



United States Department of Agriculture



Soil Health Division

Natural  
Resources  
Conservation  
Service



# Using Adaptive Grazing to Improve Soil Health in Grazing Ecosystems

January 10, 2017 | Stan Boltz

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# What is adaptive management?



- **A systematic approach for improving resource management by learning from management outcomes.**
- **Not entirely new, similar to total quality management, continuous improvement, learning organizations, holistic resource management, and the 9 steps of conservation planning.**
- **Like trial and error, but management decisions are initially made using knowledge of ecological processes, models, previous experience, etc.**



# Adaptive management

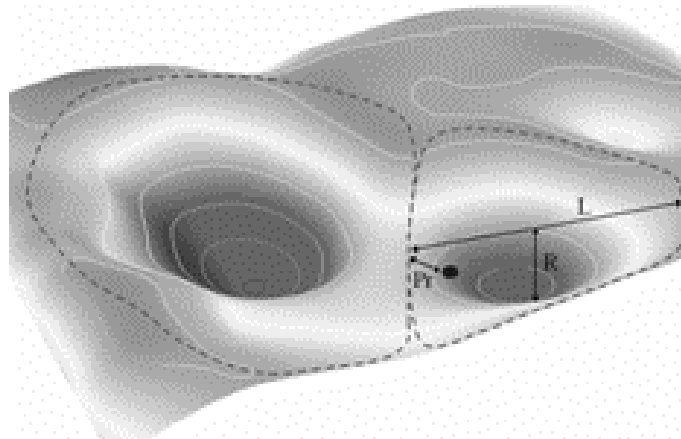
- **Ecological economics – if it makes sense ecologically, it often makes sense economically.**
- **Cannot separate the resource mechanisms from the social, institutional, and economic mechanisms.**
- **Economic feedback sometimes provides more complete, sustainable decision making and testing of assumptions, as long as it is measured and utilized in a timely manner, and includes monitoring of ecological processes.**
- **While science, assessment, and monitoring are important, and are often included, normal research is constrained by structured methodologies and does not always fit well in real-world adaptive management.**



# Systems/states (socio-ecological systems)

## Future trajectory determined by:

- **Resilience**
  - **Latitude:** maximum amount a system/state can be changed before crossing a threshold, from which it may be impossible or very difficult to return
  - **Resistance:** the ease or difficulty to change a system
  - **Precariousness:** how close is it to a threshold
  - **Panarchy:** influences from outside of the immediate system/state, such as agency policies, market shifts, political changes, broad-scale climate change, etc.



# Systems/states (socio-ecological systems)

Future trajectory determined by:

- **Resilience**
- **Adaptability – capacity of managers to influence resilience**
- **Transformability – capacity to create or function in a fundamentally new system when ecological, economic, or social conditions make the current system untenable**



# System/states described/defined in terms of:

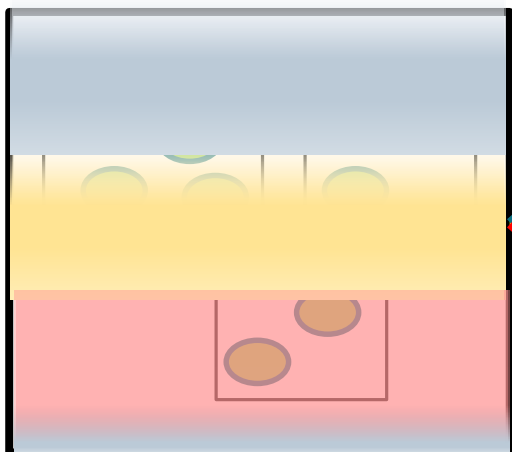
- **Abiotic foundation:** interaction of climate, soils, and topography that determine the quantity and quality of available water, air, nutrients, and energy.
- **Biotic foundation:** activity of the soil biota that influence the quantity and quality of the available water, air, nutrients and energy.
- **Biotic framework:** communities of living organisms, whose vital attributes competitively utilize the available water, air, nutrients, and space of the abiotic and biotic foundation.



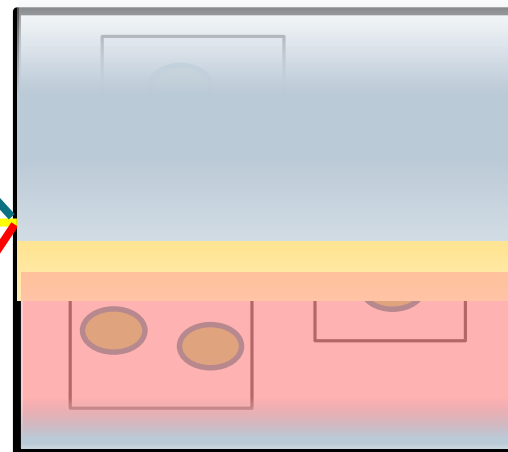
# Systems/states




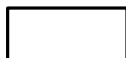



State 1



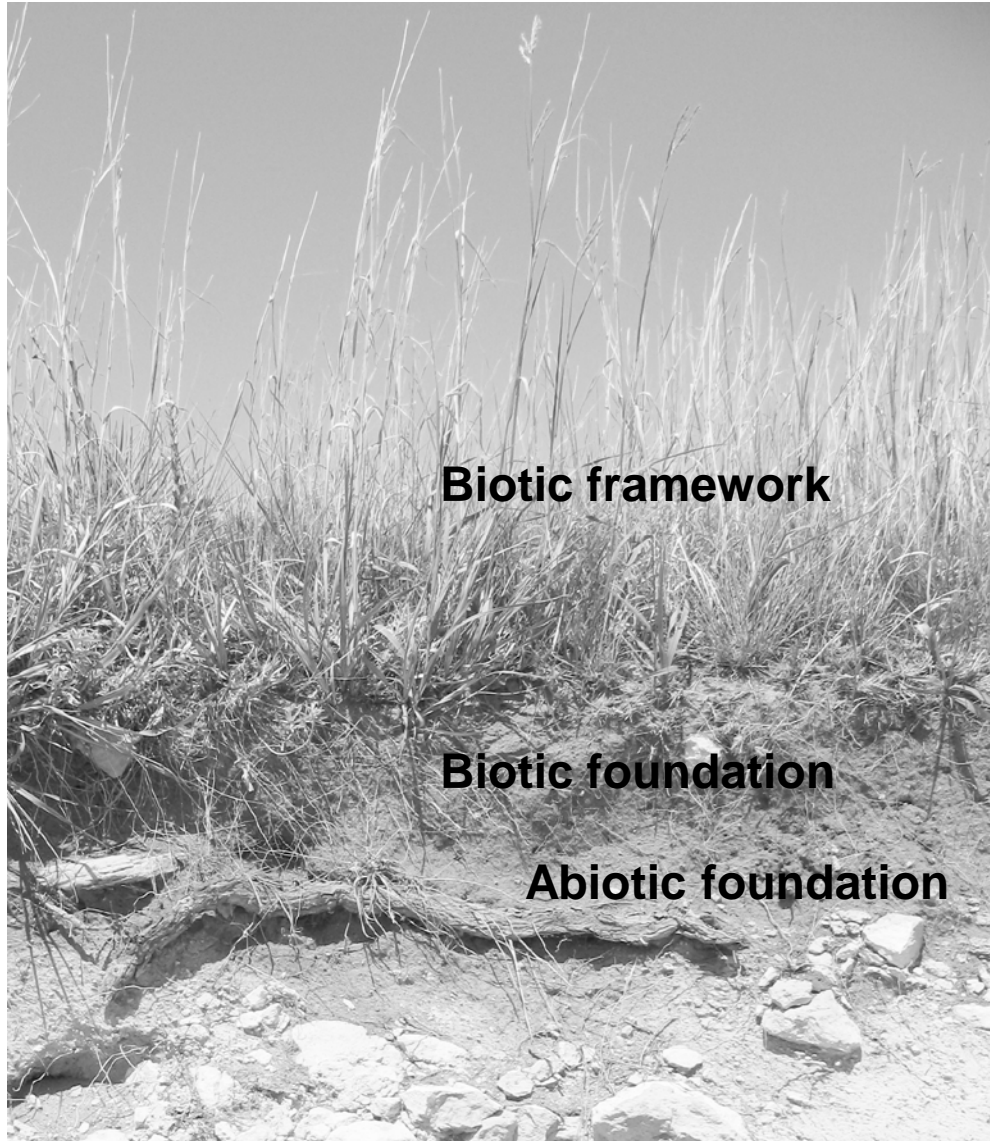
State 2



-  Abiotic foundation
-  Biotic foundation
-  Biotic framework
-  Basins of attraction/plant community phases
-  Attractor (area of equilibrium)



# Adaptive management – soil health



# Biotic framework – the actors

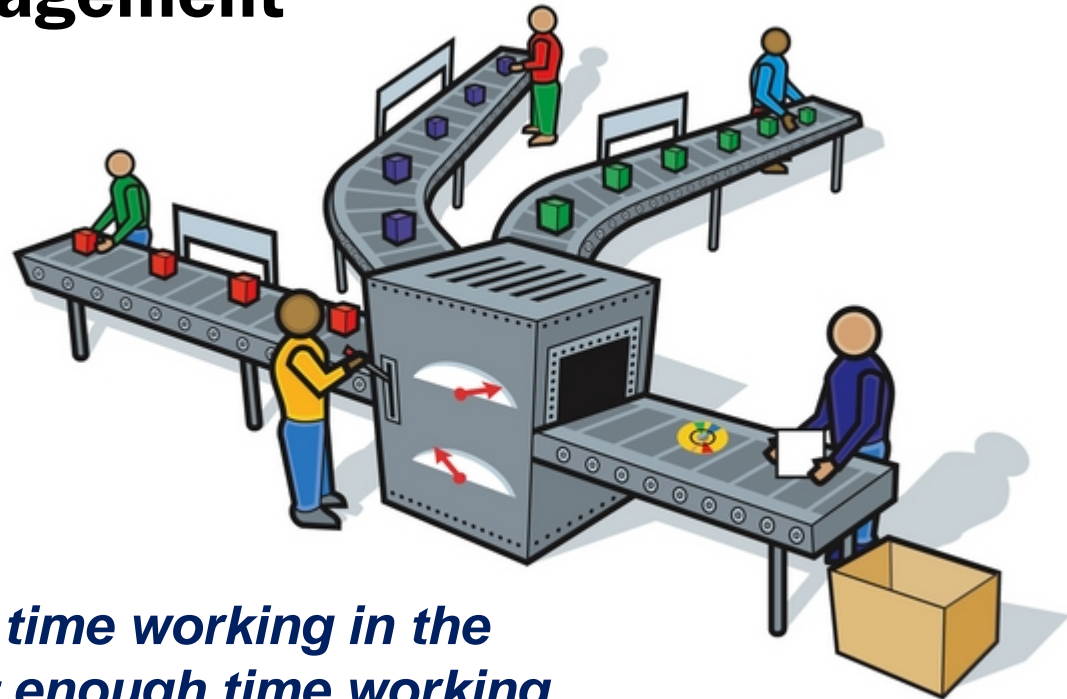


Livin' the Paradigm



# Biotic framework – the actors

## Reactive Management



*“Spend too much time working in the business, and not enough time working on the business.” Stan Parsons*

**Fix it when it happens – reliance on technology**



# Biotic framework – the actors

## Adaptive management

- **Passive – goal/outcome oriented**
- **Active – learning is a chief objective (usually results in better predictions over time)**
  - Testing assumptions
  - Adaptation
  - Learning



***Goal of most management is to reduce uncertainty, adaptive management attempts to use uncertainty as an opportunity, and embrace change – learn from it and utilize it to inform future direction.***



# Adapting economically



**“Government subsidies only serve to keep the poor managers in business.”**

**“If we didn’t do something to change the way we were doing things, we would have went broke.”**

**A lack of economic feedback can lead to poor decision making, and ultimately to uncoupling of the abiotic & biotic foundation, and the biotic framework.**

**Economic feedback can lead to questions and seeking solutions outside the normal operating mode.**

<https://www.youtube.com/watch?v=fjdVQPBBqXQ>



# Adaptive management & non-equilibrium ecology/state and transition modeling

The non-equilibrium ecology approach and state and transition modeling (and associated tools) utilized in the development of ecological site descriptions can serve as an excellent tool for:

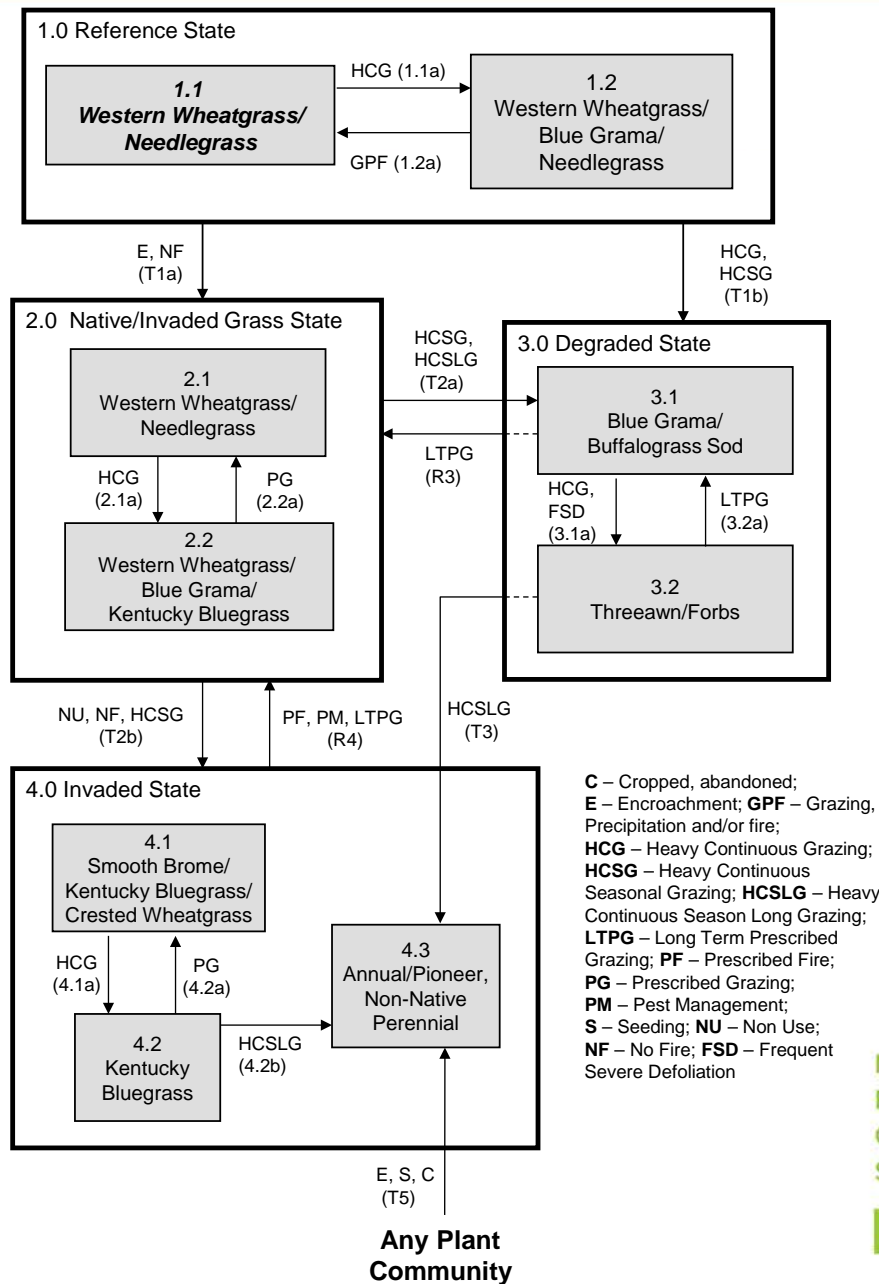
- learning about interactions of plants, soils, animals, and the ecological processes they influence
- informing managers about expected outcomes
- increasing ability to interpret and predict feedback from systems
- selecting monitoring tools to assess objective achievement



# Ecological Site Description State & Transition diagram

## Provides

- Information on interactions among soils, plants, and management
- Informs management of realistic potential
- Basis for assessment and monitoring
- Assessment of management opportunities, and prediction of outcomes



# Assessing soil health – Rangeland Health Assessment

## Principles of soil health:

1. Use *plant diversity* to increase diversity in the soil.
2. Manage *soils* more by *disturbing* them *less*.
3. *Keep plants growing* throughout the year to feed the soil.
4. Keep the *soil covered* as much as possible (*hydrology*).

## ➤ Rangeland Health attributes:

**Hydrologic function**

**Soil and site stability**

**Biotic integrity**

Printz, Jeff, David Toledo, Stanley C. Boltz. 2014. Rangeland Health Assessment: The key to understanding and assessing rangeland soil health in the Northern Great Plains. Journal of Soil and Water Conservation. 69 (3), 73A-77A.

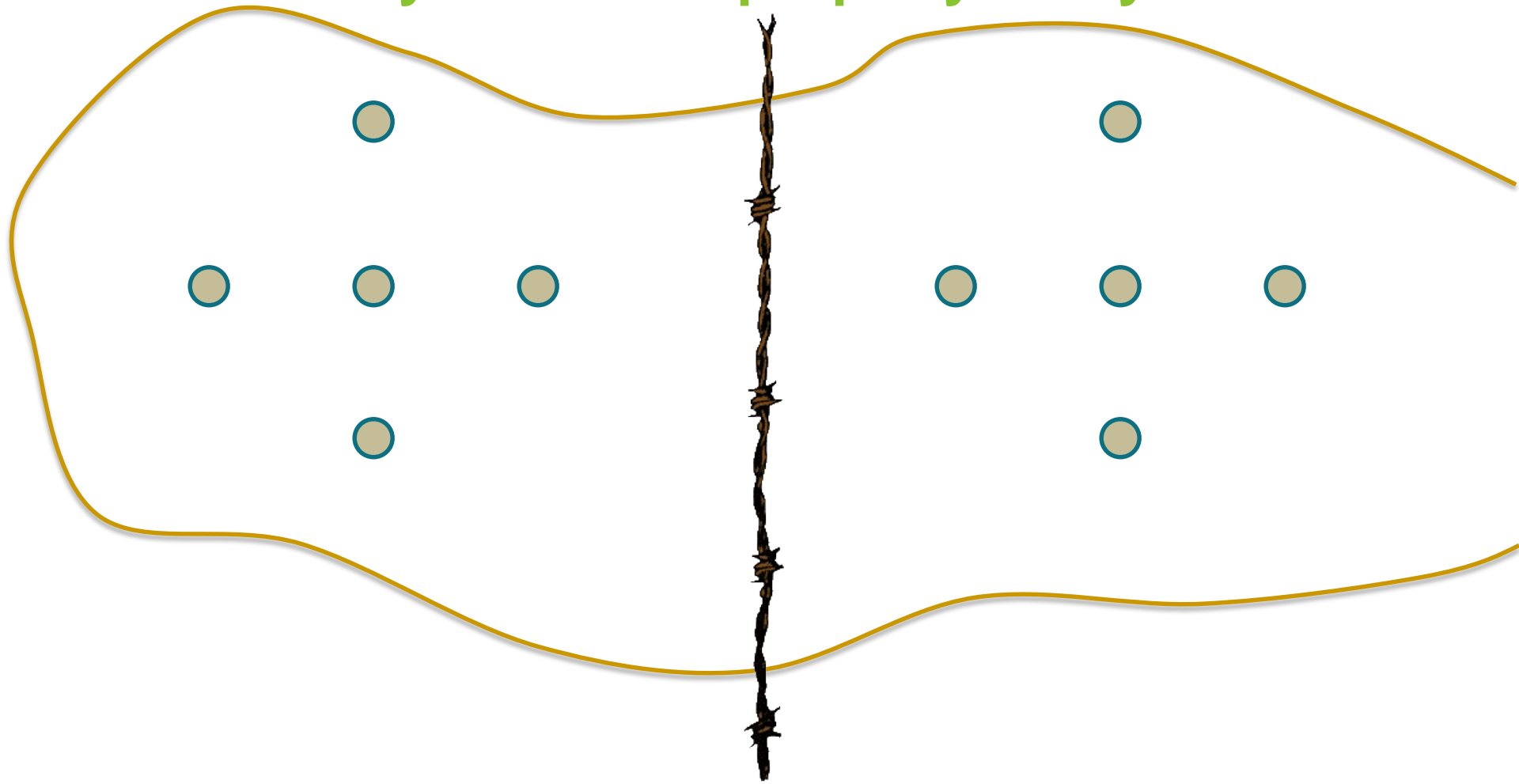


# Assessing soil health – Rangeland Health Assessment

- **Established methodology, already in use by most land management related agencies.**
- **Good linkage to significant characteristics pertaining to soil health on grasslands (dynamic soil property study sites).**
- **Similar approach being considered for pasture (Toledo 2014).**
- **Ability to assess soil health characteristics using relatively simple field techniques.**



# Dynamic soil property study



Paired sites are located on same soil, but widely different management





United States Department of Agriculture



# Barnes soil



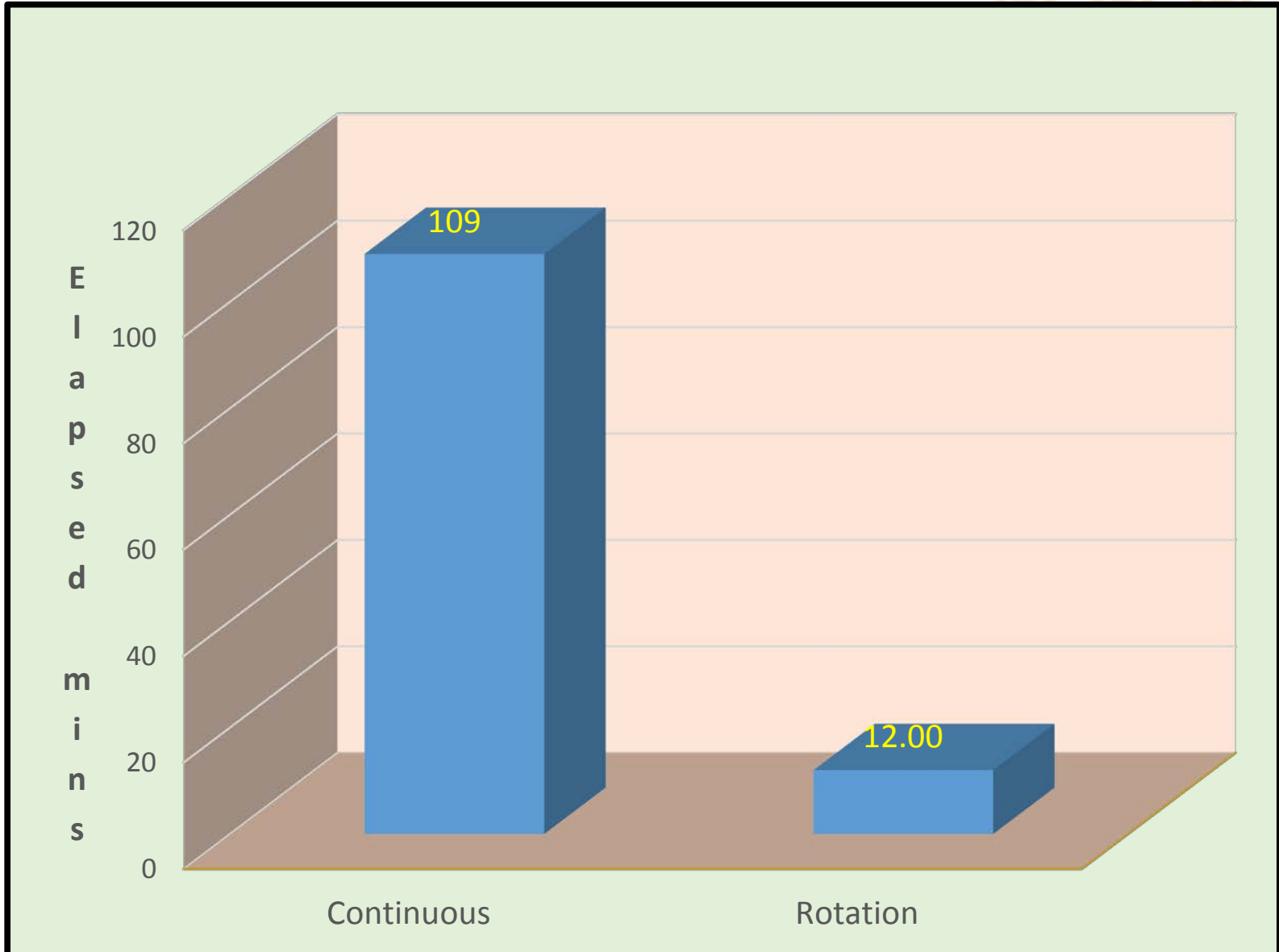
**Heavy, continuous season-long grazing**



**Moderate, rotationally grazed**

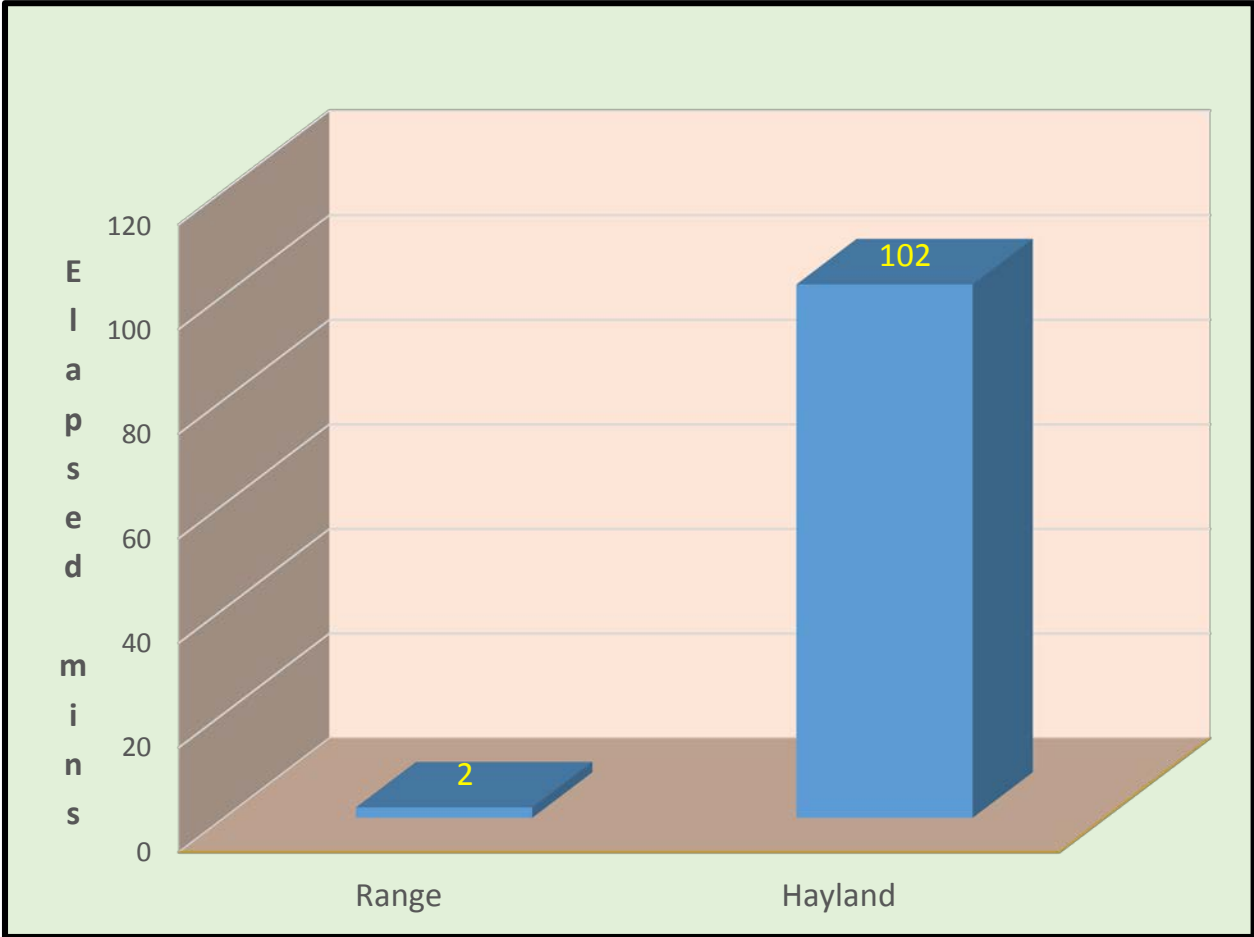


# Infiltration - Barnes



# Mellette County Kube soil

## Infiltration Rate

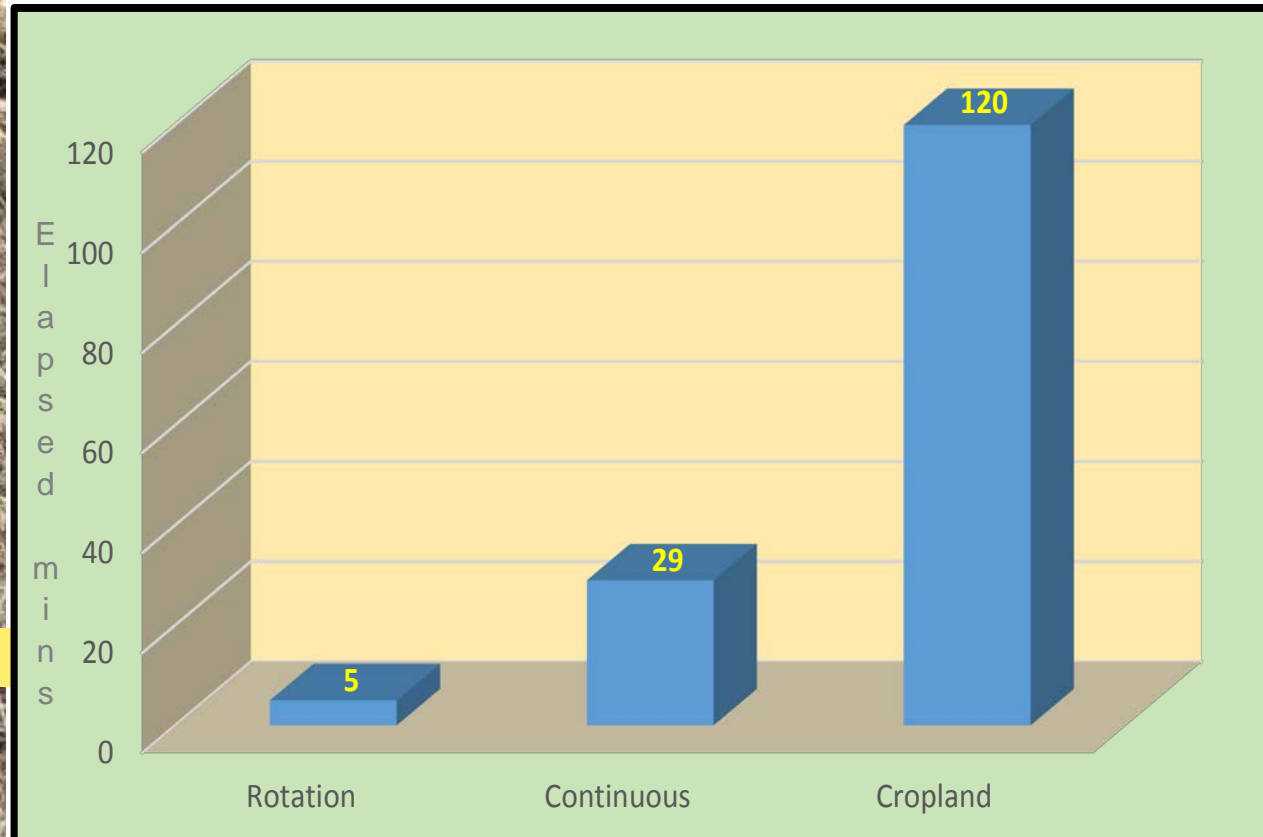


Rotational  
Grazing

Hayland

# Hyde County Glenham soil

## Infiltration Rate



# Consistent results from DSP study

- **Soil color (surrogate for organic matter)**
- **Soil structure**
- **Amount of compaction**
- **Soil aggregate stability**
- **Infiltration**

***These are the same soil health related indicators assessed in the Range Health assessment – plus they are evaluated using relatively simple field tests and observations.***



# Adaptive grazing management – the actors

**These are assessments that can be conducted by producers applying adaptive management with a minimal amount of training...**

**What are some key characteristics of those applying adaptive management and some of the grazing strategies they use?**



# Characteristics of successful operations

- **The most successful operations were determined by management's response to opportunities and challenges.**
- **Value individual education and growth.**
- **Flexibility.**
- **Understand that diversity is a critical element, in all aspects of the operation and system.**



# Characteristics of successful operations

- **A lifelong approach to management needs to be both integrative and holistic.**
- **We must strive for continuous improvement of the key resources. On most ranches these will be land, livestock and people; but could expand to include wildlife or other resources.**
- **We must assemble and use good analysis and decision-making tools.**
- **We must wage war on cost.**
- **We must place an emphasis on marketing.**

Burke Teichert, retired vice president and general manager of Ag Reserves Inc. (a.k.a. Deseret)



# Principles of grazing management

- **Proper utilization – “take half – leave half” – some species can tolerate heavier grazing, while others may be targeted to achieve resource objectives**
- **Adequate recovery periods – this changes throughout the season, shorter during rapid growth and longer during slow growth**
- **Change season of use – allows for recovery between years, especially important in mixed-grass prairies**

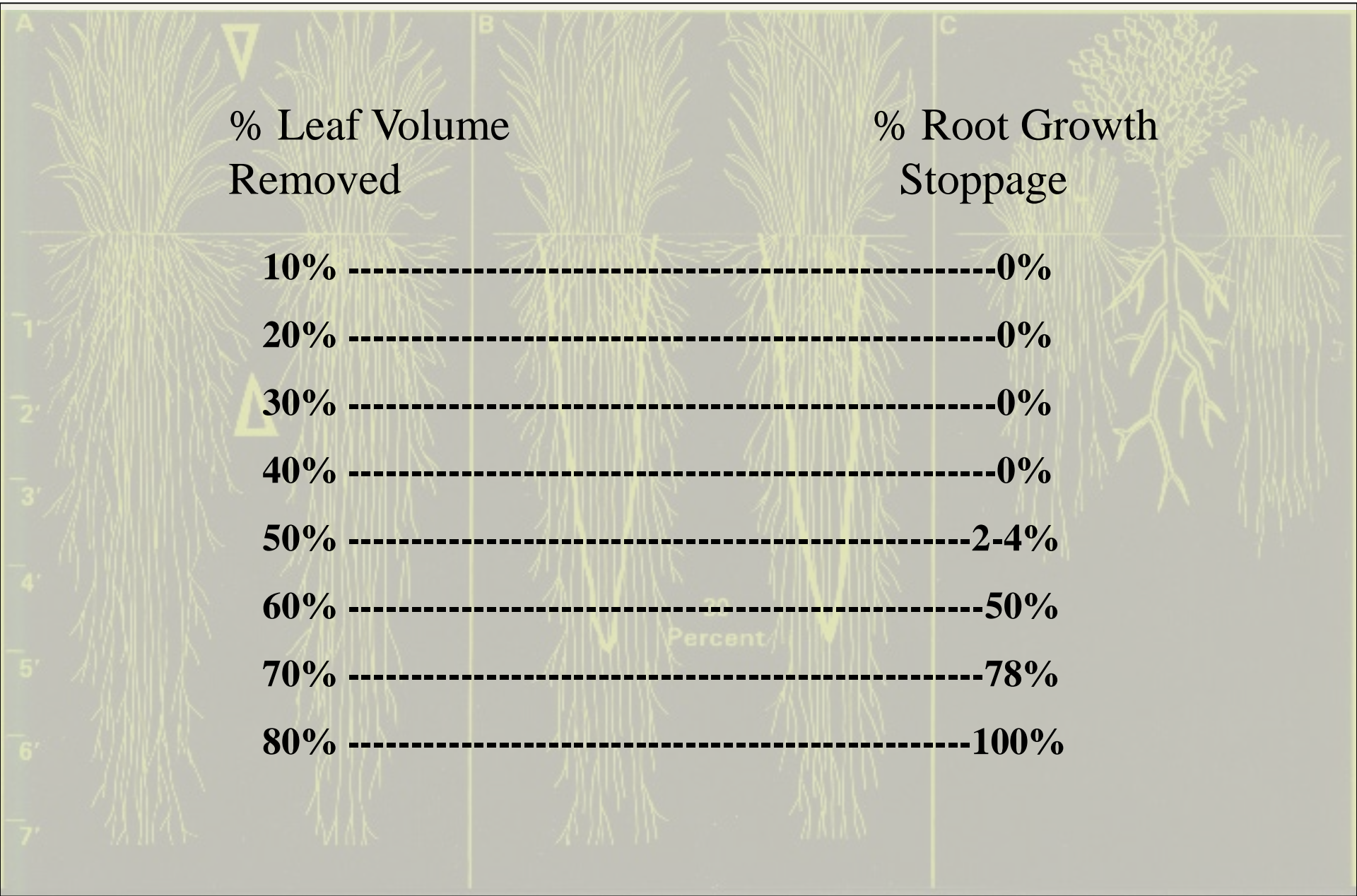


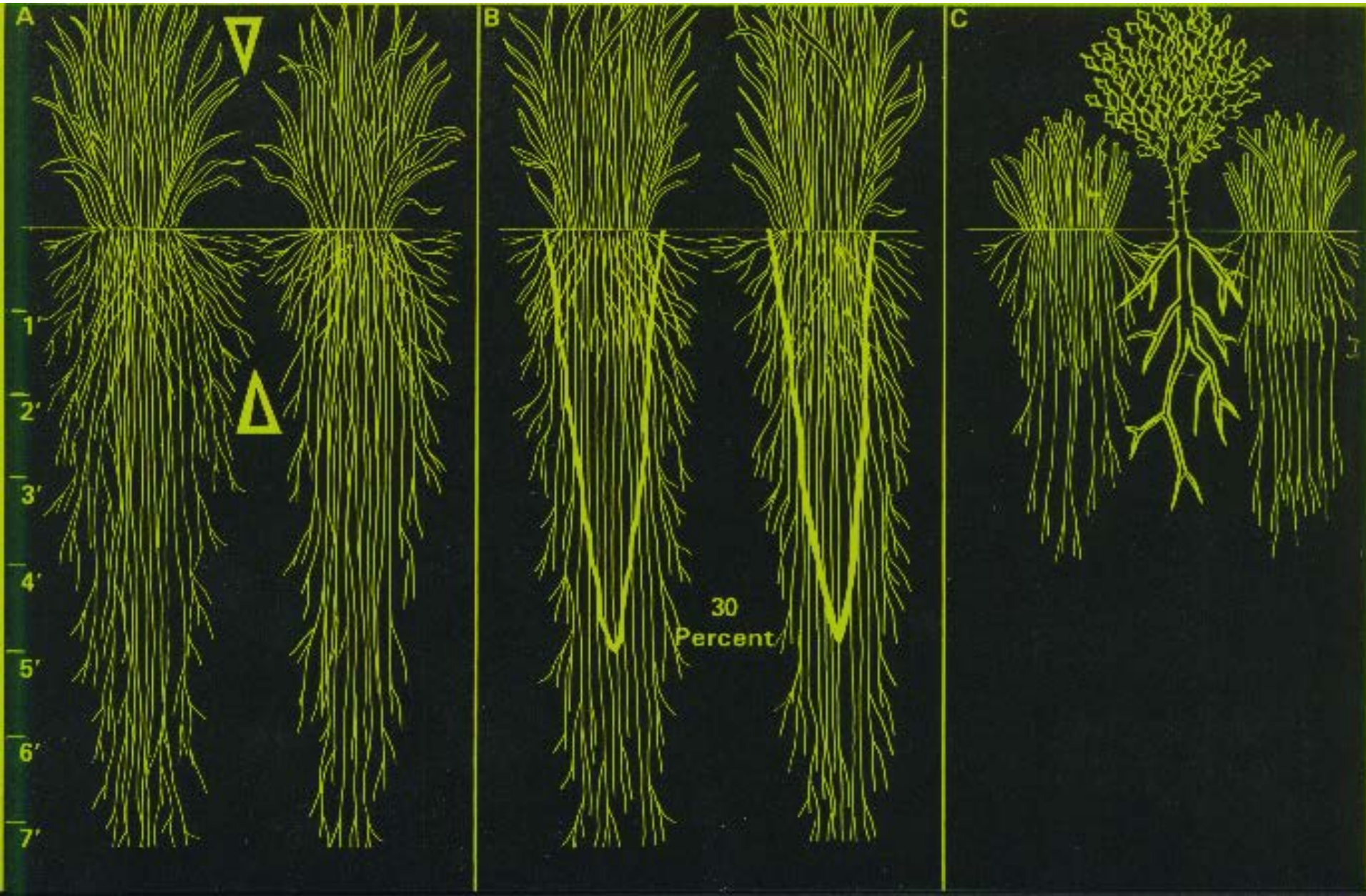
# Principles of grazing management

## Take half – leave half?

- **Idea was first mentioned in the 1940's**
- **Landmark study done in 1955**
  - Many replications of grasses
  - Different levels of defoliation by weight
  - Measured effects on roots
- **Other studies have supported these findings**



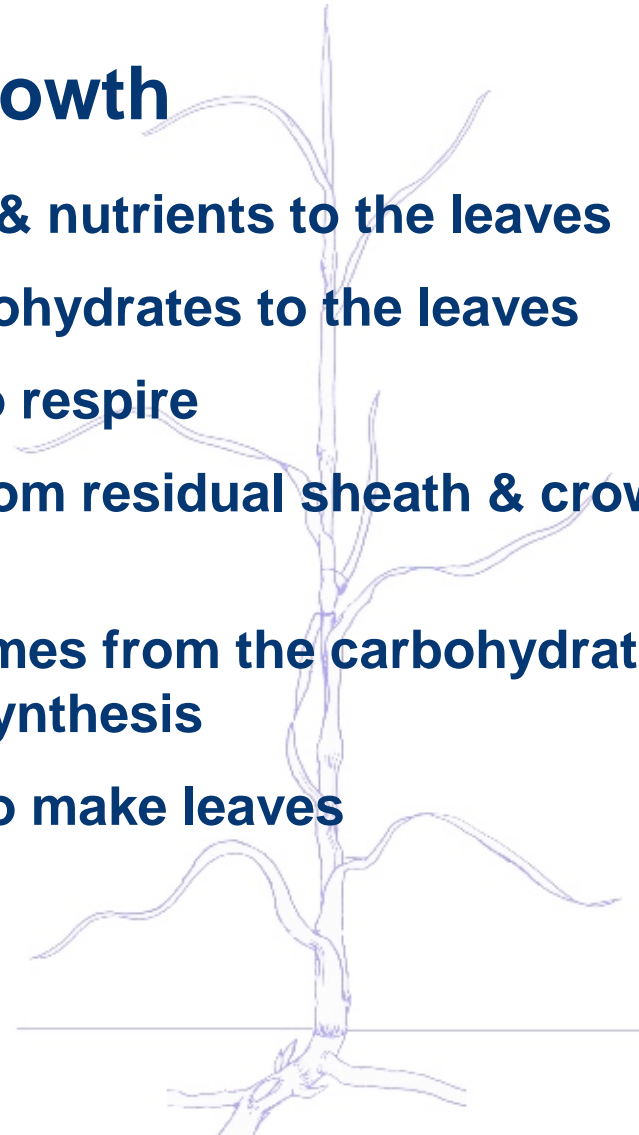




# Principles of grazing management

## Leaves – the facts of growth

- **Roots uptake and send water & nutrients to the leaves**
- **Roots DO NOT transport carbohydrates to the leaves**
- **Leaves need carbohydrates to respire**
- **5-10% of new leaf growth is from residual sheath & crown carbohydrate reserves**
- **90-95% of new leaf growth comes from the carbohydrates resulting from current photosynthesis**
- **Bottom line – it takes leaves to make leaves**

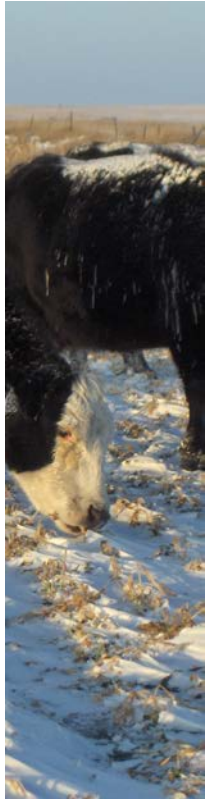


# Grazing strategies



## Graze cattle 12 months of the year

- **Cattle are much more efficient harvesters – minimize feed costs, but keep some on hand for emergencies**
- **Winter grazing on rangeland/pasture**
- **Develop alternative forage sources**
  - Crop aftermath
  - Cover crops
    - Utilize in a manner to retain soil health benefits
    - Limit percentage of Brassicas or provide grass
    - Establish grass in saline/sodic areas or other “odd areas” within cropland to provide balance
  - Annual forages

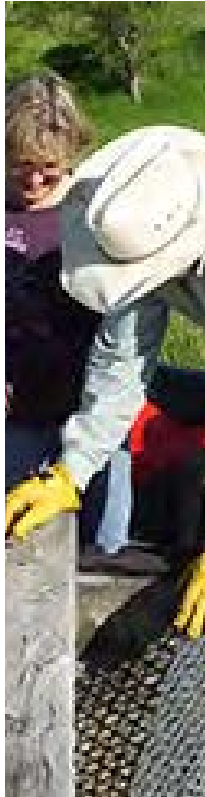


# Grazing strategies



## Rotate cattle

- **Best way to control utilization and recovery periods**
- **Has been shown to reduce pest cycles, and can effectively be used to reduce “weeds”**
- **Portable fence and water systems can reduce costs**
- **Word of advice – start small**
- **Develop a drought/contingency plan – follow it**



# Grazing strategies



## Winter grazing

- Continue to rotate cattle during the winter months
- Develop reliable, clean water sources
- Need to consider nutrient needs of growing animals, may need supplementation
- Leave cover for benefit of plants and other critters, also additional snow catch
- Monitor animal condition through the winter months
- Bale/swath grazing can reduce feeding costs & time



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# Grazing strategies



## Provide for flexibility

- **Maintain a portion (e.g., 1/4 to 1/3) of the herd as stockers/yearlings – can be quickly liquidated in case of drought or other emergencies**
- **“Stockpiling” – either in the normal sense of stockpiling forage in a field for later use, or in terms of deferment during the growing season as “insurance”**
- **Consider multiple species of livestock**



# Grazing strategies



## Match animals to resources/environment

- **Nutrient requirements/maintenance needs of animal**
  - Maintenance requirements of animals may exceed the environment
  - Animals having difficulty may indicate mismatch
- **Timing of requirements vs. availability**
  - When do the native large herbivores give birth?
  - Adjust parturition timing to line up peak requirements as close as possible to peak forage quality and sufficient quantity



# Adaptive management tools



**Calls for using models/tools to develop and refine management alternatives – examples:**

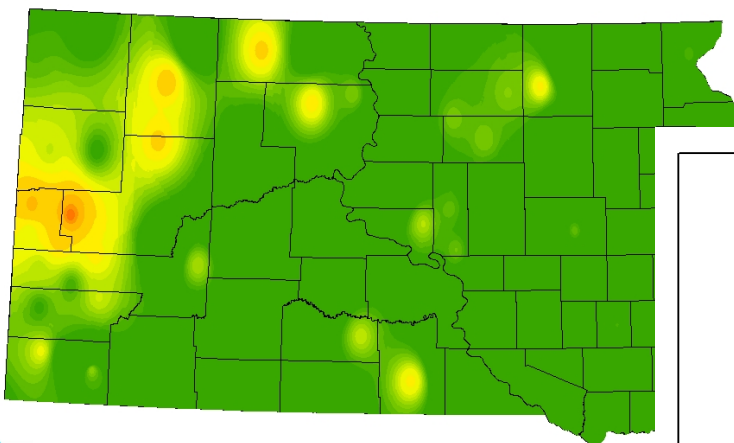
- **Ecological Site Descriptions/state and transition models**
- **SD Range Tool/ND Grass Tool: develop a feed/forage – animal balance and grazing plan**
- **SD Drought Tool/ND Drought Calculator: determine effect of reduced precipitation and develop plan to address**
- **SD Monitoring Tool – Monitoring Manual for Grassland, Shrubland and Savannah Ecosystems – DIMA**
- **Rangeland Health Assessment**



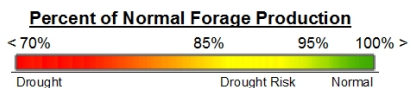
# Adaptive management tools



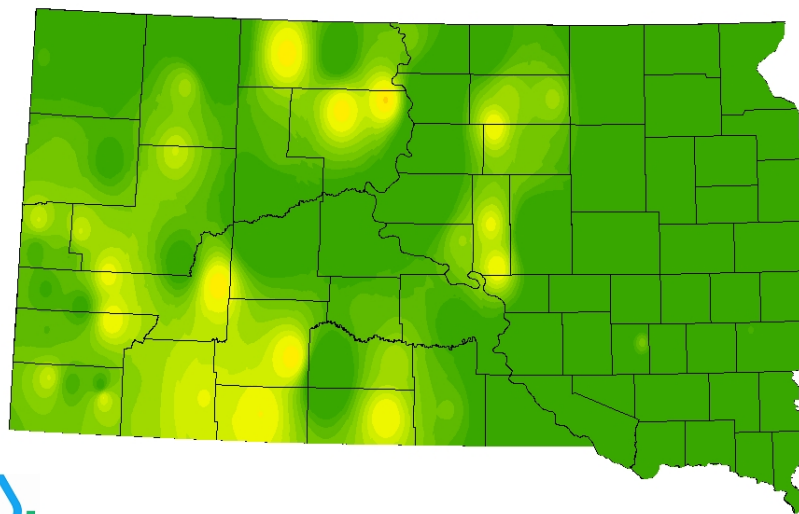
**South Dakota Grasslands Drought Condition**  
Current Status - January 1, 2017



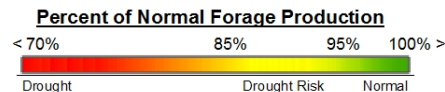
  
USDA Natural Resources  
Conservation Service  
South Dakota



**South Dakota Grasslands Drought Condition**  
Projected Peak Production\* (July 1) - January 1, 2017



  
USDA Natural Resources  
Conservation Service  
South Dakota



\*Projected status assuming future average precipitation (30-50 year average).



# Adaptive management tools



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# The Talk of Adapting



- **First to try swath grazing in this area**
- **Seed enough corn to graze cattle for the whole winter**
- **Bale grazing in the winter works in nearly all conditions, had to buy a pair of snowshoes, but have not used any diesel fuel**
- **Cut costs and maximize outputs**
- **Use the cattle to harvest the feed instead of doing it for them**
- **So much potential to make money in agriculture**
- **Meant to be a grazing animal, don't need to bring the feed to them**
- **Extend grazing 80 to 120 days each year**
- **Have to be flexible in our operation**

Alberta Agriculture: <https://www.youtube.com/playlist?list=PLOUwfF01x2YVXr2cBui0KgskBRwZsKwMr>





# Questions?

<https://www.youtube.com/watch?v=fjdVQPBBqXQ>

<https://www.youtube.com/playlist?list=PLOUwfF01x2YVXr2cBui0KgskBRwZsKwMr>

