19th Annual

Nebraska Grazing Conference

PROCEEDINGS

August 12-14, 2019

Buffalo County Fairgrounds / Kearney, NE

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Rangeland Resilience Session

Introduction

Steven S. Waller, Interim Director, Center for Grassland Studies

This is our Nineteenth Nebraska Grazing Conference. The past 18 years have been remarkably successful and informative for Nebraska graziers. The variety of topics, diversity of speakers, and composition of the audiences have been ever-changing to meet the information and innovation needs of our grazing industry. However, there has been a common thread of consistency amongst the change that ties all of the conferences together – our sponsors.

Few of us can claim a perfect attendance at the Nebraska Grazing Conference, but we are fortunate to have 10 sponsors that have been a part of every conference. They join 80 additional sponsors over the 18 years that have provided conference sponsorships through their endorsements, financial support and/or in-kind contributions. Over the years, our 90 sponsors have collectively provided 574 sponsorships, which is 32 sponsorships per conference since 2001.

The sponsors' commitment to the Conference has been a significant factor in holding the costs down for participants, resulting in one of the most affordable conferences of its kind. Each of us are benefactors of their participation and enjoy presenters made possible, in part, by their financial contributions. We can honor their role in the longevity and success of our conference by visiting their booths in the Exhibit Hall. Please take time during your day to visitor our exhibitors and thank them for spending time at the Nebraska Grazing Conference. We can also recognize those sponsors that provide endorsements or in-kind contributions by extending our personal appreciation for their investments in the Conference. Please take the time to review all of our sponsors listed in this Proceedings and visit with as many as you can. Make their experience as enjoyable and memorable as they have made our conference.

The difference between a good conference and a great conference is the participation of passionate sponsors who share the aspirations of the participants. The Nebraska Grazing Conference is great proving once again that there is no place like Nebraska!

Conference Schedule

MONDAY, AUGUST 12

Pre-Conference Tour

1:00 PM “*Plant Identification Tour*,” **Chris Helzer**, The Nature Conservancy, Aurora, NE
5:30 PM Catered Dinner for Registered Tour Participants
6:30 PM Overview of The Nature Conservancy
7:00 PM Evening Concludes

TUESDAY, AUGUST 13

Welcome Session

(Daren Redfearn, Moderator)

9:00 AM Registration (Refreshments in Exhibit Area)
9:50 AM Welcome and Opening Remarks, **Daren Redfearn**, Chair, Nebraska Grazing Conference

Rangeland Health Session

10:00 AM *“Managing Sand Deposits after the Flood,”* **Daren Redfearn**, University of Nebraska-Lincoln,
Lincoln, NE
10:40 AM *“Rangeland Health: What Is It and Why Do I Care?”* **Patrick Shaver**, Oregon State University, Monmouth, OR
11:20 AM *“Managing a Sandhills Ranch with an Eye to Soil Health,”* **Dana Larsen**, Broken Heart Livestock, Thedford, NE
12:00 PM Lunch

Grazinglands Management Session

(Mitchell Stephenson, Moderator)

1:00 PM “*Soil Health: Expectations & Evidence,”* **Virginia Jin**, USDA Agricultural Research Service, Lincoln, NE
1:30 PM *“Mob Grazing on Nebraska Sandhills Meadow,”* **Walt Schacht**, University of Nebraska-Lincoln, Lincoln, NE
2:00 PM *“Effect of Length of Grazing Period on Upland Sandhills Range,”* **Jerry Volesky**, Nebraska Extension, North Platte, NE
2:30 PM Presentation and Break
3:30 PM *“Carbon Input and Loss in Semi-arid Sandy Rangeland,”* **Martha Mamo**, University of Nebraska-Lincoln, Lincoln, NE
4:15 PM *“Graze 365,”* **Jacob Miller**, 7M Ranch, Culbertson, NE
4:45 PM *“Soil Health and Grazing Strategies: Opportunities for Increasing Soil Water,”* **Andrea Basche**, University of Nebraska-Lincoln, Lincoln, NE
5:15 PM Social (Compliments of Ramada by Wyndham Kearney)

Conference Schedule

WEDNESDAY, AUGUST 14

7:30 AM Registration (Refreshments in Exhibit Area)

Art & Science of Winter Grazing Session

(Bruce Anderson, Moderator)

8:00 AM *"Producer Panel: Winter Forage Strategies,"* **Lon Larsen**, Broken Heart Livestock, Thedford, NE; **John Maddux**, Maddux Cattle Company, Wauneta, NE; and **Logan Pribbeno**, Wine Glass Ranch, Inc., Imperial, NE

9:00 AM *"Odds and Ends of Non-traditional Winter Grazing Strategies,"* **Bruce Anderson**, University of Nebraska-Lincoln, Lincoln, NE

9:30 AM *"Size Does Not Matter When It Comes to Conservation,"* **Jim O'Rourke** (2018 Leopold Award Recipient), RuJoDen Ranch, Chadron, NE

10:00 AM Break

Rangeland Resilience Session

(Jack Arterburn, Moderator)

10:30 AM *"Resilience of Sandhills Grassland to Wildfire during Drought,"* **Jack Arterburn**, Nebraska Extension, Rushville, NE

11:00 AM *"Grazing Before and After Prescribed Burns,"* **Sarah Sortum**, Switzer Ranch, Burwell, NE

11:30 AM *"Resilience in Working Landscapes,"* **Craig Allen**, Center for Resilience in Working Agricultural Landscapes, Institute of Agriculture and Natural Resources, Lincoln, NE

12:00 PM Lunch

Conference Reflection

1:00 PM *"Where to Next?"* **Bruce Anderson**, Agronomy & Horticulture, University of Nebraska-Lincoln, Lincoln, NE

1:30 PM Final Comments and Evaluations

Conference Schedule

Nebraska Grazing Conference (NGC) was:

- Planned by the:
  ◊ *NGC Steering Committee*: **Melody Benjamin**, Nebraska Cattlemen; **Nadine Bishop**, USDA NRCS; **Ron Bolze**, Nebraska Grazing Lands Coalition; **Shelly Kelly**, Sandhills Task Force; **Brent Plugge**, Nebraska Extension; **Daren Redfearn**, University of Nebraska-Lincoln; **Steven Waller**, Center for Grassland Studies; and **Bill Vodehnal**, Nebraska Game and Parks Commission.
  ◊ *NGC Advisory Committee*: **Tyrell Anderson**, Turner Enterprises, Inc.; **Jack Arterburn**, Nebraska Extension; **Reiss Bruning**, Bruning Farms; **Julie Elliott**, USDA NRCS; **Eric Hansen**; **Chris Helzer**, The Nature Conservancy; **John Lange**; **Rob Mitchell**, USDA ARS; **Rex Peterson**, Plum Thicket Farms; **John Ravenscroft**; and **Mitchell Stephenson**, Nebraska Extension.

- Coordinated by **Daren Redfearn,** Chair, Nebraska Grazing Conference; **Brent Plugge**, Nebraska Extension; and **Margo McKendree,** Center for Grassland Studies.

- Co-hosted by the Center for Grassland Studies, University of Nebraska-Lincoln, 203 Keim Hall, Lincoln, NE 68583-0953, (402) 472-4101, grassland@unl.edu, and the Department of Agronomy & Horticulture, University of Nebraska-Lincoln, 202 Keim Hall, Lincoln, NE 68583-0915, (402) 472-2811, agrohort@unl.edu, and our co-sponsors (see Page 7).

- Proceedings edited by **Margo McKendree**, Center for Grassland Studies.

- Cover by **Liz Husmann**, Center for Grassland Studies.

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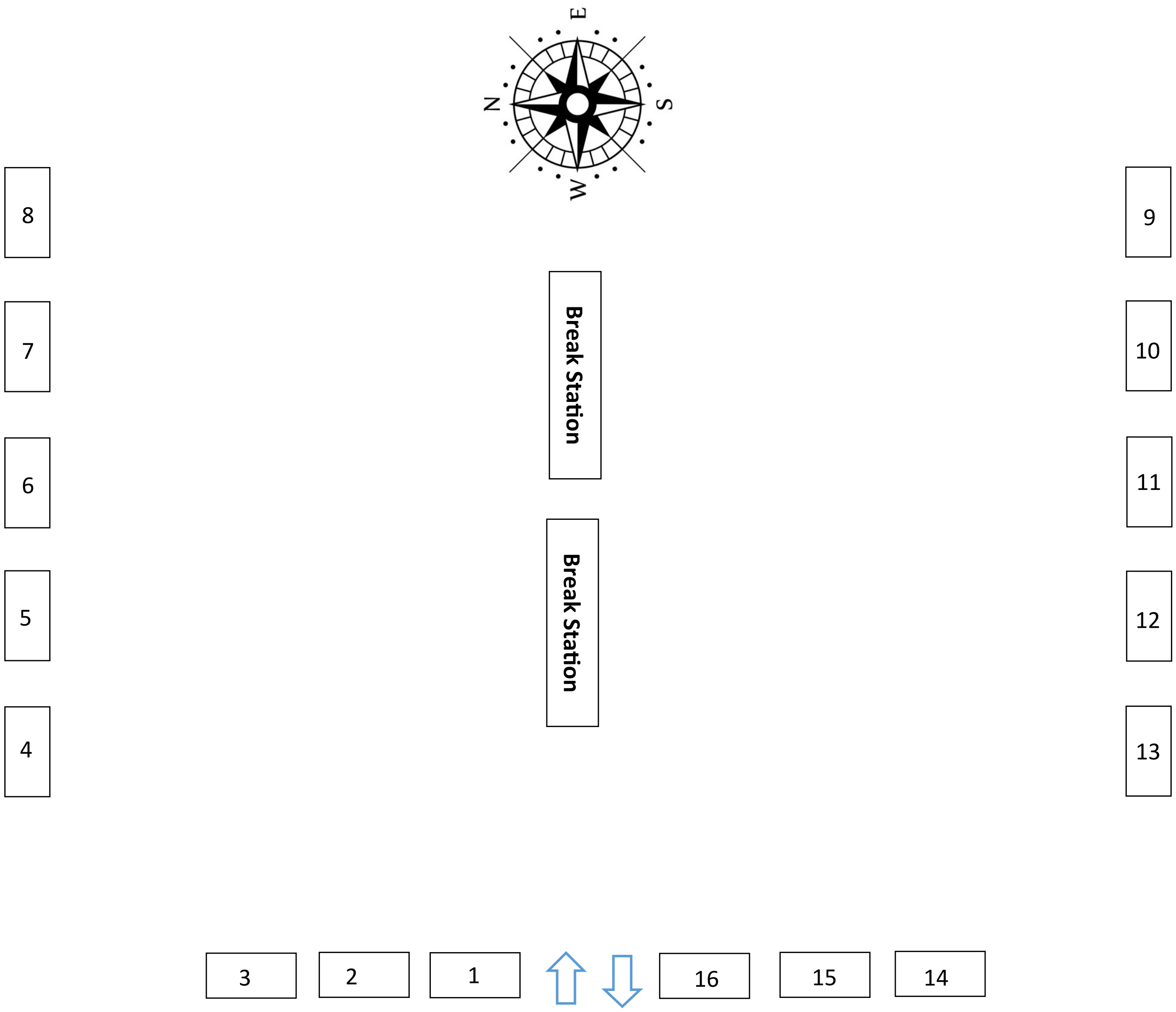

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Speaker Biography

Chris Helzer, The Nature Conservancy
Aurora, NE

Chris Helzer is the Director of Science for The Nature Conservancy in Nebraska. He has spent his 20-year career managing and restoring grasslands in the state, both for work and for his family. His current role focuses on evaluating various management strategies, including grazing, prescribed fire, and invasive species control in order to share successful techniques with landowners and other land managers. Chris writes a blog, *The Prairie Ecologist,* and authored a book entitled, *The Ecology and Management of Prairies in the Central United States*. He is also a frequent contributor to *NEBRASKAland Magazine*. Chris lives and works in Aurora, Nebraska. Helzer holds a bachelor of science degree in forestry, fishery and wildlife, and his master's in landscape ecology, both from the University of Nebraska-Lincoln.

"Plant Identification Tour"

The Plant Identification Tour will be conducted at The Nature Conservancy's Derr House, which is located at their Platte River Prairies site south of Wood River, NE. The facility sits among diverse grassland habitats that include sandhills, floodplain grasslands, wetlands, and both unplowed grasslands and some restored from crop land. The grasslands are used to develop and test prescribed fire and grazing techniques that benefit wildlife and pollinators while sustaining livestock production.

Speaker Biography

Daren Redfearn, University of Nebraska-Lincoln, Agronomy & Horticulture, Lincoln, NE

Daren Redfearn is a member of a multidisciplinary team hire focused on enhancing and developing forage-based beef production systems. His efforts are focused on developing, analyzing, and implementing integrated crop/forage/livestock systems. He is a member of the American Society of Agronomy and Crop Science Society of America. He is currently serving as co-editor for Volume II of Forages: The Science of Grassland Agriculture.

His research program emphasizes the development of management, production, and utilization strategies for annual forages used as cover crops and double-cropped following row crops. He is also involved in evaluating forage cover crop establishment, and creating unique management systems facilitating use of annual forages, perennial forages, and cover crops used as grazed forages. His extension program focus areas are enhancing the use of crop residues and annual forage cover crops into existing beef production systems and implementing economical crop residue harvest and grazing methods.

He received a doctorate and master's degree in Agronomy from the University of Nebraska-Lincoln. He has a bachelor's from Texas Tech University in Animal Science.

"Managing Sand Deposits After the Flood"

ABSTRACT

Early-spring flooding across much of the western Corn Belt was widespread and damaging. At the time, few perennial plants had broken winter dormancy. The major obstacle from this event was sand deposition of varying depths across many acres of grazing land and cropland. Following the spring-flood event, the amount of sand remaining after the water receded was not expected. The amount deposited in many areas prevented removal to enhance forage and pasture production and slowed recovery. In many instances, revegetation is the only option. Recent flooding events, although more localized, have inundated many acres of pasture and forages that were actively growing. With a few exceptions, perennial grasses and legumes are more flood tolerant than annual grasses and legumes. Similarly, grasses are generally more flood tolerant than legumes. The recovery of these depends on forage species, plant growth stage, and length of flooding.

Revisiting the Events

Major early-spring flooding impact on grass pastures was due to excessive sediment deposits, in particular the sand deposits. We have seen that early growth of many perennial forages can produce new shoots and tillers if the deposits were less than two inches. Deeper sediment can suffocate plants and result in substantial stand loss. Many pastures had sediment deposits greater than two inches. In these cases, mechanical removal is preferred to reduce forage loss and reduce the need for reseeding. The major issue with sediment deposits less than two inches is crusting, which may require light tillage to enhance recovery.

Managing Sediment

Shallow sand deposits (less than two inches) should have no or a very low impact on perennial pastures growth. If needed, light tillage or spreading may be used. Heavy sand deposits (greater than eight and ten inches) may require spreading or removal to enhance pasture recovery. It is likely that revegetation will be needed for extremely deep sand deposits.

The primary goals for managing heavy sand deposits are to:

- Stabilize sand deposits
- Add organic matter
- Bring pastures back into production

Revegetation Guidelines

Revegetating heavy sand deposits may require two years for sand stabilization and improving soil organic matter before planting perennial grasses during the third year. A suitable cover crop, such as oats, should be used to stabilize the sand deposits and add organic matter. When revegetating flood-damaged pastures, especially those with heavy sand deposits, it is important to consider perennial forages that are adapted to sandy soils (Table 2).

Table 2. Recommended cool– and warm-season perennial grass mixtures for **revegetating sand deposits.**

Cool-season grasses	Seeding rate	Warm-season grasses	Seeding rate
	lbs/acre		lbs/acre
Smooth bromegrass	5.0	Sand bluestem	2.5
Intermediate wheatgrass	6.0	Sand lovegrass	0.4
		Prairie sandreed	1.0
		Little bluestem	0.8
		Switchgrass	0.8
		Indiangrass	1.0

A cool-season perennial grass mixture would be smooth bromegrass (6 pounds seed per acre) blended with intermediate wheatgrass (5 pounds seed per acre) would be broadly-adapted. This could be seeded in April or in late August (if soil moisture is available). Oats planted at 5 to 10 pounds seed per acre may help reduce weed competition during establishment.

Suitable warm-season perennial grass mixtures may be more diverse with species adapted to sandy sites dominating the mixture. Planting sand bluestem (2.5 pounds seed per acre), sand lovegrass (0.4 pounds seed per acre), prairie sandreed (1.0 pounds seed per acre), little bluestem (0.8 pounds seed per acre), switchgrass (0.8 pounds seed per acre), and indiangrass (1.0 pounds seed per acre) in early May or during the dormant season is recommended. Similar to the cool-season perennial mixture, oats planted at 5 to 10 pounds seed per acre may help reduce weed competition during establishment.

Flooding Effects on Actively Growing Forage Plants

Forage plant response to a flood event is complex. Every stand will respond differently depending on the degree and duration of flooding, the forage species present, stand age, pasture health and vigor, fertility level, stage of plant development at the time of flooding, and temperature.

Perennial forage plants that were dormant or semi-dormant during the early-spring floods had a reduced likelihood of flood damage. Generally, flood events are more common during late winter to early spring. These early seasonal floods provide warm-season grass species a recovery advantage.

Floods with standing water can be more harmful, and likely lethal, than plants flooded by moving water. Also, severe damage is less likely for plants that have leaves and stems protruding from the water. During a flood event, oxygen uptake by plant roots is eliminated, or at least severely restricted. Living plant roots, even with dormant top growth, still require oxygen to remain healthy. This can also reduce nutrient uptake, photosynthesis, and nitrogen fixation by forage legumes.

Additional factors affecting plant response to a flood event include soil type and depth to the water table in flooded areas. Negative forage responses on heavier clay soils with high water tables than forages growing on sandier soils with deeper water tables and better drainage.

Forage Response to Flooding

The number of days **actively growing** forage crops are likely to tolerate flooding is provided as a guide to relative flooding tolerance of forage grasses and legumes (Table 1). It is based on limited research, together with observations of flooding impacts on common forage plants. With a few exceptions, perennial grasses and legumes are more flood tolerant than annual grasses and legumes. Similarly, grasses are generally more flood tolerant than legumes.

Grasses

Many grasses can withstand prolonged flooding. The native warm-season grasses have the greatest variation among forage types with indiangrass tolerant of flooding only for 3 to 4 days and eastern gamagrass tolerant of flooding up to five to six weeks. Switchgrass has greater flood tolerance than big bluestem.

Smooth bromegrass can withstand over three weeks of flooding, while reed canarygrass and timothy can withstand six weeks or more when still dormant. Most perennial cool-season grasses can tolerate more three weeks with orchardgrass, Kentucky bluegrass, and tall fescue capable of tolerating flooded conditions for up to two weeks. Small grains have minimal flood tolerance.

Legumes

Alfalfa is not very tolerant to flooding, but it can generally withstand one to two weeks of flooded conditions. Other perennial legumes, such as red clover, white clover, and birdsfoot trefoil are slightly more flood tolerant. Red clover has been reported to withstand two weeks of flooding with white clover tolerating flooded conditions for three weeks or longer. Similar to the small grains, annual legumes have minimal flood tolerance.

Table 1. Flooding tolerance for commonly used pasture and forage crops. Tolerance ratings are based on length of flooding for **actively growing** forages. Information provided is based on limited research and anecdotal observations of flooding impacts for established grasses and legumes.

	Flooding tolerance		
Forage species/type	**Low (less than 10 days**	**Medium (10 to 21 days)**	**High (greater than 21 days)**
Warm-season grasses			
Big bluestem		X	
Switchgrass			X
Indiangrass	X		
Eastern gamagrass			X
Cool-season grasses			
Smooth bromegrass			X
Orchardgrass		X	
Kentucky bluegrass		X	
Intermediate wheatgrass			X
Reed canarygrass			X
Tall fescue		X	
Timothy			X
Canada wildrye			X
Virginia wildrye			X
Western wheatgrass			X
Small grains (cereal rye, oats, barley, triticale)	X		
Legumes			
Alfalfa	X		
Red and white clover		X	
Birdsfoot trefoil		X	
Other perennial leg-umes			X
Most annual legumes	X		

IMPLICATIONS

There are several factors, including physical, and both plant and environmental, responsible for flooding recovery and tolerance of different forage species. When evaluating flood damage to pastures and forages, often patience is the first step to recovery. Most perennial grass pastures and forages are resilient and can recover from flooding under good conditions. Recovery depends on both the survival and growth of existing plants. Pastures and forages and forages that are well-managed with proper grazing or harvest management strategies often are the first to recover following an extreme weather event, including flooding. However, it is important to recognize plant adaptation characteristic when revegetation is necessary.

Speaker Biography

Patrick Shaver, Oregon State University
Monmouth, OR

After graduating from New Mexico State University with a BS in Range Science, Pat started his career with the Soil Conservation Service in Clayton, NM in 1973. He served in several locations throughout New Mexico before transferring to the Texas State Office in 1989. Pat was the State Range Conservationist in TX and UT. In 1994 Pat was assigned to the West National Technical Center in Portland OR. Dr. Shaver was assigned to work on the development of Rangeland Health in 1994 with an interagency team and has been involved since that time. Version 5 of the Interagency Technical Reference "Interpreting Indicators of Rangeland Health" is currently at the printers. Pat was reassigned to National staff in 1995 and retired from the Natural Resources Conservation Service in 2013. Pat earned his Ph.D. in Rangeland Ecology from Oregon State University in March 2010 and is a Certified Professional in Rangeland Management by the Society for Range Management. After retiring, Pat began teaching in the Animal and Rangeland Sciences Department at Oregon State University. Pat and his wife, Sharon, live on a 22 ac. silvo-pasture unit where they raise grass-fed beef for family and friends, and regularly perform the duties of grandparents.

"Rangeland Health: What Is It and Why Do I Care?"

ABSTRACT

Rangeland health is a qualitative assessment of rangeland that looks at how the ecological processes on an ecological site are functioning. The idea of qualitatively assessing rangelands has been around for several decades and there have been many applications such Leopold's 'Symptoms of Land Sickness', USFS Parker 3-Step and Phase 1 watershed assessment to name a few. As a result of a Nation Research Council's publication in 1994, "Rangeland Health: New methods to classify, inventory and monitor rangelands", an interagency committee was established by USDA and USDI to incorporate the concepts and new science of the NRC report and a Society for Range Management task force report into a common assessment protocol. Interpreting Indicators of Rangeland Health uses seventeen (17) indicators to assess the functioning of the ecological processes in three (3) attributes: Soil and Site Stability, Hydrologic Function and biotic Integrity. Using the seventeen indicators as an early warning system, or a way to conduct triage on areas of interest, it provides the manager with a fast reliable way to assess management impact and focus on resources concerns. It provides a common framework for communication or resource information among managers, agencies and organizations. It provides information describing the interaction among soils, vegetation and land management, and is a foundation to assess the condition of current resources and to monitor change. It provides a framework to assess management opportunities and predict the outcome of management decisions and a way to transfer experience and knowledge.

Speaker Biography

Dana Larsen, Broken Heart Livestock
Thedford, NE

Dana Larsen is a Utah State University graduate in Range Science, 1980. She has worked throughout the west and mid-west for both the USDA NRCS and the USDI Bureau of Land Management as a range conservationist in Nevada, Wyoming, Idaho and Nebraska. Dana was the State Rangeland Management Specialist in Nebraska for the NRCS from 2002 through 2008. In 2009, she served as an Area Resource Conservationist for the NRCS in northern Utah. Dana joined the Technical Service Provider Team at National Headquarters as a Natural Resource Specialist in 2011 and later served as National Grazing Lands Team Leader in Fort Worth, Texas until her retirement in October, 2018.

Dana is an active member of the Society for Range Management and served as a Nebraska Section President. She is a Certified Professional in Range Management. Dana and her family have owned, operated and managed cow–calf ranches throughout the west and mid-west. She and her husband Lon have leased the Hamilton Ranch in Thomas County since 2014.

"Managing a Sandhills Ranch with an Eye to Soil Health"

ABSTRACT

Soil health has taken the spot-light in natural resource management. Managing a ranch, with specific attention to incorporating soil health goals into the grazing enterprise can inform and guide transformational management change and improve grazing land resilience to environmental change. Three points outline a part of the preparation required to manage a ranch with an eye to soil health: 1) Knowledge and understanding of the fundamental ecological processes of the grazing land is critical before affecting any management change. Ecological site descriptions offer information on the physical, chemical and biological attributes of an ecological site along with the interdependent and influencing elements of hydrologic function, plant community states, transitional pathways and their triggers; 2) Integrate soil health into goal-based, adaptive management after assessing and monitoring grazing lands to evaluate management actions and climate influences. Identify the social, ecological and economic dependencies of integrating soil health goals into the ranch management scheme, especially the human dimension; and 3) Identify existing or build new partnerships on grazing lands soil health to enhance the technical capacities of students, land managers, and natural resource professionals and practiced through living laboratory networks.

INTRODUCTION

Soil health, rangeland soil health, the soil health renaissance, grazing land soil health, grazing management for soil health and many other phrases like these in the past few years have been all a-buzz in the agriculture world nation-wide. In the summer of 2016, range scientists and soil health specialists from around the country gathered to discuss grazing land soil health science with assignments to prepare papers for publication regarding various topics relating to soil health. My assignment was to contribute to a paper entitled Soil Health as a Transformational Change Agent for US Grazing Lands, published in 2018 in Rangeland Ecology and Management. The lead author, Dr. Justin Derner along with 7 other contributing rangeland scientists, professors, consultants and ranchers struggled through this topic until the most valid points emerged; soil health can be a transformational change agent at the ranch scale and at the policy and program scale.

As a rangeland management specialist, I assisted many ranchers from all parts of the country for over 30 years in putting together or evaluating grazing management plans with the goal toward improving or maintaining the health of rangeland, including soil health. Now, I am deeply immersed in helping to manage one particular ranch. The rangelands observed, the ranchers listened to and the lessons learned are recalled with only a slightly different perspective now. Still, I need to ask myself: What does soil health really mean to me? Have I been paying enough attention to the health of the soil on the rangeland I help manage? Should I be managing the land and cattle differently and will my ranch management decisions really make the soil healthier on the ranch? Will any changes in management I make strengthen or break the very thin economic thread my business balances on? Who can help me with evaluating the health of my rangeland and the management actions I have made that affect soil health in particular? Can attention to soil health be a change agent that transforms what I do on the ranch? Answering these questions leads to the following 3 points:

- Understand the fundamental ecological processes on the rangeland being managed.
- Integrate soil health into goal-based, adaptive management.
    - Assess and monitor to evaluate management actions and climate influences.
    - Identify the social, ecological and economic dependencies of integrating soil health into the ranch management scheme, especially the human dimension.
- Identify existing or build new partnerships on grazing lands soil health to enhance the technical capacities of students, land managers, and natural resource professionals. Living laboratory networks can supply the case studies for science backing.

1. **<u>Understand the fundamental ecological processes of the range.</u>**

Ecological processes on rangeland are complex. These processes influence what kind of forages grow, where they grow, how they grow and subsequently how they have been managed (Roche et al. 2015). One of the best tools for helping understand the ecological processes on rangeland is the ecological site description. An ecological site is recognized and described on the basis of the characteristics that differentiate it from other sites in its ability to produce and support a characteristic plant community. The plant community, soils, hydrology and climatic factors are all inter-related, each being influenced by the other which in turn influence the site. This description explains what distinctive differences in the soil, plants, hydrology, precipitation and other factors that make one site different from another. Soil health is highly integrated into plant health and hydrologic function and should not be looked at as a separate attribute. On many sites, vegetation largely controls and often precedes changes in soil health. I cannot manage for one attribute of soil health alone and not expect change in other related attributes.

The definition of soil health is the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals and humans. (NRCS). The ESD helps define some of the very particular functions within the capacities the soil has for its unique site. The Valentine fine sands that dominate the acres on my Sandhills range do not have the same functional capacities as the loamy soils to the south of me in the Central Loess Hills. The ecological site tells me much about the current ecological state of the range, the transitional pathways that could lead to other states, hydrological influences and the physical, chemical and biological components of the soil that influence the function of this site in terms of maintaining environmental quality, promoting plant and animal health and productivity (Doran and Zeiss, 2000).

The SANDS MEDIUM Ecological site consists mostly of Valentine fine sand, rolling with 9-24 percent slopes, precip 17 -22". The site description tells me what I can expect in soil features, the plant community, plant growth curves and patterns, hydrologic function, climatic features and more. It helps me identify the following:

- What is the current state?
- What are the transitional pathways?
- What do I understand about the energy, water and nutrient cycle on my rangeland?

Once I have a grasp on the basic ecological processes on my range, I can think about some soil health based goals for my ranch management plan that will be most effective, reasonably possible, and economically feasible.

2. **<u>Integrate soil health into goal-based adaptive management.</u>**

Adaptive management is the on-going process of strategic planning and goal setting, design and implementation. It includes monitoring the natural resources and evaluating management decisions for success or failure. Adaptive management is dependent upon: 1) Local understanding of the range, its variability, patterns and reactions to historic drivers (Fuhlendorf and Engle, 2001); 2) Managerial experience and capacity, skills, knowledge, learning and flexibility. It can be constrained by the physical (structural) resources available as well as the natural resources available (Roche et. al. 2015); and 3) Changing operational constraints of the ranch enterprise (Budd and Thorpe, 2009). Specific soil health objectives will be influenced by these dependencies and may change and adapt themselves as monitoring and assessment information is tracked and evaluated.

Goal based management is informed by specific objectives that maintain or improve soil health with directly relevant monitoring attributes. This effort should lead to guidance on whether the management action can be sustained. Monitoring for soil quality is merely a means to this end (Doran and Zeiss, 2000). The monitoring and assessment system should help me recognize impending changes so I can adjust management actions to avoid (or take advantage of) conditions that I have little control over, like climate (Brown and Herrick, 2016).

The Rangeland Health Assessment is a well-tested, qualitative assessment linked to a standard set of quantitative measurements and indicators. The assessment can alert me to impending areas of risk, and serve as an early warning system about attributes of soil health that I need to pay attention to.

The rangeland health assessment indicators correspond to four basic soil health principles (Table 1).

Soil health principle	**Qualitative rangeland assessment indicator**
Increase plant diversity	Indicator 10—Plant community composition and distribution relative to runoff
	Indicator 12—Functional/structure groups
	Indicator 13—Amount of plant mortality and decadence
	Indicator 15—Annual production
	Indicator 16—Invasive plants
Reduce soil disturbance	Indicator 9—Soil surface loss or degradation
	Indicator 8—Soil surface resistance to erosion
	Indicator 11—Compaction layer
Extend period of active plant growth	Indicator 4—Bare ground
	Indicator 12—Functional structure groups
	Indicator 15—Annual production
	Indicator 16—Invasive plants
Maintain soil cover	Indicator 4—Bare ground
	Indicator 14—Litter amount

Table 1. Four basic soil health principles and corresponding rangeland health indicators (from Printz et. al. 2014)

Do the four principles of soil health apply to rangelands? The four principles of soil health are: 1) increase plant diversity; 2) reduce soil disturbance; 3) extend period of active plant growth; and 4) maintain soil cover. These principles were largely developed for croplands which linked soil ecological processes to management. In many areas of the country, land managers and resource professionals have adopted these principles in various ways to rangeland. A symposium at the Society for Range Management Conference in 2016 on Soil Health on Rangelands brought many scientists and rangeland managers together to discuss this applicability. The overwhelming consensus was no, these principles do not or should not be sweepingly applied to rangelands. Many examples were given to illustrate where these principles digress and confound the resource objectives. For example:

A. Increasing plant diversity often results in increased above-ground plant biomass and geochemical cycling, however, the plant diversity may be from noxious or invasive plant species.
B. Increasing soil cover and decreasing bare ground in specific ecological sites can have a negative impact on wildlife and plants that require high amounts of bare ground in their habitats
C. Disturbance such as fire are critical to the ecological processes. An example is Nebraska's eastern red cedar population explosion.

Improvement where there is potential. A good grazing land inventory and assessment will help me determine where my managerial efforts are going to yield the best results. From the ecological site, I know what current ecological state my site is in and what the ecological transitional pathways and triggers are that can change it. A rangeland health assessment will provide me with 17 indicators including 10 soil health specific indicators. The rangeland health assessment relies upon a well-developed reference sheet for the ecological site being assessed. The plant community I am managing for is the reference state so the 10 soil health indicators from the rangeland health assessment will tell me what indicators depart the most from this state. Those indicators will determine what monitoring protocols I select and make part of my monitoring program.

The history of the ranch gives me a little information on its past use. Many of the pastures are named for families that lived on this range 100 years ago. Remnants of old roads, tree lots, foundations, and farming implements give evidence of past use. Certain pastures clearly exhibit signs of cultivation. How has soil health been affected by cultivation in these go-back pastures and should I consider some management actions to change it? A quick assessment helped the land manager decide to leave it alone. One of the pivots on the ranch was cultivated for several years for corn production. A management decision to plant the pivot to alfalfa and grass was influenced in part by soil health objectives as well as cattle nutrition objectives. An economic evaluation clinched the decision.

3. **<u>Holistic and integrated approaches to soil health showing the social-ecological-economic dependencies, especially the human dimension.</u>**

Integrating soil health objectives into the ranch management plan can divulge where the ranch operation is vulnerable, where risk lies, as well as where strength lies. Developing the ranch mission statement together as a family and with the ranch owners helps keep us off of wrong trails. Being mindful of our soil health goals has influenced our day to day operations, as informed by knowledge of the ecological processes that make the ranch productive, and the assessments and monitoring information that tell us the impact of our adaptive management actions.

Still, the overarching influence for my management actions comes from the economic drivers. The largest expense in our operation is the land lease, followed by fuels and oils. Any management decision that reduces those expenses is considered. With range and soil health goals integrated into management, taking an ATV out to check cattle instead of a pick- up becomes an easier choice. Unless a social element shows up in the form of grandkids where safety takes precedence over soil health.

4. **Building cross institutional partnerships on grazing lands soil health to enhance technical capacities of students, land managers, and natural resource professionals.**

Help is here: The Natural Resources Conservation Service, Natural Resource Districts, The Society for Range Management, Nebraska Grazing Lands Coalition, University of Nebraska, neighboring State coalitions and universities, and neighbors themselves. These groups and institutions are well established and have the resources for assisting ranchers in assessing, monitoring and evaluating soil health in the holistic context of the social, ecological and economic dynamics of the entire ranch operation.

The existing technology and tools we have now are under-used and under-developed. The rangeland health assessment is still not as widely adopted as it should be. Very little monitoring takes place, even when required as part of conservation programming. The interpretation of monitoring and assessment information is one aspect of ranch management that even resource professionals are seeking help with.

Creating a living laboratory network of case studies involving ranchers using soil health as part of their grazing management will promote: 1) participatory research opportunities for ranchers; 2) use of citizen science in grazing management and research; 3) integration of management (the human element) into research for successful adaptive decision making; 4) build multi-institutional partnerships; and 5) databases that support the efficacy of incorporating soil health into grazing management considerations and the ecosystem services provided by grazing lands. These networks could use rangeland health protocols with additional information to identify the causes of departure from desired ecological states, the management needs to help define explicit links between soil health and ecosystem health, and management causes and effects (Brown and Herrick, 2016).

IMPLICATIONS

Incorporating soil health goals into the ranch management plan and specifically the grazing enterprise can inform and guide transformational management changes that improve grazing land health, resilience and sustainability. Understanding the fundamental ecological processes as aided by ecological site descriptions of the grazing land managed will lead to better informed decisions affecting soil health. Integrating soil health into goal-based, adaptive management after assessing and monitoring grazing lands can help in evaluating management actions and climate influences. Social, ecological and economic dependencies will come to light when integrating soil health goals into the ranch management scheme, especially the human dimension. Partnerships formed to investigate grazing lands soil health will enhance the technical capacities of students, land managers, and natural resource professionals. Building a living laboratory network of case studies from ranchers engaged in incorporating soil health goals into grazing management will supply the science base needed to understand the complex relationships between soil health and grazing management.

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Speaker Biography

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Virginia Jin is a Research Soil Scientist for the USDA Agricultural Research Service in Lincoln, Nebraska. She has worked in soil microbial ecology and ecosystem sciences for the last 25 years. Her current research focuses on assessing how conservation vs conventional management strategies affect soil carbon and nutrient cycling, soil microbial communities, and system greenhouse gas emissions. Taken together, these areas of research contribute to a better understanding of how management affects soil quality, production sustainability, and system resilience to climate changes. Virginia is an active member of research and academic communities and serves as adjunct faculty at the University of Nebraska-Lincoln's Department of Agronomy and Horticulture. She holds a Bachelor of Science degree in biology from Duke University and attained both her Master of Science degree in Forest Resources and PhD in Plant Biology from the University of Georgia.

"Soil Health: Expectations & Evidence"

INTRODUCTION

Soil health and its various components have been studied academically for decades but only in the last several years has soil health been widely acknowledged as a keystone concept for agricultural sustainability. Importantly, soil health and the climate resilience of U.S. agricultural systems made it into the Agricultural Improvement Act of 2018 (aka the 2018 Farm Bill), signaling a major advancement for conservation efforts. The law includes soil health and climate resilience through its Environmental Quality Incentives Program (EQIP), Conservation Stewardship Program (CSP), and Conservation Reserve Program (CRP). Specifically, higher payments were allocated for cover crops, crop rotations, and advanced grazing management and payments were authorized for comprehensive conservation planning. Here, advanced grazing management refers to any combination of grazing practices, including intensive rotational grazing, that improves soil health, soil carbon storage, drought resilience, wildlife habitat, wildfire mitigation, and control of invasive plants. The 2018 Farm Bill also increased funds towards soil health research, with $25 million dedicated annually for on-farm conservation innovation trials (i.e., the USDA-led Soil Health Demonstration Trial). Landowners, industry, and researchers alike have emphasized the importance of soil health and climate resiliency on the long-term productivity and sustainability of agricultural systems, its contributions to national and international economies, and even public health. That said, long-term research has shown that the general benefits of conservation management are highly variable and location-dependent. Given our dynamic management systems, the question is, which conservation practices will work for me and how can I adapt them for my farm?

What is soil health?

Soil health and soil quality are often interchangeable terms, with both ultimately describing “the capacity of the soil to function” (Karlen et al. 1997). Soil health integrates inherent soil properties with dynamic soil management, the latter depending on producer goals (Fig. 1). Indicators for soil health are often grouped into three major categories: physical (i.e. bulk density, texture, erodibility); chemical (i.e. pH, electrical conductivity, extractable nutrients); and biological (i.e. soil microbial biomass, soil respiration, enzyme activities) (Andrews et al., 2004; Lehmann et al., 2015). While the list above does not include all possible indicators, almost every soil health aspect falls under the overarching influence of soil organic matter (SOM). Management practices aimed at enhancing SOM often benefit overall soil physical, chemical, and biological aspects. This emphasis on soil organic matter is the foundational focus for efforts to increase soil carbon storage through management.

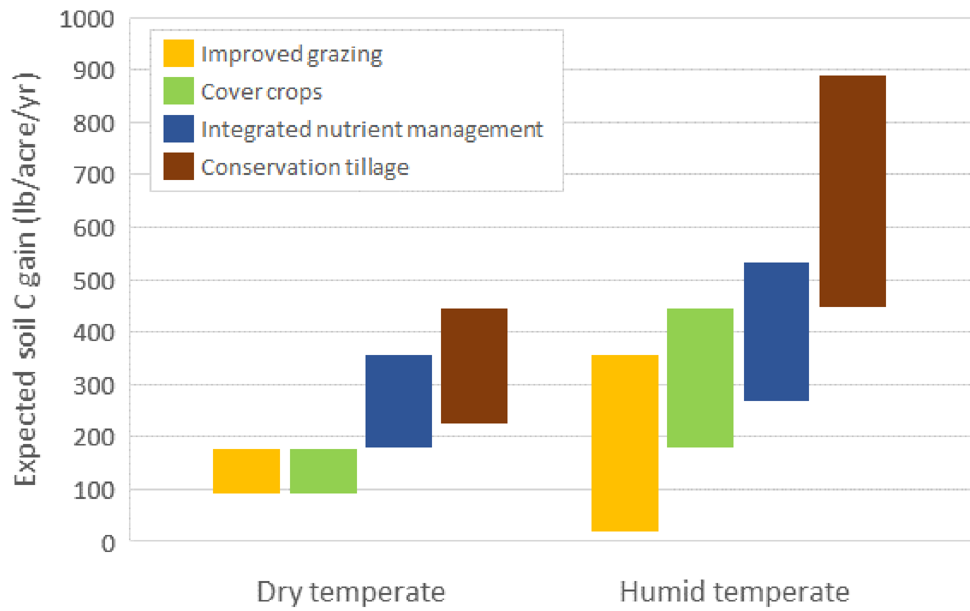
Tend to Reduce Soil Health	Tend to Promote Soil Health
Aggressive tillage	No-till or conservation tillage
Annual/seasonal fallow	Cover crops; Relay crops
Mono-cropping	Diverse crop rotations
Annual crops	Perennial crops
Excessive inorganic fertilizer use	Organic fertilizer use (manures)
Excessive crop residue removal	Crop residue retention
Broad spectrum fumigants/pesticides	Integrated pest management
Broad spectrum herbicides	Weed control by mulching, cultivation

Figure 1. Agricultural management effects on soil health (from Lehman et al., 2015).

How is management *EXPECTED* to affect soil health?

In the 2018 Farm Bill, cover crops, crop rotations, and advanced grazing management are among the major conservation practices identified for improving agricultural soil health. Here, these practices are discussed, including the expectations for implementing them and the evidence for their effectiveness.

Cover crops, crop rotations, and advanced grazing management can be viewed broadly as practices that improve the overall species diversity of an agricultural production system. For any given location, a production system is usually dependent on a few major crop and forage species. By introducing more plant diversity through complex crop rotations, cover crops, and/or livestock practices that enhance grazing land species richness, land managers seek to improve the diversity of plant input quality and quantity to maintain and build SOM (Fig. 2).



Another major benefit of increasing plant biodiversity is its cascading effect on greater habitat diversity which supports a higher diversity of other potentially beneficial organisms (i.e. soil organisms, pollinators, etc.). Diversification of cash crops, cover crops, and grazing land plant communities also can interrupt disturbance cycles to confer higher system resistance and resilience to disease and weed invasion. Increased resistance and resilience to disturbances (both biological and physical) means that producers can decrease use of chemical control agents and improve the control and recovery from wildfire and drought (Fig. 3).

In addition, there is also an expectation that as the biodiversity in the soil itself improves,

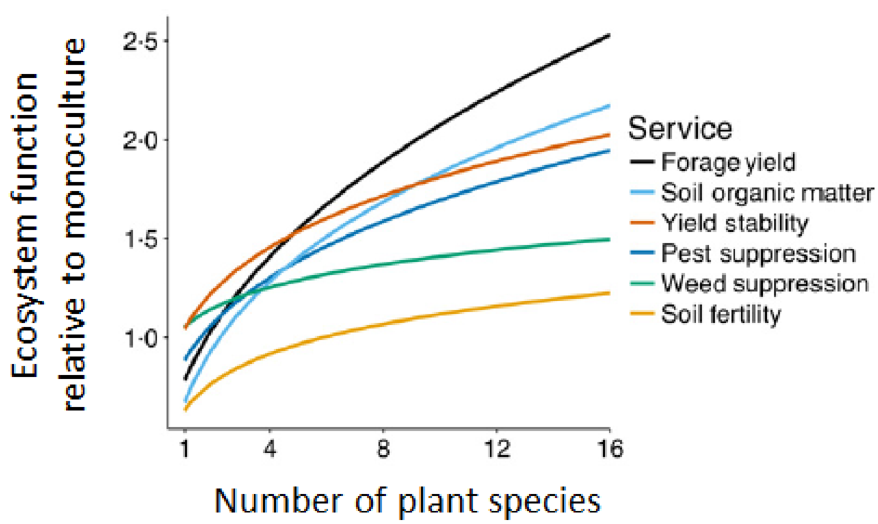


Figure 3. Higher plant diversity can improve agroecosystem services (from Isbell et al., 2017).

agroecosystem functions will also improve (Fig. 4). Again, a greater biodiversity of soil organisms increases the probability that some beneficial organisms will be successful in whatever soil environment may be present. Through agricultural system management, or more specifically "soil ecological engineering," greater soil biodiversity can be built and increase soil function (Bender et al., 2016). In other words, the expectation is that conservation management practices that increase soil health will lead to overall improvements in agroecosystem functions and services provided.

What is the *EVIDENCE* that management affects soil health?

Figure 4. Expected effects of soil biodiversity on ecosystem functions (Bender et al., 2016).

Several recent literature surveys have assessed both U.S. and global relationships between soil health and ecosystem functions. Previously, this article pointed out that most conservation management practices are aimed at increasing plant species diversity as the primary method for improving soil health, SOM, and other ecosystem services. A recent global analysis showed that plant species diversity has a variable effect on agroecosystem services, with higher diversity conferring the greatest benefit to soil carbon, a marginally positive effect on crop pollination, and no effect on pest control (Ricketts et al., 2017) (Fig. 5).

How does soil biodiversity affect SOM and other ecosystem functions? In another recent global

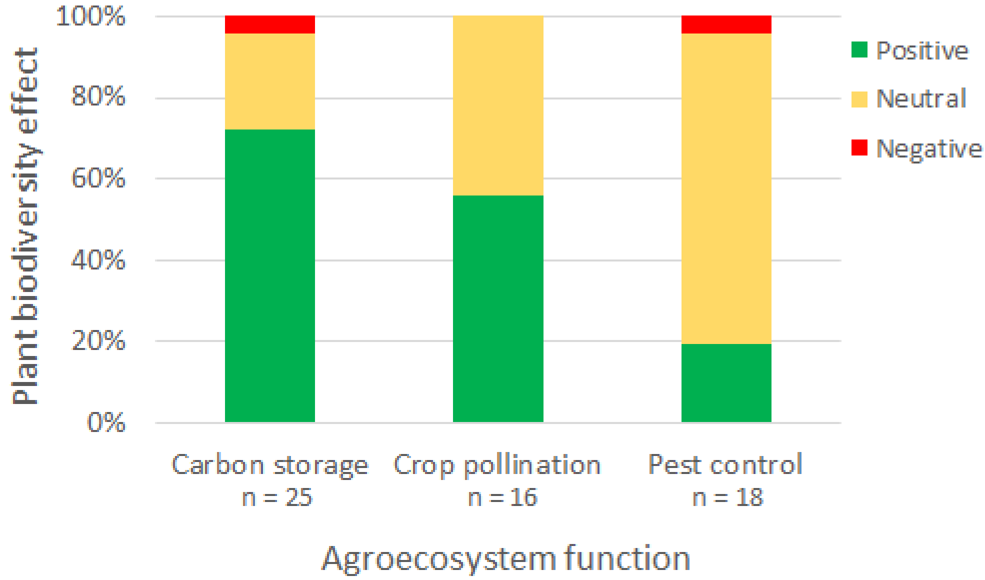


Figure 5. Global survey showing how management affects the relationship between plant biodiversity and agroecosystem functions. The number of relationships surveyed is shown below each function (from Ricketts et al., 2017).

analysis, higher soil biodiversity was found to increase the multifunctionality of ecosystem services, including pest control, plant nutrient uptake, decreased system nutrient losses, and soil carbon storage (Bender et al., 2016).

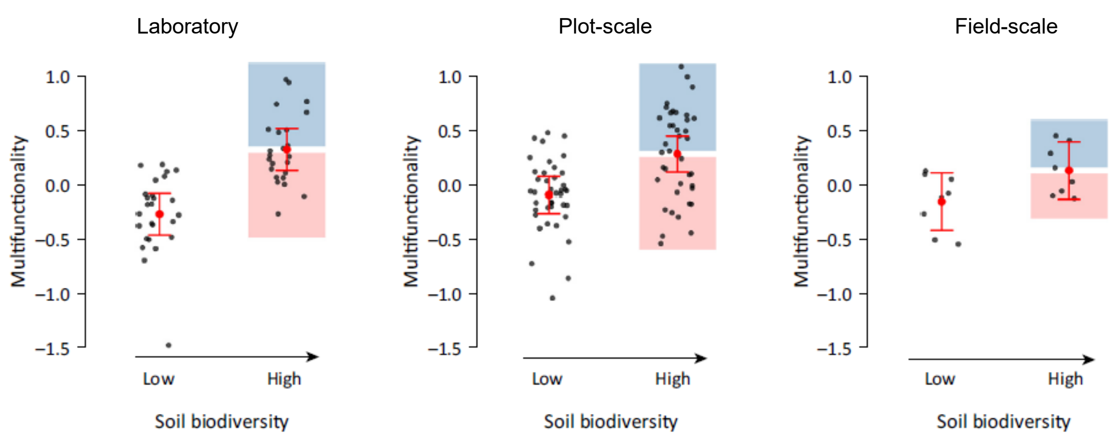


Figure 6. Increasing soil biodiversity can improve agroecosystem function at multiple scales (Bender et al., 2016). Blue is functionally optimal, pink is functionally limited.

Given the overall positive effect of plant and soil biodiversity on various ecosystem functions including SOM, how does SOM itself relate to ecosystem functions? Again, we use SOM here as a general proxy for soil health. Like biodiversity effects on ecosystem function, the effect of SOM on ecosystem functions is also highly variable. On the positive side, a global assessment showed that higher SOM was related to higher rainfed corn yields (Fig. 7a) as well as higher soil microbial biomass (Fig. 7b). A survey of U.S. soils showed that greater SOM improved soil bulk density (i.e. bulk density decreases) (Fig. 7c), though note that soil carbon in U.S. Great Plains and Midwest production systems typically fall within the large cloud of points below 10% soil organic carbon (SOC).

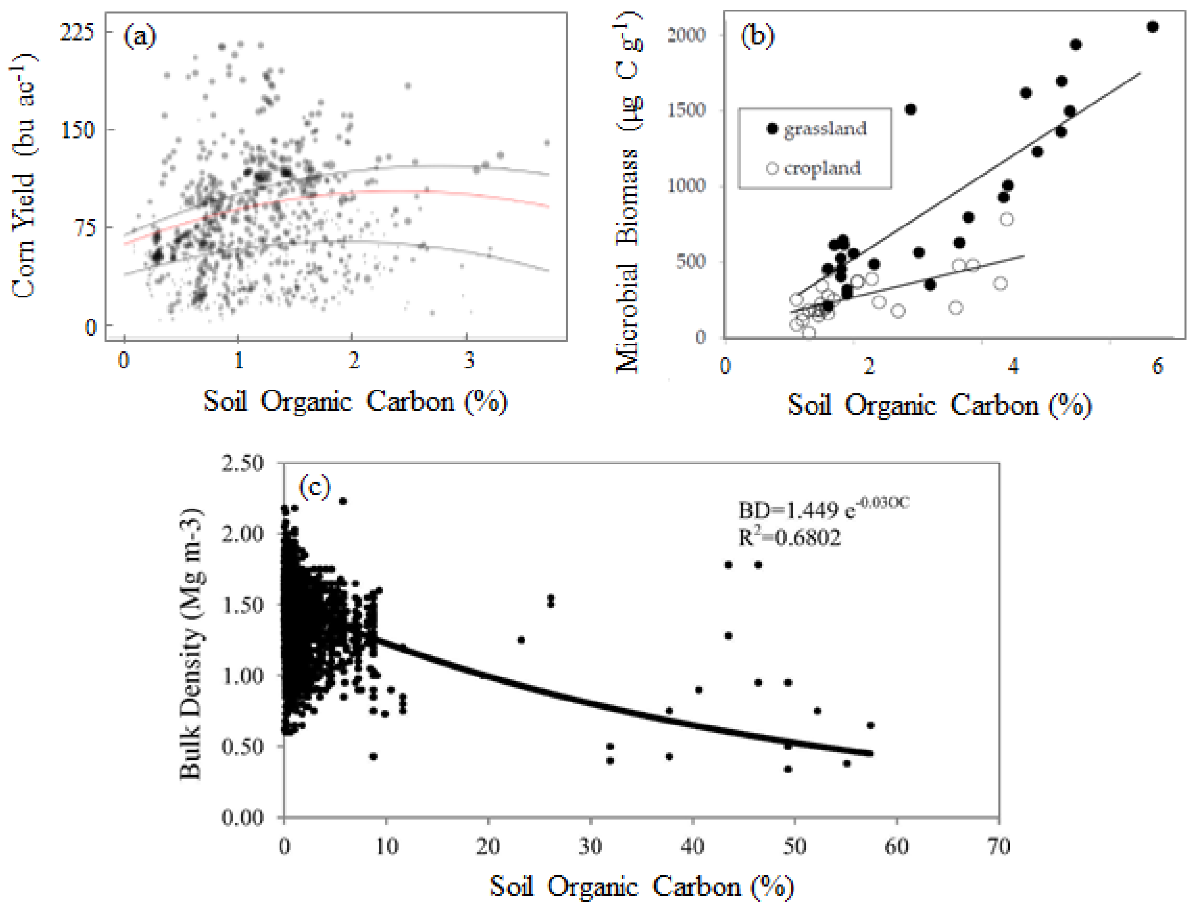


Figure 7. Greater soil organic carbon is associated with improved soil properties and ecosystem functions (a) rainfed corn yield (Oldfield et al., 2019); (b) soil microbial biomass (McGonigle and Turner 2017); and (c) soil bulk density (Abdelbaki 2018). Note that the scale in SOC changes between figure panels.

In a recent review of grazing management effects on SOM and soil water availability (represented by water infiltration rates), authors found that greater increases in soil carbon with advanced grazing management (Fig. 8a) such that infiltration rates also improved (DeLonge and Basche, 2017) (Fig. 8b).

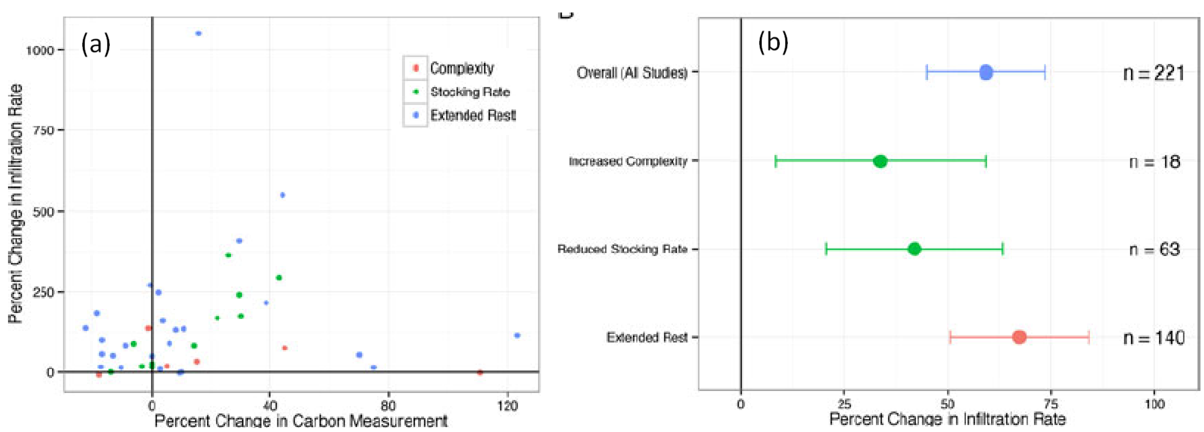


Figure 8. Advanced grazing management improved soil carbon changes and water infiltration rates (DeLonge and Basche, 2017).

In contrast, other assessments have found that expectations between SOM and other ecosystem functions are weak. A global survey found that higher SOM had slightly positive effects on soil water availability as expected, but the overall impact was negligible (Minasny and McBratney 2017). These authors found that increasing soil organic carbon by 1% increased available soil water capacity by ~1.5% (volumetric) (Fig. 9). To illustrate, consider a typical silt loam which has about 2.2 inches of available soil water per foot of soil depth (Yonts et al., 2008). If a 1% increase in SOC leads to a 1.5% increase in volumetric water content, available soil water increases from 2.2 to 2.4 inches per foot of soil, or ~9% increase in soil water.

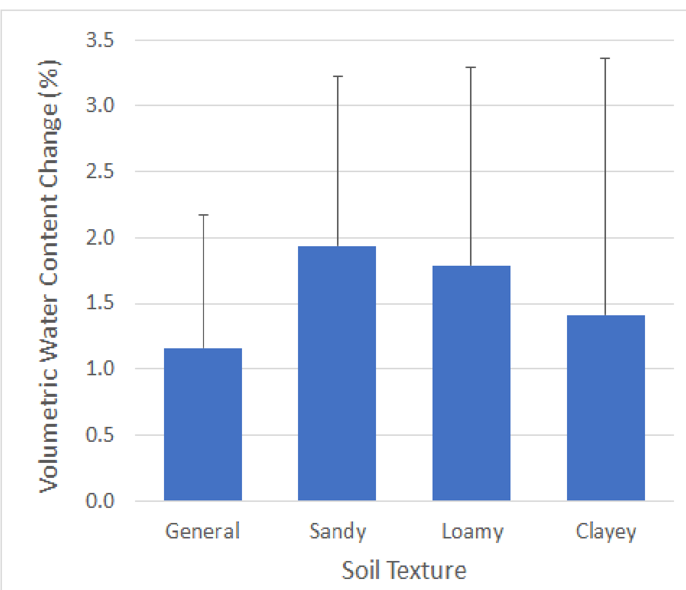


Figure 9. Increasing soil carbon by 1% had positive but negligible effects on soil available water capacity (after Minasny and McBratney 2017).

Many studies have shown that adopting no-tillage (NT) practices tends to build SOM. A recent global analysis of nitrate loss, however, showed that NT increased nitrate lost through leaching but tended to decrease nitrate lost in surface run-off (Daryanto et al., 2017) (Fig. 10). Authors concluded that additional conservation practices (i.e., cover crops, improved N management) were needed along with NT to improve soil N retention and increase water quality.

IMPLICATIONS

Evidence-based management is key to improving soil health and achieving the agroecosystem benefits they purport. While the regional and global literature surveys presented here show that there are some benefits of management practices on various ecosystem functions, their effectiveness is highly variable. Generally, there is evidence that increasing plant diversity and soil diversity can improve some ecosystem functions (i.e., soil carbon storage, pollinators) but not others (i.e., pest resistance). There is evidence that building SOM in soils can boost crop yield to some extent, improve soil physical and chemical properties, including soil moisture characteristics (but not in all cases).

Given the variability of these broad surveys, it is clear that no single set of conservation practices are likely to produce the "silver-bullet" effect of improving all ecosystem function. It is also clear that to implement conservation practices such as cover crops, increased crop rotation complexity, and advanced grazing management, producers are in need of information that is standardized to allow fair comparisons and information that gives economic value to soil health and ecosystem functioning. While the economic component is beyond the scope of this review, the development of tools and technology to rapidly assess and valuate soil and ecosystem health will be a critical component of improving the resistance and resilience of our agricultural production systems to climate changes.

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Speaker Biography

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Dr. Walter H. Schacht is the Sunkist Fiesta Bowl Professor of Sustainability in the Department of Agronomy and Horticulture and the School of Natural Resources at the University of Nebraska-Lincoln (UNL). Schacht's research emphasizes ecosystem responses to grazing and associated management practices in the Nebraska Sandhills and cool-season grass pasture in the eastern Great Plains. He has been a principal investigator in studies quantifying range vegetation response to season and intensity of grazing at UNL's Gudmundsen Sandhills Laboratory and in grazing systems comparison studies at UNL's Barta Brothers Ranch. In eastern Nebraska and south central Iowa, his studies have focused on nutrient cycling and improvement of pasture quality with the use of fire, grazing strategies, legumes, and herbicides. His former students are farm and ranch managers and in key positions with university research and extension, NRCS, FSA, US Forest Service, NRDs, Board of Educational Lands and Funds, Nebraska Department of Transportation, Nebraska Game and Parks Commission, Agricultural Research Service, and numerous conservation groups. Overall, his career has focused on undergraduate and graduate education and evaluating and developing management strategies that ensure the ecological and economic sustainability of grazing lands for multiple uses, including livestock grazing.

"Mob Grazing on Nebraska Sandhills Meadow"

Walter Schacht, Jerry Volesky, Aaron Shropshire, Torie Lindsey, Miles Redden, Ben Beckman, Jordan Johnson, Ana Wingeyer, and Martha Mamo

ABSTRACT

Mob grazing, grazing at ultrahigh stocking densities, involves concentrating grazing livestock into small pastures to achieve stocking densities of 200,000 lbs/acre or greater. Maintaining animals at these densities usually requires moving animals through multiple pastures each day. A wide variety of benefits are reported including increased forage production, increased plant diversity, improved distribution of livestock grazing, improved soil function, and rapid rate of soil development (Gompert 2010). The high stocking densities used in mob grazing systems reportedly result in even distribution of grazing pressure, hoof action, and excreta across a pasture (Peterson and Gerrish 1995). The excellent growing conditions and high forage production on Sandhills meadows appear to be well suited for such management intensive grazing practices as mob grazing. Our on-ranch and on-station (at UNL's Barta Brothers Ranch) research documented that mob grazing has potential for relatively high grazing efficiency (as much as 43%) with even utilization across the grazing unit but changes in plant

composition and production are minimal. Timing of grazing relative to the stage of growth of dominant forage plants is critical in affecting harvest efficiency, animal performance (average daily gain), and animal production (total weight gain per acre). As plants mature, percentage trampling of standing forage plants increases, forage quality and nutrient intake declines, and animal performance decreases. Mob grazing can be effective in increasing harvest efficiency and animal production per acre when grazing during the vegetative/elongation stage of growth. Mob grazing does not appear to increase soil development, soil organic matter, and plant production on subirrigated meadows.

Study Sites and Procedures

On-Ranch

Vegetation and soil data were collected in 2012 and 2013 on meadows of three Sandhills ranches practicing mob grazing (Table 1). Stocking densities ranged from 200,000 to 1,000,000 lbs/acre with 2 to 8 moves per day. Grazing began in mid- to late May with one or two grazing periods per season. The meadows were grazed by cow-calf pairs or yearling steers. The meadows had been mob grazed annually for 1 to 11 years at the time of data collection. Vegetation and soil response to mob grazing was compared to that of neighboring hay meadows.

Barta Brothers Ranch

Research was conducted on the subirrigated meadow at the Barta Brothers Ranch (BBR) in southern Rock County. Stocking density on the mob-grazed pastures was 220,000 lbs/acre with 2 moves per day. Grazing began in mid-June with one grazing period per season. Other treatment pastures were grazed in 4-pasture rotation systems with either a single grazing cycle (4PR1) or two grazing cycles (4PR2) during the grazing season. The meadow was grazed by yearling steers at 3 AUM/acre for 8 consecutive years (2000-2017) with data collected each of the 8 years. Vegetation, soil, and animal response was compared among the mob, 4PR1, and 4PR2 pastures.

Does Mob Grazing Affect Grazing Efficiency?

The increased costs generally associated with mob grazing can be justified only if carrying capacity can be increased with greater harvest or grazing efficiency. Grazing at ultrahigh stocking densities can result in increased harvest efficiency at the vegetative and early elongation stage because of even distribution of grazing and relatively low level of trampling. We found that harvest efficiency is relatively low at elongation to reproductive stages of plant growth because of a high level of trampling (45 to 60% trampling of standing vegetation). Our on-ranch research showed a wide range of harvest efficiency, ranging from 33 to 43% (Figure 1). Harvest efficiency on the mob-grazed pastures at BBR was as low as 30% because grazing was initiated in mid-June when the dominant cool-season grasses were in elongation and reproductive stages.

Does Mob Grazing Affect Plant Species Composition?

Mob grazing is recommended in a number of different situations where grazing intensity can impact the dominant, undesirable plant species, e.g., a degraded warm-season grass pasture. The species composition of subirrigated meadows dominated by perennial, cool-season grasses was largely unaffected by mob grazing at both on-ranch and BBR sites (Figure 2). At BBR, species composition did not differ between mob and 4PR pastures over the 8 years of the study. On-ranch, there were not differences between mob-grazed pastures and the adjacent hay meadows except sedges and rushes were less common and grasses were more common on mob-grazed pastures.

Does Mob Grazing Affect Plant Production?

Belowground

Root production in the third and fourth year of the study at BBR did not differ between the mob and the 4PR pastures (Figure 3). After the fourth year of treatments, the shorter grazing periods and long recovery offered with the mob grazing (ultrahigh stocking density) did not result in the increased net root production that was hypothesized. Our results show that these pastures, when stocked at the same stocking rate, do not differ in net annual root production in response to method of grazing.

Aboveground

Increased aboveground production with mob grazing is hypothesized to occur because of the expected changes in soil health and to a more productive plant composition. We did not find greater aboveground plant production on mob-grazed pastures on ranches compared to the adjacent hay meadows or on mob-grazed pastures compared to that of the 4PR pastures at BBR (Figure 4). While differences in grazing treatments, such as recovery period and stocking density impact factors such as harvest efficiency, it appears their effect on the vegetation production in the subirrigated meadow is minimal. With an absence of changes in soils and plant composition, aboveground plant production was unaffected.

Does Mob Grazing Affect Animal Performance?

We were not able to arrive at estimates of animal performance on ranches because we did not have facilities necessary to weigh animals. At BBR, animal performance differed between grazing treatments and among years. Yearling steer daily gains in the 4PR2 (1.43 lbs/head/day) treatment differed among years but were greater than the 4PR1 (0.55 lb/head/day) and mob (0.33 lb/head/day) treatments in all years. The 4PR1 treatment had greater gains than the mob treatment in 2011 and 2015 but gains did not differ in the other years. Crude protein content (%) of standing vegetation was greater for the 4PR2 (8.0%) pastures than the 4PR1 (6.6%) and mob (6.9%) pastures in the years measured (2010, 2011, 2013, and 2017). This was attributed to the earlier start of grazing and regrowth occurring after the first grazing cycle for 4PR2 pastures. The high grazing pressure and limited forage intake due to the high levels of trampling also may have contributed to depressed gains in the mob pastures.

Does Mob Grazing Affect Soil Organic Matter?

Soil organic matter content was not affected by mob grazing (Figure 5). Soil organic matter content did not differ between mob-grazed pastures and adjacent hayed meadows on the ranches nor did soil organic matter differ between mob-grazed pastures and the 4PR pastures on the meadow at BBR. The depth of soil also did not appear to be affected by grazing practice.

IMPLICATIONS

Mob grazing (above 200,000 lbs liveweight/acre) on Sandhills meadow dominated by cool-season grasses appears to be sustainable with relatively high harvest efficiencies (>40%). However, we found no evidence of increased soil organic matter and aboveground plant production on mob-grazed meadows when compared to meadows managed with simple rotation grazing systems or to conventionally hayed meadows. Additionally, at the higher grazing pressure associated with mob grazing, animal performance (ADG) proved to be relatively low for mob-grazed pastures compared to simple rotation grazing systems, although animal performance (average daily gain) likely is highly associated with timing of grazing relative to stage of plant growth. Therefore, high harvest efficiency is possible and sustainable with mob grazing but animal performance appears to be compromised.
In effect, we found no benefit to the ultrahigh stocking density and grazing pressure associated with mob grazing on soil properties/development and aboveground plant production on Sandhills meadows. We found (1) better distribution of grazing and near-complete utilization of standing vegetation with mob grazing through trampling and higher harvest efficiency and (2) patchy distribution of grazing and incomplete utilization of standing vegetation with the 4-pasture systems. However, we did not find that soil properties and vegetation production responded to the more even use of the standing vegetation and the trampling of standing vegetation. We concluded that the primary driver of soil organic matter content is root production not trampling of aboveground plant mass. We concluded the following:

- increased evenness of trampling has little to no effect on soil organic matter content and aboveground plant production;
- the amount of standing vegetation remaining following grazing in simple rotation systems represents a relatively small source of soil organic matter compared to the plant roots;
- the major driver of soil organic matter content and plant production (above and below ground) is the maintenance of vigorous plants through implementation of appropriate stocking rates;
- the implementation of simple rotational grazing systems may have relatively low harvest efficiency but longer-term plant productivity is not affected;
- the patchy grazing associated with simple rotational grazing systems, however, allows for selective grazing resulting in greater diet quality and animal performance; and
- mob grazing might result in increased harvest efficiency but the resulting increased carrying capacity likely does not justify the added production costs.

Tables and Figures

	2012		2013		
	Ranch 1	**Ranch 2**	**Ranch 1**	**Ranch 2**	**Ranch 3**
Class of cattle	Cow-calf	Heifers	Cow-calf	Cow-calf	Heifers
Number in herd	750 + bulls	705	800 + bulls	550	114
Moves/day	8	2 or 3	3	2 or 3	2
Stocking rate					
Mob period	2.3 AUM/ac	2.0 AUM/ac	3.4 AUM/ac	2.9 AUM/ac	
Off-season		0.2 AUM/ac		2.1 AUM/ac	
Stocking density	800,000 lb/ac	230,000 lb/ac	270,000 lb/ac	86,500 lb/ac	250,000 lb/ac
Began mob grazing	2001	2006	2001	2006	2013
Mob-grazed acres	190	200	190	2000	50

Table 1. Statistics for the three Sandhills ranches practicing mob grazing.

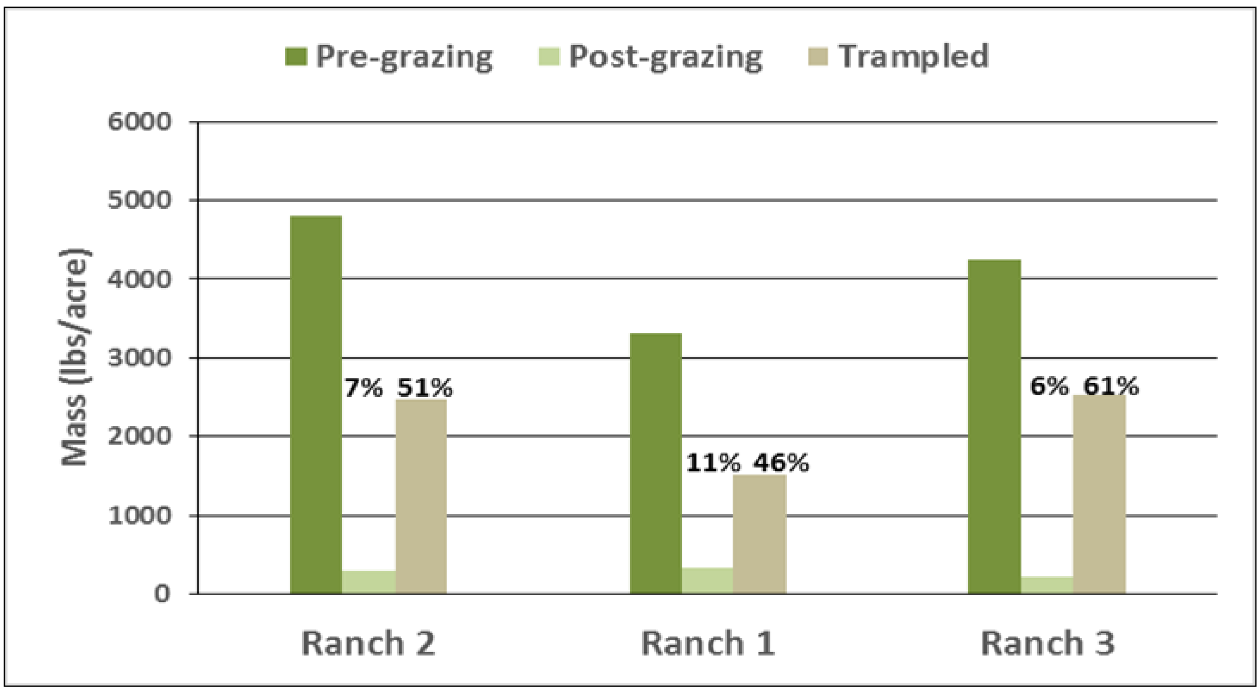

Figure 1. Percentage of the pre-grazing standing live vegetation that was trampled or remained following grazing as standing live vegetation in 2013. Grazing efficiency was 42%, 43%, and 33% for Ranches 2, 1, and 3, respectively.

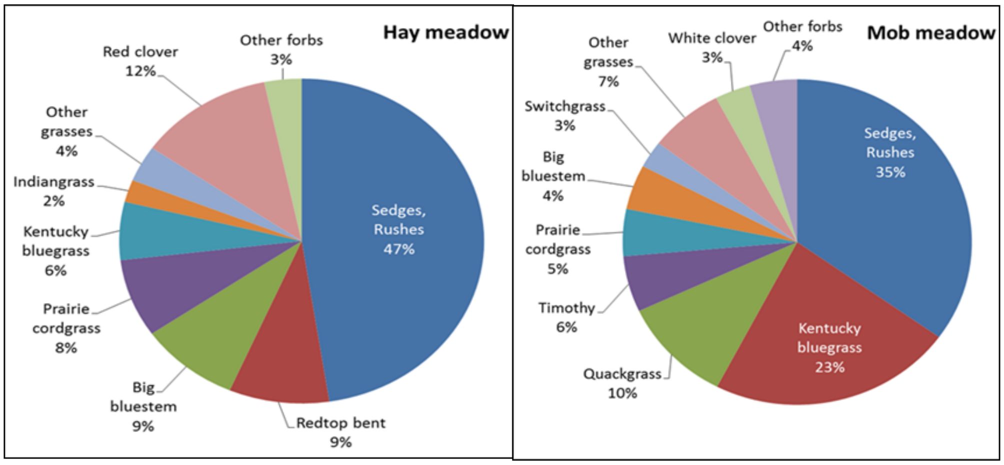

Figure 2. Botanical composition of hay meadow and mob-grazed meadow on Ranch 1 in 2013.

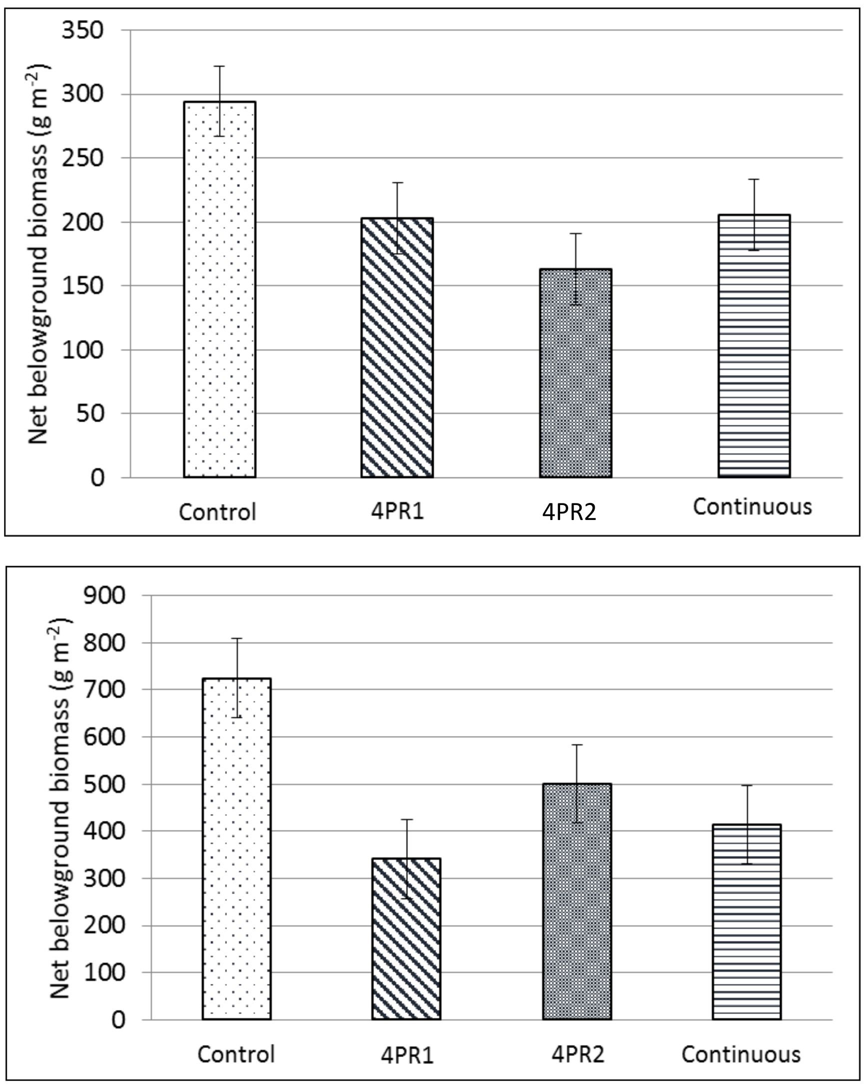

Figure 3. Net annual belowground biomass produced during 2012 (top) and 2013 (bottom) growing season across treatments on the BBR meadow.

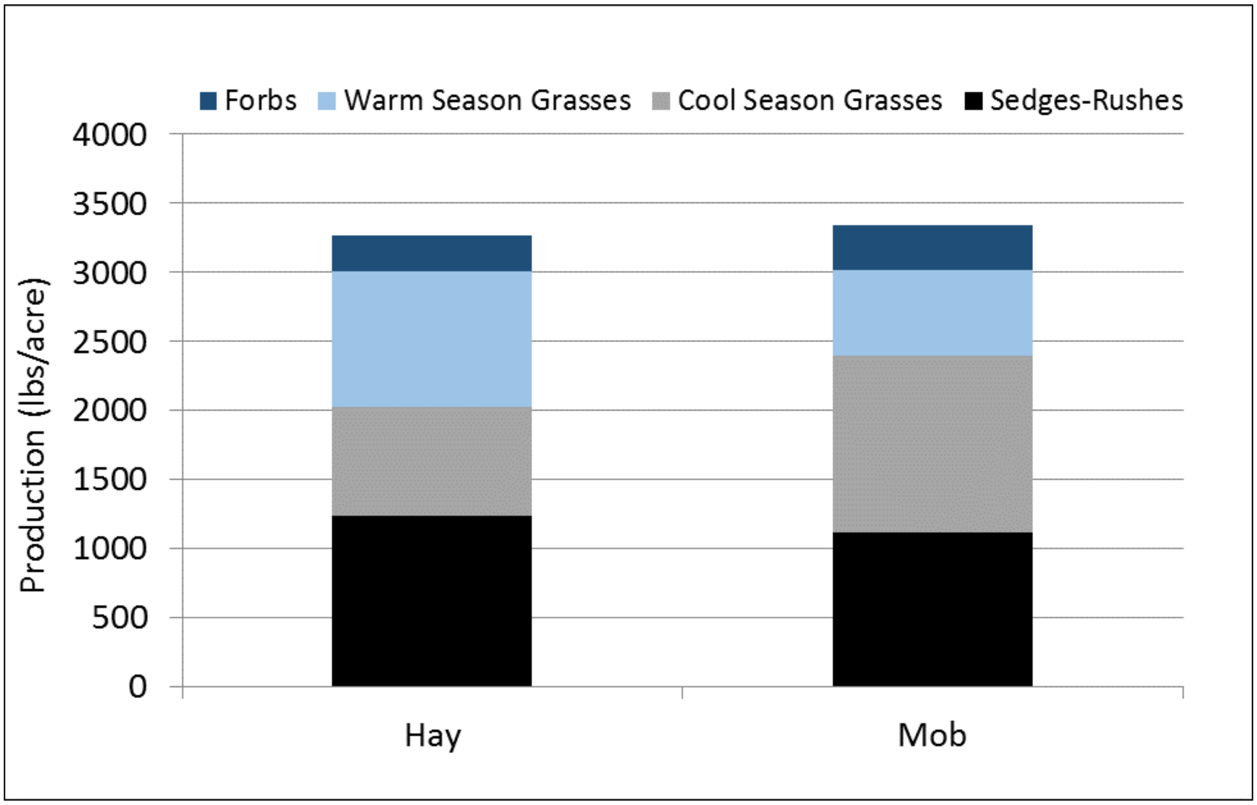

Figure 4. Aboveground plant production on hay and mob-grazed meadows on Ranch 1 in 2013.

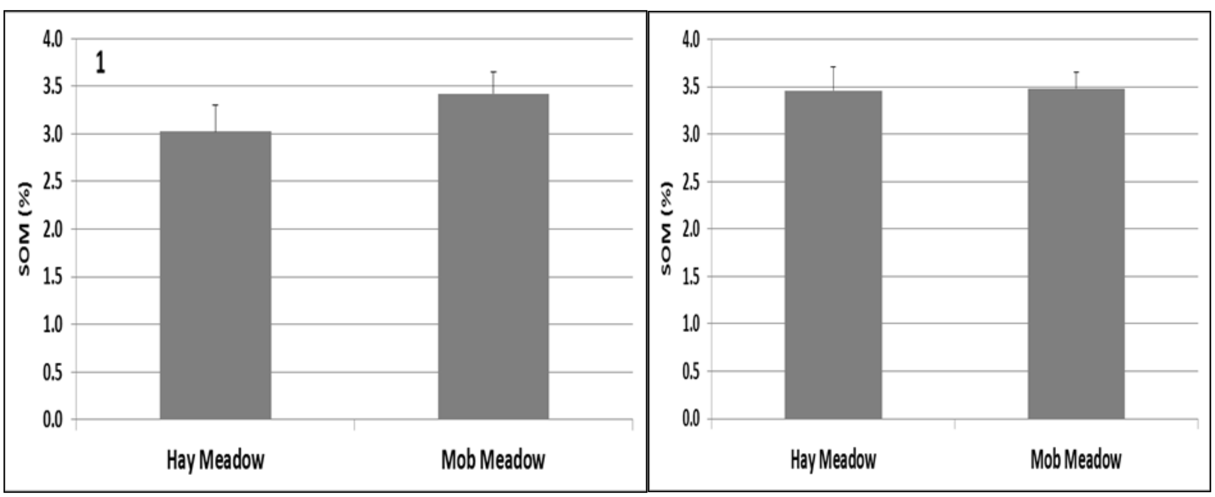

Figure 5. Soil organic matter (%) of hay meadow and mob-grazed meadow on Ranches 1 and 2, respectively, in 2013.

Speaker Biography

Jerry Volesky, Nebraska Extension
North Platte, NE

Jerry Volesky is a Professor and Range and Forage Specialist with the University of Nebraska-Lincoln West Central Research and Extension Center located in North Platte. He has been with UNL for 24 years. His responsibilities include conducting grazing management and forage systems research on native range and seeded pasturelands in central and western Nebraska. Extension responsibilities include development and delivery of range and forage management programming for both adult and youth clientele in Nebraska.

"Effect of Length of Grazing Period on Upland Sandhills Range"

Jerry Volesky, Walter Schacht, Robert Vavala, Jordan Johnson, Kayla Tarr, and Jessica Milby

Introduction

Grazing strategies on range and pasture commonly are designed with grazing period length as a focus. Grazing period length can affect recovery period length and grazing pressure; thereby, possibly impacting aboveground plant production and heterogeneity of vegetation structure and composition. Our objectives were to quantify plant production, composition, and structural heterogeneity on upland pastures in the Nebraska Sandhills in response to different combinations of cattle grazing and recovery period lengths.

Study Sites and Procedures

The research was conducted at the University of Nebraska-Lincoln Barta Brothers Ranch near Rose, NE from 2010 through 2018. The site was a typical upland sands ecological site with vegetation of the study area is a mixture of warm- and cool-season grasses, forbs, shrubs, and sedges. Dominant grasses include prairie sandreed, sand bluestem, little bluestem, switchgrass, sand dropseed, and blue grama. Common cool-season species included porcupine grass, needleandthread, prairie junegrass, and rosette grass. Kentucky bluegrass was also present, particularly in the interdunal swales. Several species of sedges were also common. Common forbs and shrubs are western ragweed, cudweed sagewort, prairie wild rose and leadplant.

Three grazing period lengths at each of two stocking rates were tested on the pastures grazed annually by cattle from mid-May to mid-October. Grazing period lengths are 3 days in a 50-pasture rotation, 37 days in a 4-pasture DR (deferred rotation), and 150 days in a season-long continuously-stocked pastures. There were 3 replications of each grazing treatment as well as an ungrazed control. The moderate stocking rate was 0.75 AUM/acre and the heavy stocking rate was 1.5 times that

(1.13 AUM/acre). These stocking rates were used over the 8 years of the study, except in 2012 when stocking rates were reduced by 1/3 because of drought. The grazing was applied by yearling spayed heifer weighing an average of 700 lb. Details of the treatments are provided in Table 1.

Table 1. Characteristics of grazing treatments.

Treatments	Grazing period length (days)	Stocking rate (AUM/acre)	Stocking density (AU/acre)
Continuous grazing – moderate	150	0.75	0.15
Continuous grazing – heavy	150	1.13	0.30
4-pasture DR – moderate	37	0.75	0.60
4-pasture DR – heavy	37	1.13	1.50
50-pasture rotation - moderate	3	0.75	1.50
50-pasture rotation – heavy	3	1.13	11.40
Control	- -	- -	- -

The mid-May to mid-October grazing season was divided into 4 time periods: 1) May 15 to June 16, 2) June 17 to July 23, 3) July 24 to September 2, and 4) September 3 to October 15. Each year, the time period that the 4-pasture DR and 50-pasture rotation treatments were grazed was changed following a sequence consistent with deferred-rotation grazing. As a result and over the course of the 8 year study, 4-pasture DR and 50 pasture rotation pastures were grazed twice in each of the 4 time periods.

Plant functional group composition and aboveground production was estimated by clipping standing vegetation at ground level in 12 grazing exclosures per pasture in mid-August. Clipped vegetation was sorted into warm-season, cool-season, sedge, forb, and shrub components. Placement of the 12 exclosures was equally divided over the 4 topographical positions of interdunal, south-slope, dune top, and north-slope.

Stubble heights are measured within 2 days following termination of grazing to estimate utilization and heterogeneity (variance among sampling points) by topographic position and pasture. Within each topographical position of each pasture, 25 measurements were taken at random locations using a plexiglass plate where residual stubble height was taken when about 10% of the standing vegetation came into contact with the plate.

Plant species frequency of occurrence was collected from 3 permanent-transect sites located in each study pasture. At each site, a 100-m transect will be located on south-slope, dune-top, and north-slope topographical positions. A 50-m transect will be established on interdunal positions. Frequency of occurrence data are collected by recording all plant species present in a 0.1 m2 quadrat that is placed at each 4th meter along the transect. Baseline data collection occurred in the year prior to the start of the grazing study (year 0) and then every 2 years until year 8. Diversity indices will be calculated using these data and treatment comparisons made over topographical positions and time.

Results

Annual precipitation was near or above the long-term average during 8 of the 9 years of data collection in this study (Figure 1). For critical months within the growing season, monthly rainfall totals were near or above average in most years except during the 2012 drought and during May 2014 and June 2017.

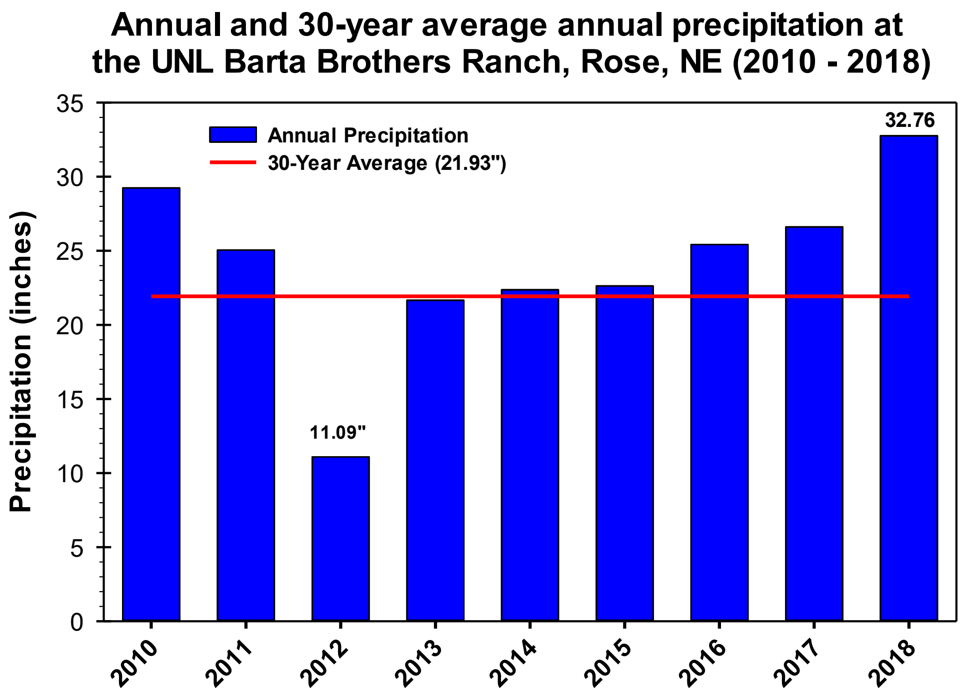

Figure 1

The presentation associated with this paper will include results associated with treatment effects on vegetation production, plant functional group composition, post-grazing stubble heights, and plant species frequency of occurrence.

Speaker Biography

Martha Mamo, University of Nebraska-Lincoln, Agronomy & Horticulture Department Lincoln, NE

Martha Mamo holds the John E. Weaver Professorship and currently serves as the Head of the Department of Agronomy and Horticulture at the University of Nebraska-Lincoln. Mamo's research is on nutrient cycling in low input rangeland ecosystems – evaluating grazing strategies and dung pat impact on soil C and N. Mamo provided leadership in the undergraduate curriculum and taught two core large enrollment soil courses for 15+ years. She received her B.S. and M.S. from Alabama A&M University, and Ph.D. from the University of Minnesota.

"Carbon Input and Loss in Semi-arid Sandy Rangeland"

ABSTRACT

Decomposition of organic materials from plants and dung pats on grasslands leads to nutrient availability and nutrient cycling, which define quality and functionality of rangeland ecosystems. The translocation of dung nutrients into the soil is largely related to decomposition rates, and complete decomposition can take anywhere from 30 to 1,000 days or more, depending upon environmental conditions. Factors affecting dung decomposition are expected to affect also carbon and nitrogen dynamics. In particular, soil fauna, such as dung beetle, can be factors in facilitating dung decomposition and affect nitrogen input and carbon loss. We will discuss the effect of dung beetles on carbon loss and nitrogen input into soil from dung pats on rangeland meadows of the Nebraska Sandhills.

Speaker Biography

Jacob Miller, 7M Ranch
Culbertson, NE

Jake Miller is a third-generation Nebraska rancher from Culbertson. He and his Dad, John run a commercial cow/calf operation and retain the stocker calves to run as yearlings. They retain all their own heifers and most of their own bulls. A 365-day grazing system is utilized, the forage base includes native range, expired CRP, and both dryland and irrigated farm ground. Grazing management is focused on frequent moves, increasing stock density, and more efficient forage utilization.

Along with cattle, Jake and his wife, Cassie, are working to integrate a multi-species grazing program. They are working with chickens and sheep to improve grazing efficiency, plant species diversity, and reduce parasite loads. Jake and Cassie started Livewire Fence Supply in 2015, a fence supply business that develops solar fence chargers, and specializes in hi-tensile and portable fence products used for managed grazing systems. Jake and Cassie were excited to welcome their daughter and fourth generation to the ranch this April.

"Graze 365"

Speaker Biography

Andrea Basche, University of Nebraska-Lincoln,
Agronomy & Horticulture Department
Lincoln, NE

Andrea Basche is an assistant professor in Cropping Systems at the University of Nebraska-Lincoln's Department of Agronomy and Horticulture. Her research focus is on the agronomic benefits and tradeoffs of diversified cropping systems including perennial crops and cover crops. She also has experience researching the opportunities that improved soil health offers for managing water related risks, such as floods and droughts. In her role, she is also teaching undergraduate courses in crop management. Basche holds a B.S. in biology from Fordham University, an M.A. in applied climate science from Columbia University, and a Ph.D. in agronomy and sustainable agriculture from Iowa State University.

"Soil Health and Grazing Strategies: Opportunities for Increasing Soil Water"

ABSTRACT

Soil health is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans. Increasing rainfall variability has contributed to substantial interest in opportunities to improve soil health to help farmers and ranchers adapt to and mitigate weather related risks. Within this discussion, grasslands and grazinglands are particularly important, due to their geographic range, capacity to store substantial quantities of carbon relative to cultivated croplands, and potential role in mitigating droughts and floods. However, using grasslands and grazinglands for this purpose will require a better understanding of how farmers and ranchers might alter management to ultimately improve water related outcomes, such as continued productivity and reduced soil degradation in periods of floods and droughts. The work included in this presentation details an extensive review of over 120 cropland and grazing studies across the globe to assess how management changes impact soil water infiltration rates, the rate at which water enters the soil. Infiltration is a critical ecosystem function that can mitigate drought and flood risk by facilitating water entry into the soil and reducing water losses by runoff. The cropland conservation management practices that we considered were no-till, cover crops, crop rotation, livestock integration and perennial crops compared to annual crops only. The management changes in grazing systems that we considered were reducing stocking rates, adding complexity to grazing strategies (from continuous grazing to strategies such as rotational, mob or adaptive management, and agroforestry), or extended rest from livestock, relative to a control such as continuous grazing or higher stocking rates. Across these management changes, we found the greatest opportunities to improve infiltration rates to be from practices where roots were continuously in the soil, including perennial crops, cover crops and grazing management such as reduced stocking rates and adding complexity to grazing strategies.

Detailed Findings

In the cropland experiments, we found that introducing perennials (grasses, agroforestry, managed forestry) or cover crops led to the largest increases in infiltration rates (average increase of 59% and 35% compared to conventional controls, Figure 1). The effect of no-till on infiltration rates was inconsistent across experiments, but the practice led to increases in wetter climates and when combined with residue retention. Our findings suggest that practices promoting ground cover and continuous roots, both of which improve soil structure, were most effective at increasing infiltration rates.

In the grazing experiments, we found that in 82% of experiments, one of the management changes – extended rest from livestock, reduced stocking rates or added grazing complexity – increased infiltration rates relative to a control (such as continuous grazing or higher stocking rates, Figure 1). Consistently, all of the grazing management changes evaluated led to consistent increases in infiltration rates. Extended rest from grazing led to a mean increase in infiltration of 68%, reduced stocking rates of 42% and added complexity of 34%.

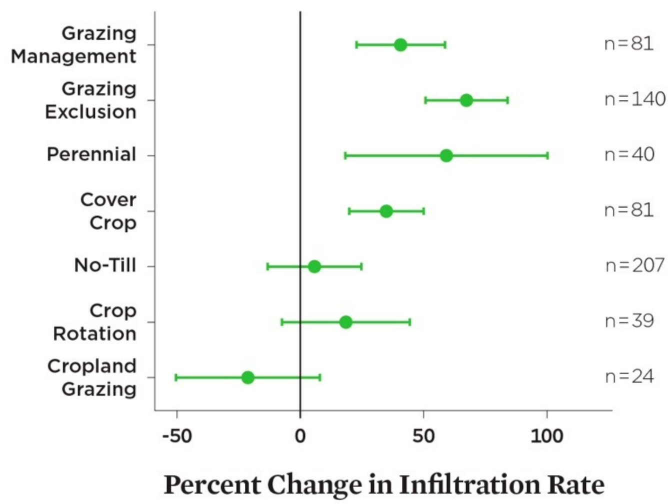

Figure 1. Percent change (means and 95% confidence intervals) in infiltration rates grouped by grazing management and conservation cropland management in this analysis. The black line at zero represents no change in infiltration when management changes were compared to controls.

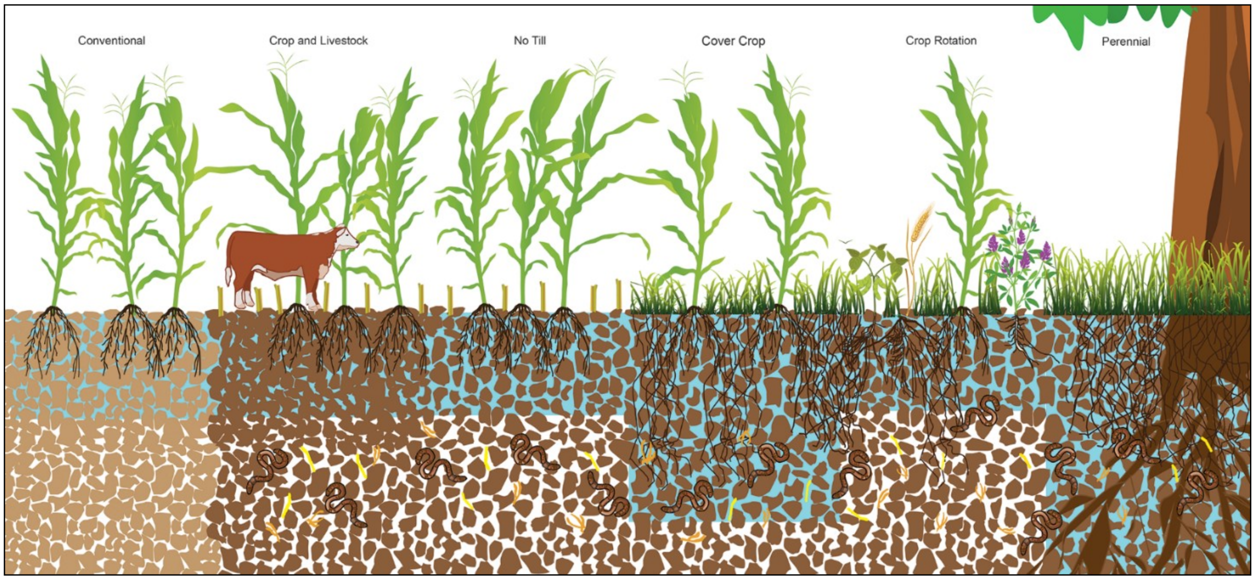

Figure 2. Representation of the conservation cropland practices evaluated in this analysis and their impact on infiltration rates, including an example of a conventional practice control. Infiltration is a key component of the water cycle, influencing how much precipitation becomes available to plants as opposed to what is lost through other pathways such as runoff and evaporation. Conventional management is represented by tillage, a lack of crop rotation, no livestock, and non-continuous cover of plant roots. Conservation or more diversified cropland management includes the presence of livestock, crop residue, continuous plant roots and crop diversity. These alternatives could alter infiltration rates through a range of physical, chemical or biological processes, as shown in the illustration. Possible soil biological changes are represented through the addition of bacteria and fungi (represented as yellow and orange symbols). Possible soil physical changes are represented by differences in porosity, compaction and aggregation as represented in the size and distribution of soil aggregates. Possible soil chemical changes are represented in the addition of carbon represented in the soil coloration, which is lighter in the conventional management and darker in the alternatives. Depth of water movement represents a significant increase in the cover crop and perennial treatments as was found in this analysis. Artwork by Lana Koepke Johnson.

IMPLICATIONS

Across experiments, we found that there was substantial opportunity to increase water infiltration rates with grazing management shifts including reduced stocking rates, adding complexity (i.e. rotational management) and extended rest from livestock. Overall, our findings reveal that a variety of management strategies have the potential to improve soil water infiltration rates, with possible benefits for soil carbon as well, and therefore could improve outcomes with increased periods of floods and droughts.

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Speaker Biography

"Producer Panel: Winter Forage Strategies"

Lon Larsen, Broken Heart Livestock, Thedford, NE

Lon Larsen owns and operates Broken Heart Livestock Company since 1982 along with his wife Dana Larsen. They, along with their son, Quinn and his family, currently lease the Reed Hamilton Ranch in Thomas and Cherry County, Nebraska.

Lon is a graduate of Utah State University with a B.S. in Animal Science, King Ranch Institute for Ranch Management Certification Program, as well as the Ranching for Profit School. He is a member of the Nebraska Cattlemen and of the Society for Range Management.

For the last 35 years (25 in Nebraska) Lon has managed ranches in three different states with diverse rainfall of 7 to 50 inches, elevations ranging from 1,200 to 9,000 feet, and acreages from 750 to over 1 million. He has supervised as many as 23 employees in managing livestock numbers from 250 to 12,000 head.

Lon is passionate about being a lifelong learner, enjoys working with family, friends, horses and dogs, and is an advocate of low-stress cattle handling methods.

Logan Pribbeno, Wine Glass Ranch, Inc. Imperial, NE

Photo and biography unavailable.

Speaker Biography

John Maddux, Maddux Cattle Company
Wauneta, NE

John owns and manages the family ranch operations, which includes 45,000 deeded and leased acres, 2,500 mother cows, and 4,000 yearlings. In addition to his daily ranch duties, he is also a member of the Nebraska Grazing Lands Coalition; Nebraska Investment Council, which is responsible for managing the state's pension assets; and a member of the State Bank Board of Directors. Prior to running the ranch, John was employed by Goldman Sachs of New York, and worked with Elanco selling herbicides.

ABSTRACT

Post weaning, wintering strategies are a key factor in the profitability of the stocker/yearling enterprise. I will review our approach to this segment of yearling production including: grazing corn residue with supplementation, windrow grazing, small grain grazing, wintering calves with dams, backgrounding, and grazing standing forage. I will also discuss the challenges in analyzing which strategies are the least cost approaches to wintering stocker cattle.

Speaker Biography

Bruce Anderson, University of Nebraska-Lincoln, Agronomy & Horticulture Department, Lincoln, NE

Dr. Bruce Anderson is Extension Forage Specialist and Professor of Agronomy & Horticulture at the University of Nebraska-Lincoln. His many grazing research trials studied grazing strategies with native warm-season grasses and with legumes interseeded into existing grass sods. Bruce has presented/discussed grazing on six continents as well as throughout the U.S. His extension efforts focus on pasture/ grazing management and alfalfa production but also include responding to clientele needs with annual forages, forage quality and testing, toxic and anti-quality compounds in forages, and unique individual problems. He has written and delivered over 3000 Hay & Forage Minute radio programs that are broadcast by over 50 stations in Nebraska and the region.

Bruce has been an active leader with the Nebraska Grazing Conference from the beginning. He, along with extension educators Bob Scriven and the late Terry Gompert, developed the conference idea. They presented it to Dr. Martin Massengale and the Center for Grassland Studies so it may be inclusive of all agencies, industries, production regions, and interest groups affected by grazing in Nebraska. Since the successful establishment of the conference in 2001, Bruce served as treasurer for the first 17 years. He also was part of the program committee during those same years, serving as program chair for the last 13 years before transferring those responsibilities for these last 2 conferences.

"Odds and Ends of Non-traditional Winter Grazing Strategies"

INTRODUCTION

Winter grazing attracts much interest from many farmers and ranchers. It often can be less expensive than using traditional hay or silage feeding systems, saving as much as $ 1 per head per day. However, winter grazing has special challenges to overcome if it is to be successful.

Cold temperatures can make it uncomfortable and potentially dangerous for both grazier and livestock. Snow, ice, and even cold rain can limit access to winter forage. Lack of fencing and making water available can be a major barrier. In addition, uncertain dietary nutritional quality from dormant, weathered, mature forage can make balancing diets difficult. Fortunately, numerous types of supplements are available, including alfalfa hay, corn by-products, range cubes, lick tanks and tubs, and others.

Most challenging of all might be simply having access to grazable forage during winter following grazing during the growing season. Traditional sources have been corn stalk residues, planted cover crops, and stockpiled pasture acquired as a result of conservative stocking rates. These sources should continue to be used increasingly.

Other options developed recently include grazing hay meadow regrowth and windrow grazing of seeded annuals or meadow hay.

Not all graziers have economic access to these traditional sources of winter forage, however. As a result, alternative, non-traditional winter grazing strategies are needed. Creative and opportunistic thinking can help develop more winter forage sources.

Opportunistic

Spring floods laid waste to many acres of pasture, hay, and cropland this past spring, often depositing layers of sand too thick to economically remove. Multi-species cover crops can and should be planted to stabilize these sites. Lack of organic matter and fertility limits the ease at which these sands can be returned to productive uses.

While the planted cover crops could provide one source of winter grazing, an even better approach may be to combine it with bale grazing. Grazing hay bales placed throughout the cover crop-covered sand could provide abundant grazing while also adding significant amounts of organic matter and nutrients to the sand. This could potentially hasten the rate at which this land can be returned to more productive uses. Of course, adequate fence and water resources would be needed.

Another winter grazing option available some years would be grazing wet hay meadows that were not harvested during the growing season. Plants could be cut and windrowed if conditions permit or they may be left standing. Strip grazing would enable much of the forage to be consumed while spreading manure more uniformly across the meadow.

Similarly, planting cover crops to be grazed on prevented planting acres can only be grazed during winter since grazing cannot begin until November 1. Selection of both the cover crop and planting date will be critical for success. Summer annual forages may seem to be the natural selection. However, if they are planted in early summer they will be very mature, low quality, and possibly lodged by November 1. Planting in early to mid-August may result in a better quality resource. Likewise, early to mid-August is a good time to plant cover crop mixes like oats and turnips that normally are not grazed until November.

Creative

Planning for regular use of less traditional winter grazing opportunities may require modifying other management practices. For instance, the most rapid accumulation of forage in cool-season pastures is during May and June while in warm-season range it is in June and July. Grazing during these months significantly reduces the total potential forage production for the year. If other resources can be fed during these months, the forage yield gained by delaying initiation of grazing could be used for extra winter grazing.

Various feedstuffs could be used. Hay, crop residues, annual forages or other feedstuffs could be used at this time if acquiring extra forage production from permanent pastures is worthwhile. Since less hay would be needed for winter-feeding, it may be practical for some ranchers to graze the spring growth of hay meadows during the two growing season months that grazing is deferred rather than harvest it for hay. These major changes might require other major changes in the operation. Calving dates may need to be moved or the herd structure, like fewer cows and more yearlings may be needed to successfully use these resources.

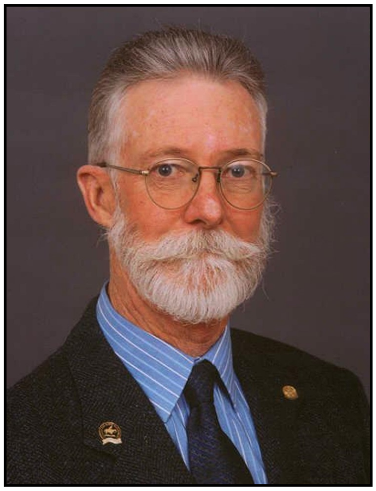
Corn residues are grazed during winter—why cannot wheat residues be grazed during summer? With proper supplements, dry fall calving cows could use these residues effectively, leaving ungrazed pasture for winter use.

Winter grazing can be an important part of a drought plan. Primary herd structure and stocking rates can be modified so few changes are needed when drought reduces pasture growth. However, during good production years, there will be forage remaining in pastures at the end of the growing season. Depending on current conditions and markets, this forage could be grazed by the base cow herd, retained calf yearlings, purchased calves or yearlings, or even left ungrazed as part of a deferred grassland improvement plan.

IMPLICATIONS

Winter grazing is not for everyone. While many forage types can be grazed during winter, they often require active preparation during the growing season to be successful. Winter grazing requires good creative planning and/or responsive action to unusual opportunities. Sometimes it may be better to effectively use all grazing resources during the growing season and use traditional feeding programs during winter.

Speaker Biography



James T. O'Rourke, RuJoDen Ranch
Chadron, NE
2018 Leopold Award Recipient

Jim has lived eight years in Africa working on range livestock projects, taught range management at Utah State University for six years and at Chadron State College for 15 years, and worked for the U.S. Forest Service for two years along with earlier employment. The Range Management Program, which he designed and initiated at Chadron State College, is currently one of the two largest programs in the U.S. with a new center opened in 2017. For this effort, he received the Chadron State College Distinguished Service Award in 2017.

He has served in numerous consultancies with the U.S. Agency for International Development, FAO, the World Bank, and the Swiss Agency for Development and Cooperation, as well as ranching operations in the western United States. The international consultancies have been in Senegal, Sierra Leone, Cote d'Ivoire, The Gambia, Sudan, Kenya, Oman, Djibouti, Central African Republic, Columbia and Mongolia. He has worked on range management related business with the International Rangeland and Grassland Congresses in Australia, South Africa, Namibia, China, Argentina, Japan, the Philippines, New Zealand and Canada.

From 1988 to the present, concurrently with teaching at Chadron State College from 1988 - 2002, he has run the family ranch involving intensive grazing management of native and introduced pastures, seed production of grass species biologically competitive with noxious weeds, timber management, expansion of riparian areas with planted hardwood mast species suitable for wildlife, and development of a recreation business involving sheepwagon stays. This ranch received the Leopold Conservation Award for Nebraska from the Sand County Foundation in 2018. (wwww.sandcountyfoundation.org; Our Work; Leopold Conservation Award; Award Recipients; map of U.S.; Nebraska; 2018 RUJODEN Ranch, Chadron, NE, or simply Google rujoden ranch; RuJoDen Ranch/ Sand County Foundation)

Jim is Past President of the Society for Range Management, Past President of the Nebraska Section of the Society for Range Management, Past President and current Secretariat of the Continuing Committee of the International Rangeland Congresses and current Chair of the Steering Committee to secure a UN designation for an International Year of Rangelands and Pastoralists (google IYRP and click on International Year of Rangelands and Pastoralists Initiative/Global…).

"Size Does Not Matter When It Comes to Conservation"

It truly was an honor to be included in the distinguished group of operations that have received the Leopold Conservation Award through the Sand County Foundation in Nebraska since 2006.

Our ranch represents the smaller operations. Today a small tract is ½ section, 1 or 2 sections or 360 to 1280 acres. These smaller tracts were once part of a larger ranch but sold to save the rest of the ranch. These "small" operations are increasing in number, often because of a desire to be involved in the livestock industry, to own a piece of the American west, for hunting areas or for some other form of recreation. The total acreage they represent is enormous. Those rangeland operations are not economically sustainable on ranch based income alone. In our case, ranch income pays property tax, liability insurance and perhaps some improvements in some years. Another source of income off the ranch is necessary to pay family living expenses. On a small operation there is little room for error.

Conservation or stewardship of those lands is as important as that of larger operations. Knowledge of how that land developed is essential. Rangelands developed under grazing and fire. Those tools must be used to sustain those ecosystems. A basic understanding of plant growth, ecological sites, constant monitoring and staying abreast of new ideas are essential. This comes as an additional expense that may not be compensated for from ranch income.

But how does one regard conservation or stewardship as a top priority when ranch income may not pay the bill? The answer is that it has to come from the heart. And owning a piece of land has to come with a sense of responsibility to that land. With that also comes pride in knowing that what you are accomplishing in natural resource conservation or stewardship is benefitting the general public through clean air, clean water, wildlife habitat, aesthetics and recreational opportunities. As Aldo Leopold has said in the Sand County Almanac, "a system of conservation based solely on economic self-interest is hopelessly lopsided. It tends to ignore, and thus eventually eliminate, many elements in the land community that lack commercial value, but that are essential to its healthy functioning. An ethical obligation on the part of the private owner is the only visible remedy for these situations."

The Leopold Conservation Award should be regarded as a goal setter for every land owner. It certainly will spur our efforts.

NEBRASKA LEOPOLD CONSERVATION AWARD 2018
RuJoDen RANCH – O'ROURKE FAMILY

Speaker Biography

Jack Arterburn, Panhandle Research & Extension Center
Rushville, NE

Jack Arterburn is the Beef Systems Educator for Nebraska Extension in northwest Nebraska. He provides research-based educational programs and resources to meet the goals of beef producers. Jack earned bachelors and master's degrees from the University of Nebraska-Lincoln focusing on rangeland ecology and management. Jack is an advisor to the Nebraska Grazing Lands Coalition, a Nebraska Section of the Society for Range Management council member, and a member of the Nebraska Grazing Conference Advisory Committee. In 2018 Jack was named one of the Cattle Business Weekly Top 10 Industry Leaders Under 40. He lives in Chadron, Nebraska with his wife and 3 kids. Reach Jack at 308-327-2312 or jack.arterburn@unl.edu.

"Resilience of Sandhills Grassland to Wildfire during Drought"

ABSTRACT

In the Nebraska Sandhills, one of the largest contiguous grassland ecoregions remaining in North America, sandy textured soils are stabilized by fine root biomass from predominately warm-season grasses. Concerns over destabilization have led to management that aims to avoid an undesirable state change toward mobile sand dunes. In 2012, the Sandhills experienced extreme drought conditions that coincided with the worst wildfire year on state record. According to state-and-transition models and ecosystem managers, the combination of wildfire and drought conditions should cause a state transition due to a lack of recovery of grassland vegetation and a loss of sand dune stability. To test this hypothesis, we implemented a time since fire study to track biomass recovery of Sandhills grassland vegetation following a wildfire on The Nature Conservancy's Niobrara Valley Preserve in burned and unburned areas. Two years following the wildfire, aboveground herbaceous biomass in burned areas had recovered to levels that did not differ from unburned areas, maintaining the stability of the sand dunes. This provides evidence that counters current land management frameworks that portray Sandhills grassland as highly vulnerable to destabilization when wildfires occur during severe drought conditions.

Speaker Biography

Sarah Sortum, Switzer Ranch
Burwell, NE

Sarah (Switzer) Sortum lives and works on the Switzer Ranch in Loup County, Nebraska. After receiving her bachelor of science degree from University of Minnesota-Mankato, she was a co-manager of a high-end resort ranch in Colorado. In 2006 Sarah and her husband, Mark, moved back to the family ranch where they are raising their two boys, Emmett and Henry. Sarah, along with her brother Adam and parents, Bruce and Sue Ann, operate the Switzer Ranch which is diversified into custom grazing, custom backgrounding and short-term cow/calf enterprises. The Switzer Ranch is also home to their nature-based tourism operation, Calamus Outfitters. Sarah enjoys serving her community in a variety of ways including 4-H leader, various positions in her local church, Loup County School Board, and Nebraska State Tourism Commissioner.

"Grazing Before and After Prescribed Burns"

ABSTRACT

Sarah will share the lessons learned from utilizing grazing and prescribed burns on their ranch in the Sandhills. She will relate how her family plans and prepares for a prescribed burn and how those areas are utilized post burn. She will also share her family's perspectives of how the fire-grazing interaction has helped them work towards ranch management and biodiversity goals they have set for themselves.

INTRODUCTION

The Switzer Ranch is located in Loup County, in the eastern Sandhills region. We are a family run ranch that supports three families. We employ three revenue streams on the ranch; custom grazing, custom backgrounding and a short-term cow/calf program. We also operate a nature-based tourism operation on the same acres; Calamus Outfitters. This business offers lodging, river-trips, hunting, bird watching and jeep/ranch tours.

We began using prescribed burns on our ranch 10 years ago (so we are still new to this practice and still learning a lot). The main impetus for us to turn to burning was the challenge of controlling the invasive red cedar.

Our overall goals for burning.

- To maintain and improve the health of our native Sandhills rangeland.
- To provide optimum habitat for grassland birds, especially Greater Prairie-Chickens and Sharp-tailed Grouse.
- Increase bio-diversity.

Considerations/planning before the burn.

- We try to plan for our prescribed burns two years in advance. Factors that we look at include:
  - ◊ What/where are our priority areas?
  - ◊ Where can we have the biggest effect now and in 2-5 years from now?
  - ◊ What has been done to that area recently? Mechanical cutting?

Considerations/preparation for the next year's spring burn (during the previous growing season).

- Timing of grazing to allow utilization the current year as well as building up the fuel load for an effective burn.
- Moisture levels throughout the season.

We perform prescribed burns in the spring (usually early March). While fall burns would also be effective in killing trees, we are not comfortable leaving our sandy hills exposed to our winter winds. It's just a personal bias that we're not willing to experiment with.

To prepare for the actual burn, we mow a perimeter around the entire area we plan on burning. Most often, we try to perform back burns prior to the main burn. We burn in the evening…burning as long as the humidity will allow. Once we are happy with our back burns we try to perform the main burn on a 20/20 day (less than 20 mph winds, approx. 20% humidity).

We have invested in our own equipment to perform prescribed burns. However, we also utilize our Loup County Rural Volunteer Fire Dept. as well as friends and neighbors. It's important to make it a successful, fun event. It's also great to have friends and neighbors see how the pastures that we have burned in previous years are looking when they come back to help…seeing is believing. We are trying to include responsible prescribed burning in our overall culture of land stewardship so making these events multi-generational is a real benefit.

Immediately after the burn we closely monitor for any flare-ups. It is amazing how long tree trunks and cow pies can hold heat!!

Since we usually burn in early March, we have just a little time to wait until the growing season begins. Of course, the cool-season grasses will spring up first, most of these are in our valleys. In some areas, we feel that Kentucky bluegrass and Brome grass is outperforming some of our other native grasses, with the result that some of our valleys are becoming less diverse.

We try to alleviate this through grazing after a burn. Timing this grazing treatment is always a challenge. Factors that go into our decision include:

- When can our custom graze cattle get here?;
- What is the re-growth on the burn area looking like?;
- Is the terrain mostly upland hills, valleys or a mix?; and
- Family biases. You've got to agree and get along.

Grazing duration is a judgement call for us. We do make a grazing schedule plan but rely on our guts to make the ultimate decision. We want the cattle to really scrub down the cool-season grasses we are targeting. Once they have done that for a day or two beyond our comfort zone, we move them on to the next grazing stop. Usually, we will then come back into that burn area to graze again in the fall… depending on how things look.

Since we custom graze, utilizing our acres for grazing is very important for our revenue stream. We have not had to decrease our custom grazing income due to incorporating prescribed burns. Our grazing income has remained the same.

These are some of the main benefits we like as a result of burning and grazing;

- Invasive red cedar control that is cost effective;
- Rapid green up and great early utilization;
- Increased diversity, especially forbs which will draw in more insects = more food for our grassland birds;
- Reduce/remove thatch and return nutrients to soil;
- Increase patchiness;
- Hopefully affect plant composition;
- Possibly reduce parasites; and
- Visually appealing.

There are a lot of great resources out there for anyone looking to learn more about prescribed burns. We have partnered with several organizations and are thankful to the following for their support.

- The Sandhills Task Force, USFW
- NGPC
- Nebraska Environmental Trust
- Loup County Rural Fire Department
- Burwell Rural Fire District

We are also very appreciative to the Platte Basin Timelapse Project. They have helped us monitor areas of our ranch, including hydrology, tree removal and post burn grazing, in unique ways through time lapse photography. This is a great addition to our other monitoring tools.

IMPLICATIONS

Prescribed burns can be an efficient, cost effective tool in promoting rangeland health and wildlife habitat. Utilizing grazing as a tool before and after a prescribed burn may assist land managers in meeting overall goals. While there are multiple factors to consider when applying grazing to burn areas, deferment does not have to be the only option.

Speaker Biography

Craig Allen, Center for Resilience in Working Agricultural Landscapes, IANR Lincoln, NE

Craig R. Allen is the Director of the Center for Resilience in Agricultural Working Landscapes at the University of Nebraska. Prior to his position with the University of Nebraska, Dr. Allen was Leader of the USGS Nebraska Cooperative Fish and Wildlife Research Unit. Dr. Allen's current work focuses on resilience of working landscapes, including the interaction between social, ecological and economic aspects of complex systems of people and nature. Dr. Allen is from Wisconsin, and returned to the Midwest (Nebraska) in 2004, after working in South Carolina and receiving graduate degrees from Texas Tech University and the University of Florida.

"Resilience in Working Landscapes"

ABSTRACT

Agriculture drives the Nebraska economy, with irrigated agricultural systems that are among the most efficient and productive in the world. However, these systems are less than a century old and have not yet stood the test of time; their resilience is unknown. Nebraska is a global food producer and ensuring agricultural sustainability is critical to the state and nation. Agricultural production must increase by more than 70% by 2050 to meet the increasing global demand for food, fuel and fiber. Meeting this goal will require agricultural intensification and the use of more marginal lands, while contending with a suite of complex and interacting drivers of global change, including extreme weather, soil degradation and biological invasions. Sustainable intensification of agriculture is a grand challenge for humanity that will require fostering resilient working landscapes and transforming landscapes that are currently in undesirable states.

Resilience is now a term widely used in every-day language, including by every major federal granting agency, agricultural producers and industries, policymakers, and even in interviews of professional athletes and in video games (e.g., World of Warcraft). But resilience is not a metaphor; it is an emergent property that can be measured and operationalized to explicitly help us solve many of the issues that challenge human well-being in the 21st century. Resilience describes the amount of stress, or disturbance, a system can withstand before it collapses. Nebraska has experienced a number of well -know social, ecological, or social-ecological collapses associated with the loss of resilience: A historic example is the dust bowl; a contemporary and current example is toxic algal blooms. The dust bowl and toxic algal blooms are termed "alternative states" of particular systems, undesired states compared to the systems they replaced. Nebraska's desire to manage limited resources in an agricultural landscape has given rise to the need to understand what generates resilience in complex systems. Productivity in agricultural landscapes is impacted by complex ecological and socioeconomic interactions that provide the foundation for intensive agricultural activity as well as other ecosystem services that support human well-being. Resilience theory provides an alternative approach to the traditions of a singular optimal resource management strategy, and instead pursues management capable of sustaining, or enhancing, multiple desirable properties of systems – now and in the future.

Optimization approaches seek to maximize production under ideal conditions, whereas resilience approaches seek to guarantee production under a wide variety of conditions.

The irrigated agricultural systems of the Great Plains constitute an enormous investment in social, economic, and political infrastructure, creating one of the most complex irrigation societies in the world. The science and technology that has enabled this agricultural production have been exported as a global solution to food insecurity, yet the resilience and long-term sustainability of this model is uncertain and untested. There is basic disagreement on how to meet human resource demands in the future. Continued intensification left unchecked will eventually exceed limits and ultimately undermine the human life support systems provided by the natural environment — including agricultural production. Sustainable intensification of agriculture should be guided by an understanding of boundaries, context and resilience. There is a clear need to distinguish a safe operating space (i.e., safe to fail agricultural practices at local to landscape scales) for agricultural production in order to sustain production in an era of rapid global change. The importance of this system, and others like it, demands an understanding of its response to stress, and what critical tipping points may be present and which may be vulnerable — its resilience.

Resilience, panarchy and complex adaptive systems theories have great potential to increase our understanding of coupled human-natural systems and what defines resilient agroecosystems. Applying these theories and models to working landscapes will help manage, design, foster and, when needed, transform landscapes and their associated social-ecological systems such that they are resilient, equitable, just and provide needed ecosystem services over a wide variety of conditions. This complex systems approach is appropriate for reducing risk while maintaining yields in intensive production systems, because it provides insight into general system dynamics while transcending detail. Such a framework for agricultural landscapes may help organize agricultural research into actionable steps for policymakers, corporate partners and producers. Development of such a framework, facilitated by our center, will empower producers, resource managers, policymakers and others to apply and adapt their knowledge in real time, providing multiple pathways specific to the landscape that will help meet global production demands without compromising future options.