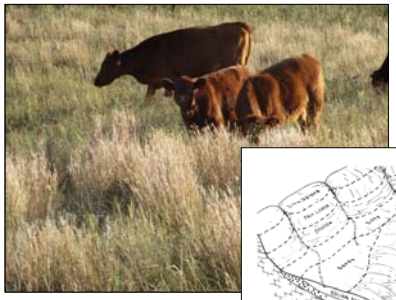
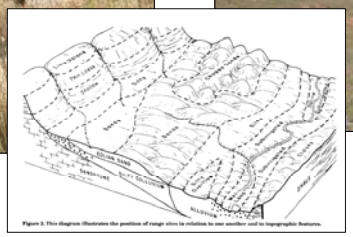
Nebraska's Rangelands: A valuable resource

Mitch Stephenson
Range and Forage Specialist
UNL Panhandle Research and Extension Center





Nebraska Lincoln

What are Rangelands?

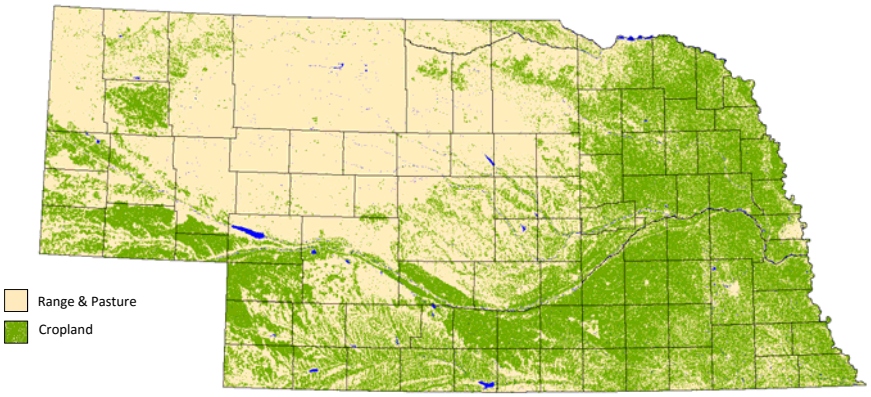
- Rangelands (n) *uncultivated lands on which vegetation is predominantly native grasses, grass-likes, forbs, and shrubs. Rangelands include grasslands, savannas, shrublands, desert, alpine communities, and meadows*

Rangelands

47 % of the World's land area is rangeland
(17.3 billion acres)

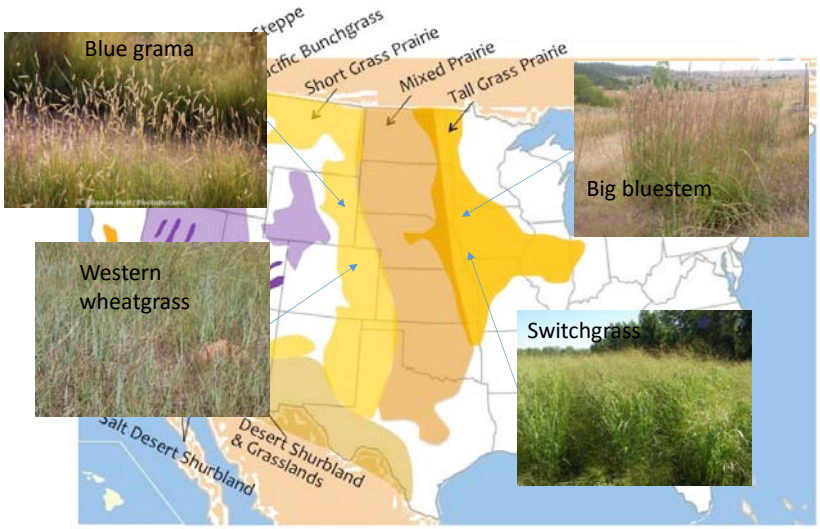
36 % of the United States is rangeland
(876 million acres)

Rangelands



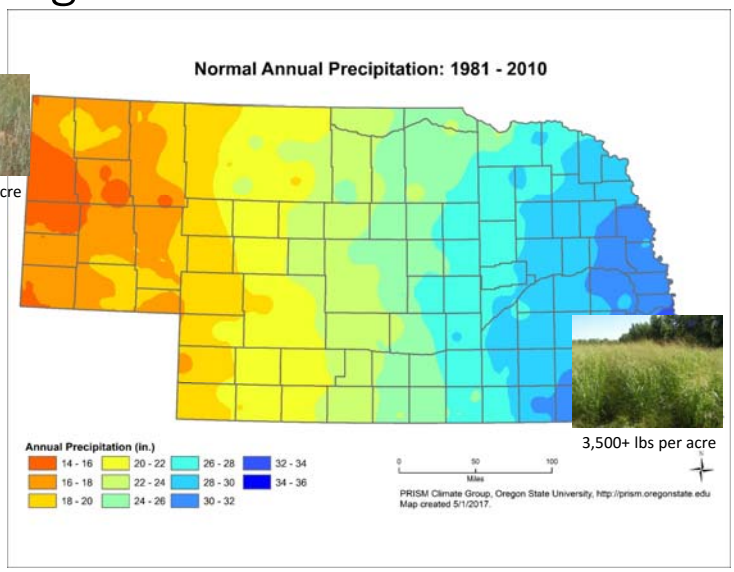
~ 46 % of Nebraska is rangeland (23 million acres)
~ 1.9 million beef cows

Rangelands



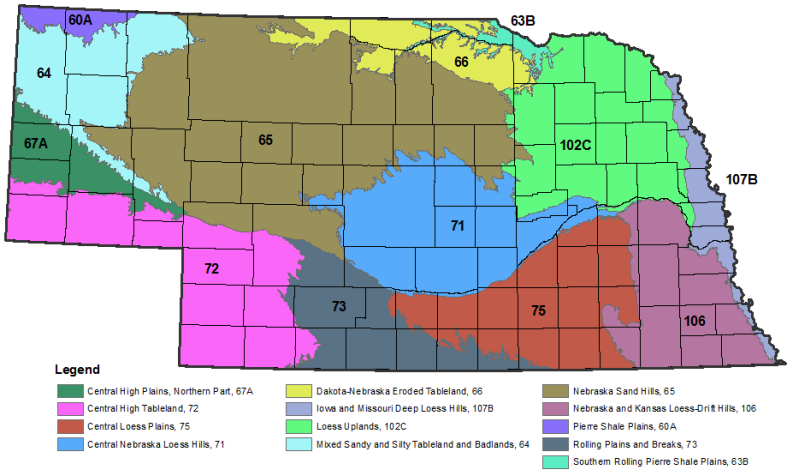
Rangelands

1,400 lbs per acre



3,500+ lbs per acre

Rangelands



Historical Perspective of Range Management

Heavy livestock buildup in the late 1800s

Classic example of the "Tragedy of the Commons"

Historical Perspective of Range Management

"Men of every rank were eager to get into the cattle industry. In a short time every acre of grass was stocked beyond its fullest capacity….. The grasses were entirely consumed; their very roots were trampled into the dust and destroyed. In their eagerness to get something for nothing, speculators did not hesitate at the permanent injury, if not the total ruin, of the finest grazing country in America"

(H.L. Bentley 1898 in Abilene, TX)

Historical Perspective of Range Management

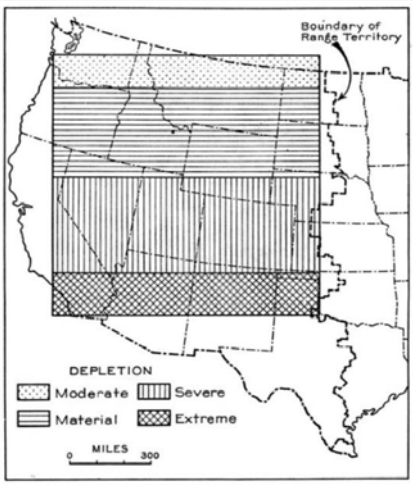


FIGURE 2.—RANGE DEPLETION CLASSES.

Definition

"Range management is the science and the art of planning and directing range use so as to obtain the maximum livestock production consistent with conservation of the range resources"

(Stoddart and Smith 1943)

Rangeland Management

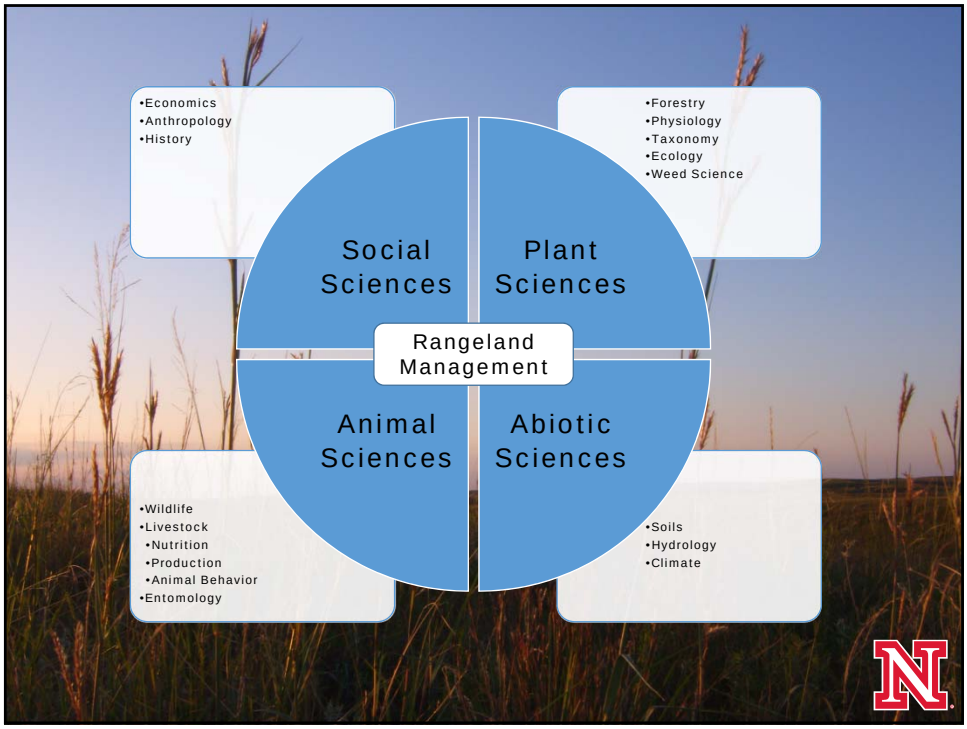
"Range Management is a discipline and an art that skillfully applies an organized body of knowledge accumulated by range science and practical experience for two purposes: 1) protection, improvement, and continued welfare of the basic resources, which in many situations include soils, vegetation, endangered plants and animals, wilderness, water, and historical sites; and 2) optimum production of goods and services in combinations needed by society"

(Heady and Child 1994)

Science

AND

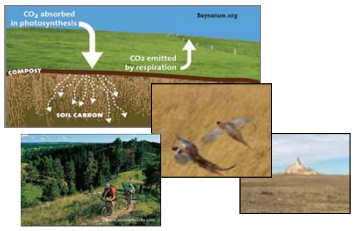
Art



Importance of Rangelands

Ecosystem Services

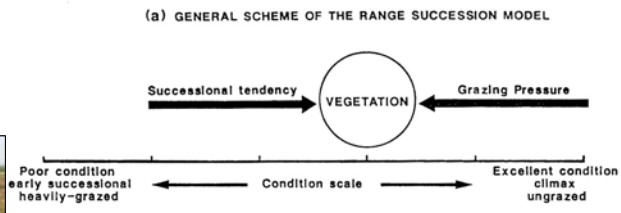
- Carbon sequestration
- Air and water purification
- Wildlife and plant habitat
- Erosion control
- Recreation
- Aesthetics and cultural heritage



Products

- Food
  - Plants and animals
- Fiber
  - Wool, leather, etc.
- Lands for renewable energy
  - Wind, solar, etc.
- Mining
- Recreation

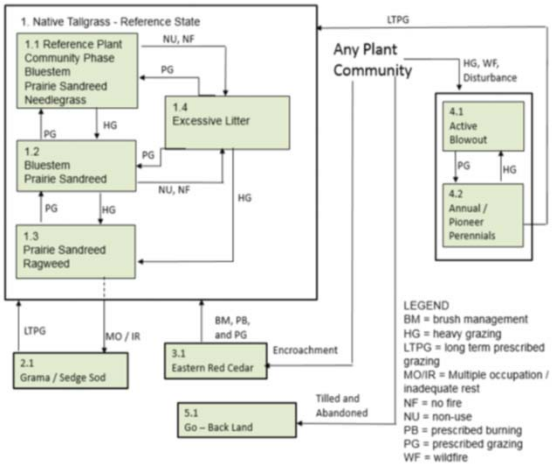
RANGELAND MANAGEMENT



Westoby et al. 1989, Opportunistic management for rangelands not at equilibrium

RANGELAND MANAGEMENT

Figure 2: State and Transition Model
MLRA 65 – Nebraska Sandhills – Sands Site (17-22" Precipitation).



Grazing Management

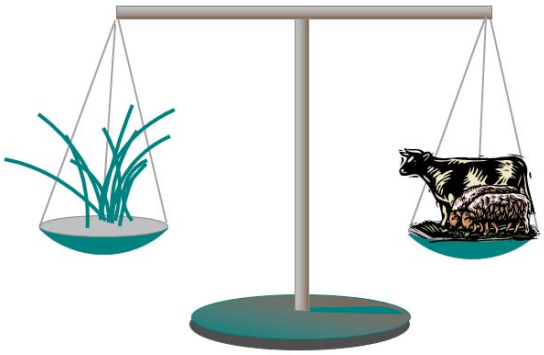
- Stocking Rate
- Distribution
- Timing of grazing


"….ungulates are important agents of change in ecosystems, acting to create spatial heterogeneity, modulate successional processes, and control the switching of ecosystems between alternative states."

"Modifications of ecosystems by ungulates", Hobbs 1996



Stocking Rate



Sustainably balancing forage supply with the nutrient demand from livestock and other animals

Stocking Rate

Kind/class of animal	Animal Unit Equivalent (AUE)	Estimated air dry-matter intake (lbs/day)[1]	
Cattle		Day	Month
Cow (1000 lb) and calf in the first 3 months	1.00	26.0	790
Cow (1100 lb) and calf in the first 3 months	1.10	28.6	869
Cow (1200 lb) and calf in the first 3 months	1.20	31.2	948
Cow (1300 lb) and calf in the first 3 months	1.30	33.8	1028
Cow (1400 lb) and calf in the first 3 months	1.40	36.4	1107
Dry cow (1,000 lb)	0.92	23.9	727
Calf (Spring calving, 3 months of age to weaning)	0.30	7.8	237
Weaned calf to yearling (6 - 12 months)	0.60	15.6	474
Yearling (12 - 17 months)	0.70	18.2	553
Yearling (18 - 24 months)	0.80	20.8	632
Young Bulls (1 - 2 years)	1.20	31.2	948
Mature Bulls (2 + years)	1.50	39.0	1186
Horses			
Yearling horse	0.75	19.5	593
Young horse (1 - 2 years)	1.00	26.0	790
Mature light horse	1.25	32.5	988
Sheep			
Mature ewe	0.20	5.2	158
Lamb (weaned to yearling)	0.12	3.1	95
Yearling lamb	0.15	3.9	119
Ram	0.25	6.5	198
Goats			
Mature (doe or buck)	0.15	3.9	119
Kid (yearling)	0.10	2.6	79
Other			
Deer (White-tailed)	0.15	3.9	119
Deer (Mule)	0.20	5.2	158
Antelope	0.20	5.2	158
Bison cow, Mature	0.90	23.4	711
Bison bull, Mature	1.50	39.0	1186
Elk	0.60	15.6	474

Stocking Rate

"Relationship between the number of animals and the grazing management unit utilized over a specified time period"
(AU/Area/Time)

Stocking Density

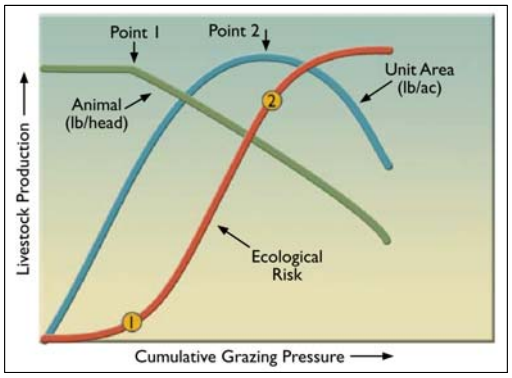
"Relationship between the number of animals and a specific unit of land being grazed at any one point in time"
(AU/Area)

Grazing Pressure

"Animal-to-forage relationship" (AU/weight of available forage)

Carrying Capacity

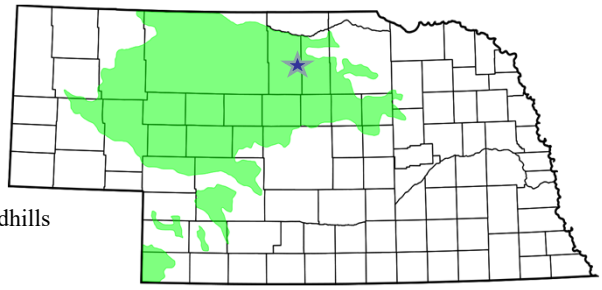
The number of animals that a piece of land can support on a long-term basis without causing damage to the ecosystem



Stocking rate

Herbage production is one of the most important and variable factors for livestock production on rangelands

Study Site Location



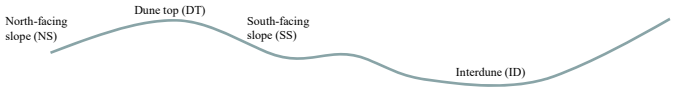
- 5,500 acres upland Sandhills range

Study Site Location

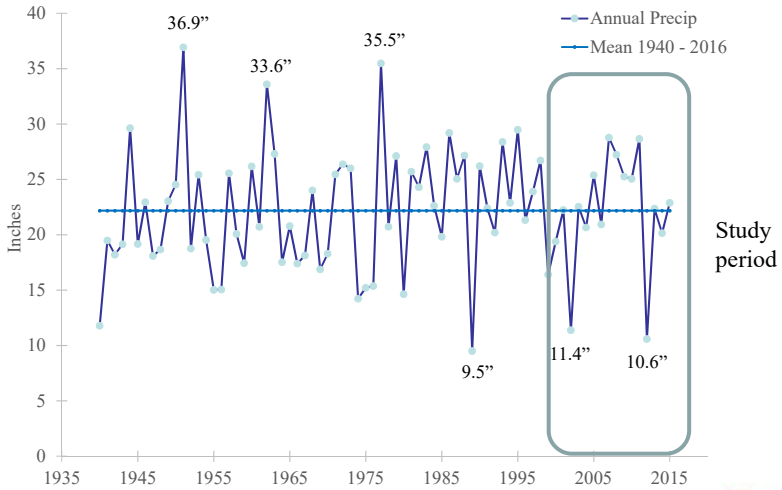
2001 to present
- ¼ m^2 quadrats at 4 different topographic positions

Harvests
- Mid-June
- Mid-August

Plants separated
- Warm-season grasses
- Cool-season grasses
- Forbs
- Shrubs
- Sedges

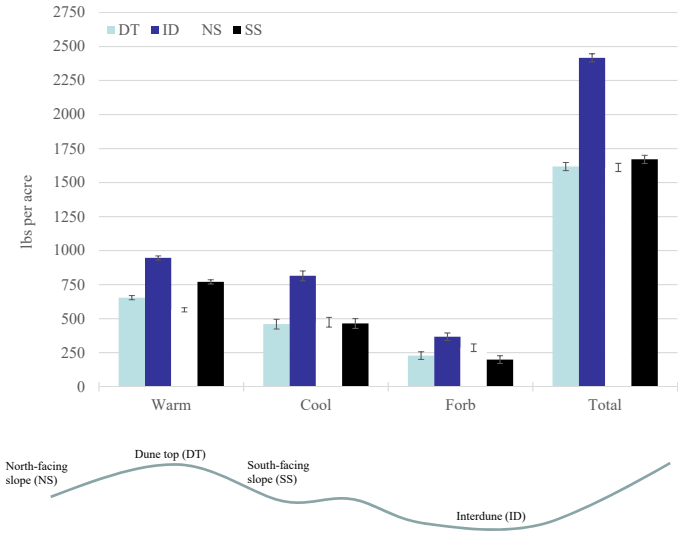


Results: Annual Precipitation

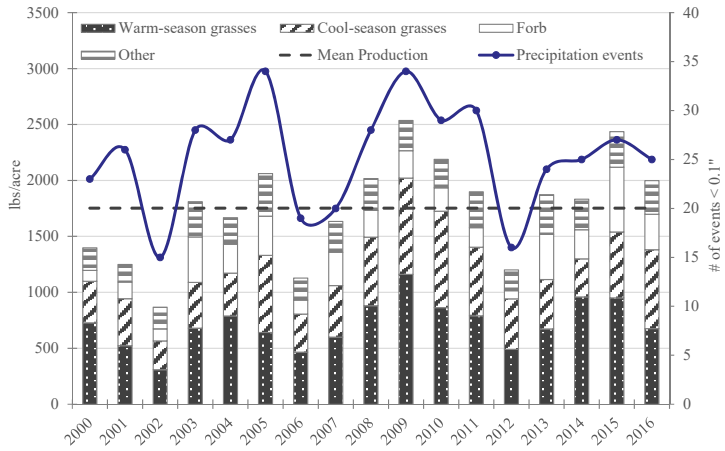


Data from the High Plains Regional Climate Center from Ainsworth, NE: climod.unl.edu

Herbage yields in mid-August



Peak Herbage Production at the Barta Brother Ranch: Mid-August



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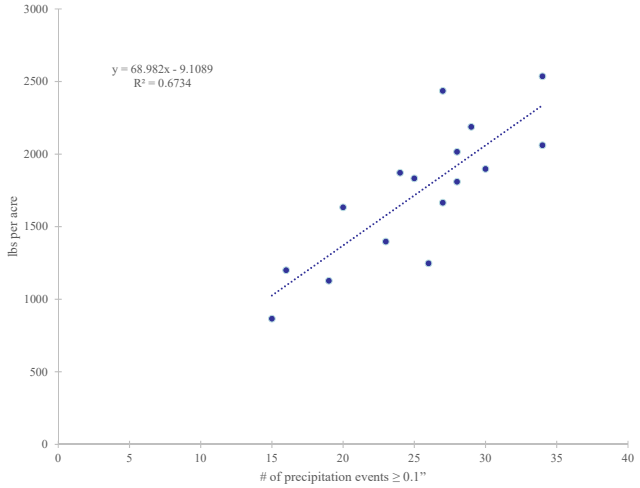
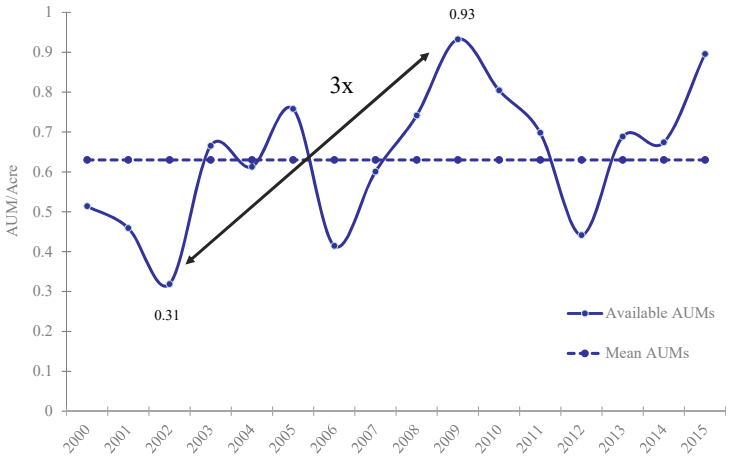


Stocking Rate



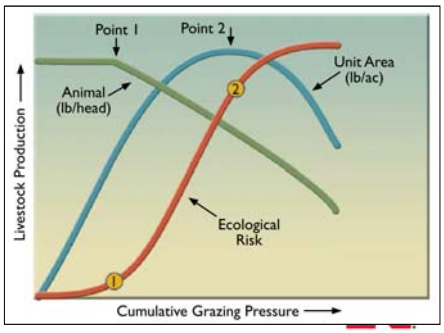
How do I manage under this kind of variability?

- "Maintaining grazing flexibility was determined to be very important for managing variable forage conditions, and its importance increases with the level of variability." Torell et al. 2010
- Including yearlings in the operation:
  - "As forage variability increased to levels observed on the arid rangelands of the western United States, a 50:50 forage allocation between cow-calf and yearling enterprises was found to be optimal" Torell et al. 2010
- Maintaining a reserves of forage:
  - Stock conservatively to always maintain a stockpile of forage that can be used when in need

Stocking Rate

"The combination of heavy grazing and drought is the primary cause of decline in range condition"

Reece et al. 2008



Discussion: Climate change – 2050

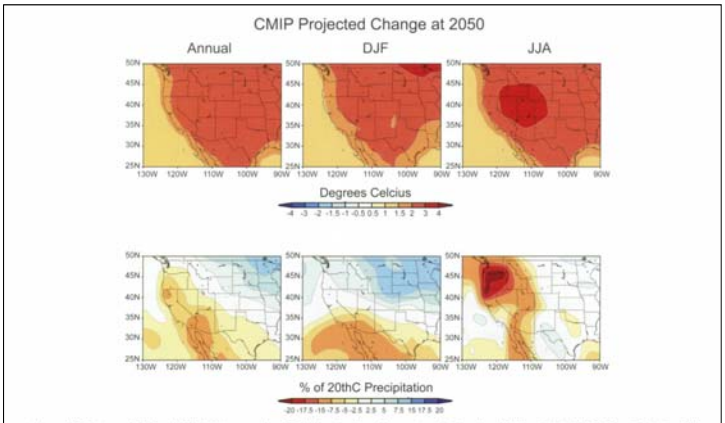
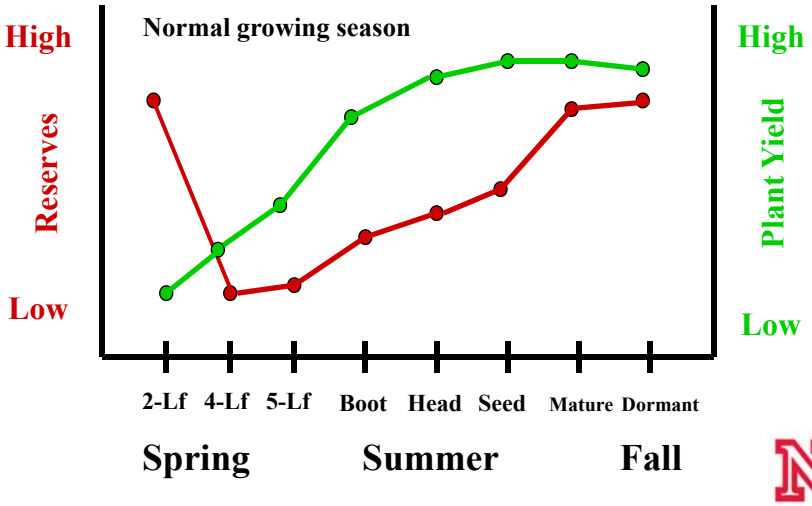


Figure 4. Climate model (Coupled Model Intercomparison Project) projections of temperature (top) and precipitation (bottom) for 2050 relative to the 20th century. Values are presented for the entire year (left), winter (center), and summer (right).

Polley et al. 2013, "Climate change and North American rangelands: Trends, projections, and implications"

Carbohydrate reserves (●—●) and perennial plant yield (●—●) in relation to growth stage



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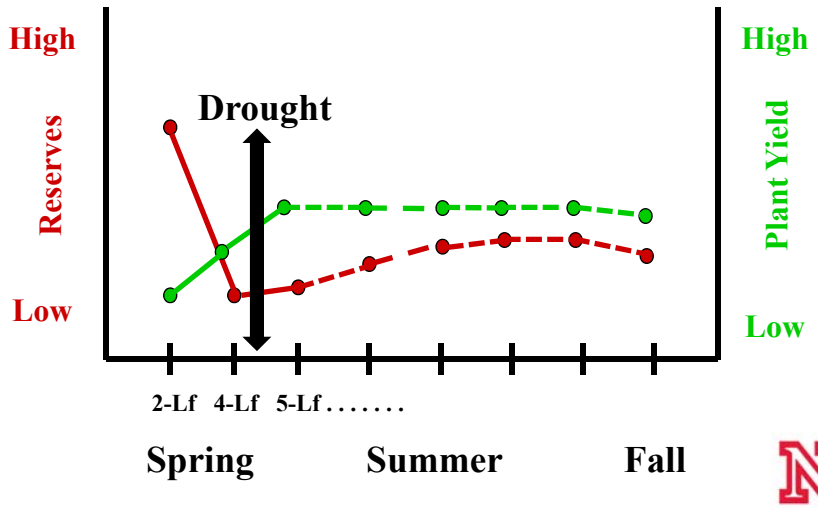
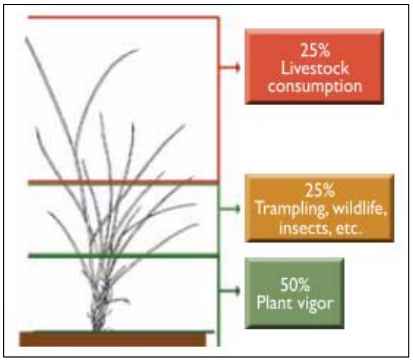


Stocking Rate



Utilization measurements to determine if stocking rates are appropriate in each year

Grazing Intensity

Level of Removal

Overgrazing = repeated heavy grazing such that damage to the plant community occurs

Stocking Rate

Stocking rates vs. trend

Grazing Intensity	% Use	% studies showing: ↓	=	↑
Heavy	51-65	90	10	0
Moderate	40-50	23	30	47
Light	< 40%	5	21	74

Summary of 25 studies evaluating the effects of grazing intensity on rangeland condition in North America (Holechek et al. 1999)

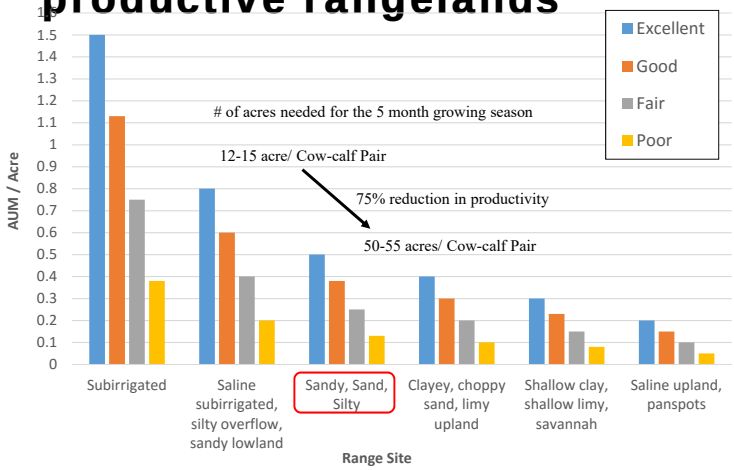
Stocking Rate

Stocking rates vs. forage production

	Heavy	Moderate	Light
Utilization (%)	57	43	32
Avg. forage production (lb/acre/yr)	1,175	1,473	1,597
Forage production drought years (lb/acre/yr)	820	986	1,219

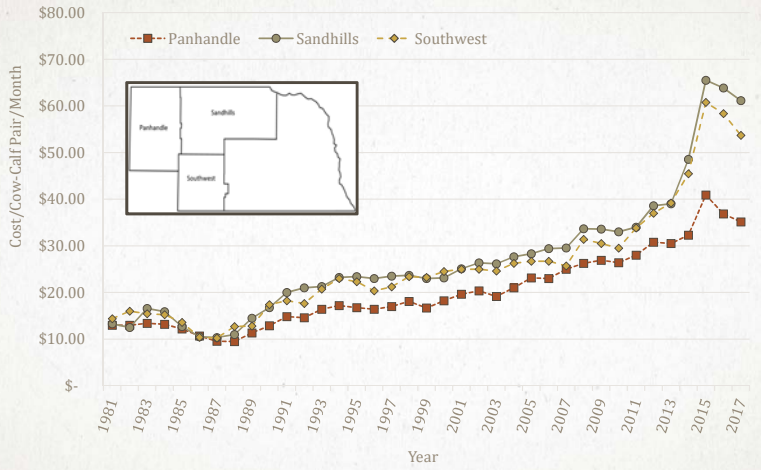
Summary of 25 studies evaluating the effects of grazing intensity on rangeland condition in North America. (Holechek et al. 1999)

Economic importance of productive rangelands



Stubbendieck and Reece 1992, "Nebraska Handbook of Range Management"

ECONOMIC IMPORTANCE OF BEEF PRODUCTION ON PRODUCTIVE RANGELANDS



Jansen 2017, "Nebraska Farm Real Estate Market Highlights" http://agecon.unl.edu/cornhuskereconomics

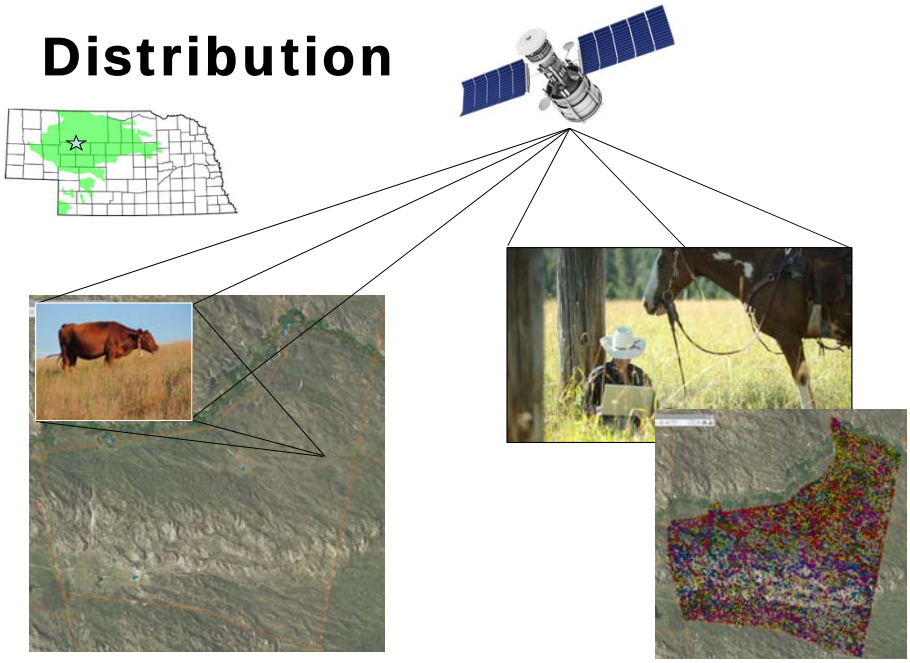
Grazing Management

- Stocking Rate
  - Most important variable to get right
- Distribution
- Timing of grazing

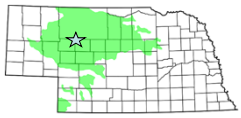
Distribution

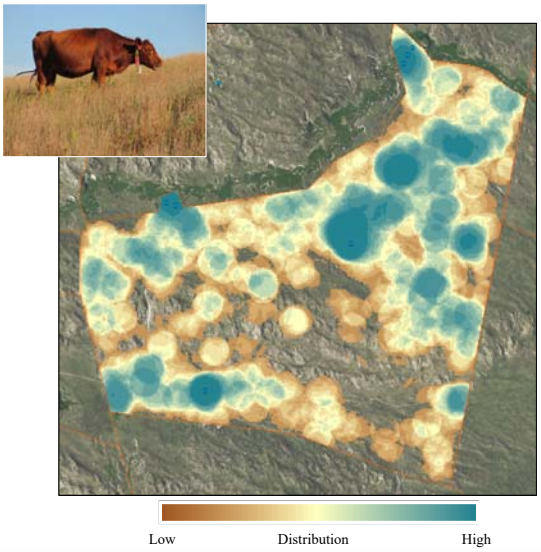
"Many of the concerns regarding livestock grazing on rangelands are the result of uneven livestock distribution rather than inappropriate stocking rates." *(Bailey 2005)*

Distribution



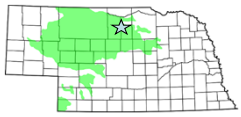
Grazing Distribution

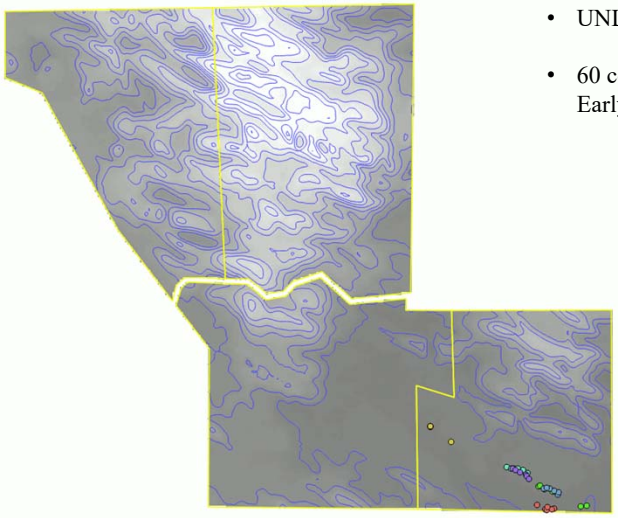




- Gudmundsen Sandhills Lab near Whitman, NE
- 1423 acres, 5 tracked cows in a herd of ~100 grazing from mid-July to October

Grazing Distribution

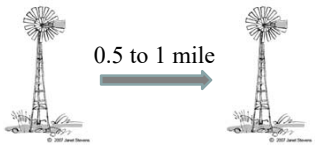




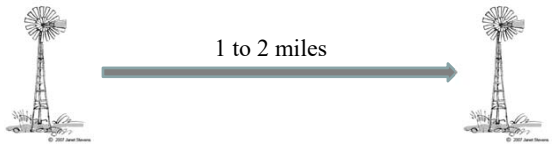
- UNL Barta Brothers Ranch
- 60 cow/calf pairs 140 acres Early-June

Grazing Distribution

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

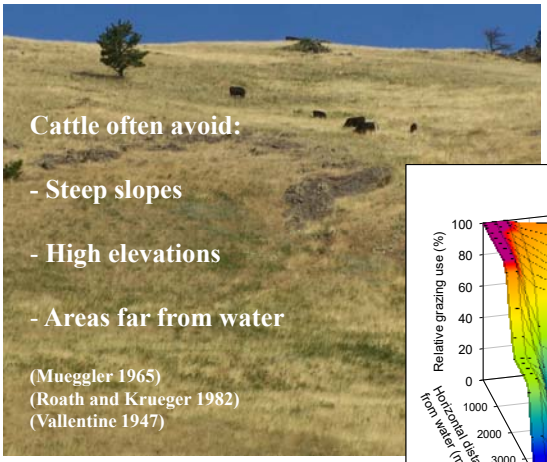


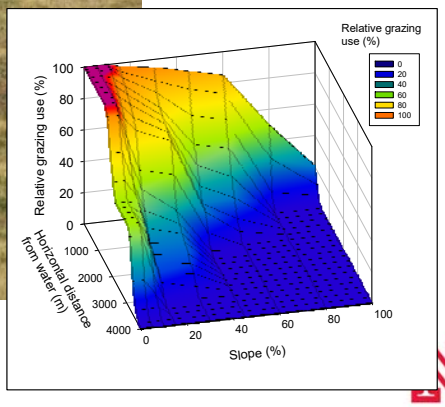
Rough Terrain



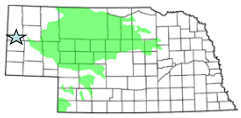
Flat Terrain

Grazing Distribution





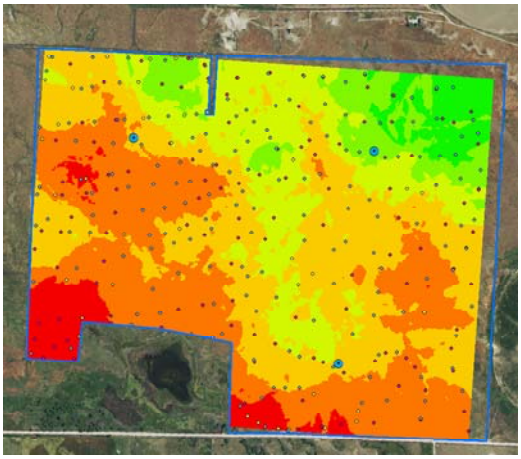
Grazing Distribution



Panhandle Experimental Range
186 yearling heifers – May 15 to July 16

1 pasture = 730 acre

Grazing Distribution



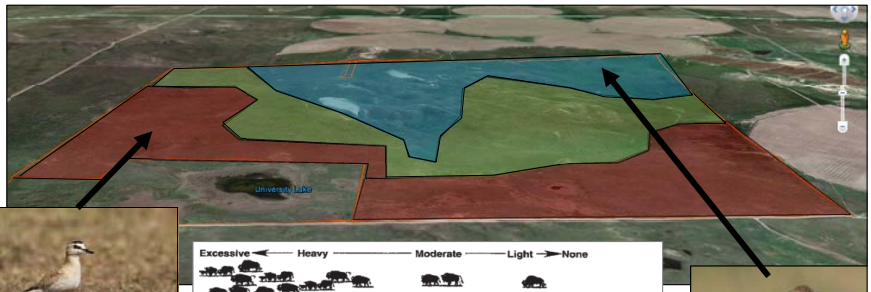
Key Grass Species
Stubble Heights

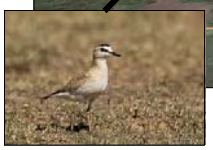
- 8.324016571 - 11.16511154
- 11.16511155 - 14.00620651
- 14.00620652 - 16.84730148
- 16.84730149 - 19.68839645
- 19.68839646 - 22.52949142
- 22.52949143 - 25.3705864

Grazing Distribution

- Heavy Grazing Utilization
- Moderate Grazing Utilization
- Light Grazing Utilization

Grazing Distribution





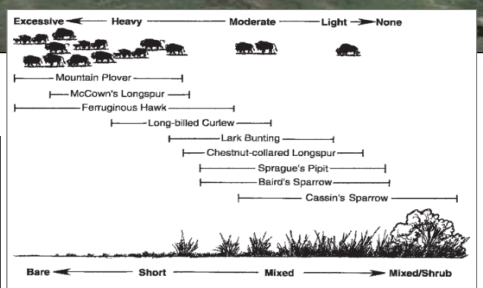
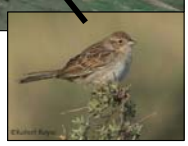
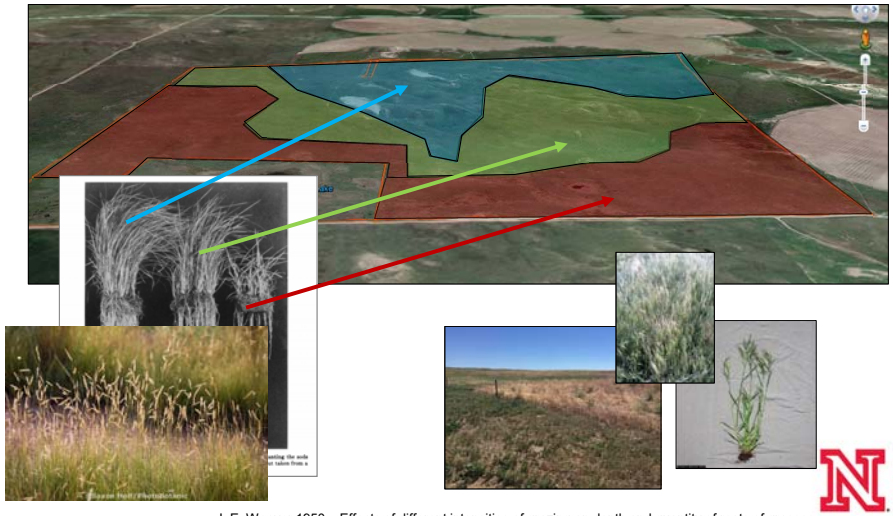


Figure 1. Responses of grassland birds in shortgrass steppe to a vegetation structure gradient (modified from Knopf 1996).



Grazing Distribution



J. E. Weaver 1950 – Effects of different intensities of grazing on depth and quantity of roots of grasses

Grazing Rotations

Deferred Rotation Growing Season Grazing

Pasture	May	Jun	Jul	Aug	Sep	Oct
1						
2						
3						
4						

5
6…

4 pasture = 150 to 200 acres each

Grazing Management

- Stocking Rate
  - Most important variable to get right
- Distribution
  - Smaller pastures and/or more water locations increases harvest efficiency and reduces areas of over and under use
- Timing of grazing

Grazing Rotations

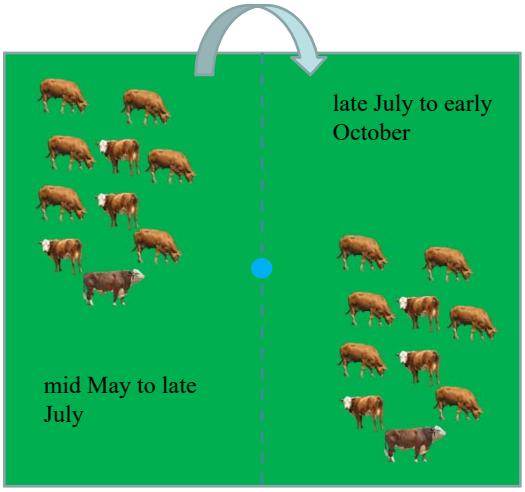
A practice of grazing planning that provides pastures with deferment, rest, and rotation

- **Deferment**, Delay grazing in a pasture until seed maturity of key forage species
- **Rest,** Pasture receives no use for one full year
- **Rotation,** Scheduled movement of livestock from one pasture to another

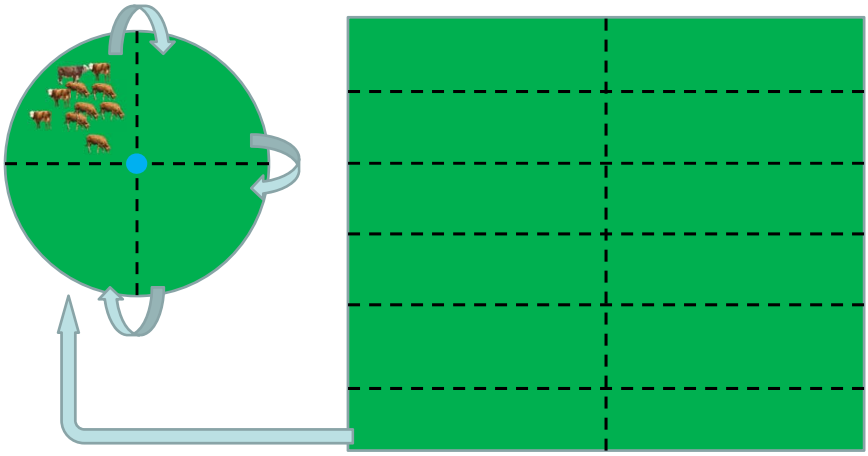
Distribution and Timing of Grazing

Holechek et al. 2011. Range Management Principles and Practices

Grazing rotations - Simple



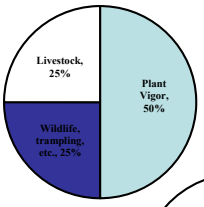
Grazing rotations - Complex



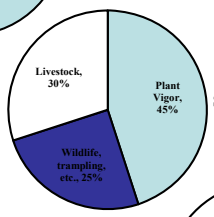
Annual warm-season forage September to mid-October

Pasture mid-May to mid-July through October

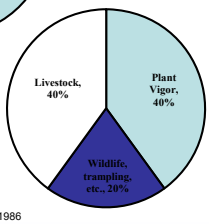
Stocking Rates with 25, 30, and 40% harvest efficiency



Continuous Grazing, low input, Extensive management



Simple Rotation, moderate input

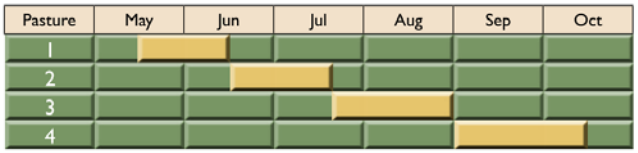


Complex rotation, high input, Intensive management

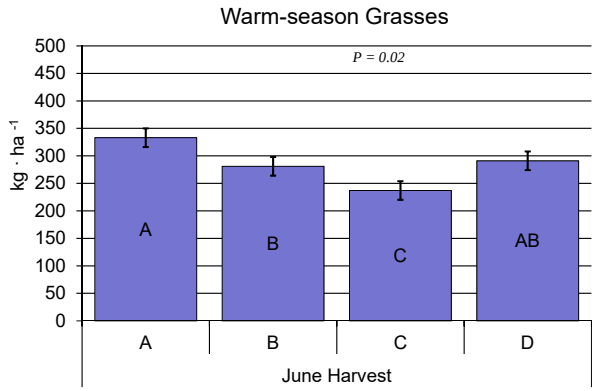
"A guide for planning and analyzing a year-round forage program", Waller et al. 1986

Grazing rotations

One of the major benefits of rotational grazing strategies is providing the livestock manager with options to alter the time of grazing in subsequent years = **Flexibility**



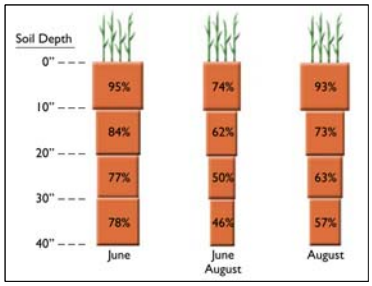
Timing of Grazing

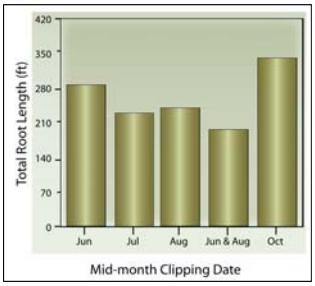


Pasture	May	June	July	August	September	October
1		A				
2			B			
3				C		
4					D	

Stephenson et al. 2015

Timing of Grazing

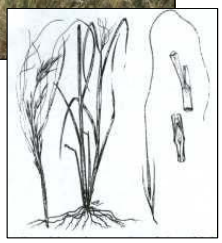




Effect of time of defoliation on belowground biomass of Sand bluestem
(Engel et al. 1998)

Timing of Grazing

- Subsequent year yield when tillers were clipped at 0, 40%, and 80% utilization in a drought year (2002; precipitation 40% below average)



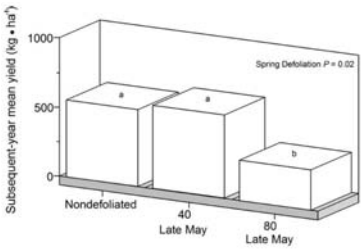
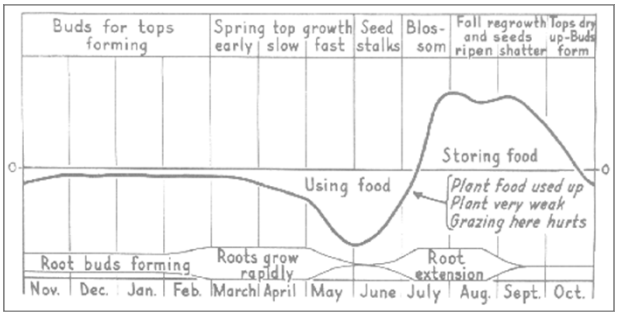
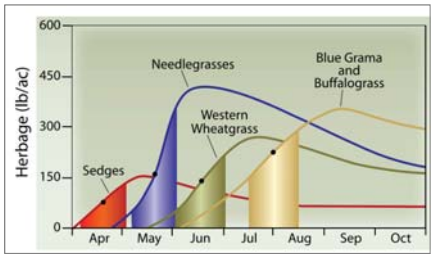


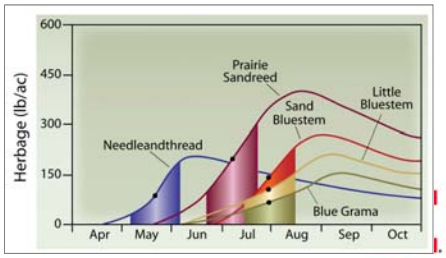
Figure 3. Subsequent-year yield (kg · ha^{-1}) of needle-and-thread in response to three levels of spring defoliation. Spring and fall defoliation treatments were applied during the same growing season in 2002. Columns with different letters are significantly different ($P \leq 0.05$). Standard errors ranged from 62 to 82. The study was located 21 km north of Potter, Nebraska.

Koehler et al. 2014, "Yield response of needle-and-thread and threadleaf sedge to moisture regime and spring and fall defoliation"

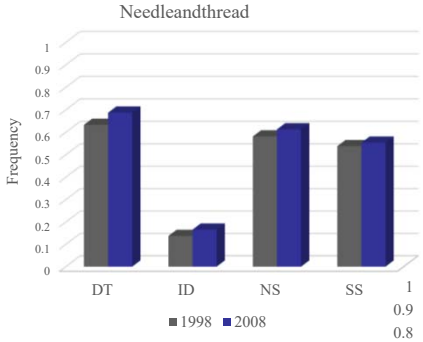
Range Plant Physiology







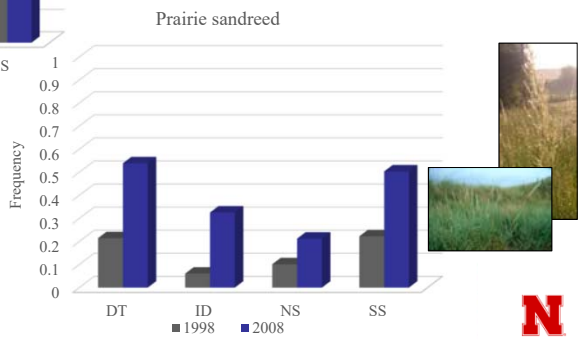
Timing of Grazing



Change from continuous summer grazing to a rotational grazing system

- Increased water locations
- Smaller pasture size
- Altered time of grazing

Stephenson et al. 2013



Timing of Grazing

"Annually rotating pastures within a deferred rotation appears to be an excellent grazing method to avoid directional changes of vegetation on Nebraska Sandhills grazing lands."

Grazing Management

- Stocking Rate
  - Most important variable to get right
- Distribution
  - Smaller pastures and/or more water locations increases grazing efficiency and reduces areas of over and under use
- Timing of grazing
  - Grazing rotations provide managers flexibility in adjusting the time during the growing season when grazing occurs and provides options for increased recovery time


Thank You
UNL Range & Forage
@UNLRangeForage
Mitchell B. Stephenson, Ph.D.
Range and Forage Management Specialist
Panhandle Research and Extension Center
University of Nebraska - Lincoln
4502 Avenue I
Scottsbluff, NE 69361
mstephenson@unl.edu
(308) 632-1355 - Work
(307) 321-5827 - Cell