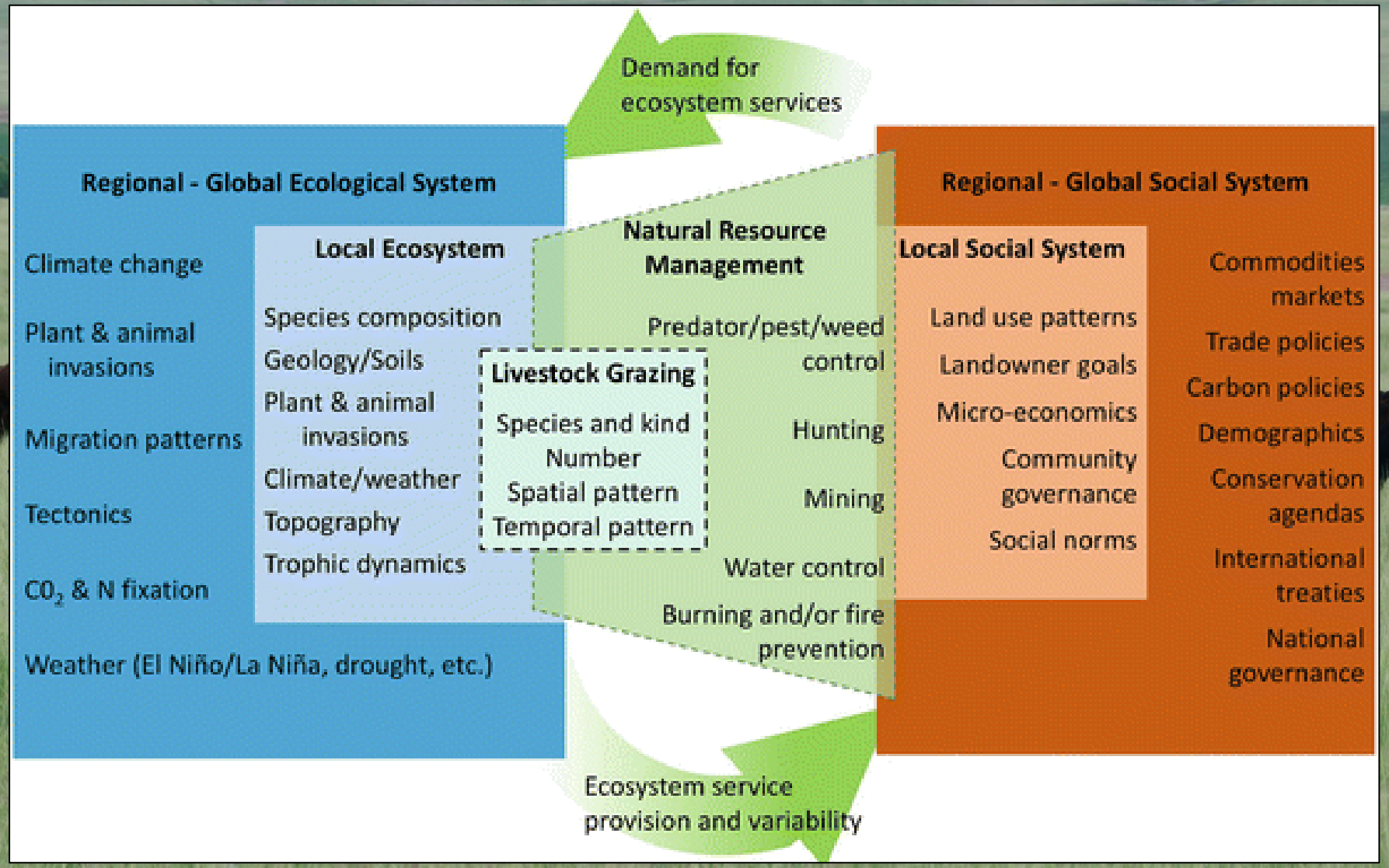
Diet Selection and Animal Behavior

Mitch Stephenson – Range Management Specialist

Rangelands are Social-Ecological Systems



From Hruska et al. 2017 – Rangelands as social-ecological systems

Grazing Management

Livestock Grazing

Species and kind
Number
Spatial pattern
Temporal pattern

SPATIAL PATTERN
Spatial grazing distribution

SPECIES AND KIND
Sheep
Goats
Cow/calf
Yearlings
Horses
Bison
Chickens

TEMPORAL PATTERN
Season of grazing
Rotation of grazing
Recovery following grazing

NUMBER
Stocking Rate
Stock density

Grazing Management

- **“The manipulation of animal grazing to achieve desired results based on animal, plant, land, or economic responses.” -Valentine 2001-**

Distribution

"Many of the concerns regarding livestock grazing on rangelands are the result of uneven livestock distribution rather than inappropriate stocking rates." *(Bailey 2005)*

Changing attributes of the pasture	Modifying animal behavior
Season of use	Salt, mineral, protein supplements
Cross fencing pastures	Low-stress herding
Increasing water locations	Breed selection
Fire: Patch-burn	Genetic selection

Distribution

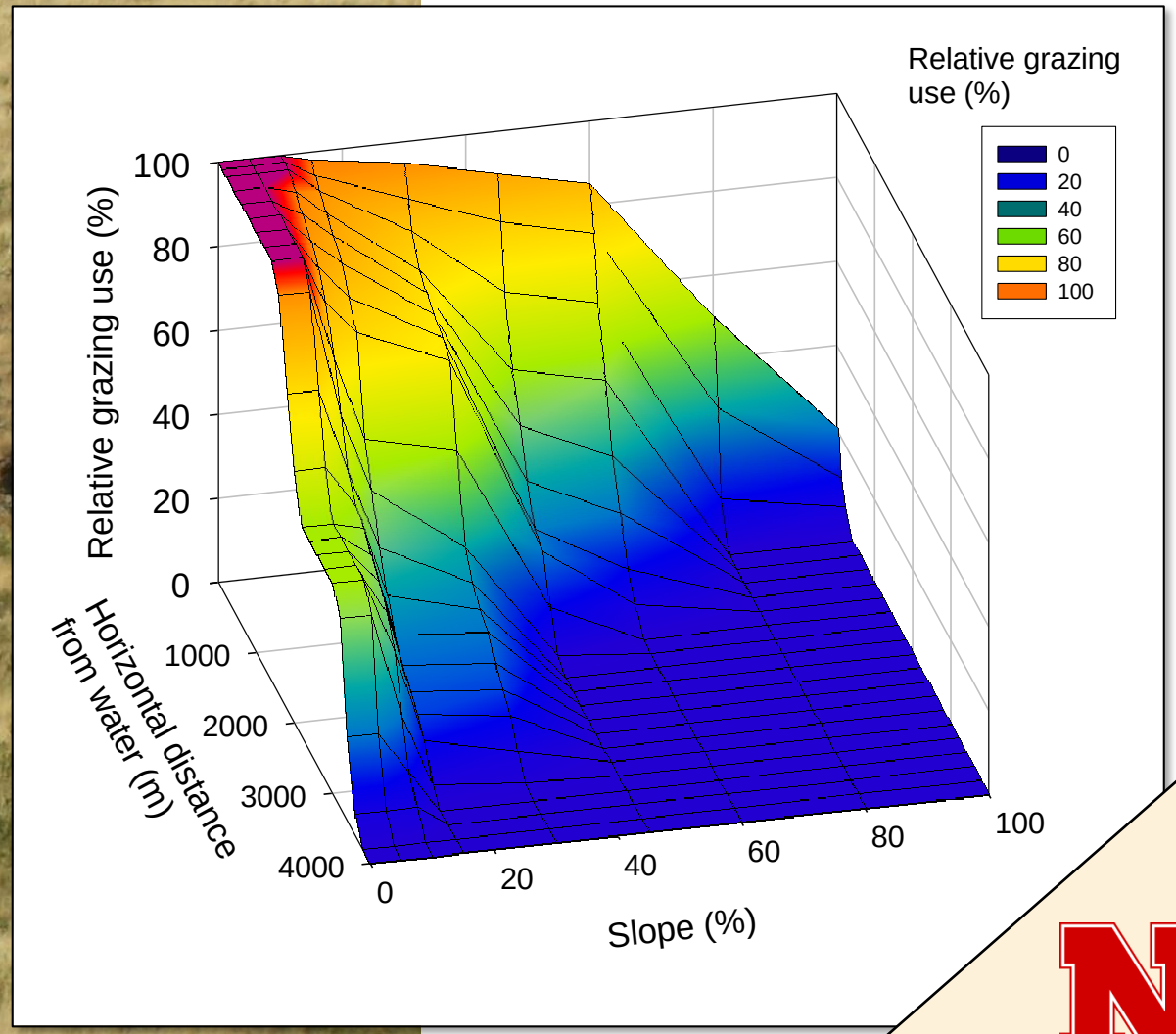
Cattle often avoid:

- Steep slopes

- High elevations

- Areas far from water

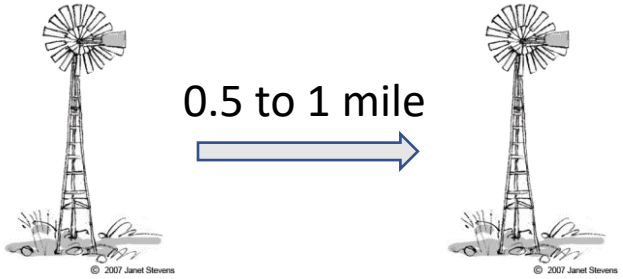
(Mueggler 1965)
(Roath and Krueger 1982)
(Vallentine 1947)



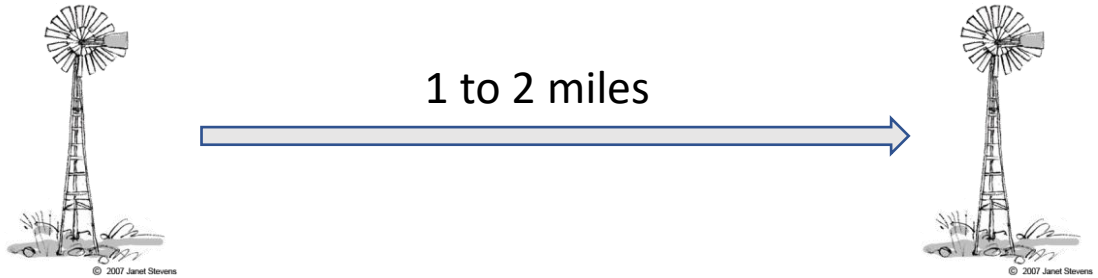
Watering locations

Distance from Water	Utilization(%)
0 – 0.5 miles	50
0.5 – 1.0 miles	38
1.0 – 1.5 miles	26
1.5 – 2.0 miles	17
2.0 – 2.5 miles	12

Chihuahuan desert in southern NM

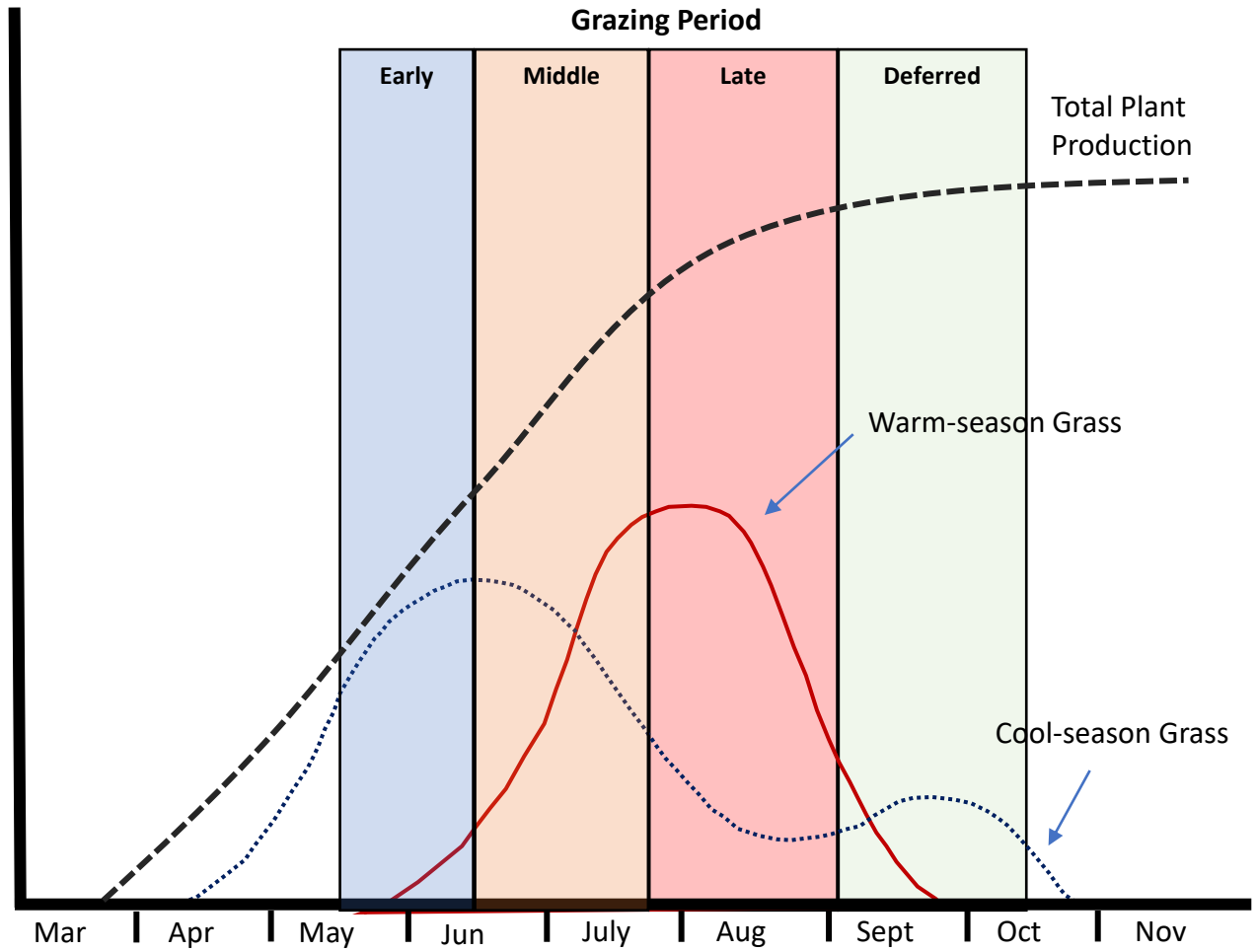


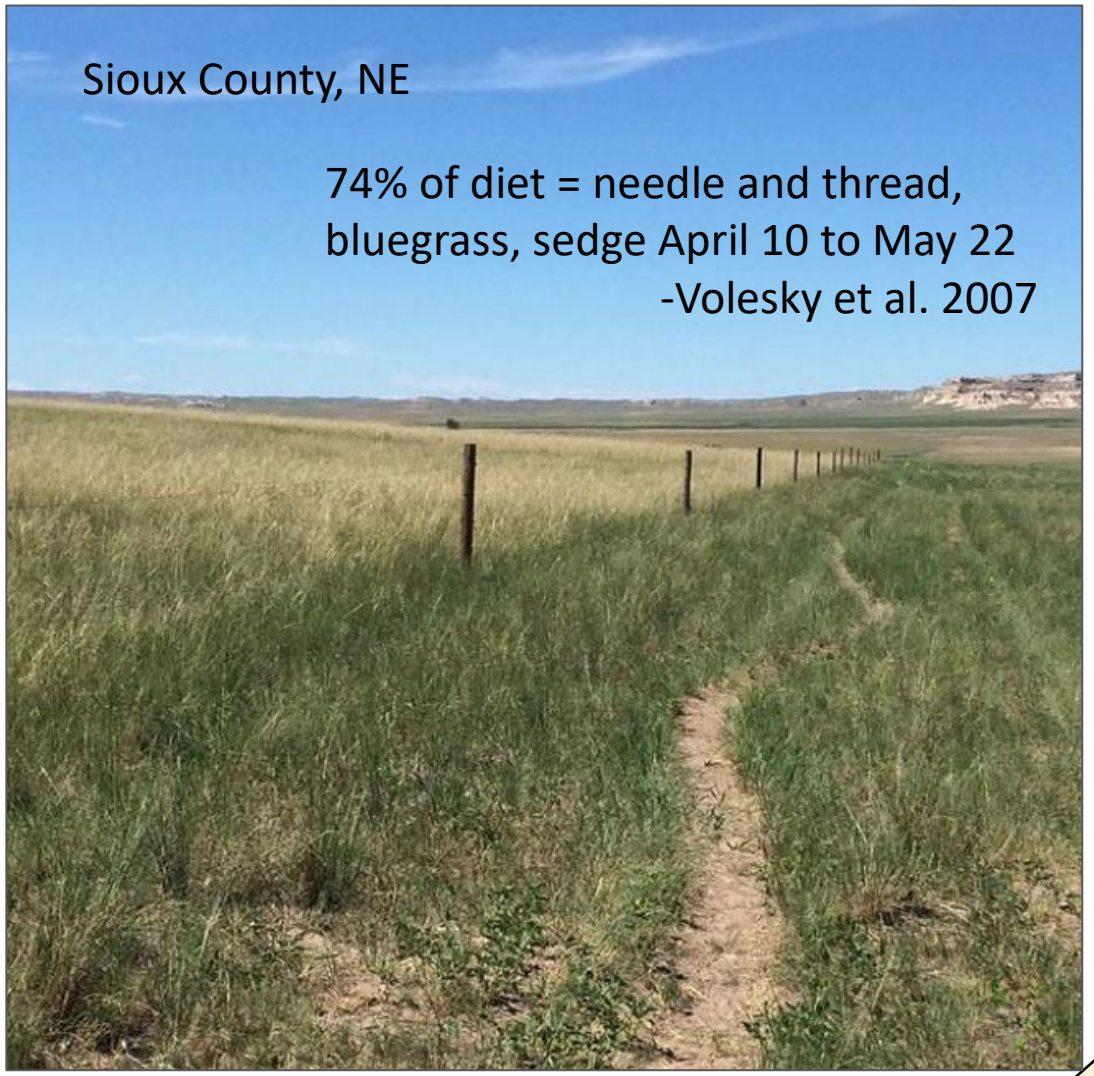
Rough Terrain



Flat Terrain

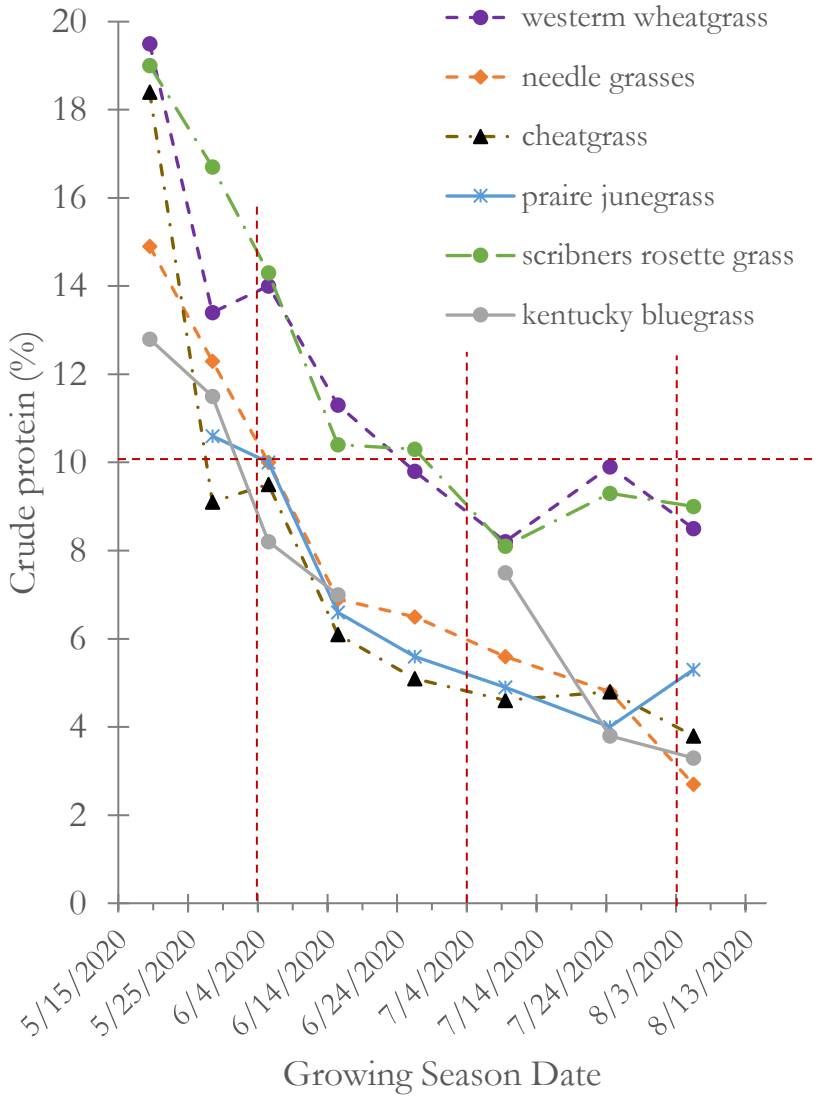
Season of use



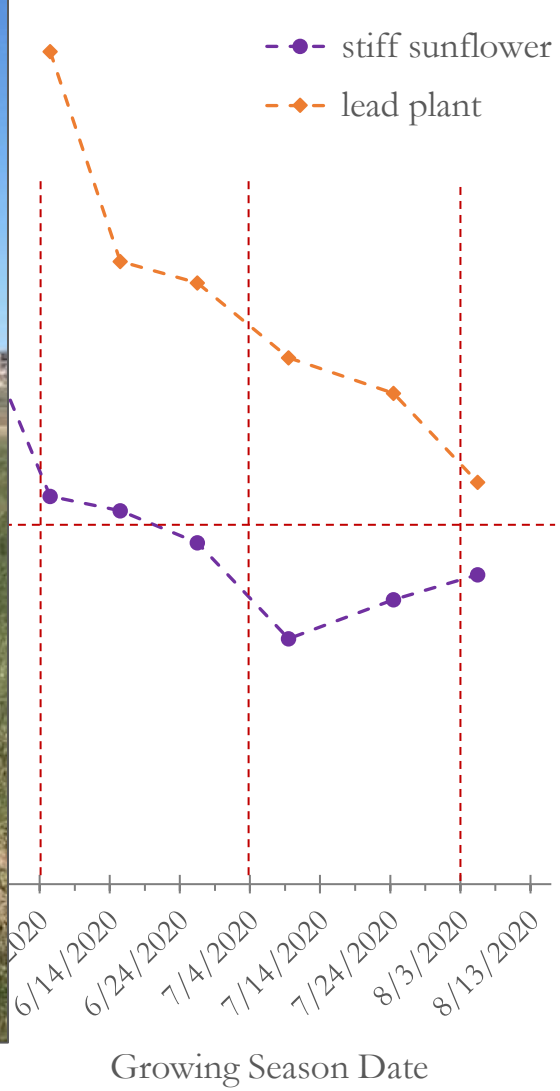


Prairie sandreed, sand bluestem = highly selected
Little bluestem, grama, forbs = less selected
-Northrup 1993

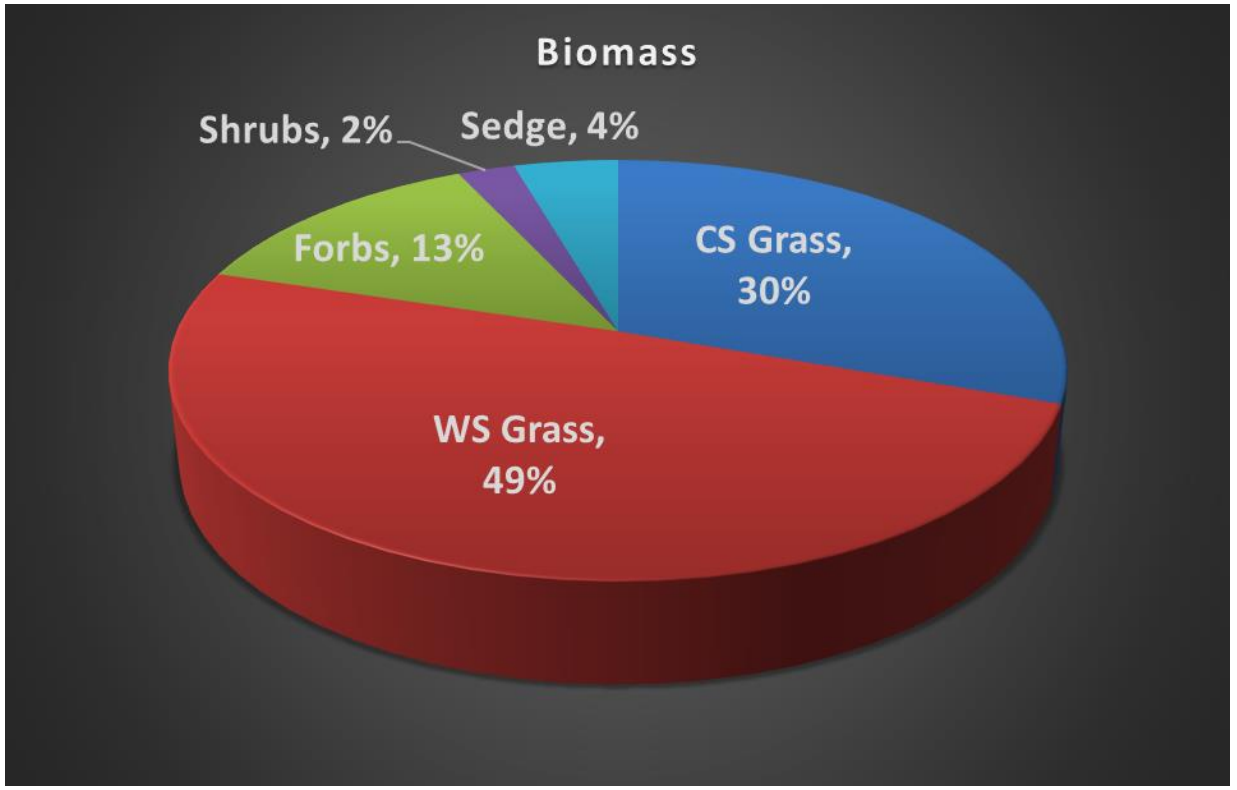
GSL 2020 Forage Quality- CP%



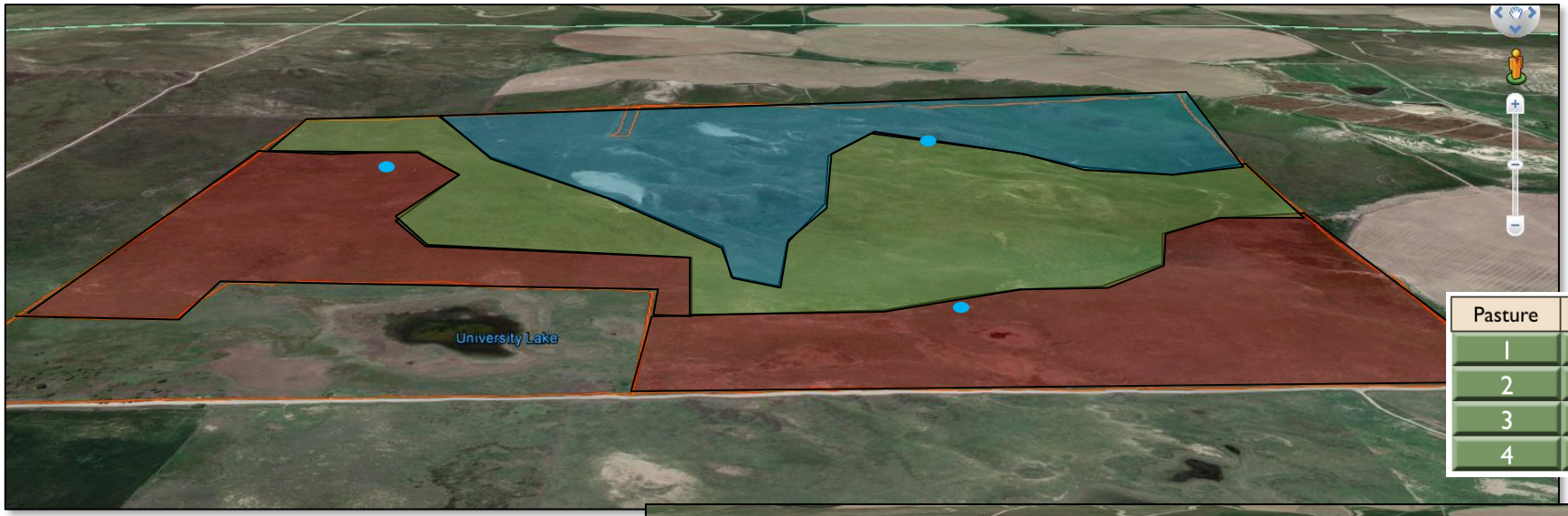
Growing Season Date



Sandhill Plant Community

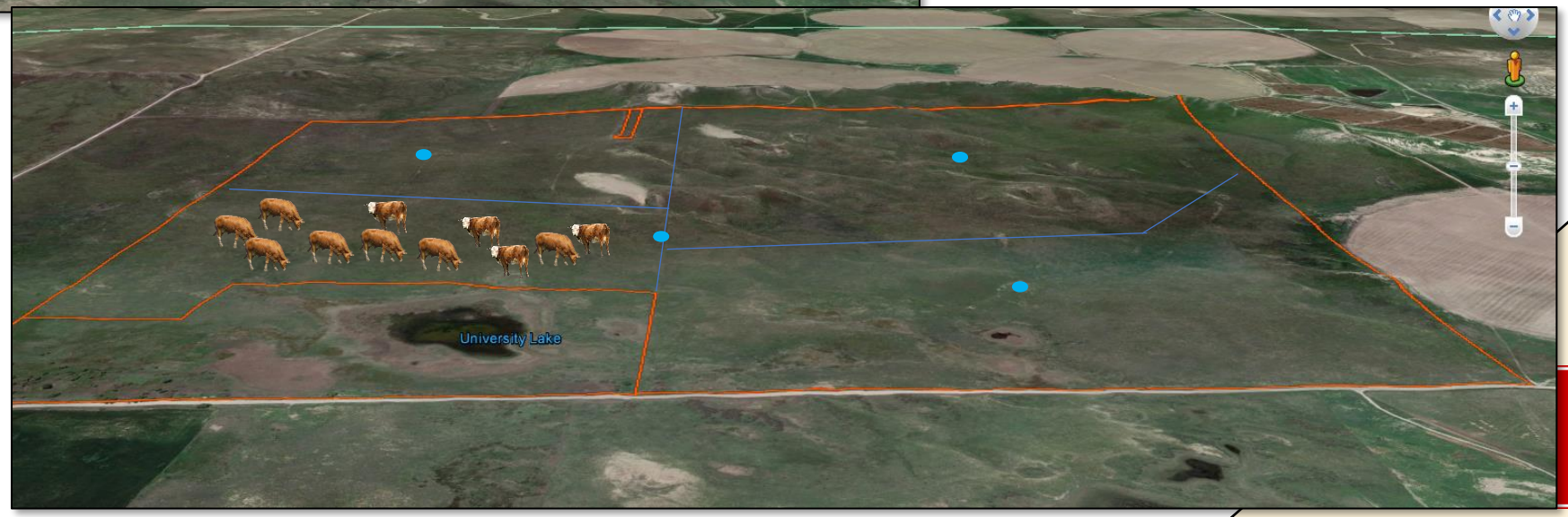


Cross fencing and adding water

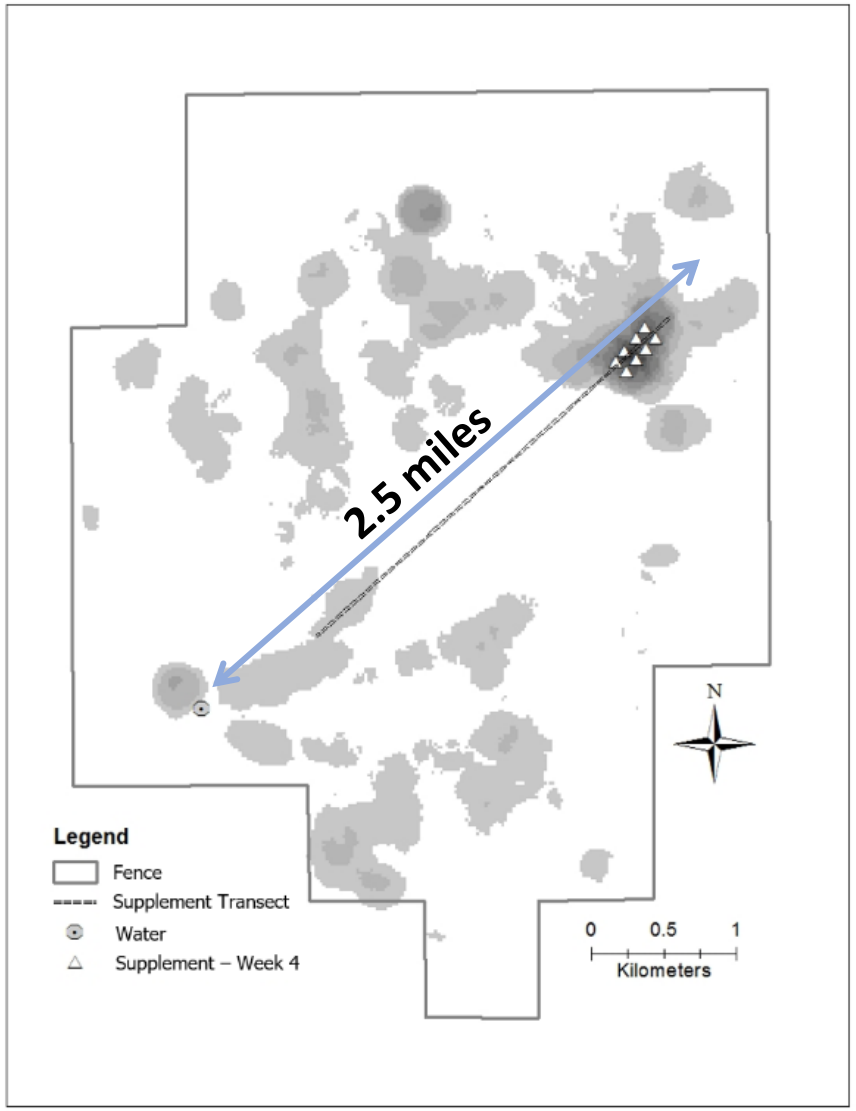


Pasture	May	Jun	Jul	Aug	Sep	Oct
1						
2						
3						
4						

- Heavy Grazing
- Moderate Grazing
- Light Grazing



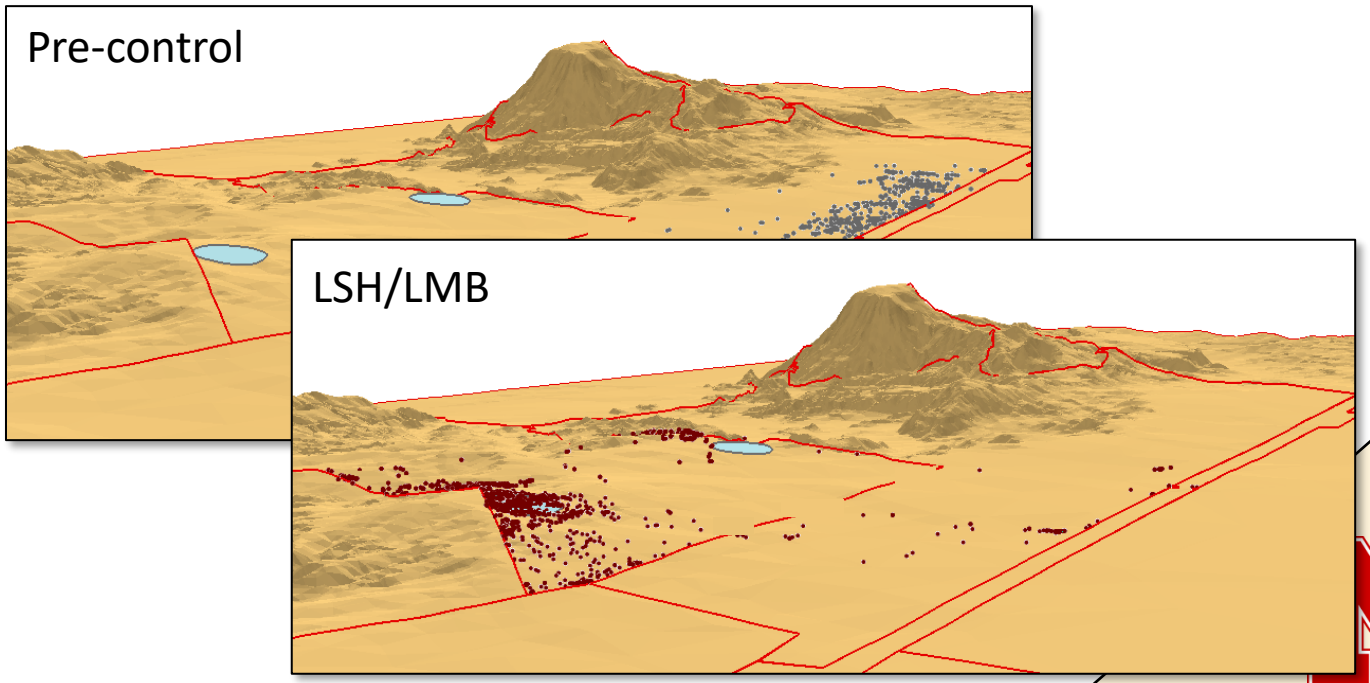
Salt, Mineral, Protein supplements



Low Point Density High

Low stress herding

"…livestock-centered, behaviorally-correct, psychologically-oriented, ethical, and humane method of working livestock based on mutual communication and understanding." (Stockmanship Journal, Hibbard 2012)



Breed and Genetic Selection

Hereford vs. Santa Gertrudis

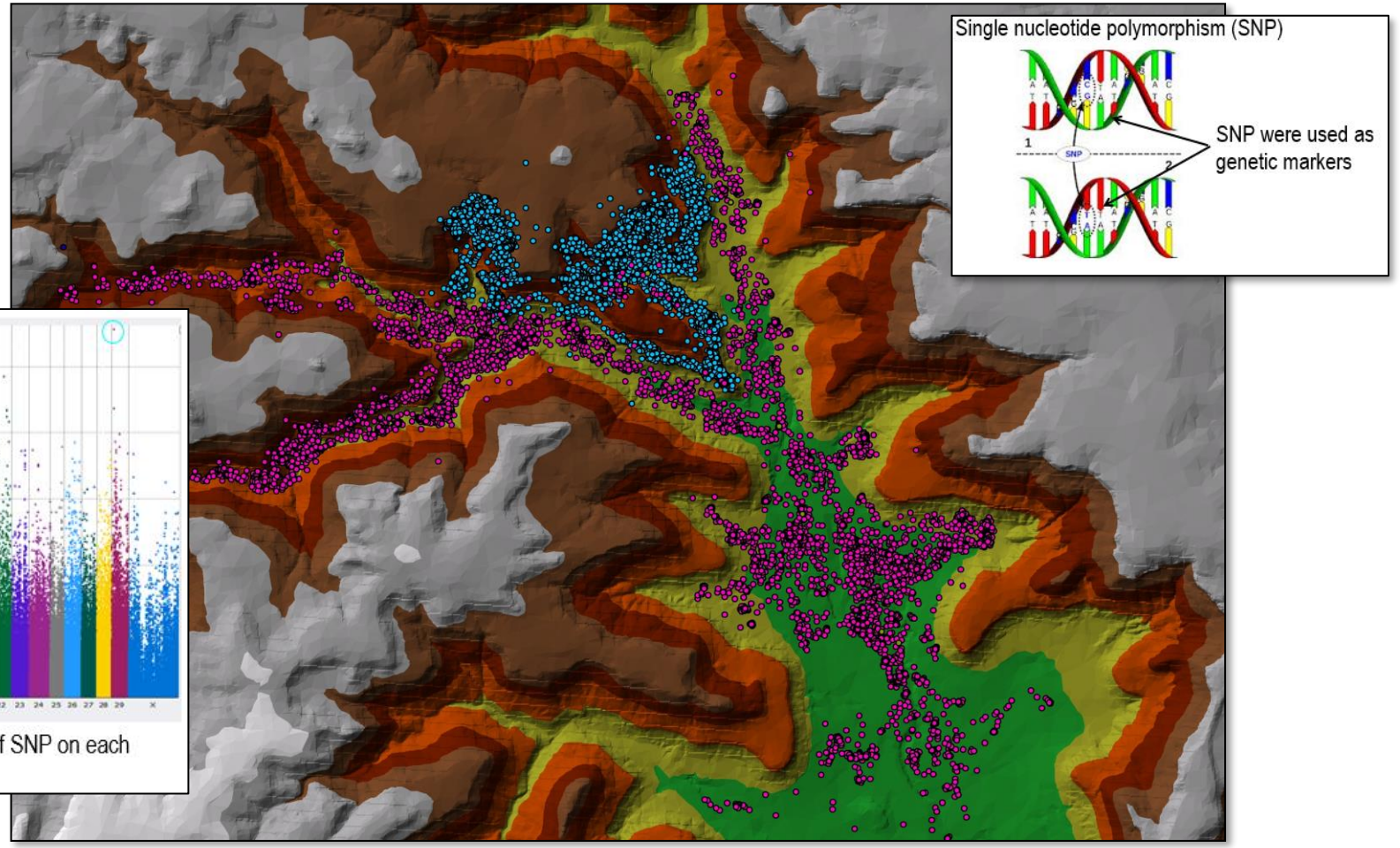
Miles traveled per day

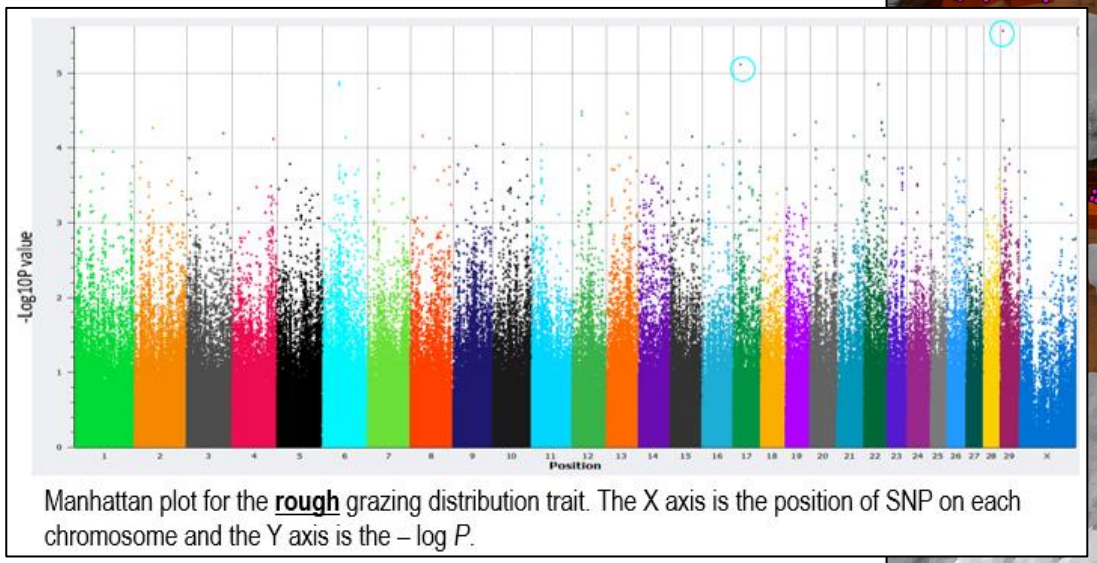
Season	Hereford	Santa Gertrudis
Fall	5.3	8.0
Winter	5.2	6.1
Spring	4.6	8.3
Summer	4.3	9.1

"Activities of Hereford and Santa Gertrudis cattle on a southern NM Range".
Herbel and Nelson 1966

Applications for Livestock Production

- GPS tracking can assist in the genetic selection of replacement cattle that use a larger region of the pasture



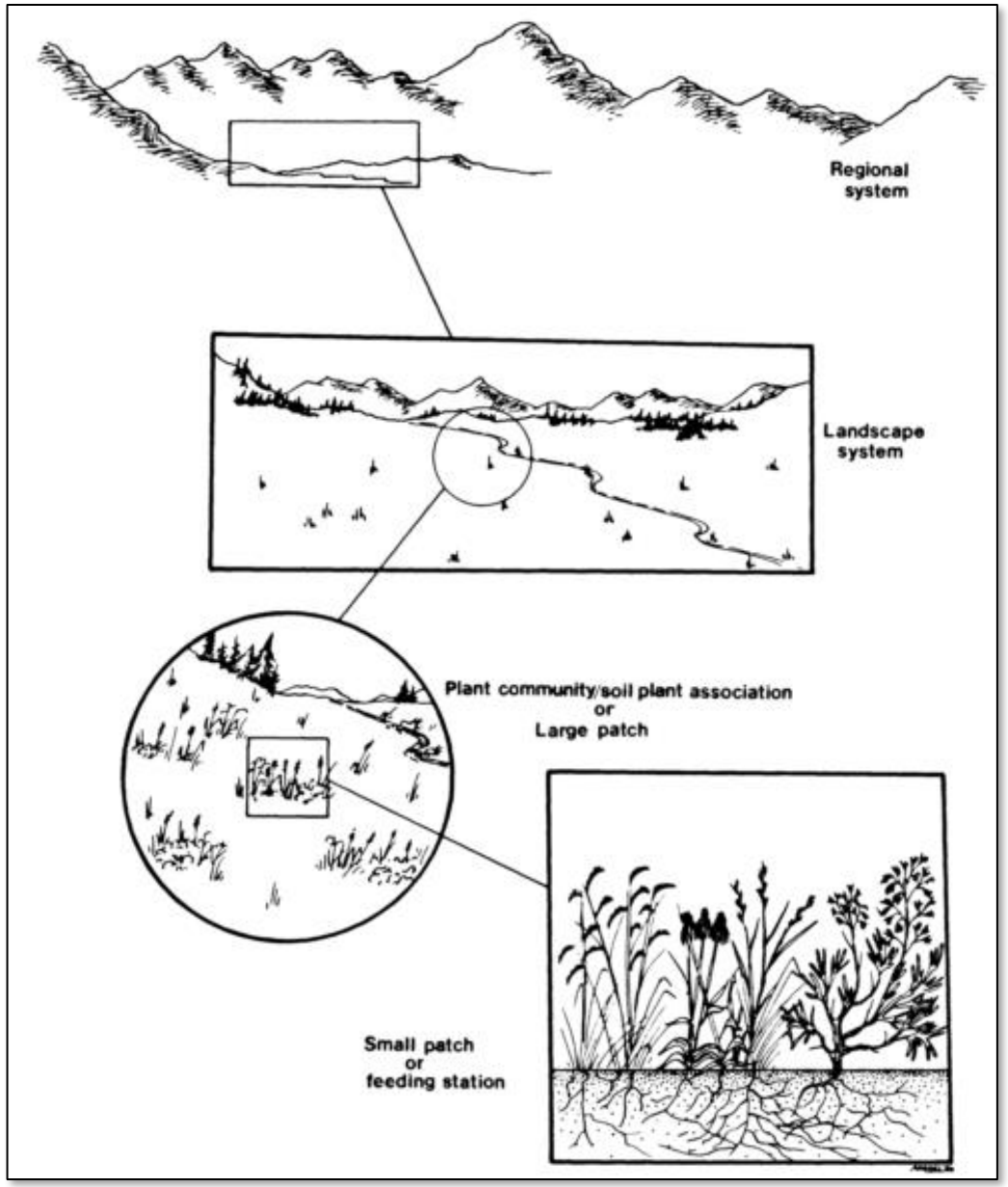


Manhattan plot for the **rough** grazing distribution trait. The X axis is the position of SNP on each chromosome and the Y axis is the – log *P*.

Hill Climber

Bottom Dweller

Bailey et al. 2015

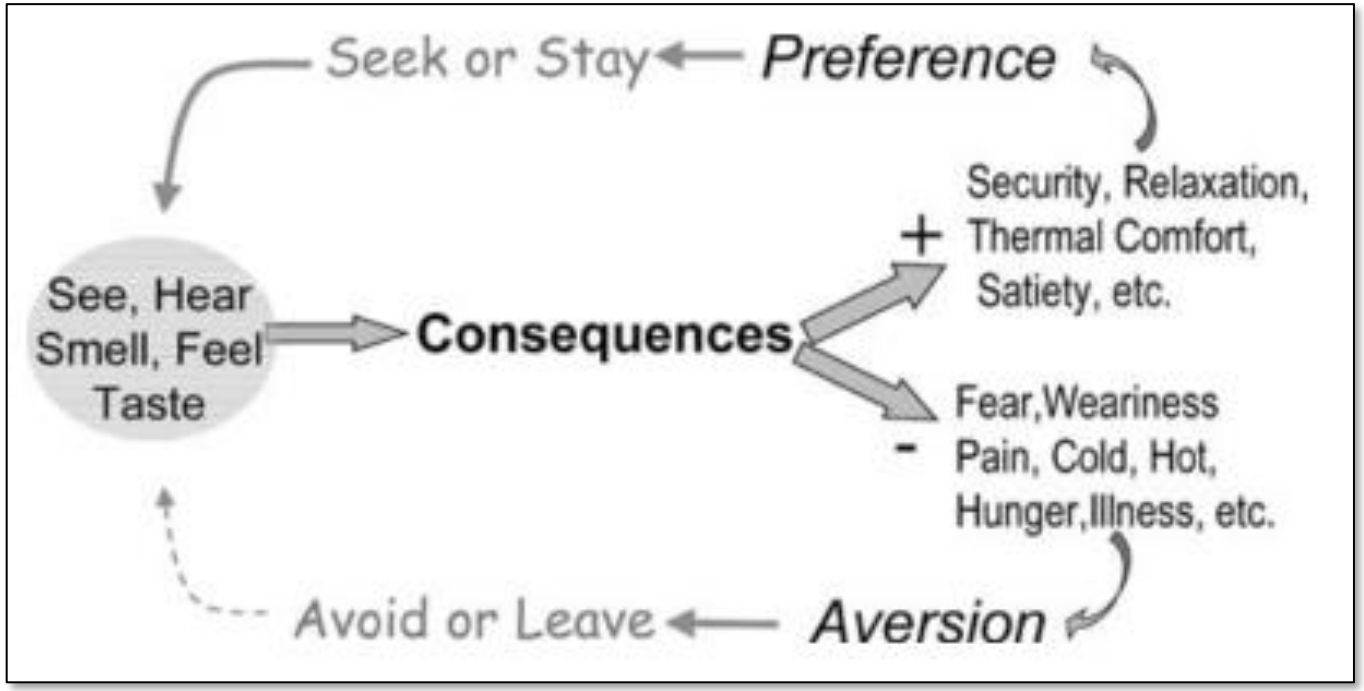


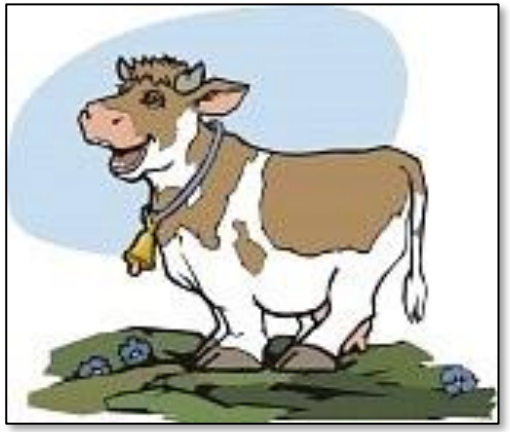
"Large herbivore foraging and ecological hierarchies", Senft et al. 1987

Large herbivores make foraging decisions at multiple spatial scales

Many factors affect these decisions

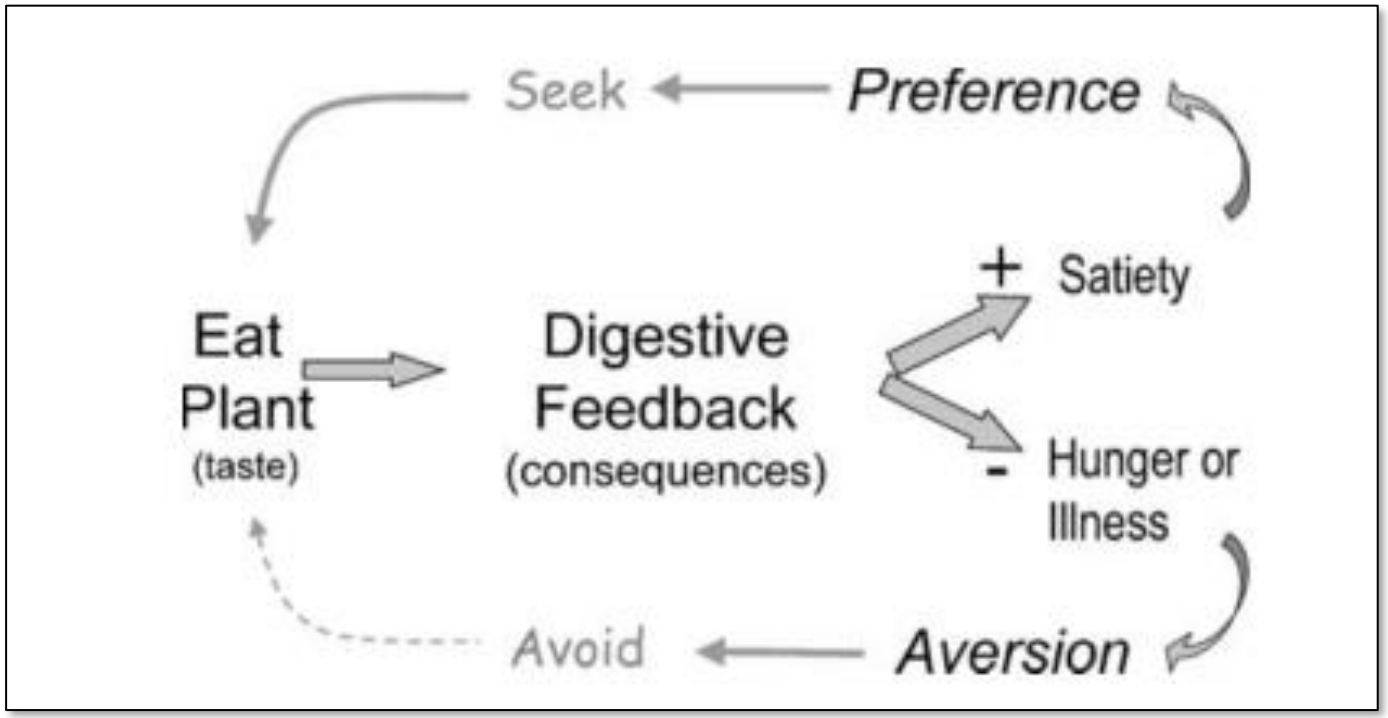
Preference and Aversion





"Understanding landscape use patterns of livestock as a consequence of foraging behavior", Launchbaugh and Howery 2005

Post-ingestive feedback



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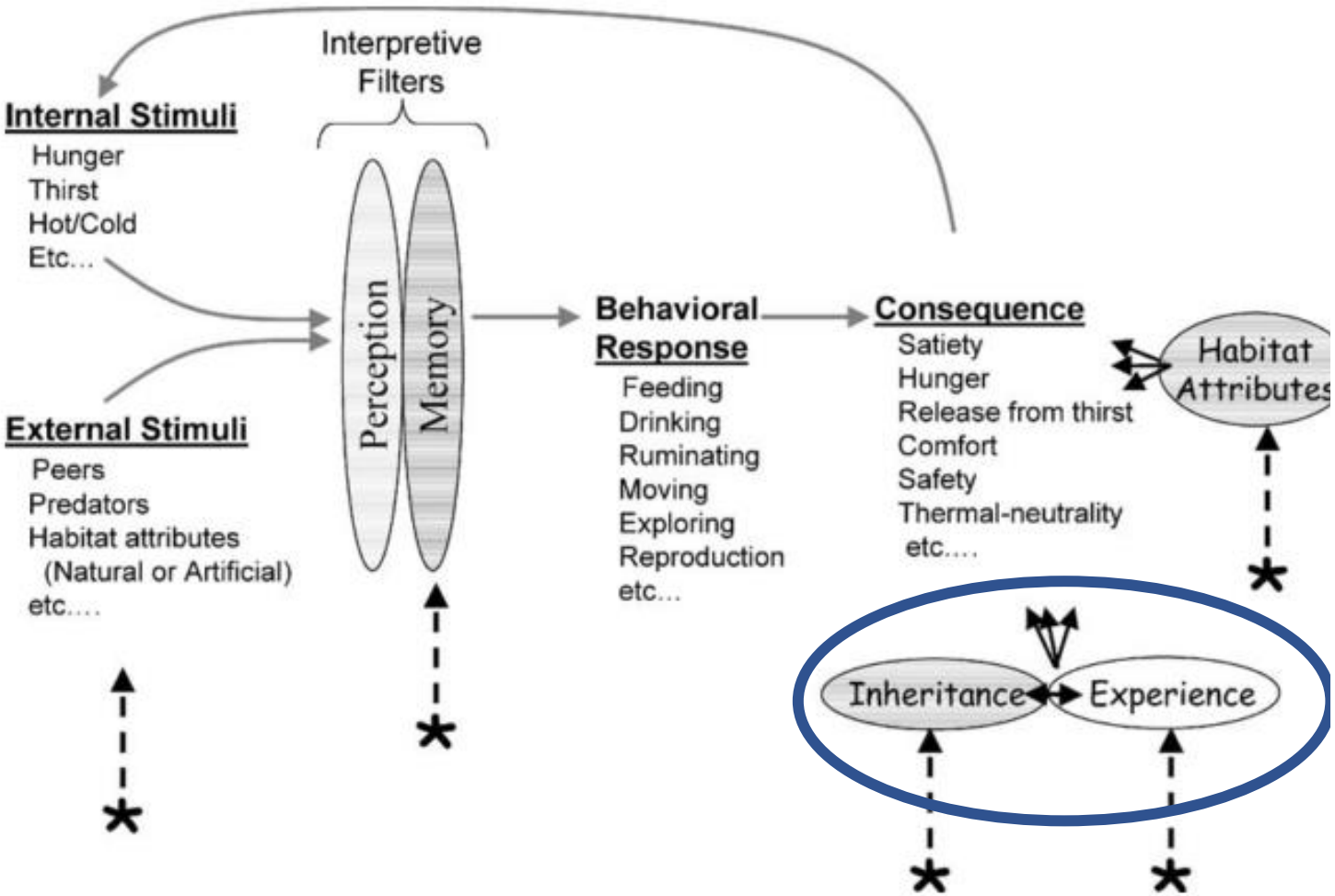
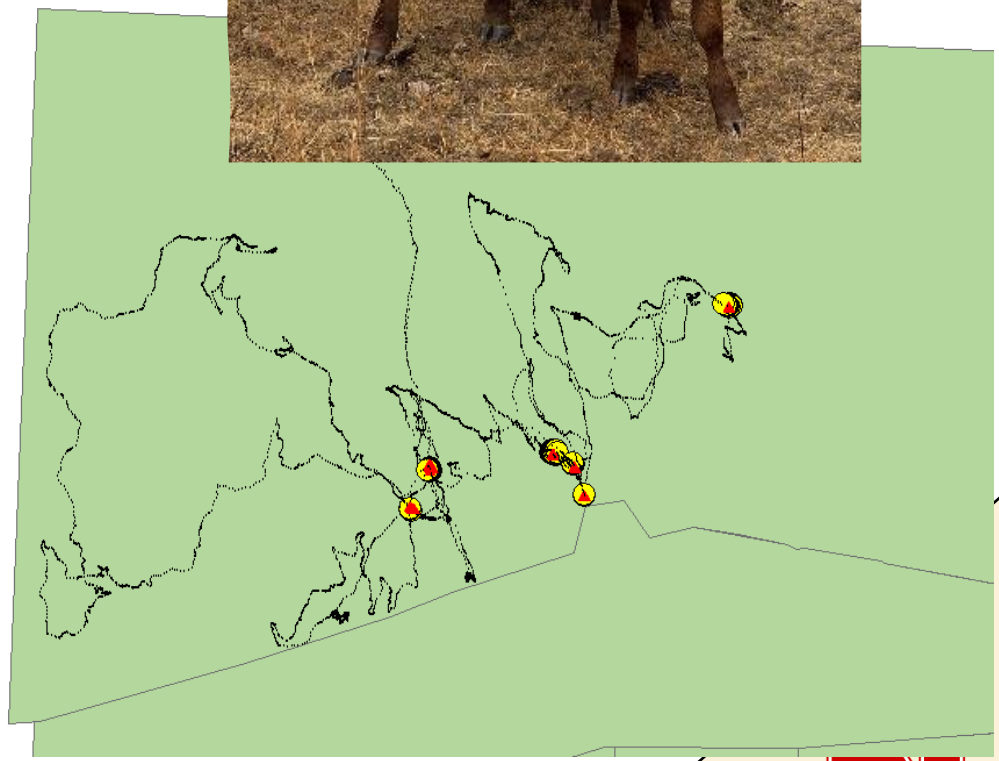




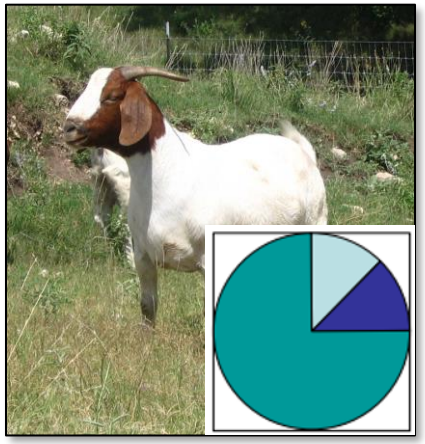
"Understanding landscape use patterns of livestock as a consequence of foraging behavior", Launchbaugh and Howery 2005

Diet Selection

65% diet overlap in the Flint Hills of Kansas (Sowers et al. 2019)

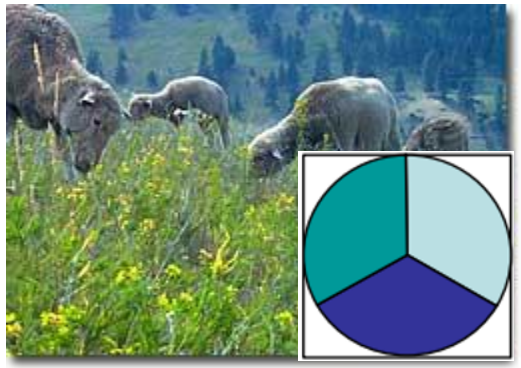
Goats

- Prefer browse also eat forbs
- Selective grazers
- Very tolerant to secondary plant compounds



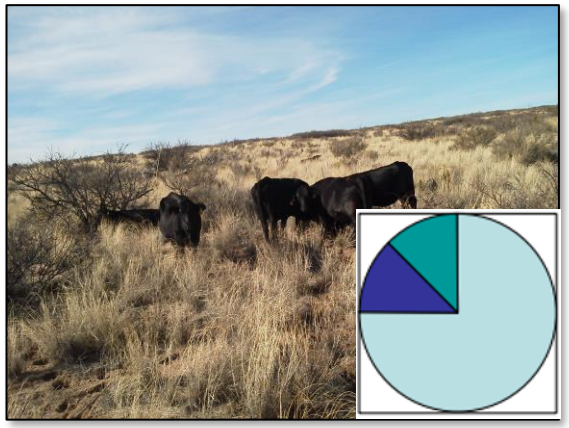
Sheep

- Prefer forbs and grasses
- Selective grazers
- More tolerant of secondary compounds than cattle



Cattle

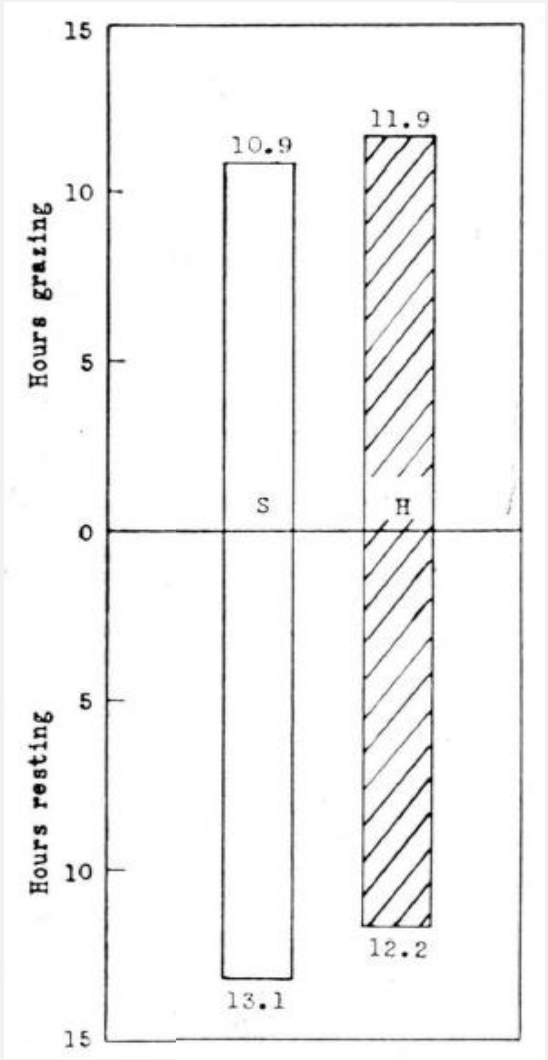
- Prefer Grasses
- Less selective
- Graze more uniformly
- Least tolerant of secondary plant compounds



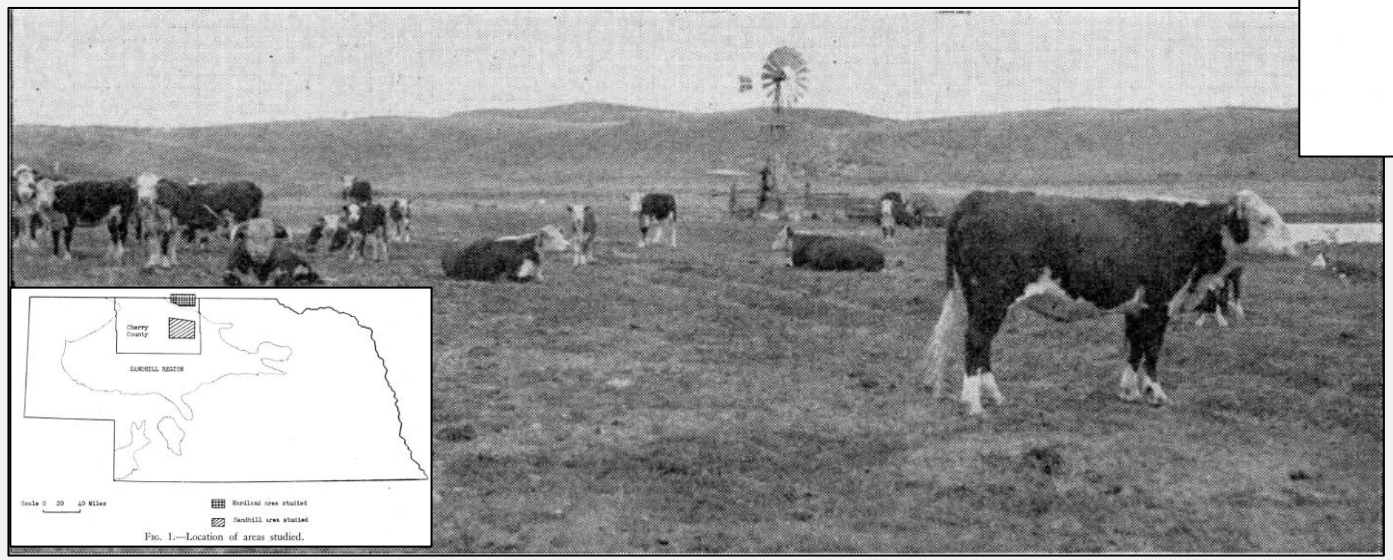
From http://www.webpages.uidaho.edu/

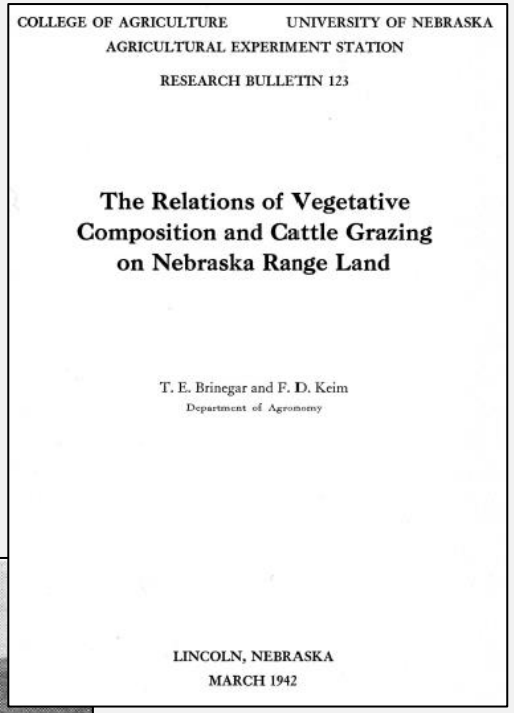
Browse *Forb* *Grass*

Cattle tracking in Nebraska



- Cattle visually observed over 24-hr periods in 1938 - 5 times
- Spotlight and car
  - Noted: full moon nights were helpful
- Observers recorded cattle behavior at ½ hr intervals





COLLEGE OF AGRICULTURE UNIVERSITY OF NEBRASKA
AGRICULTURAL EXPERIMENT STATION

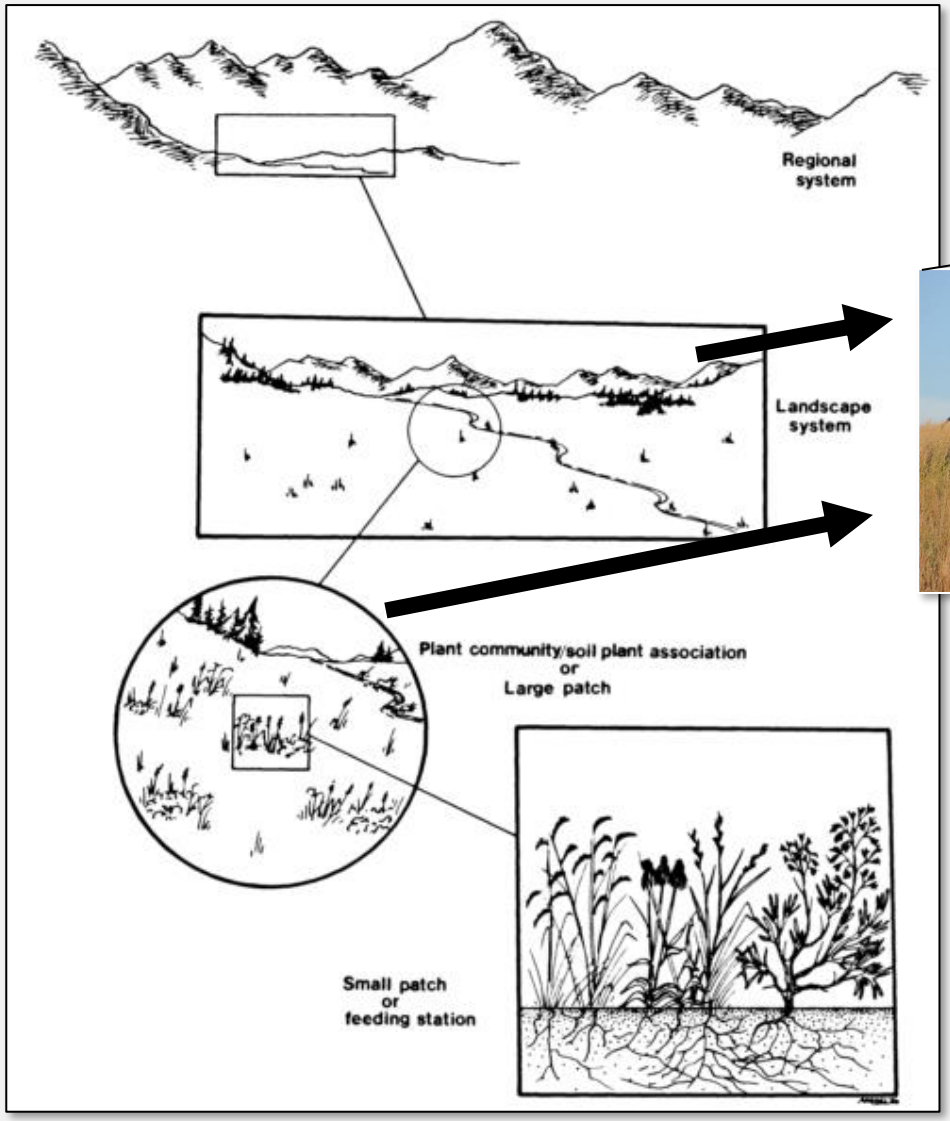
RESEARCH BULLETIN 123

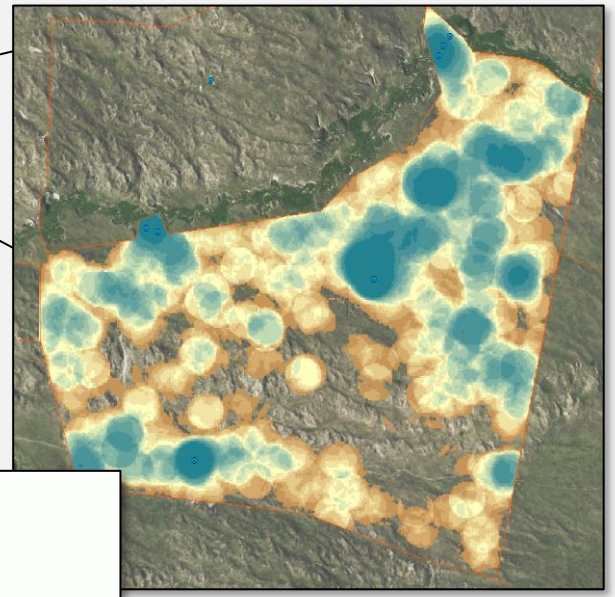
The Relations of Vegetative Composition and Cattle Grazing on Nebraska Range Land

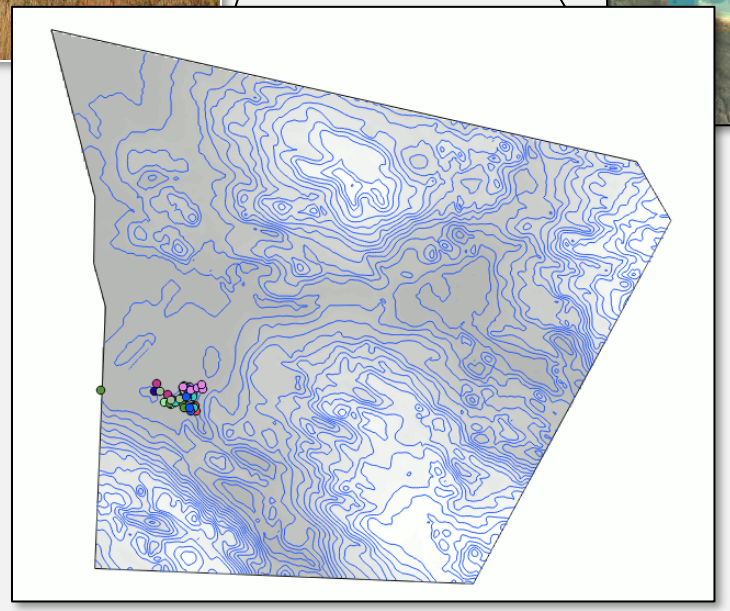
T. E. Brinegar and F. D. Keim
Department of Agronomy

LINCOLN, NEBRASKA
MARCH 1942

Where are my cattle grazing?

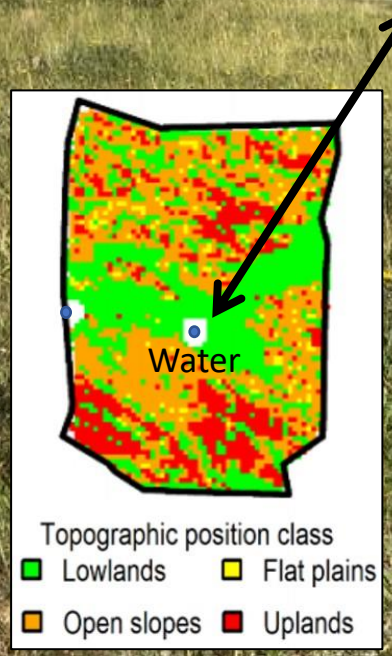


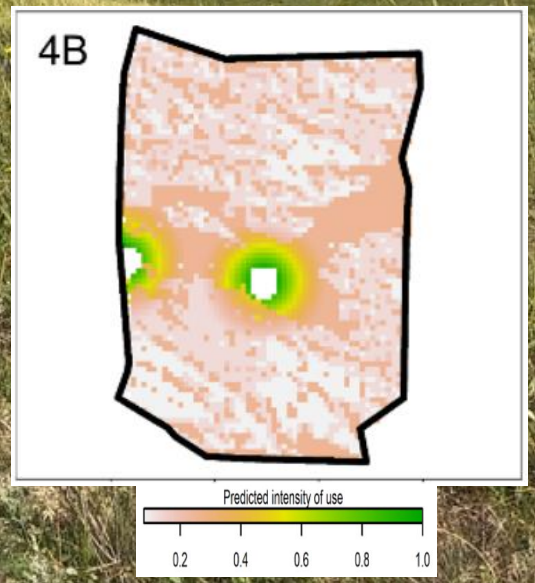


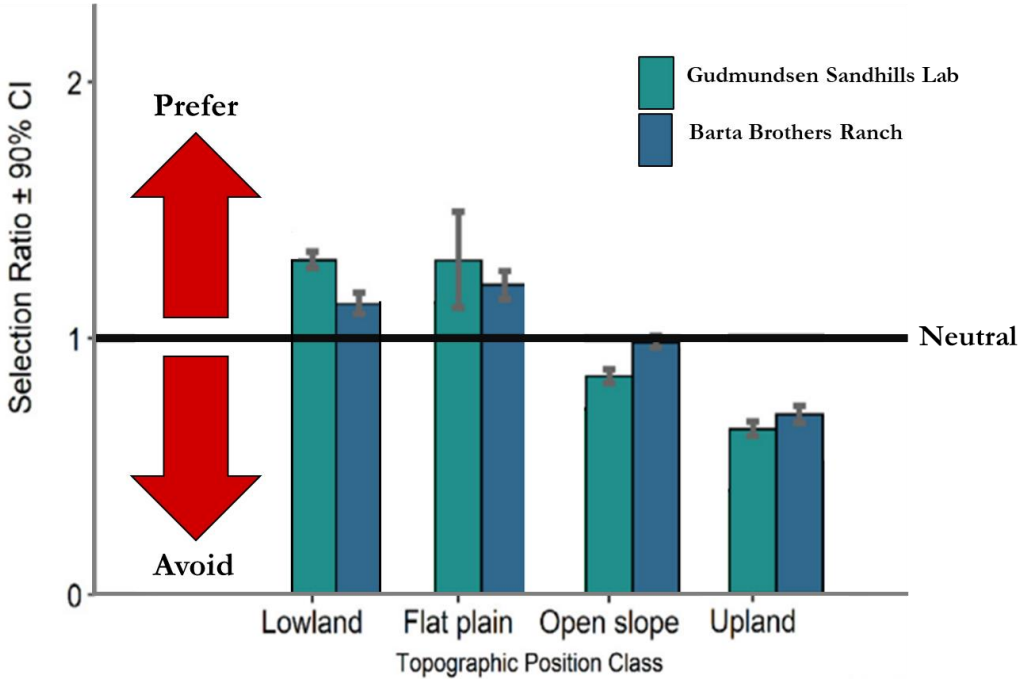


"Large herbivore foraging and ecological hierarchies", Senft et al. 1987

How does topography influence cattle grazing?







- Cattle graze lowlands and flat plains more intensively than open slopes and uplands.
- Understanding the interaction between topography, grazing patterns, and management is important for improving rangeland health and diversity.

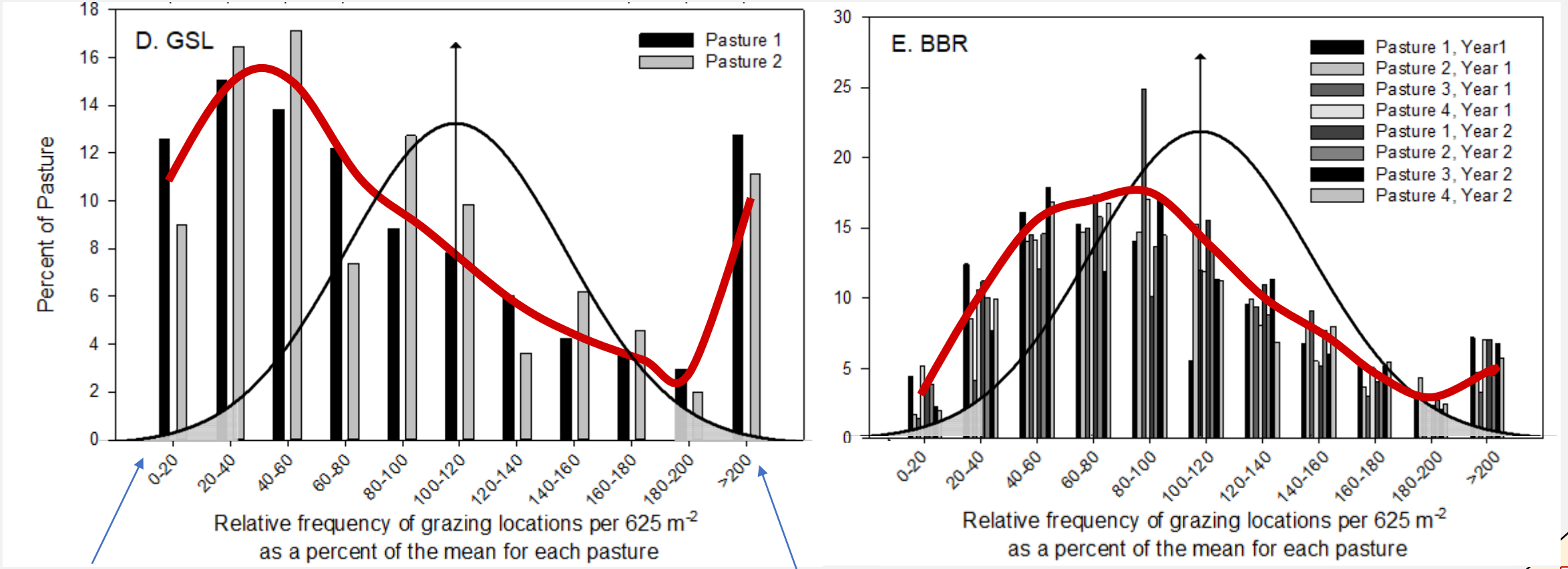
Raynor et al. 2021 – *Cattle grazing distribution patterns related to topography across diverse rangeland ecosystems of North America*

USDA Agricultural Research Service

Predicting cattle grazing locations

Larger pastures (600 to 1100 acre) – lower stock density

Smaller pastures (100 to 200 acre) – higher stock density



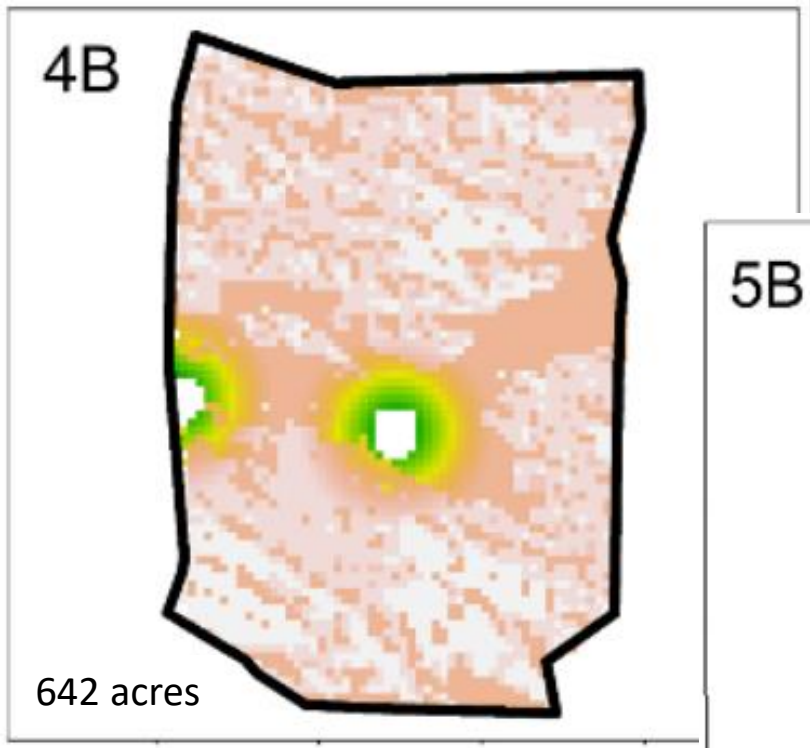
Lightly grazed

Heavily grazed

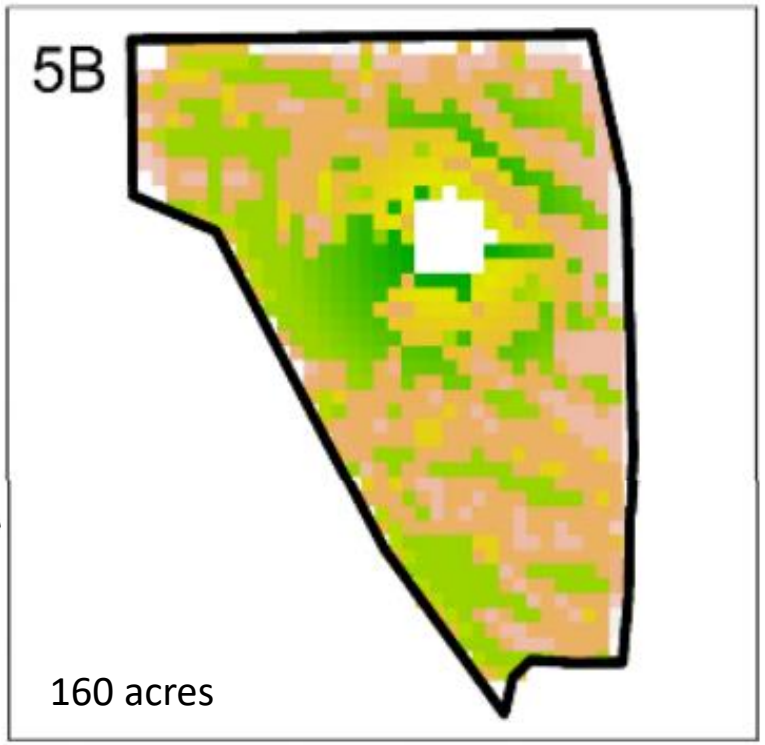
USDA Agricultural Research Service

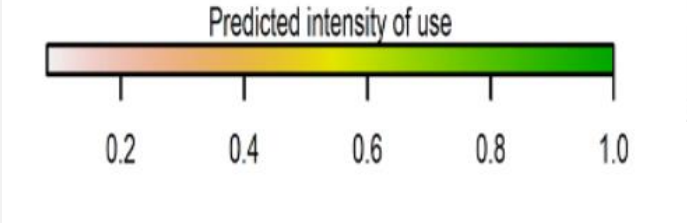
Raynor et al. "Cattle grazing distribution in relation to topography across diverse rangeland ecosystems" In Review

Predicting cattle grazing locations



Gudmundsen Sandhills Lab





Barta Brothers Ranch

Resource selection probability functions (RSPF)

- An estimate of the true probability of use of a given pixel
- Identify areas of the pasture that receive higher grazing pressure under different grazing strategies

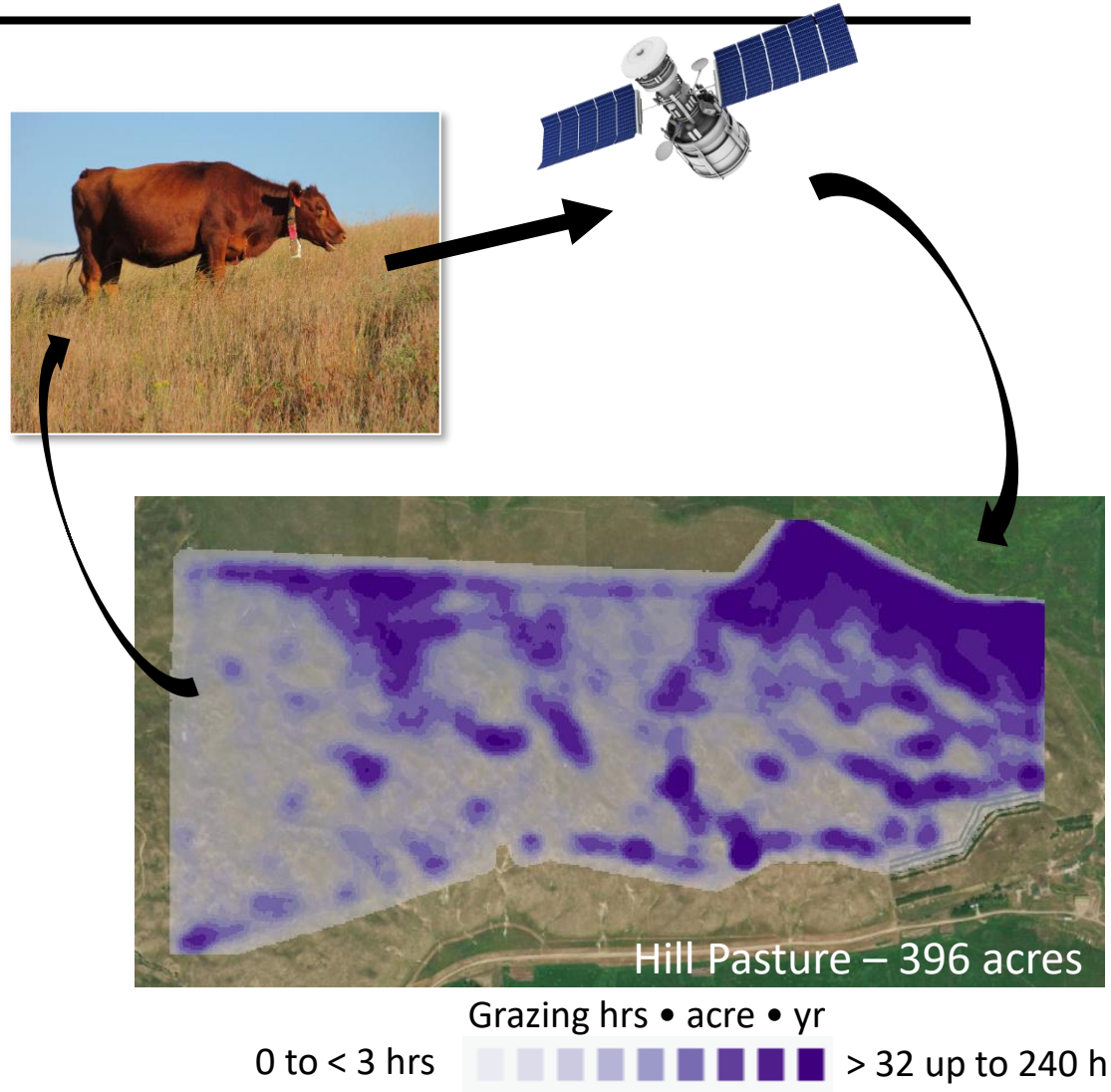
USDA Agricultural Research Service

Raynor et al. 2021. "Cattle grazing distribution in relation to topography across diverse rangeland ecosystems"

Relating GPS tracking to rangeland health

Plant community and ground cover

Greater in heavily grazed areas	Greater in lightly grazed areas
Western ragweed	Wild rose
Scribner's rosettegrass	Needle and thread
Kentucky bluegrass	Little bluestem
Annual invasive grasses	Prairie junegrass
Blue grama	Vegetation cover
Bare ground	

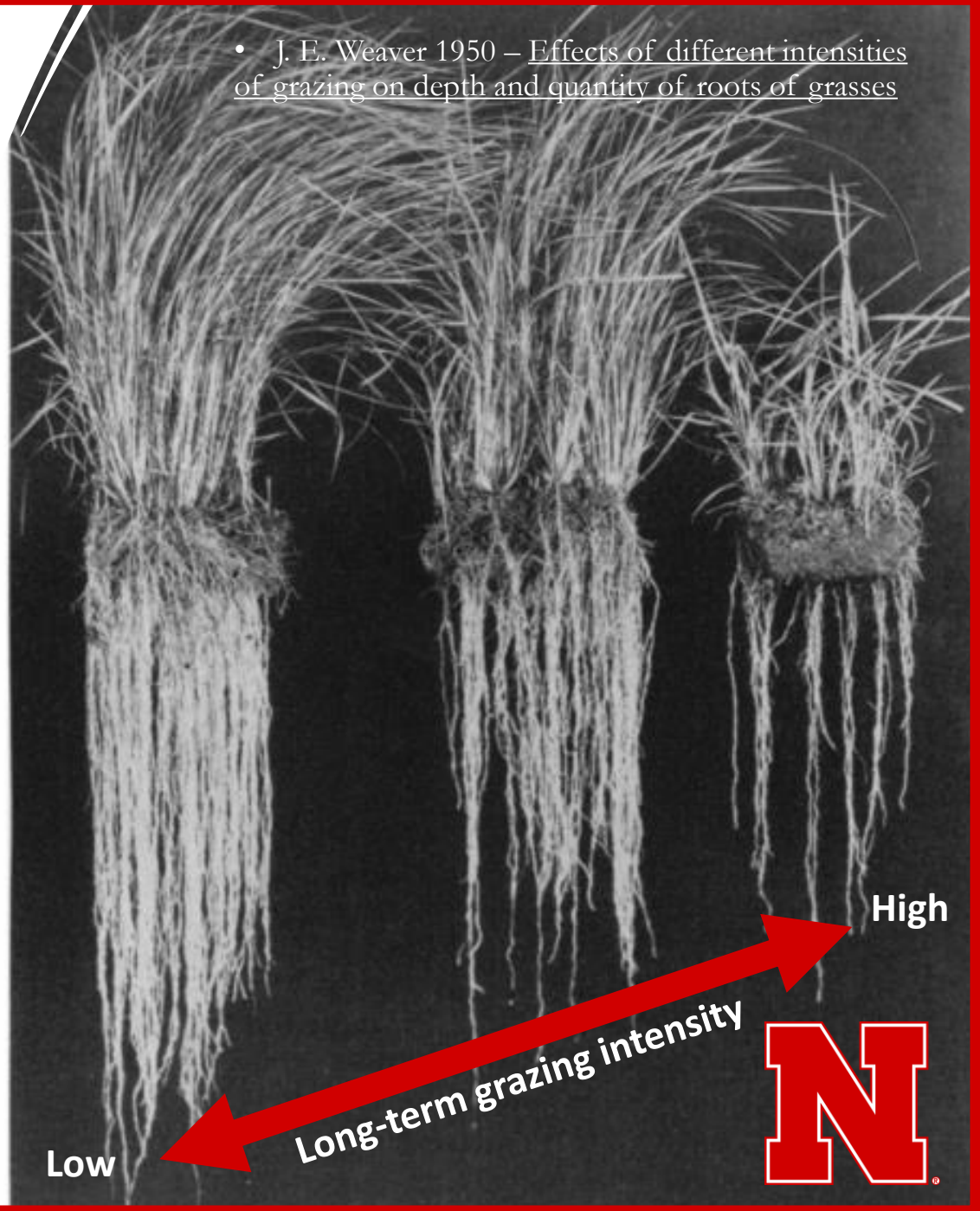


Influence of grazing intensity on below ground biomass

- Little bluestem plants collected in areas with long-term **heavy** grazing intensity had fewer roots than plants collected in areas with long-term **low** grazing intensity

- Long-term grazing intensity was the result of differences in grazing distribution across the pasture

- 52% of carbon in regrowing shoots comes from below-ground remobilization during the first 30 days after defoliation (Yang et al. 2023)



Predicting cattle grazing locations

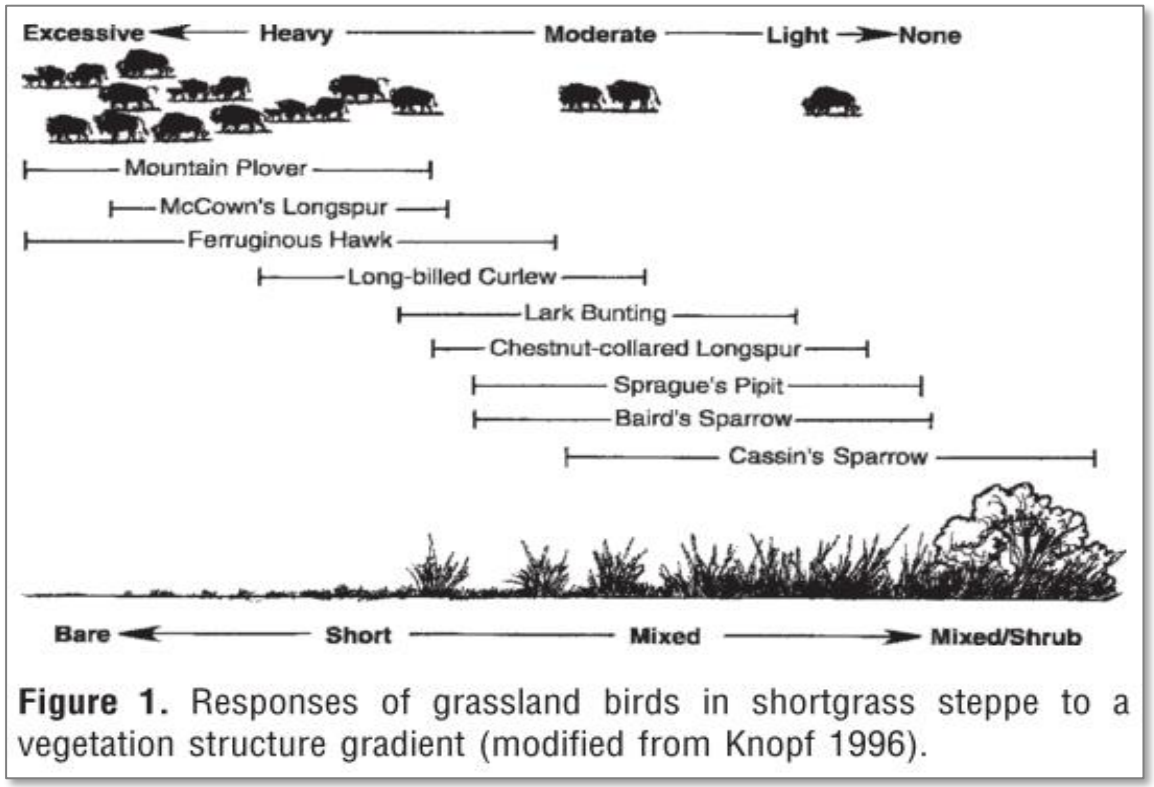
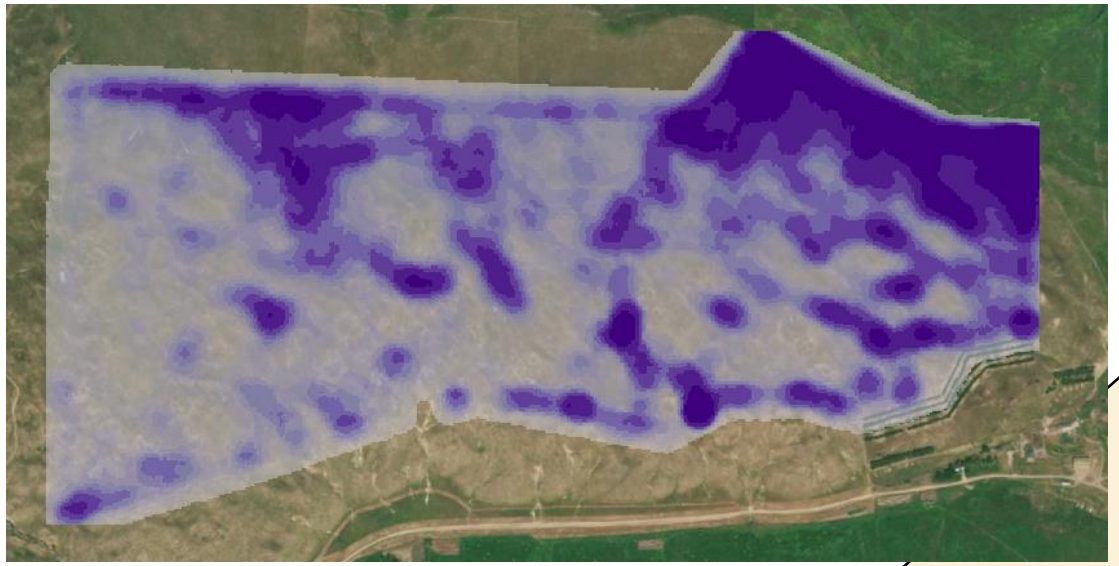


Figure 1. Responses of grassland birds in shortgrass steppe to a vegetation structure gradient (modified from Knopf 1996).

Derner et al. 2009

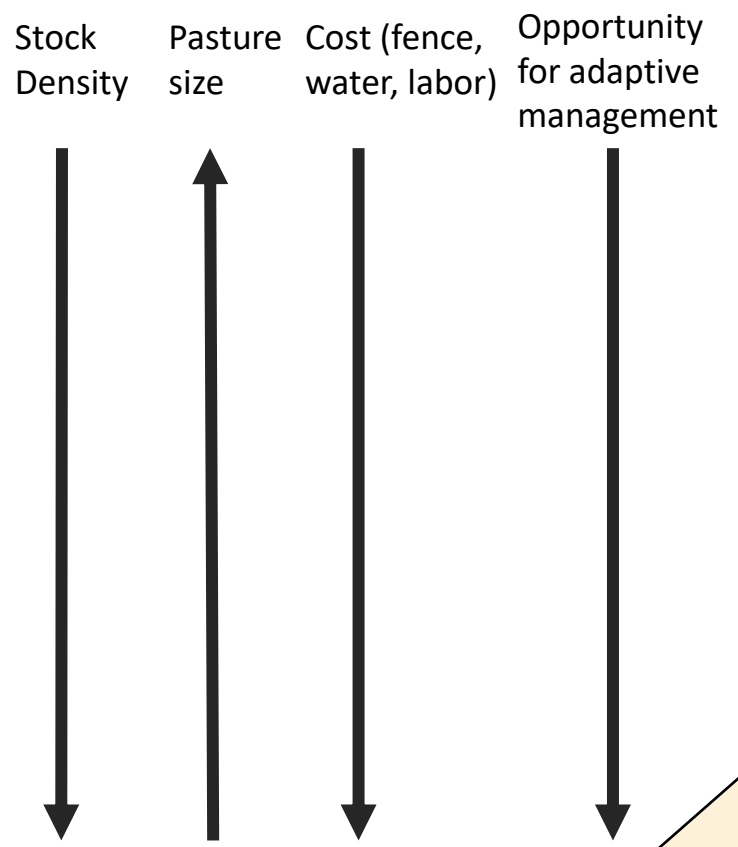
Grazing behavior

- Spatial influence on vegetation composition and structure
- Grazing tolerant grasses and forbs
- Multiple ecosystem structures within the same pasture

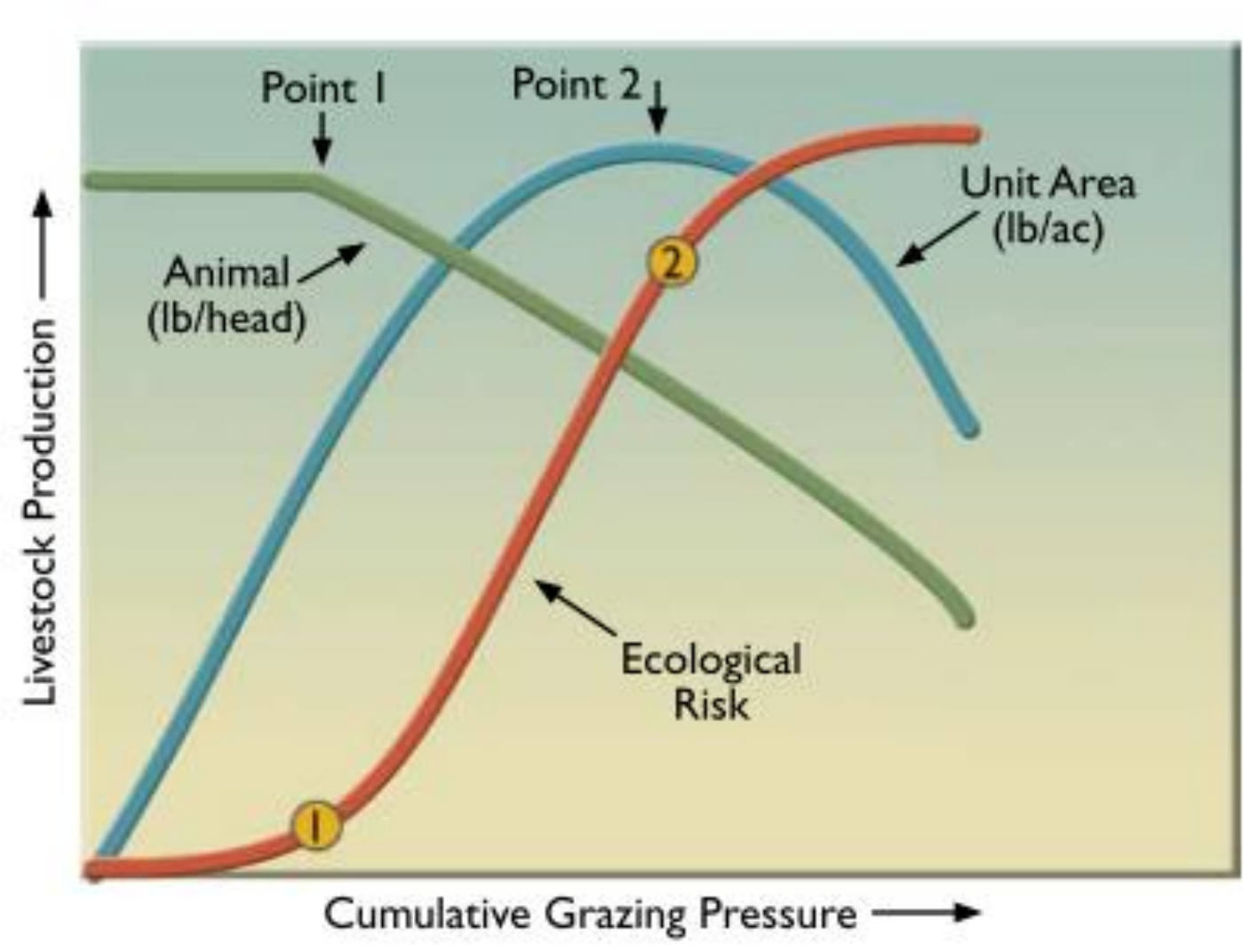


Grazing management strategies

Management Level	Grazing Strategy	# of Pastures	Definition
Extensive	Continuous grazing	1	Grazing on a specific pasture throughout the entire growing season or year.
	Deferred rotation grazing	2 to 7	Rotational grazing that annually provides a portion of the pastures deferment until plants have reached reproductive maturity. Pastures are only grazed one time per growing season.
	Adaptive multi-paddock grazing	8 or greater	Rotational grazing with relatively short grazing periods. This grazing strategy can incorporate multiple grazing events based on plant regrowth characteristics or can have only single grazing events during the growing season.
Intensive	Mob grazing	Several	Typically grazing with large numbers of animals on relatively small pasture for a short time period (Very high stocking densities). Extremes of this strategy may have animals stocked at levels that require multiple moves in a single day.

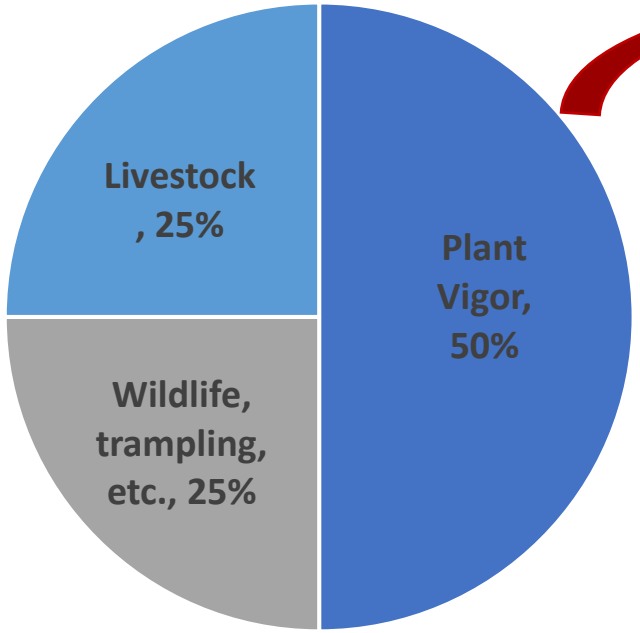


Grazing pressure and livestock production



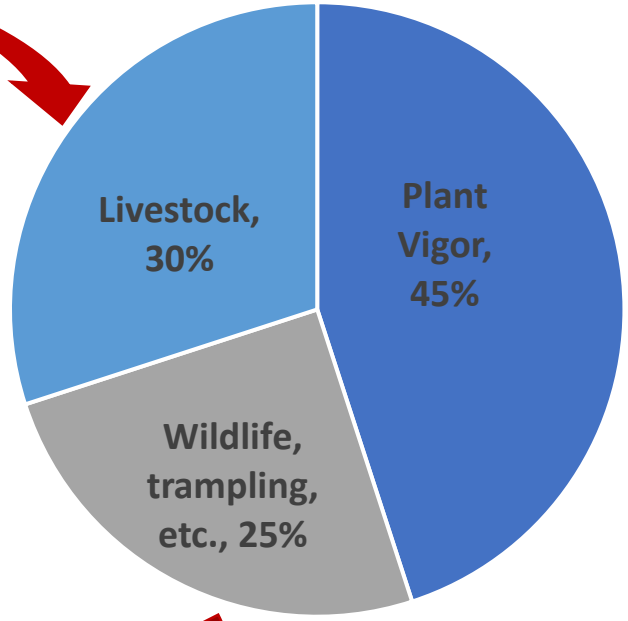
- ***Grazing Pressure*** = An animal to forage relationship measured in terms of animal units per unit weight of forage at any instant, i.e., AU/kg or ton.

How to increase harvest efficiency

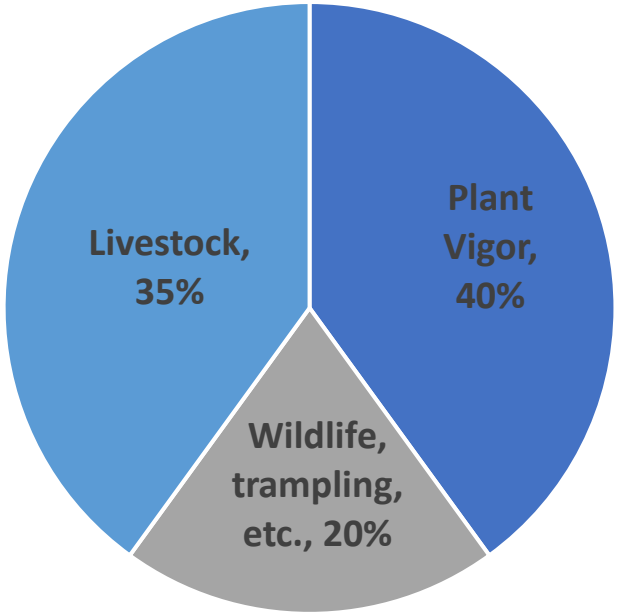


Continuous Grazing, low input, large pastures, extensive management

20% increase in stocking rate



Simple Rotation, 4 to 6 pastures, moderate input



Complex rotation, high input, many pastures intensive management

20% increase in stocking rate

"A guide for planning and analyzing a year-round forage program", Waller et al. 1986

Tracking cattle within a Patch-burn system

Cellular Cattle GPS Tracking

Easily track your cattle with cellular technology

With no base station to install, you can quickly connect one of our cellular GPS trackers to your animals in minutes. The tracking device will operate on the local cellular network and provide locations directly to your phone or computer.

Location updates can be as fast as every 5 minutes. Update frequency can be changed remotely.

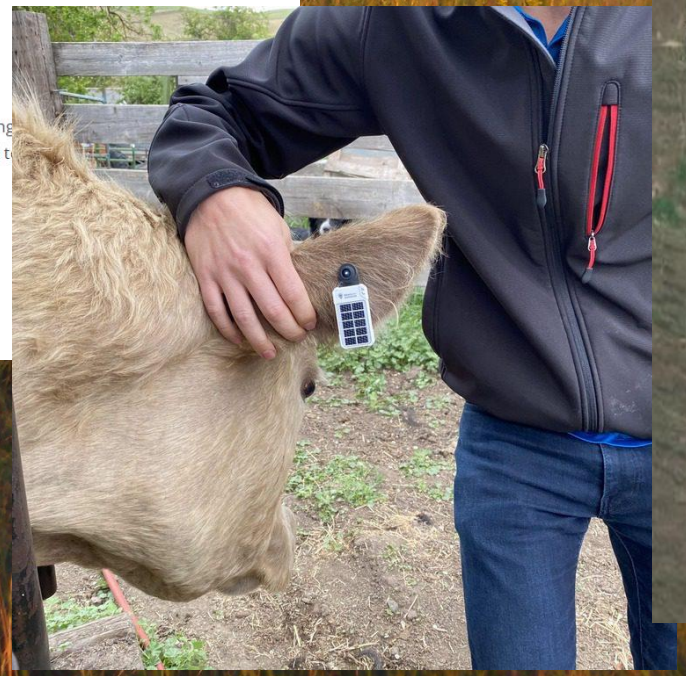
Connecting a cellular tracking device to the animal can sometimes be tricky. We see many users attaching collar and strapping this to the animal. Sim cards are included and the device will automatically connect t animal travels outside of cellular coverage, you will not receive any livestock tracking updates.

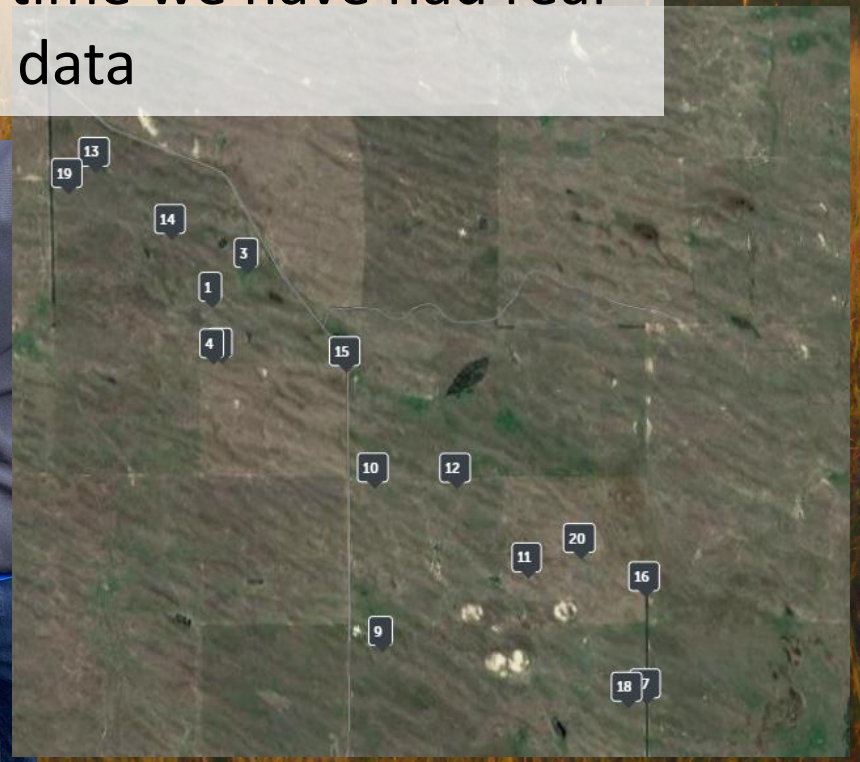
Battery life estimates for the cellular based cattle/animal trackers are as follows:

- 15 Minutes – 11 Weeks
- 1 Hour – 44 Weeks
- 6 Hour – 257 Weeks

https://www.lonestartracking.com

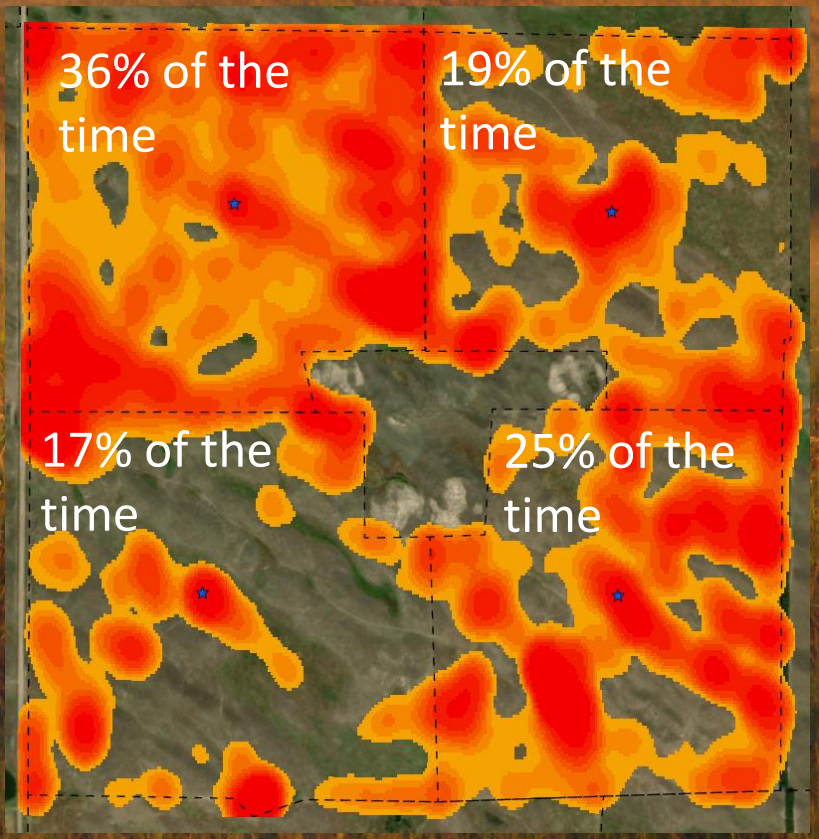
- $120 per unit
- $10 leather tool belt
- $8.50 per month
- First time we have had real-time data



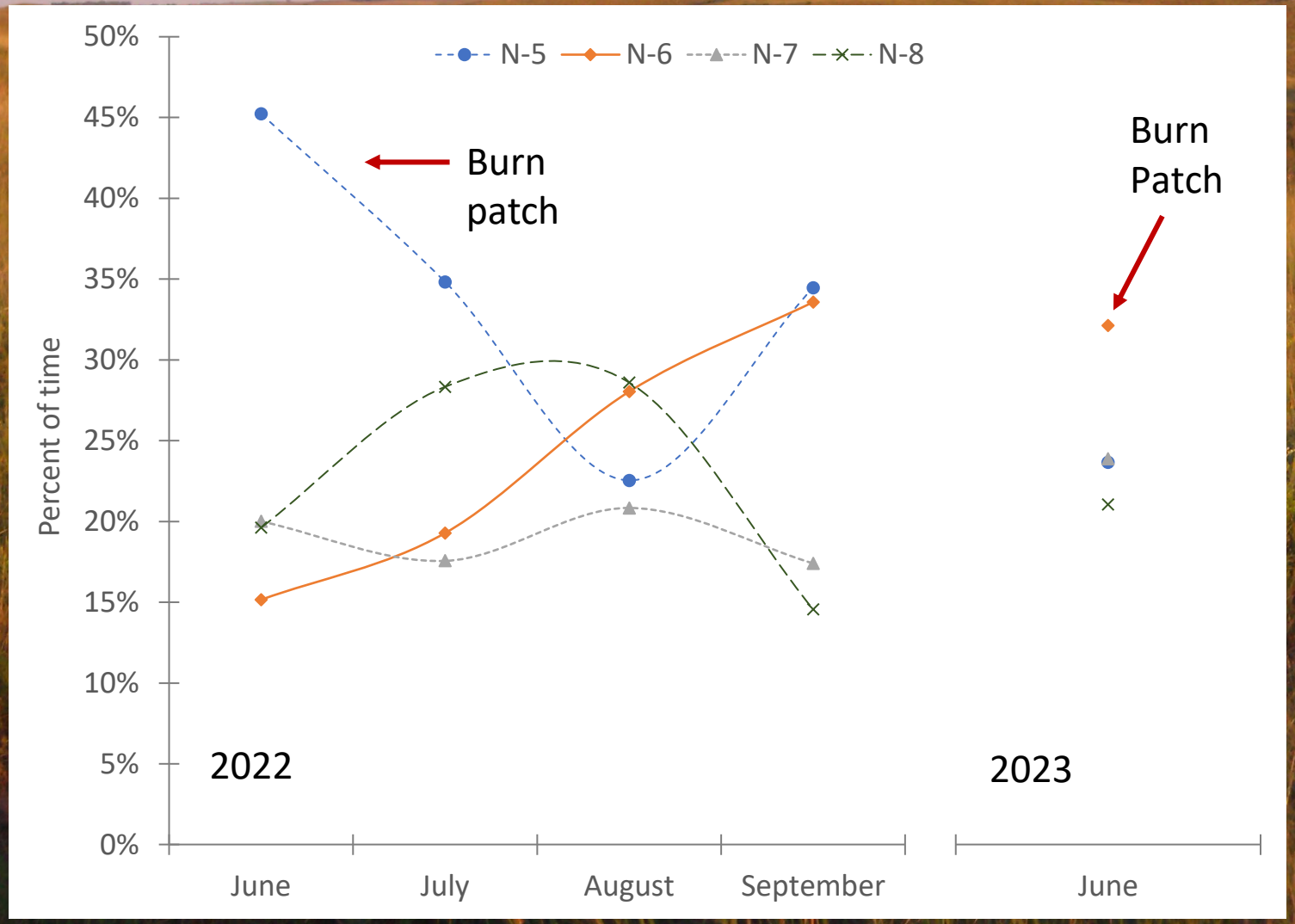


Tracking cattle within a Patch-burn system

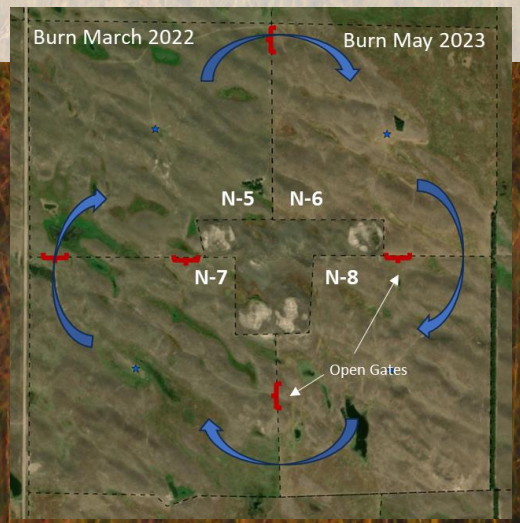
Spayed heifers: 100 hd with a May turn out (8 with GPS collars)



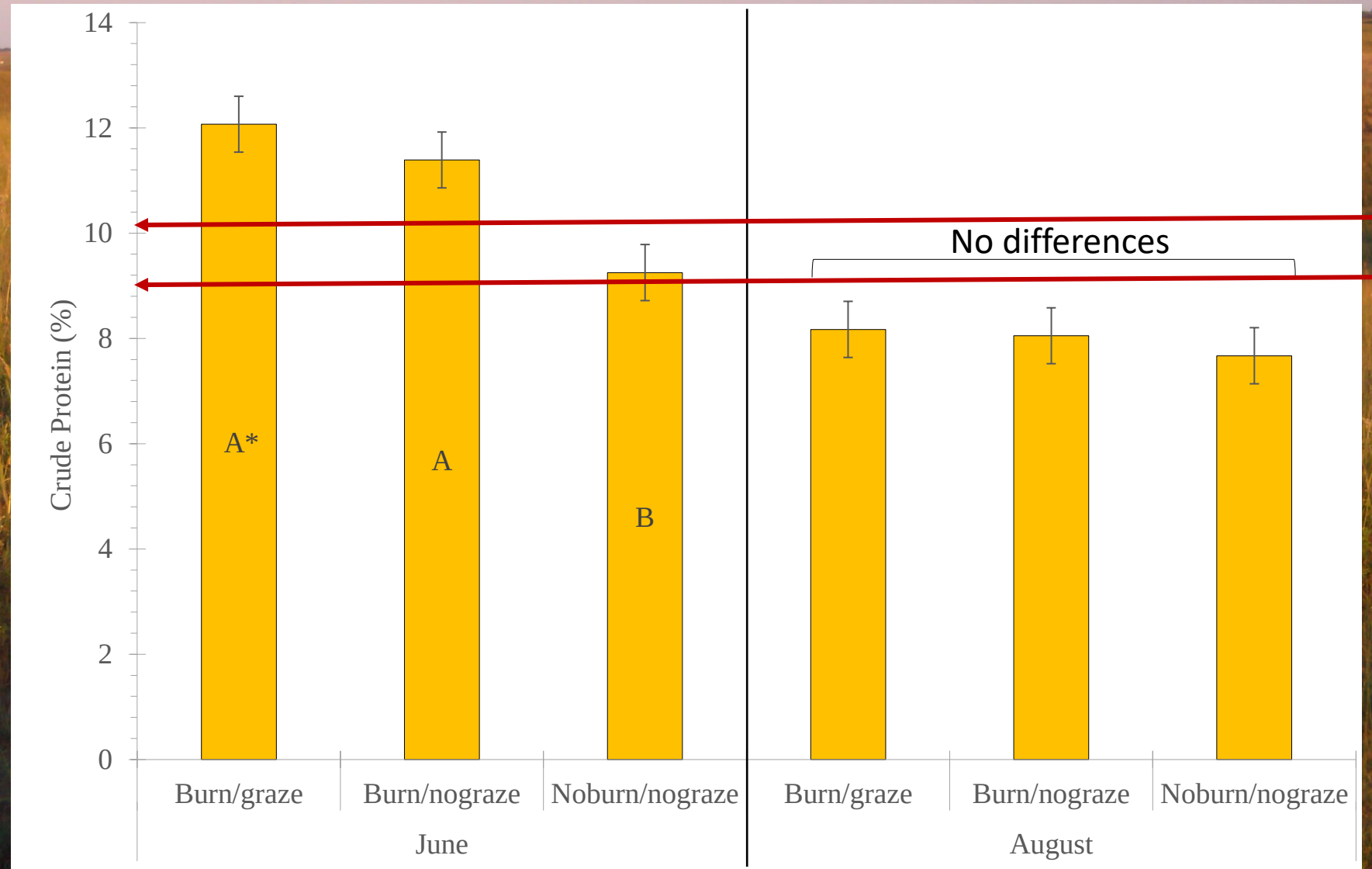
Tracking cattle within a Patch-burn system



- Selection for burn patch decreased as growing season progressed
- Make data driven decisions based on cattle behavior
- Compliment pasture observations



2022 Forage Quality



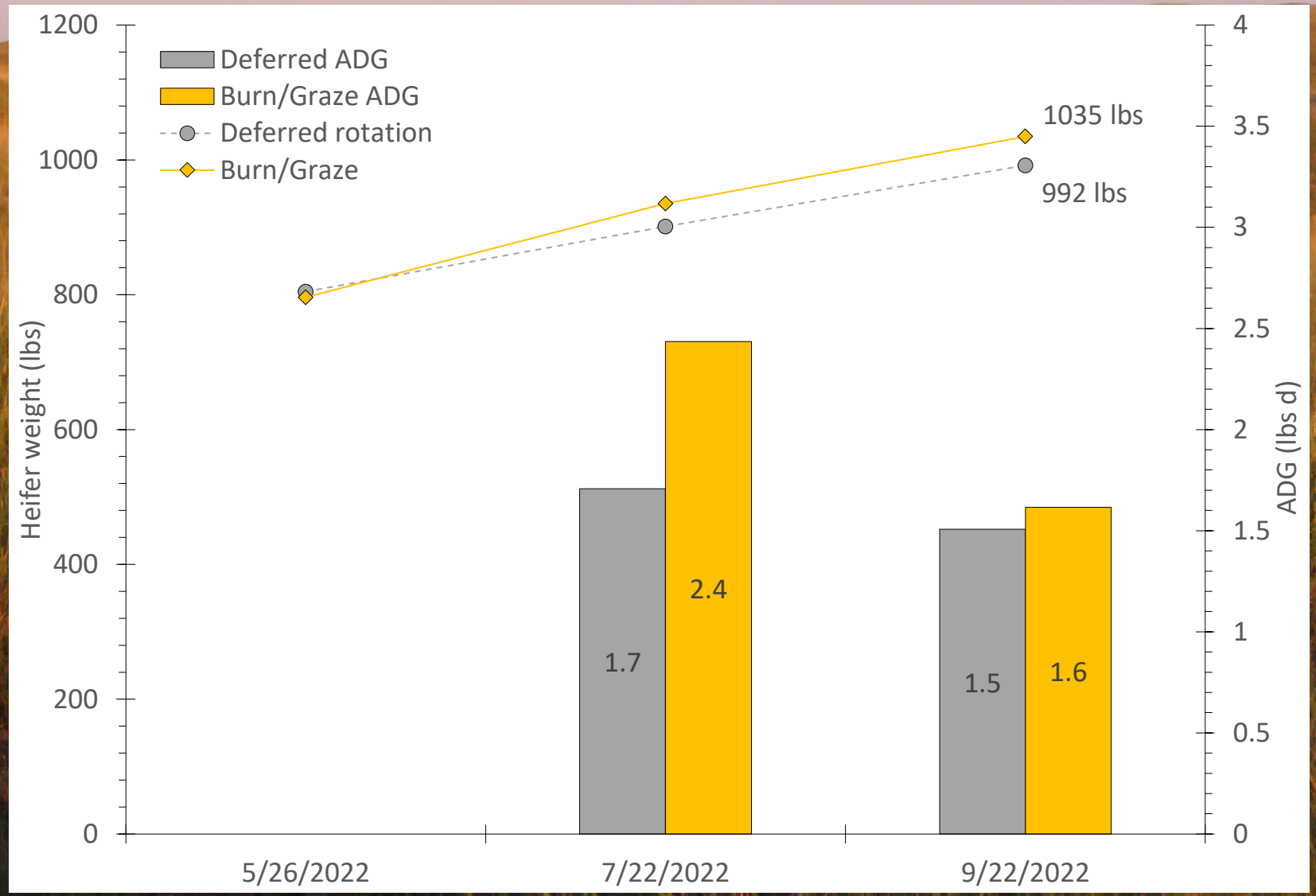
* Treatments with different letters indicate statistically significant differences within treatment periods at p < 0.05

Requirement for a 1.5 lb gain*

Requirement for a 1.0 lb gain

*Lalman and Richards 2017

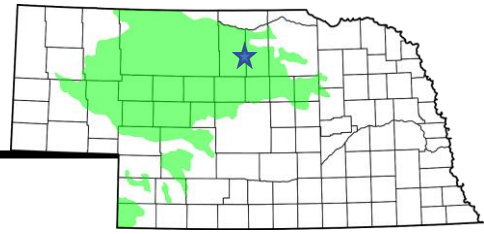
2022 spayed heifer performance

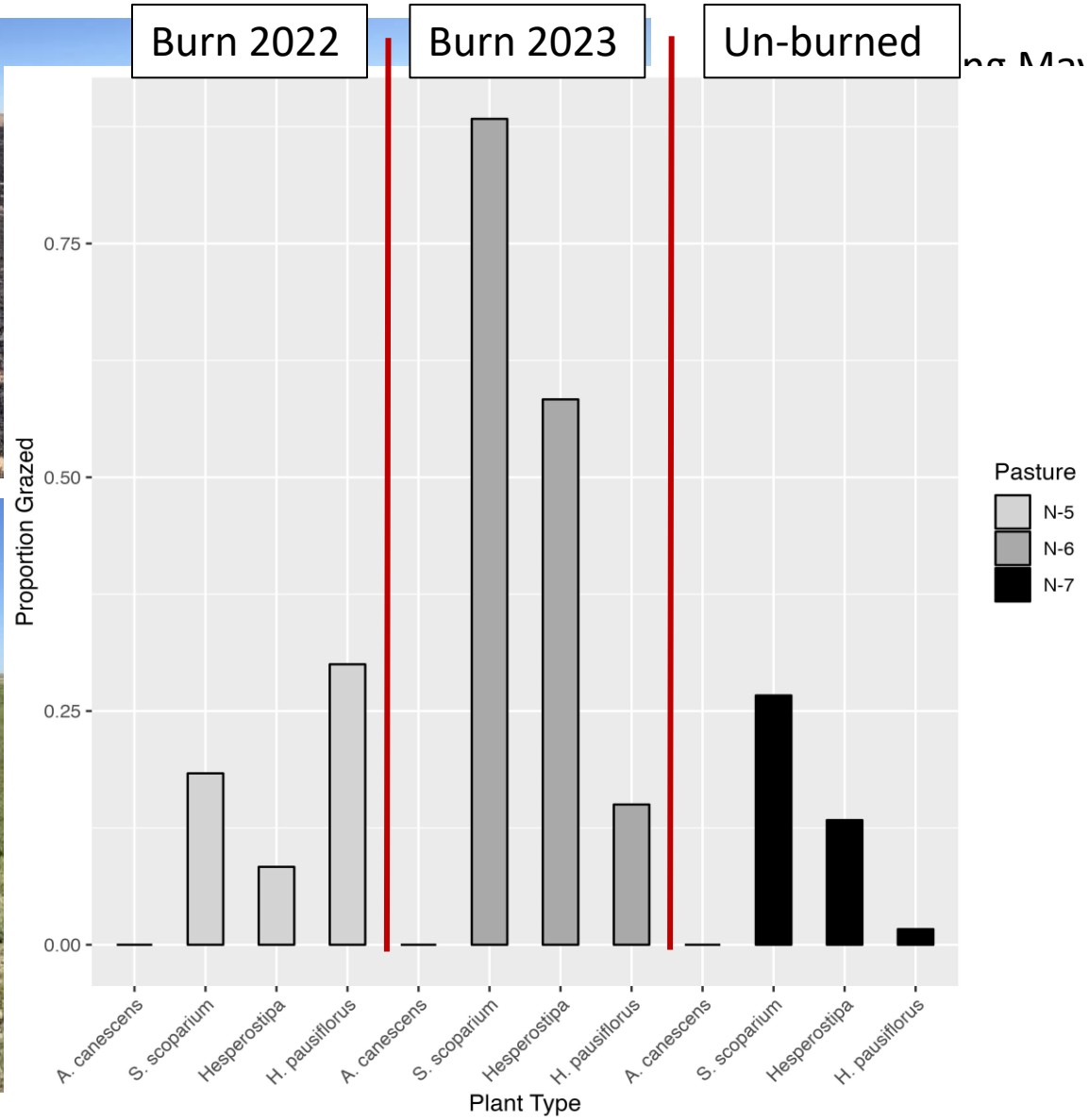


Note:

- Only year 1 results - Need more research to make strong conclusions
- Greater selection opportunities on the Burn/Graze
- Higher stock density on the deferred rotation

Spring Prescribed Burn + Grazing

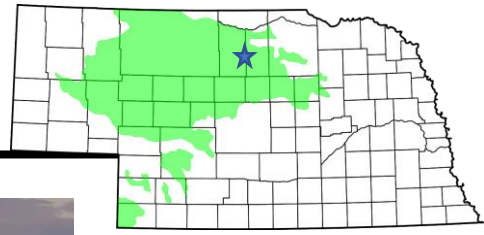




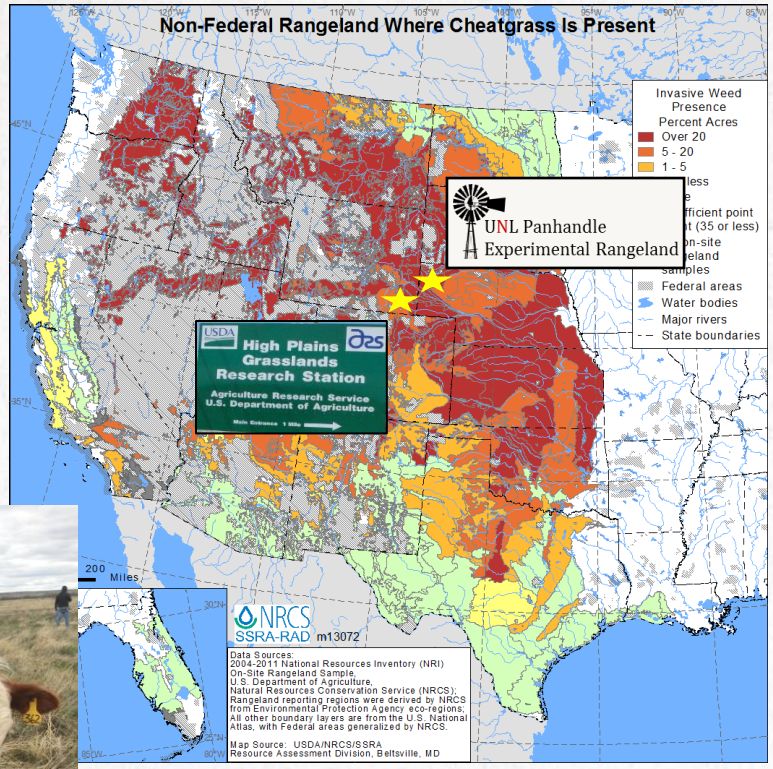
ng May 26, 2022

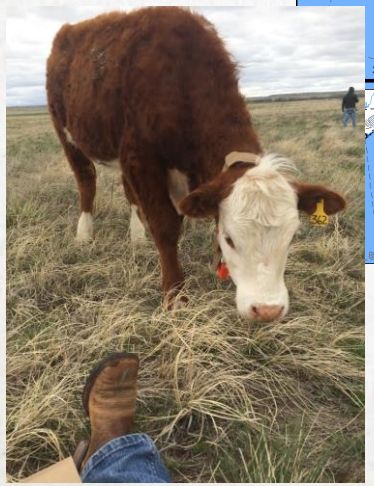
le bluestem

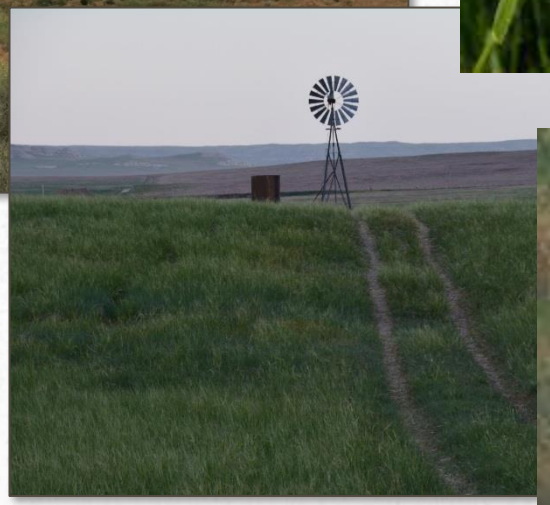
2022 Burn + Grazing



Targeted grazing to control cheatgrass in mixed-grass rangeland



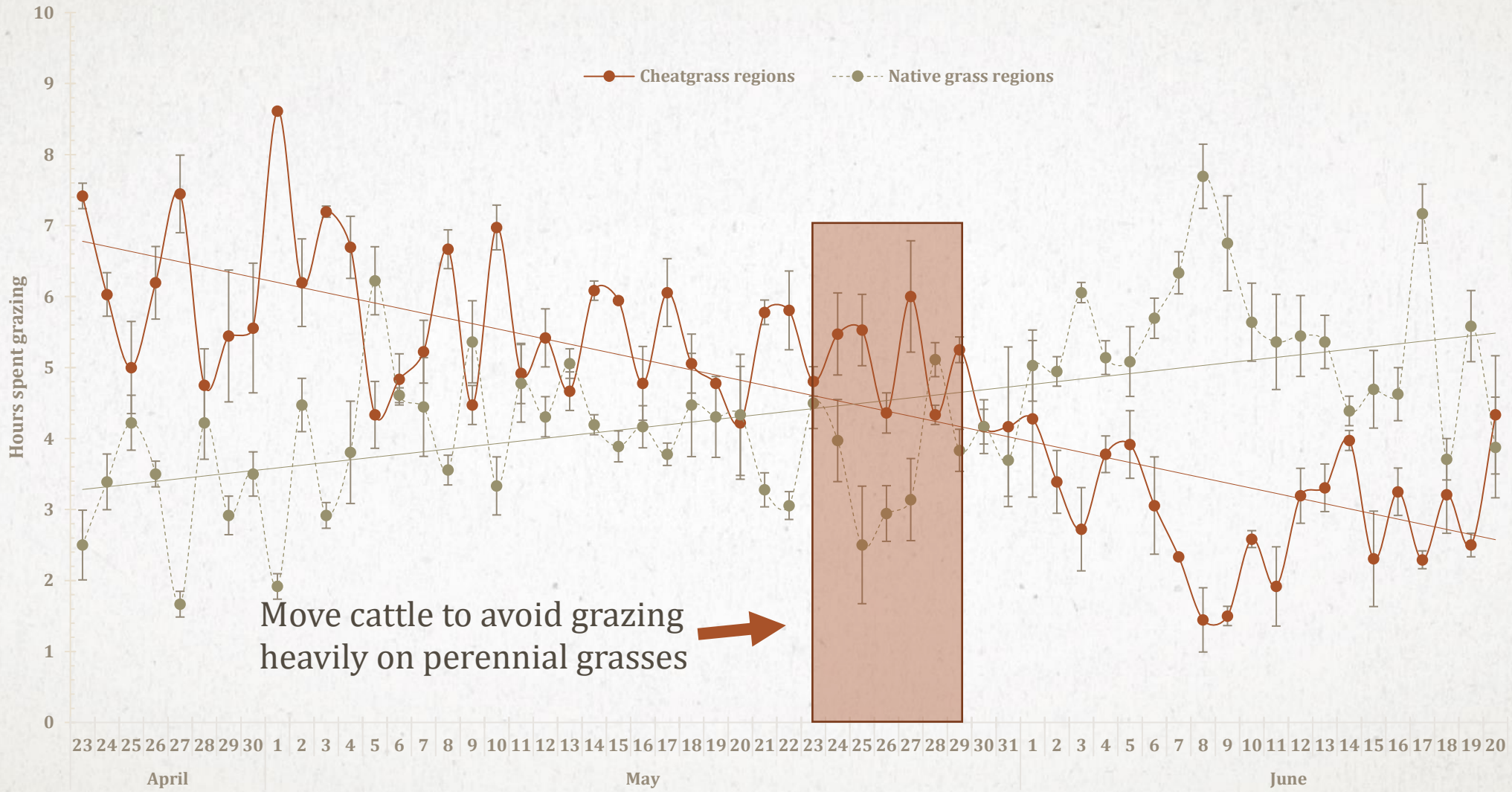




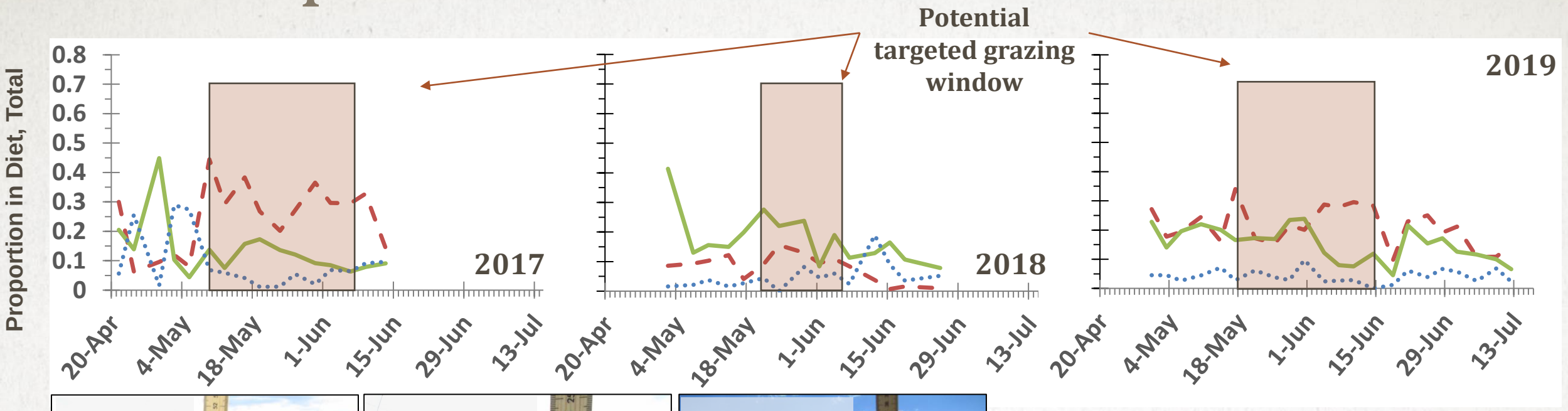
USDA Agricultural Research Service

University of Nebraska Lincoln

Targeted grazing to control cheatgrass in mixed-grass rangeland



Grass species in diet



Photos taken June 12

Targeted grazing to control cheatgrass in mixed-grass rangeland

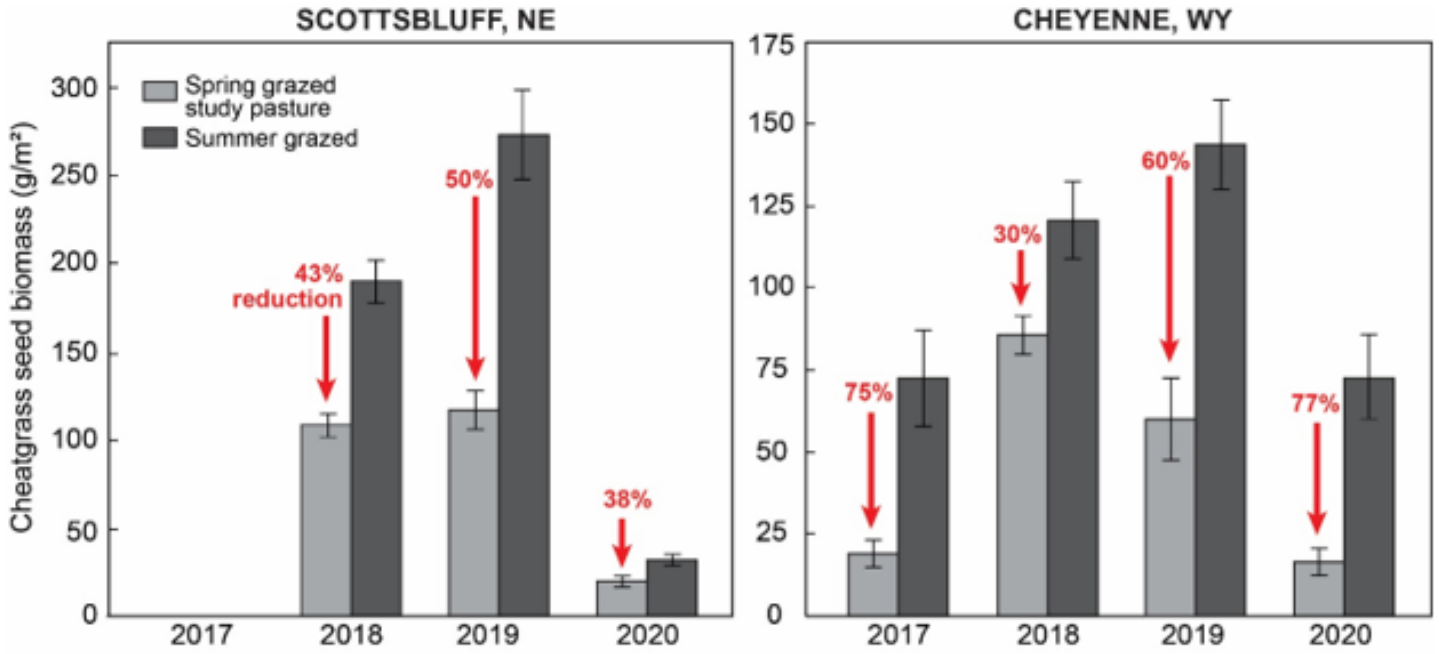
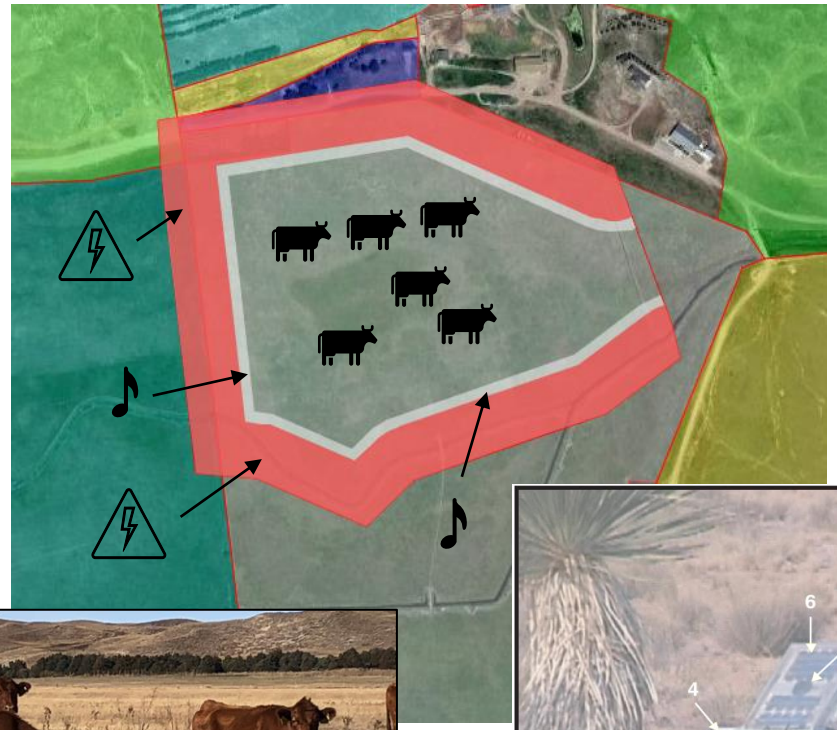


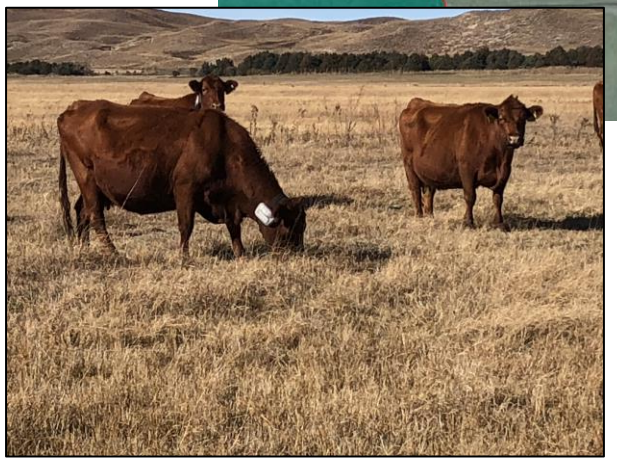
Figure 6. Reduction in brome seed production from targeted spring grazing, compared with summer grazing, in Scottsbluff and Cheyenne, 2017-2020. Seed production was not measured in Scottsbluff in 2017.

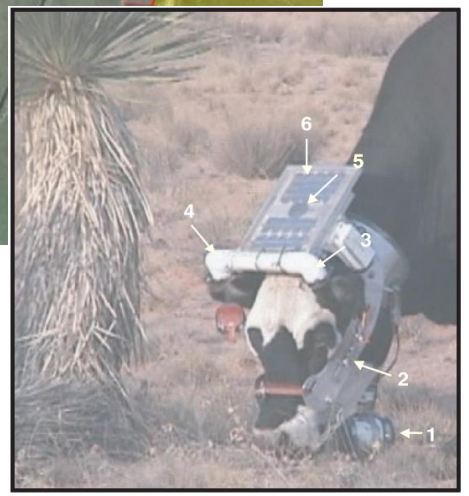
Potential to focus cattle grazing on cheatgrass areas and off native grass areas with virtual fence

Virtual Fence

- Management of grazing across large pastures
- Novel research questions
  - Timing of grazing
  - Frequency of grazing
  - Grazing pressure
  - Invasive species management
  - Wildlife habitat at strategic locations
- Tradeoffs
  - Fence *vs* herding *vs* virtual fence
  - "New" *vs* “old” management





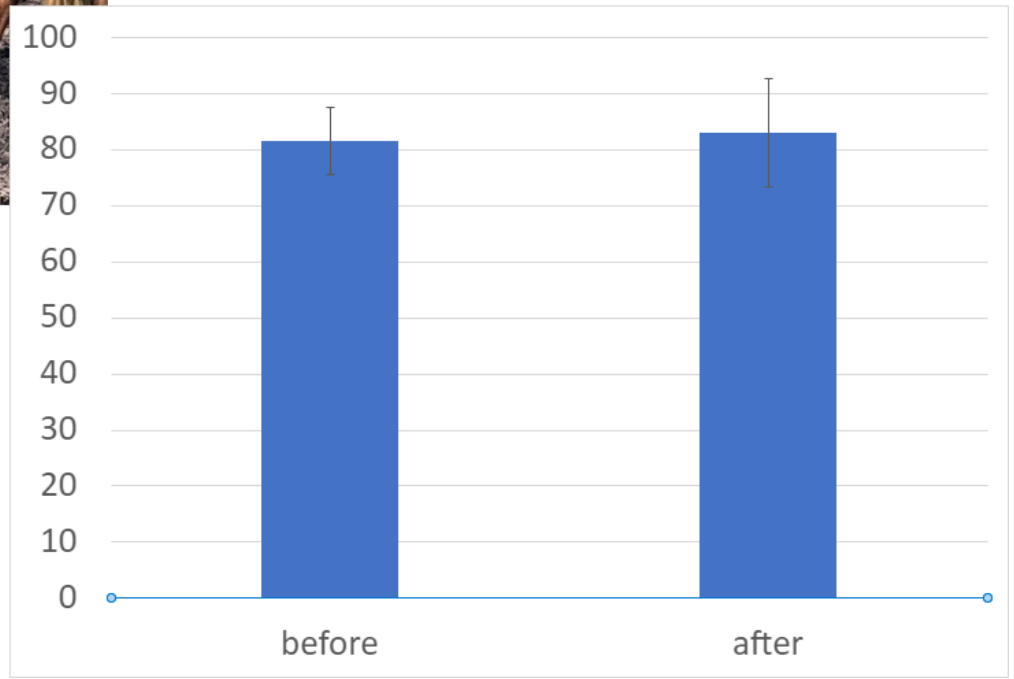


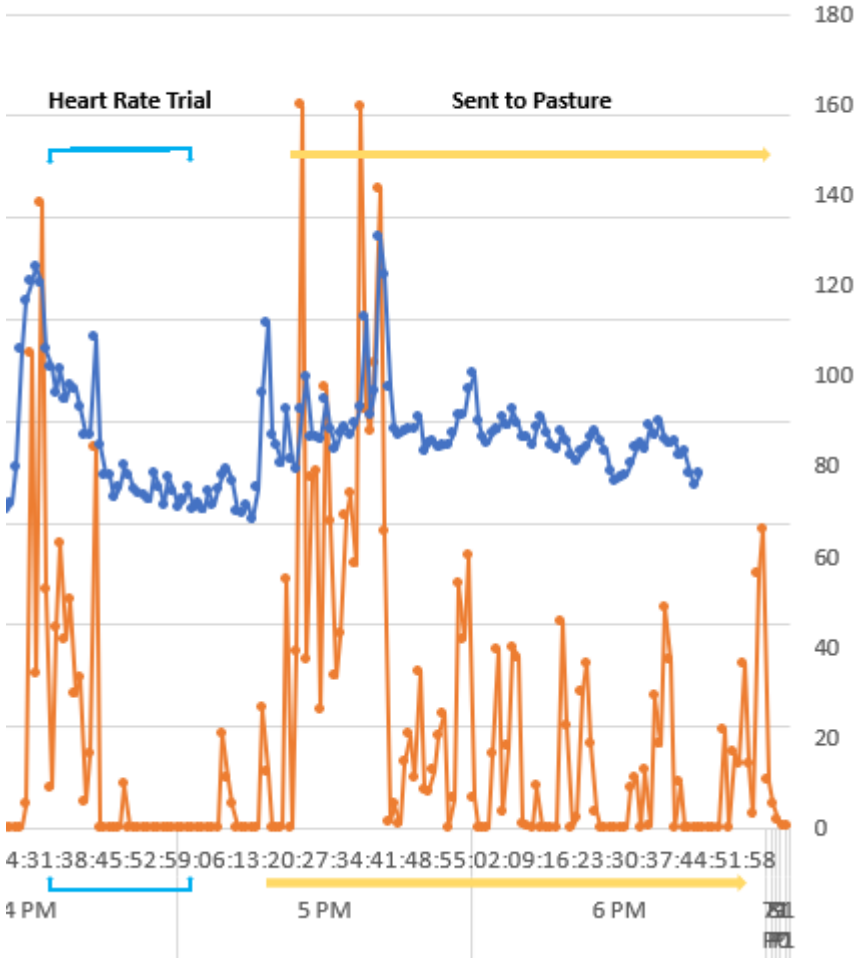
First virtual fence prototypes early 2000s - Anderson 2007

Virtual Fence – Effect on Heart Rate

Blue line - Heart Rate
Orange line - Movement

No difference in heart rates with and without virtual fence collars





Virtual Fence – Stress to Animal

- "Main cattle behaviour on pasture was not affected by the fencing system. Live weight gain, herbage consumption and fecal cortisol metabolites also revealed no significant differences." (Hamidi et al. 2022)

Contents lists available at ScienceDirect

Animal

The international journal of animal biosciences

Heifers don't care: no evidence of negative impact on animal welfare of growing heifers when using virtual fences compared to physical fences for grazing

D. Hamidi [a,*], N.A. Grinnell [a], M. Komainda [a], F. Riesch [a,c], J. Horn [a], S. Ammer [b], I. Traulsen [b], R. Palme [d], M. Hamidi [e], J. Isselstein [a,c]

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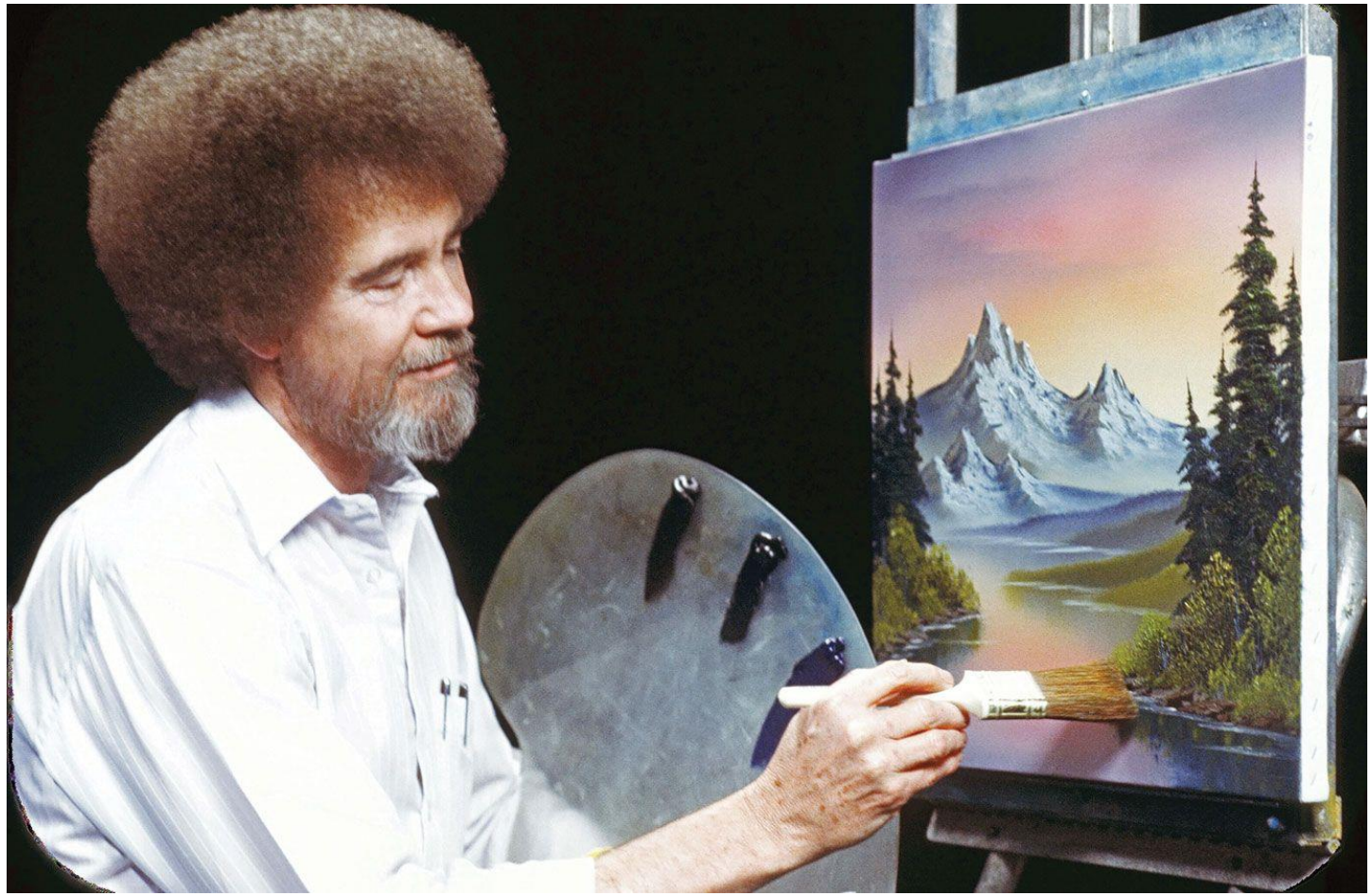
[c] Centre for Biodiversity and Sustainable Land Use, Büsgenweg 1, D-37077 Göttingen, Germany
[d] University of Veterinary Medicine, Department of Biomedical Sciences, Unit of Physiology, Pathophysiology and Experimental Endocrinology, Veterinärplatz 1, 1210 Vienna, Austria
[e] Heisterholz-Mühle 1, D-30916 Isernhagen, Germany

Art of grazing management



- Virtual Fence and other technologies provide viable tools (paint brushes) for cattle grazing management.
- They do not replace a skilled grazing manager (painter).
- Early stages of development at commercial scales
- Weigh cost:benefits

Wrap Up

- **Multiple variables influence livestock grazing distribution (e.g., distance to water, topography, pasture size, stock density, etc.)**

- **Poor grazing distribution causes areas of heavy grazing and areas of light grazing**
  - **Reduces harvest efficiency, but may have some benefits in some situations (Uniform grazing may not always be the best)**

- **Cattle select mostly grasses, but this can vary depending on the time of year and the grass quality**

- **Adaptive grazing management is an <u>ART</u> because of so much spatial and temporal variability**

Questions

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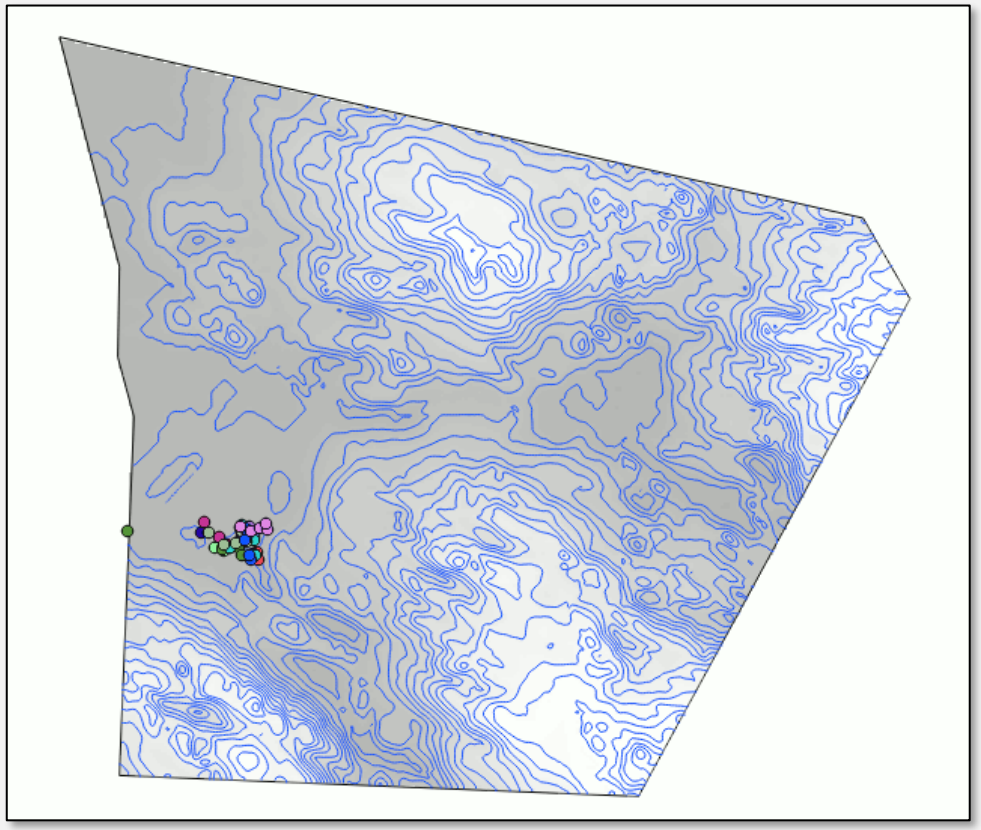
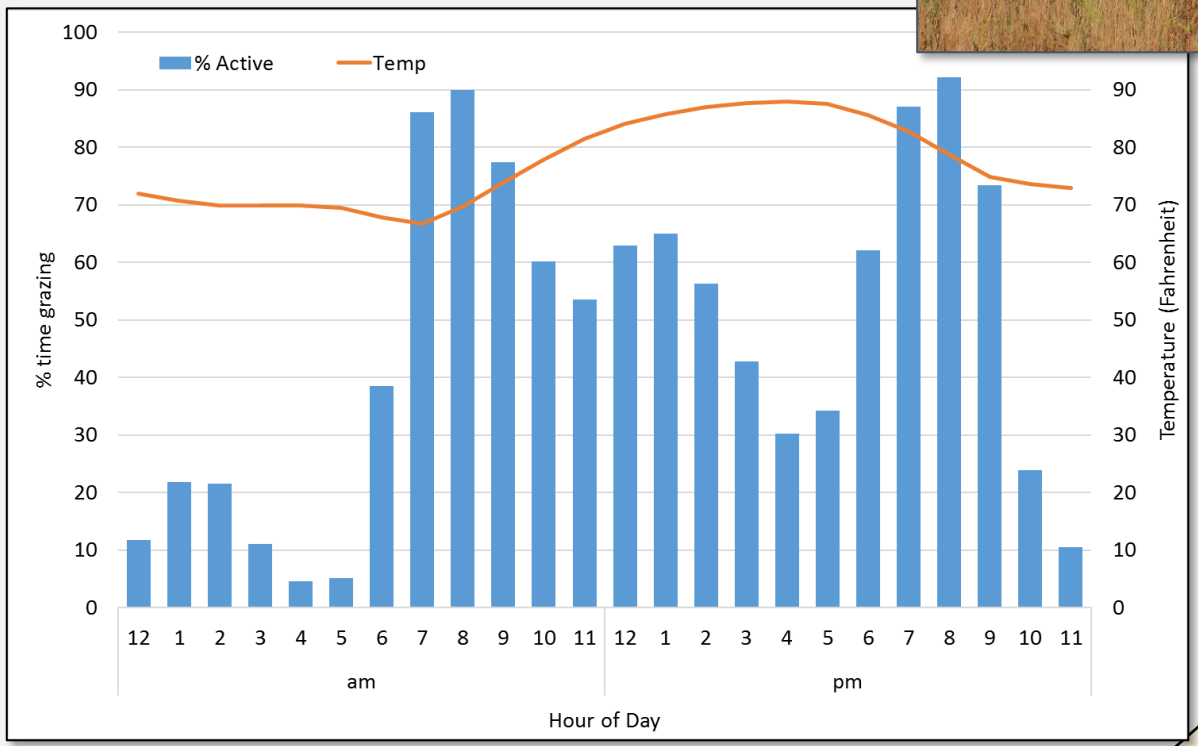
@UNLRangeForage

University of Nebraska Lincoln

Cattle tracking in Nebraska - GPS

- GPS technology continuous tracking
  - 3 weeks to 3+ months
  - 1-sec to 10-min intervals

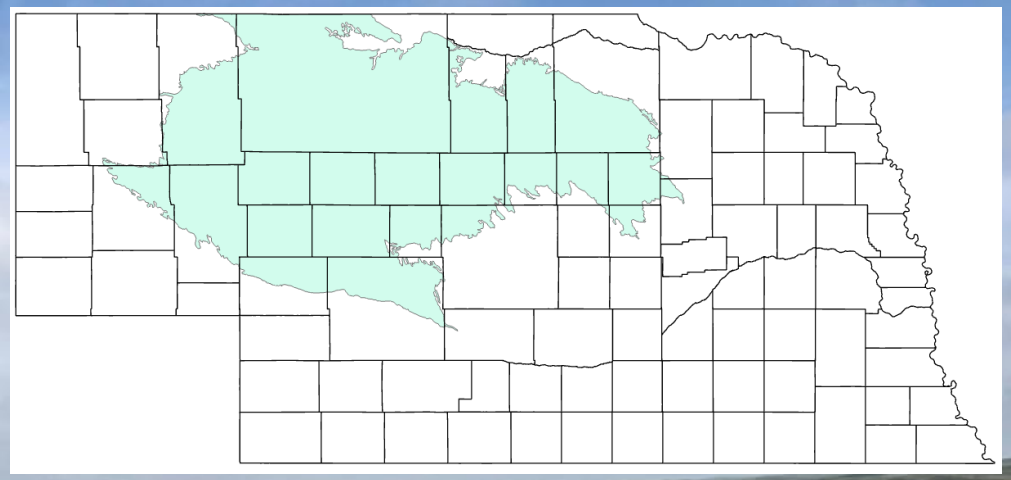




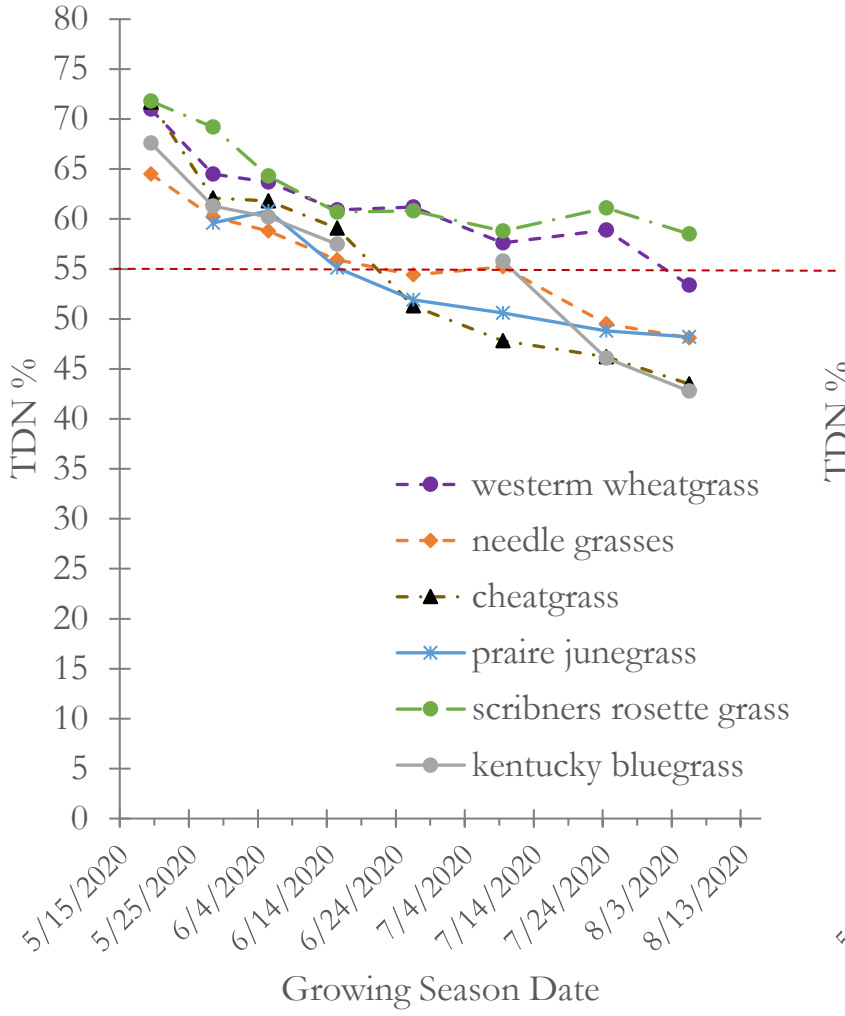
Columbus p-1 units:
David Smith ARS

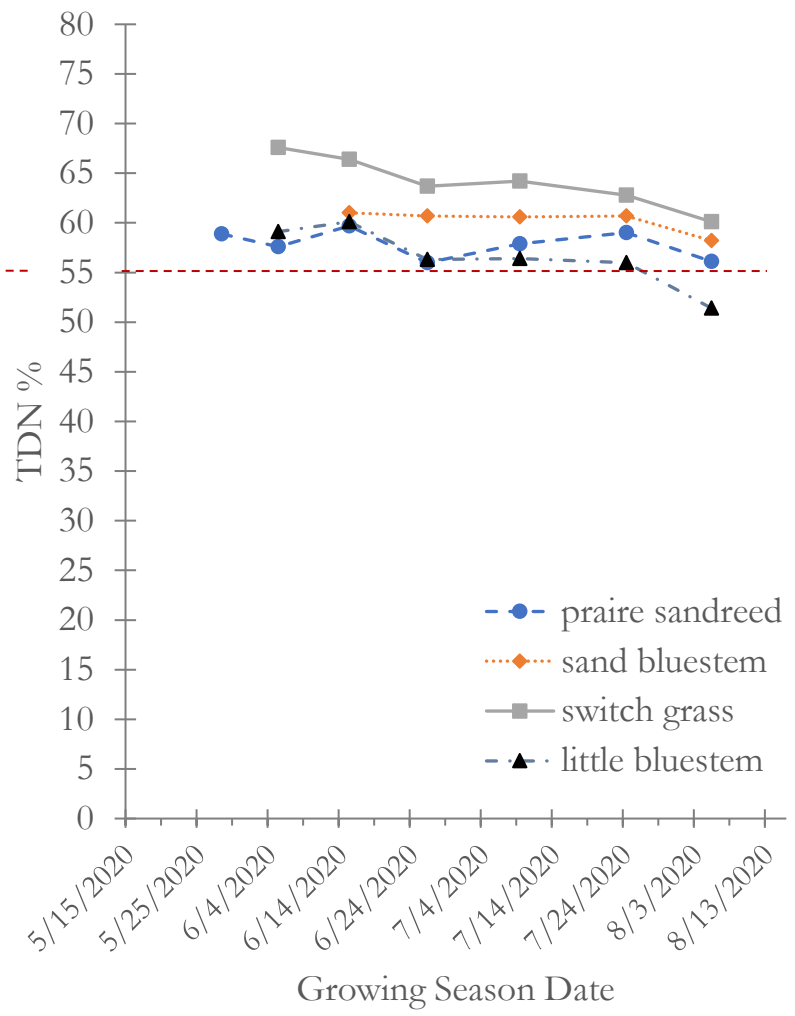
The Nebraska Sandhills: A unique and important working landscape

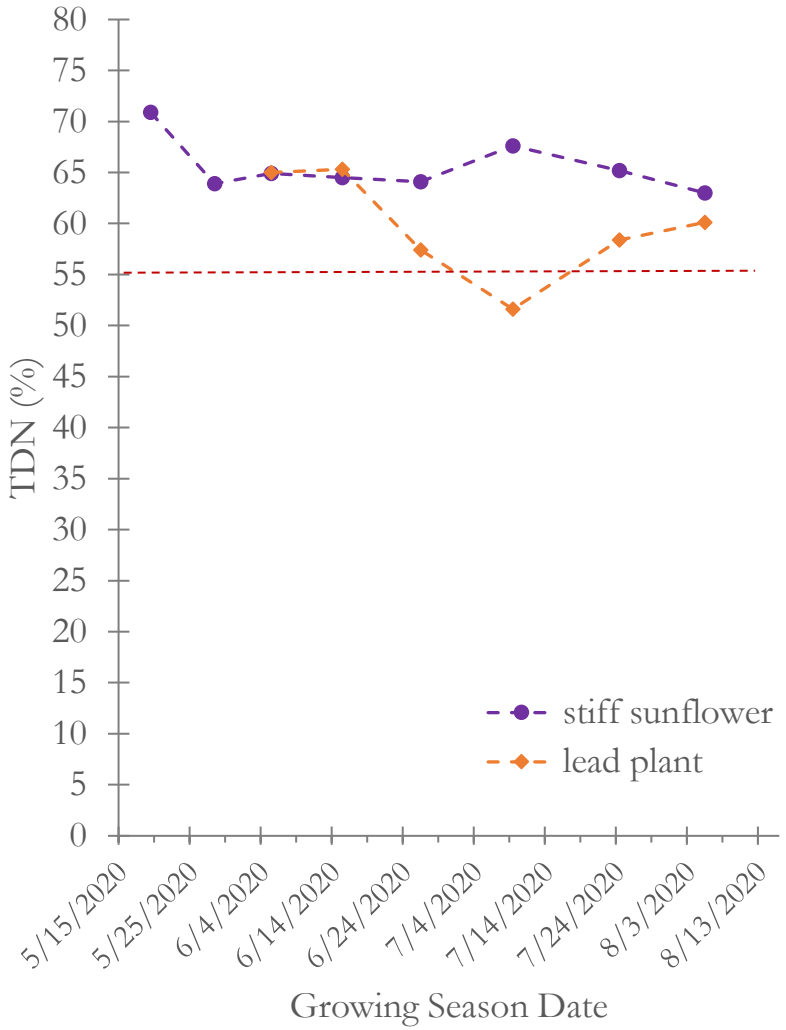
- 20,179 square miles (*12.9 million acres*)
- Lands of the Pawnee and Sioux
- Largest sand dune formation in the western hemisphere
- One of the most intact grasslands in the world
- Over 720 different plant species
- Key habitat for plant and wildlife
- Important wetland system for the Great Plains
- Social Ecological Systems = livelihoods and communities



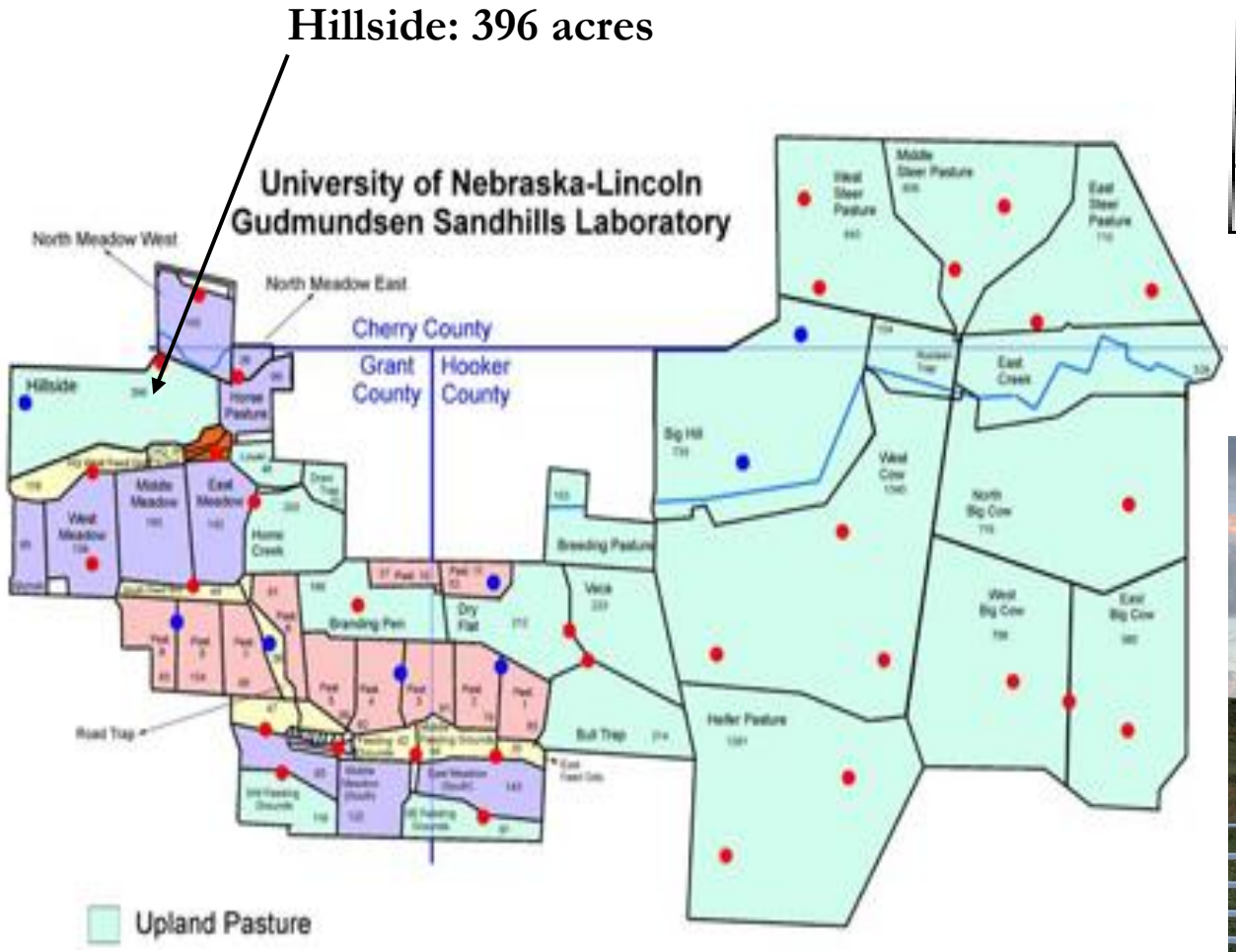
GSL 2020 Forage Quality- TDN%

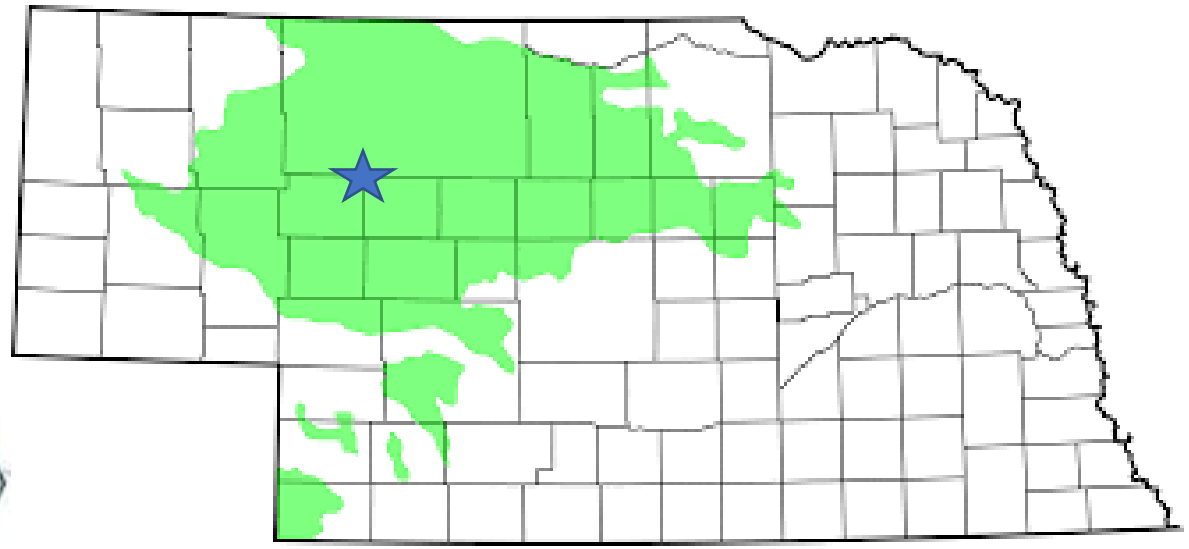






Study site location: UNL Gudmundsen Sandhills Laboratory (GSL)





Data Collection

- May 19th to August 5th
- Every 7-15 days
- Current years growth only
- Sampled 10-20 different plants (1-2 handfuls)

Data Collection- cont.

- Samples dried at 60°C for 48 hours
- Samples sent to Ward Labs
  - Wet Chemistry Analyzes
    - Crude Protein (CP) %
    - Total Digestible Nutrients (TDN) %

Plant Community

Plant Functional group	Number of Species	% of Total Species
Forbs	60	67%
Cool season grasses & grasslike	11	12%
Warm season grasses	11	12%
Shrubs	8	9%
Total	**90**	**100%**