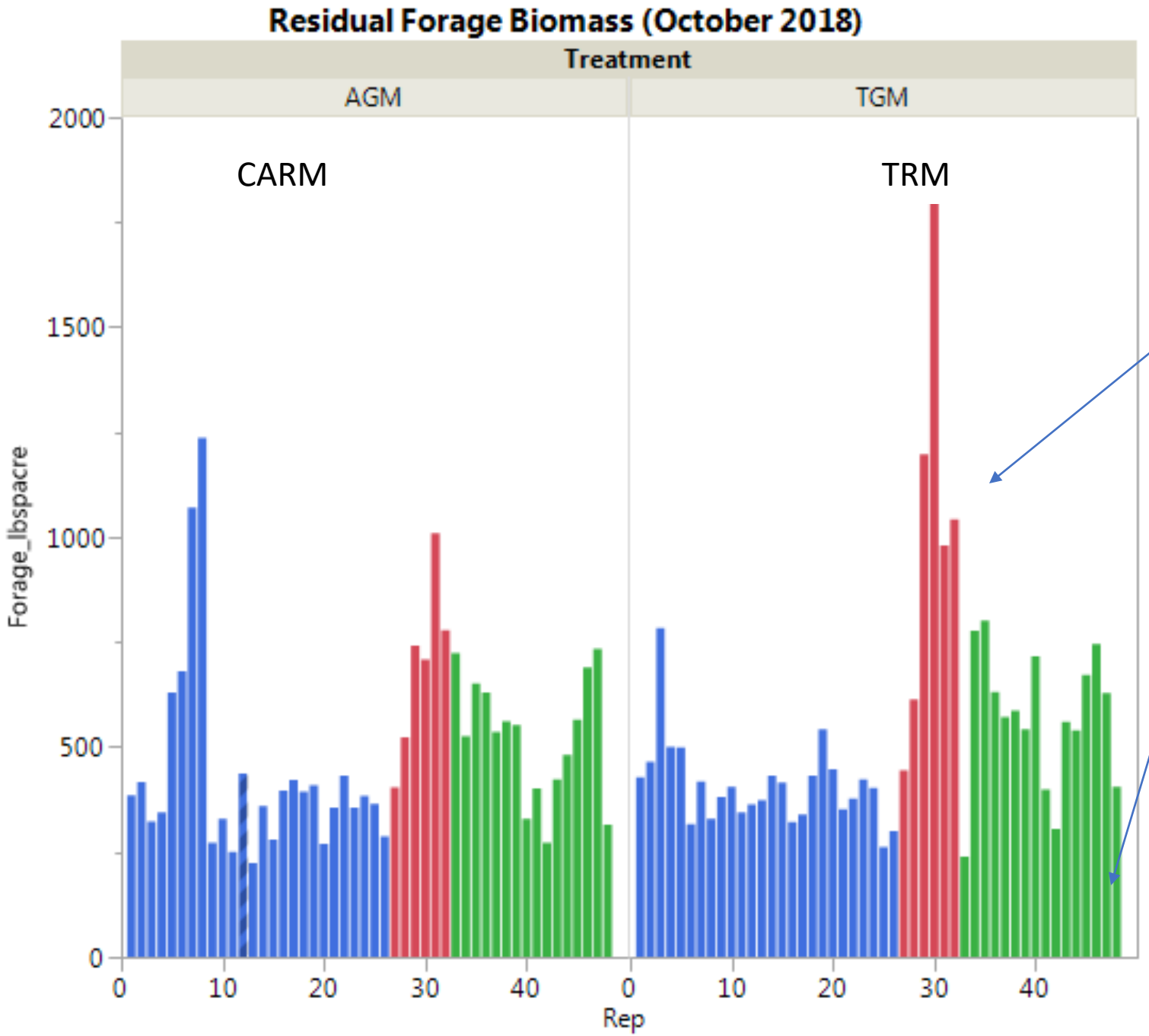
Generalized linear mixed models for densities of individual species, incorporating repeated measures (same pastures measured each year) and randomized block design (pastures paired based on initial conditions). All models used 2013 and 2014 density estimates as pre-treatment covariates, and test for CARM effect during 2015 – 2018.



Western Wheatgrass Tiller Density: Effect of CARM?



Type III Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	1	351	0.68	0.4085
Year	3	350.2	1.07	0.3638
Year*Treatment	3	350.2	1.57	0.1953
LogPASM201314	1	359	2748.83	<.0001



Mean October biomass per plot

Ecosite

- Loamy
- Salt Flats
- Sandy

Among-Plot Variance

	CARM	TRM
Loamy	55	10
Salt Flats	44	250
Sandy	21	27

Social Learning

Na

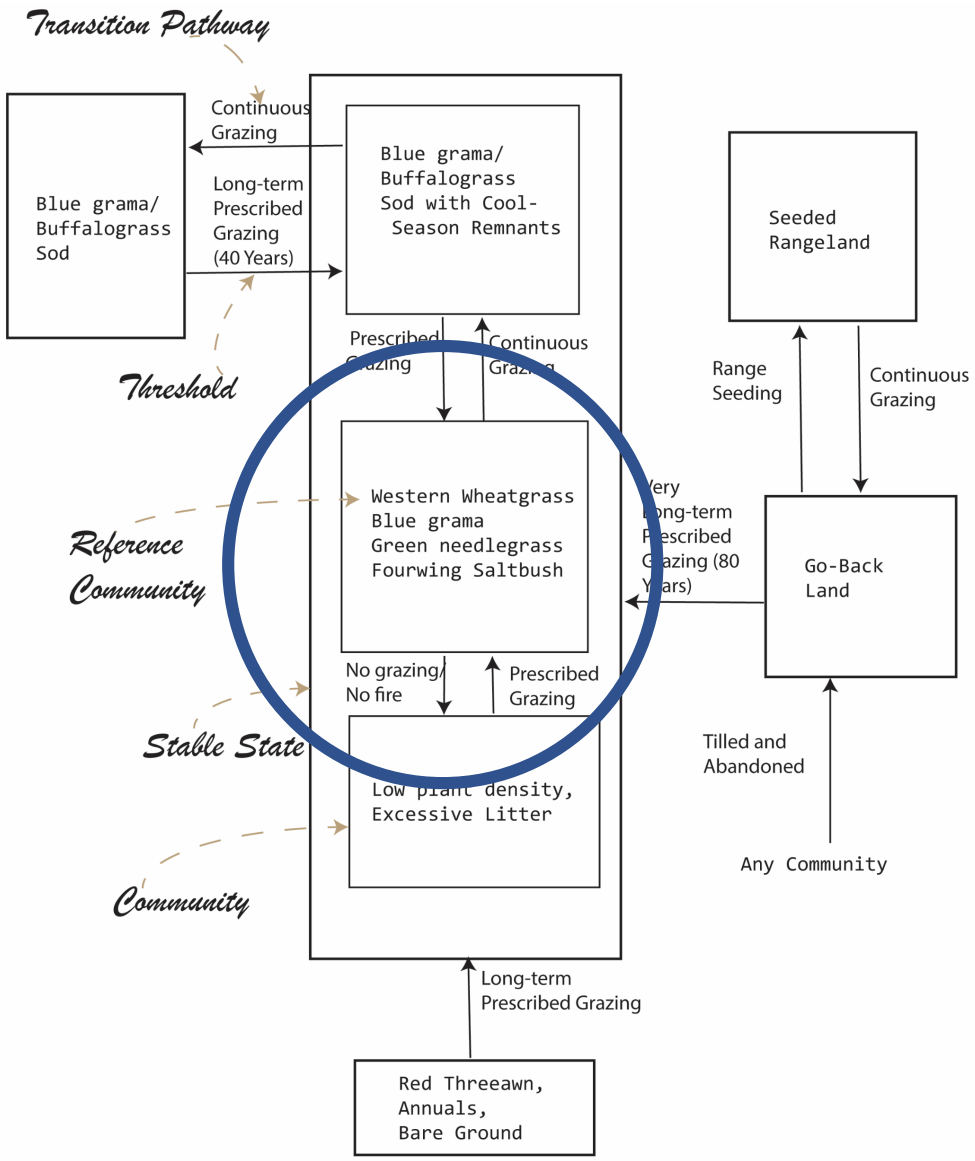

Sense of Place
Hope

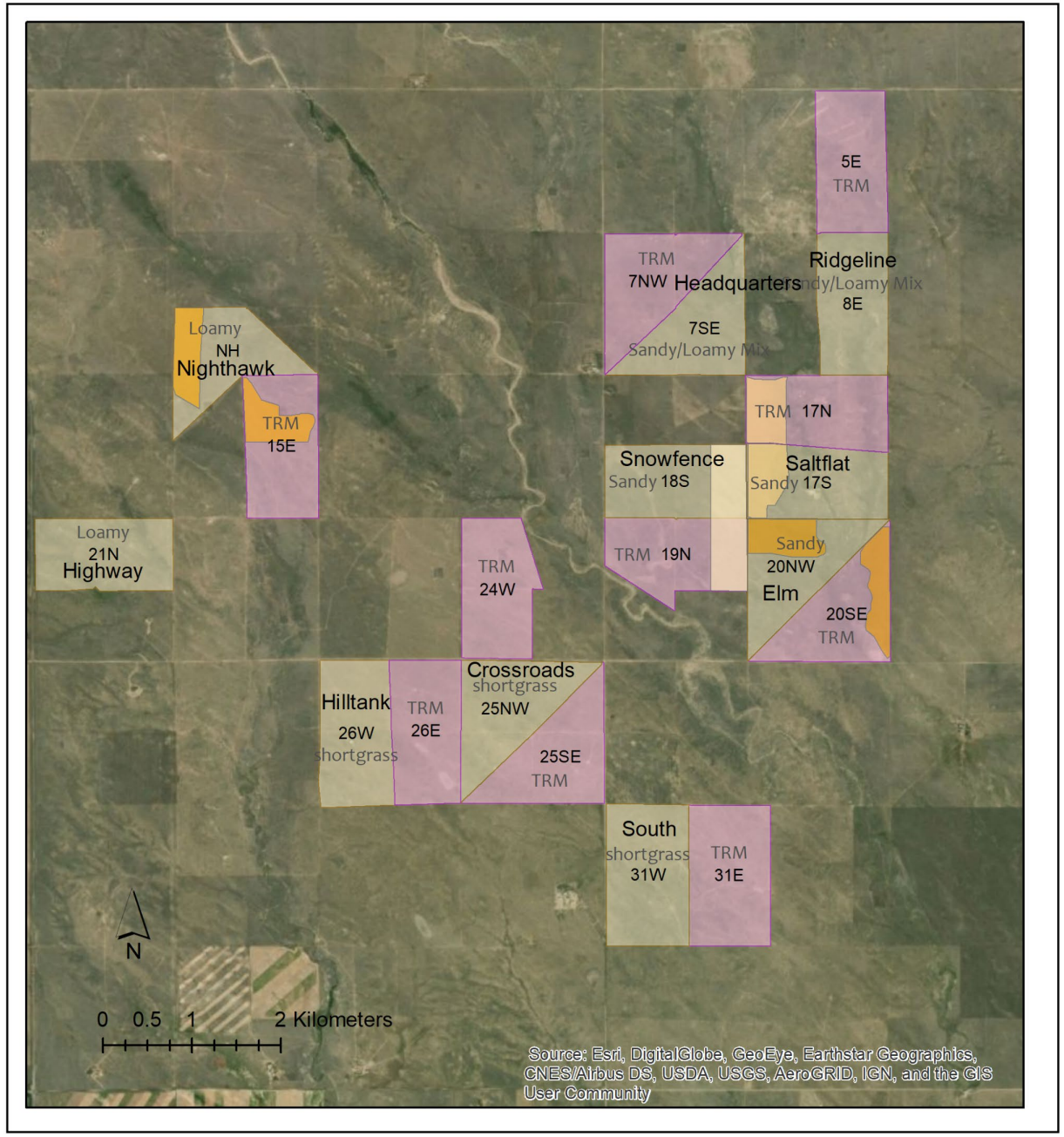
Vegetation objective	
2012	“Increase percentage of cool-season grasses and non-shortgrass native plants, by weight and number of plants.”
Revised (2018)	A) “Attain and/or maintain abundances of cool-season perennial graminoids within 30% of 2015 targets”. This is specific to sandy, loamy and shortgrass-specific sites for each plot using a three-year running average to assess trends. B) “Maintain or increase plant compositional diversity both within and across pastures using a three-year running average to assess trend.”

McCown's Longspur Objective	
2012	"Maintain populations of McCown's Longspur, Western Meadow Lark and Horned Lark." In the proposed revised objectives, the team established an individual objective for the Longspur because of the exceptional rate of population decline for that species."
Revised (2018)	"Create or maintain high-quality breeding habitat for McCown's Longspurs on 20 – 40% of the total landscape. Prioritize management for McCown's Longspur habitat on loamy ecological sites with flat or gently rolling uplands (shortgrass target areas)"


Sense of Place
Hope


Sense of Place
Hailey Wilmer


Transition Pathway
Blue grama/
Buffalograss
Sod
Continuous
Grazing
Long-term
Prescribed
Grazing
(40 Years)
Blue grama/
Buffalograss
Sod with Cool-
Season Remnants
Threshold
Prescribed
Grazing
Continuous
Grazing
Seeded
Rangeland
Range
Seeding
Continuous
Grazing
Reference
Community
Western Wheatgrass
Blue grama
Green needlegrass
Fourwing Saltbush
Very
Long-term
Prescribed
Grazing (80
Years)
Go-Back
Land
No grazing/
No fire
Prescribed
Grazing
Stable State
Low plant density,
Excessive Litter
Tilled and
Abandoned
Any Community
Community
Long-term
Prescribed Grazing
Red Threeawn,
Annuals,
Bare Ground



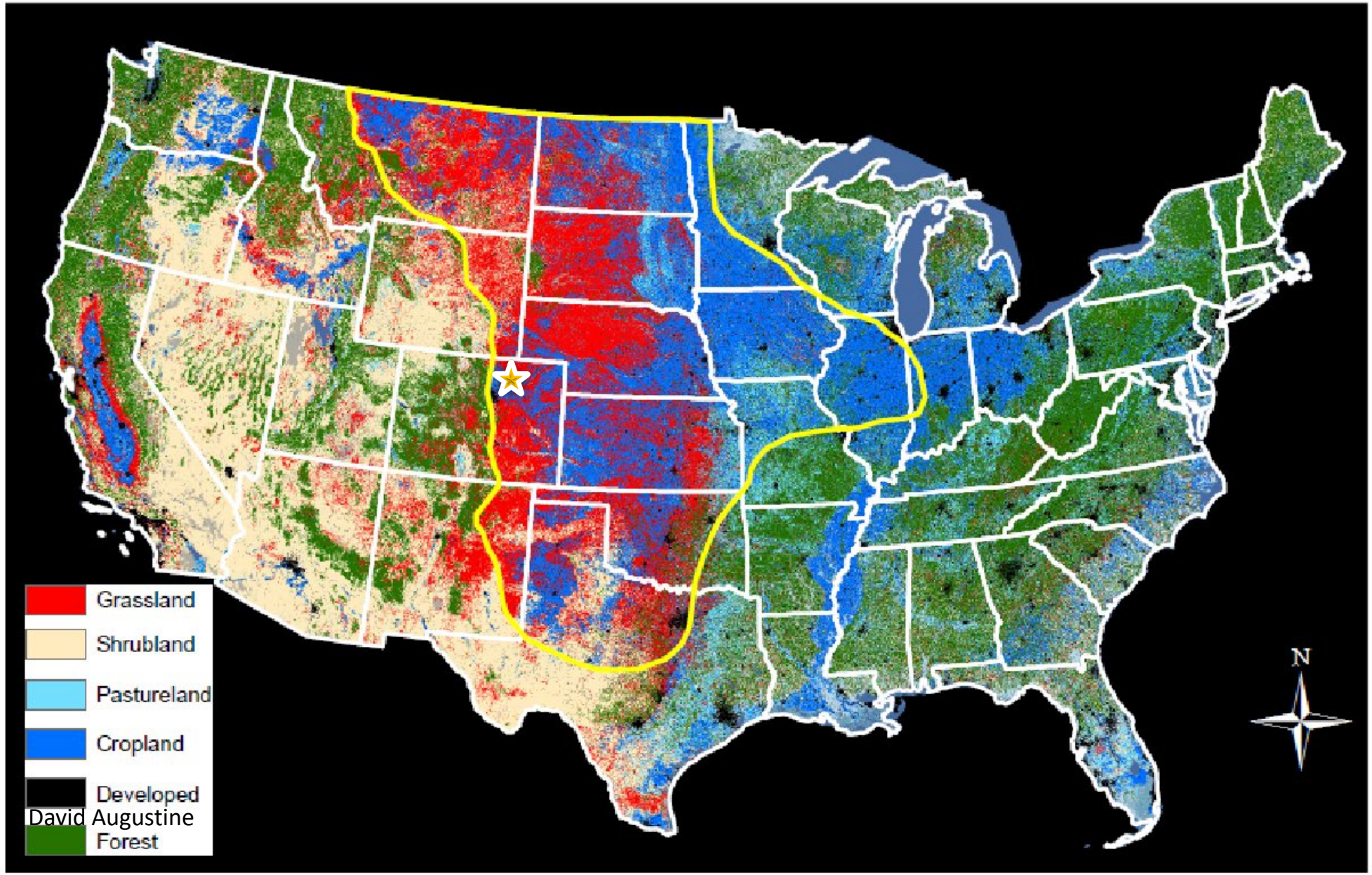
Legend

AGM_Pastures

- 2014 Burn 1
- 2014 Burn 2
- 2016 Burn
- 2017 Burn

Grazing

- CARM Pasture
- TRM Pasture



David Augustine

A v

Natureculture

Sense of Place

Natureculture

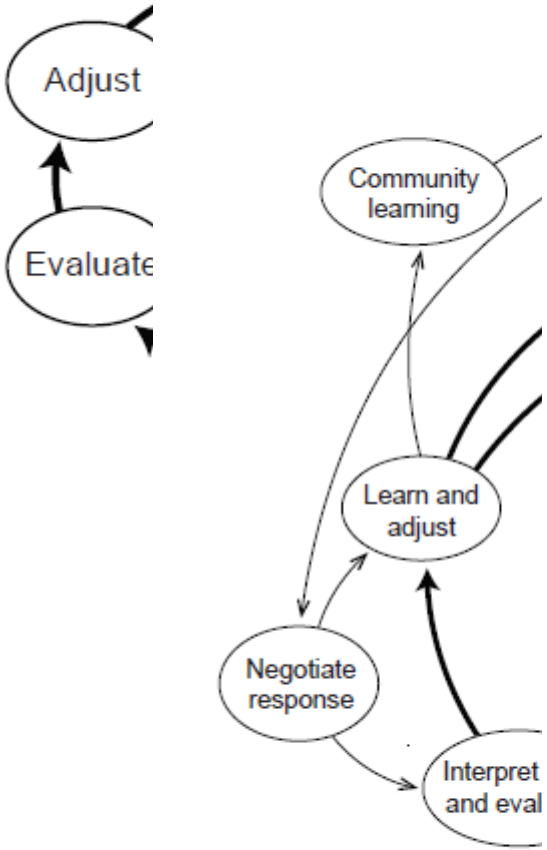
Hope

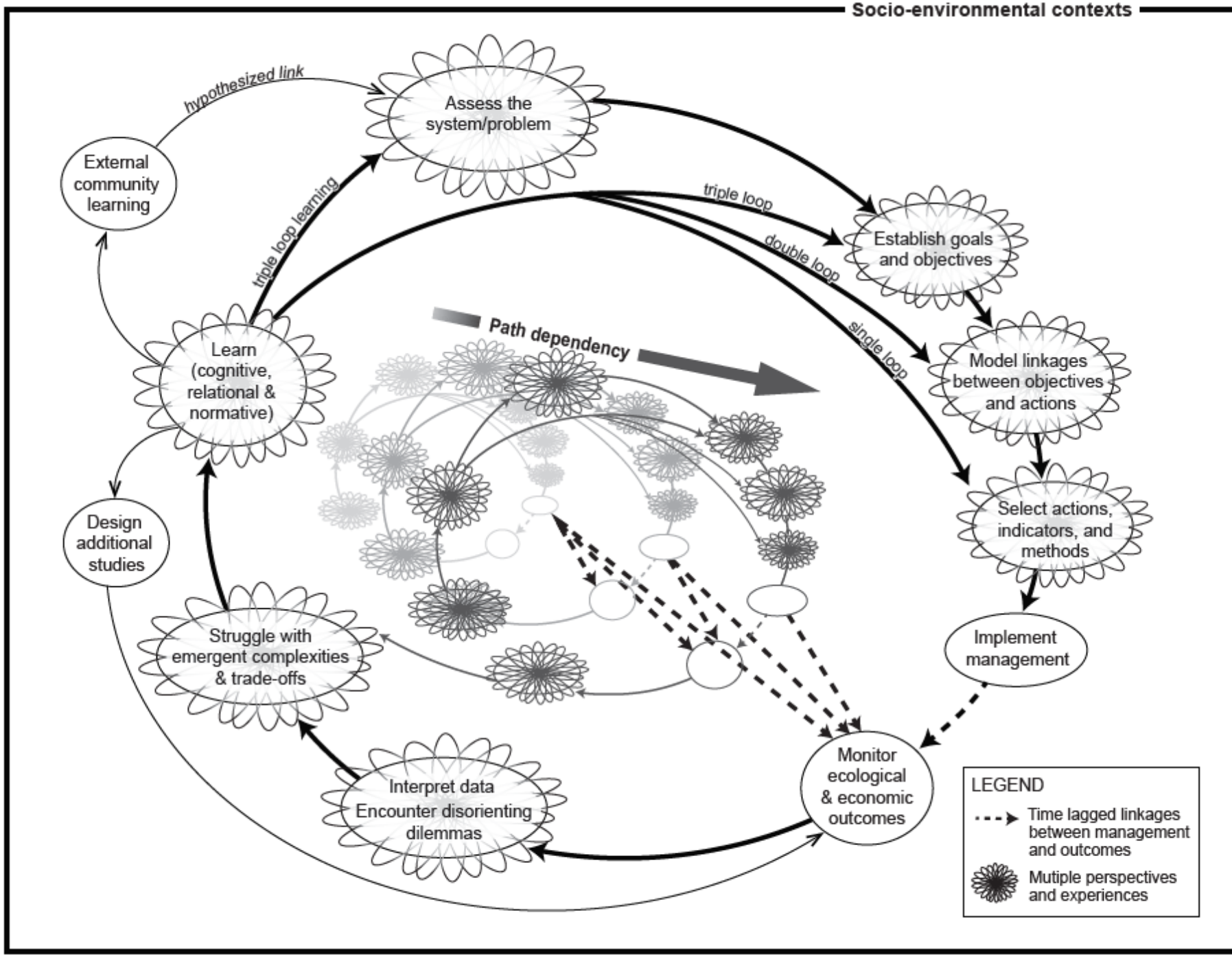
Tim Cox: “Maybe it will be a good year”

Hailey Wilmer

1a. Idealized adaptive man

1b. Hypothesized col
Council (2013).





TEXAS A&M
UNIVERSITY

WARNER COLLEGE
OF NATURAL RESOURCES
COLORADO STATE UNIVERSITY

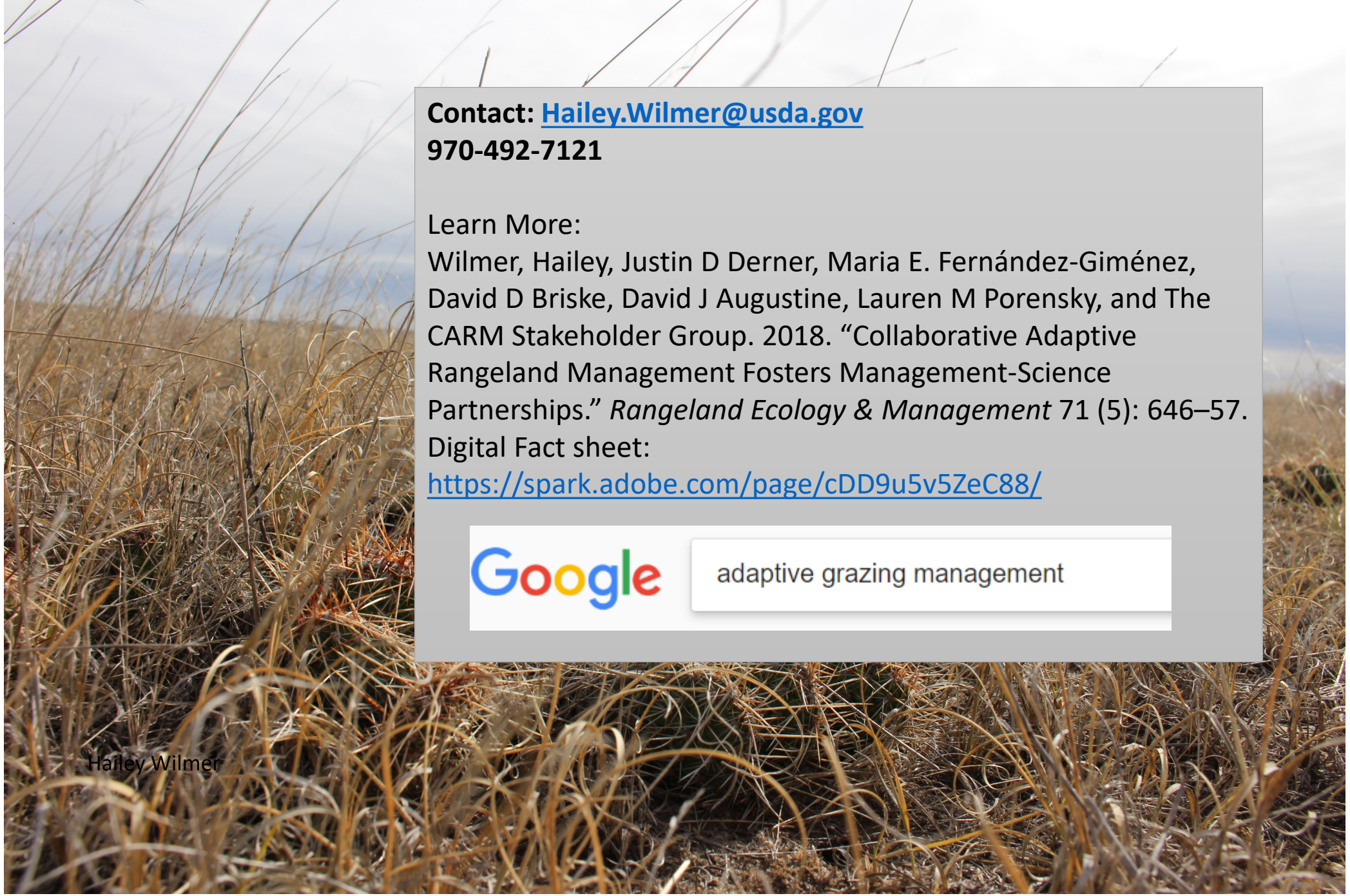
Northern Plains Climate Hub
U.S. DEPARTMENT OF AGRICULTURE

COLORADO STATE UNIVERSITY
EXTENSION

Crow Valley
Livestock Cooperative, Inc.

The Nature
Conservancy

UNIVERSITY
OF WYOMING



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970-492-7121

Learn More:

Wilmer, Hailey, Justin D Derner, Maria E. Fernández-Giménez, David D Briske, David J Augustine, Lauren M Porensky, and The CARM Stakeholder Group. 2018. “Collaborative Adaptive Rangeland Management Fosters Management-Science Partnerships.” *Rangeland Ecology & Management* 71 (5): 646–57.

Digital Fact sheet:
https://spark.adobe.com/page/cDD9u5v5ZeC88/

Hailey Wilmer