WHAT REALLY MATTERS IN GRAZING MANAGEMENT

Jim Gerrish
American GrazingLands Services LLC
Patterson, Idaho

Only four necessary ingredients for making meat, milk, and fiber
- CO₂
- Solar energy
- Water
- Soil minerals

Ranch management should be about balancing ecosystem processes, .... not manipulating inputs
- Solar energy flow
- Water cycle
- Mineral cycle
- Biodiversity

Why Management-intensive Grazing?
- Cows "intensively graze" by nature, only people can "intensively manage"

Management is what is intensified.... NOT grazing

Management-intensive Grazing

Getting the most out of your pastures
- Step 1: Build a better solar panel
Bare soil does not make a good solar panel!

Mature plants don’t make a very good solar panel!

Principle #1: Only green, growing leaves carry out photosynthesis.

It takes grass to grow grass!

Leaf Area Index (LAI):

The ratio of leaf area to ground area.

1 sq ft of leaf = LAI of 1
1 sq ft of soil

Leaf Area Index (LAI):

The ratio of leaf area to ground area.

5 sq ft of leaf = LAI of 5
1 sq ft of soil

The Three Phases of Growth and Yield - Quality Compromise:

Phase 1: Less rest
Phase 2: More rest
Phase 3: Quality
Yield
Example of LAI response

Solar energy capture will approach 100% but will never actually be achieved.

Example of LAI response

Different plant communities differ in typical leaf density.

Visualize solar interception here

Phase 1: 10-15% solar capture

Visualize solar interception here

Early Phase 2: 35-40% solar capture

Where do you graze?

The factory is only operating at about 25-30% average efficiency when grazing in this zone.

Visualize solar capture here

Late Phase 2: 65-70% solar capture
Grazing in Phase 2

Greatest photosynthetic efficiency occurs in the phase 2 part of the growth cycle.

**Figure 1.** Effect of post-grazing residual on pasture daily growth rate (MU-FSRC)

**Visualize solar capture here**

Phase 3: 80-85% solar capture

**What is the typical pasture condition?**

Where’s the Phase 2? Phase 1 Phase 3 Bare ground

Why Phase 3 is less productive even though solar capture is high

- Plants have maintenance requirements just like your livestock
- As the pasture grows towards Phase 3, more photosynthetic energy goes to maintenance
For most cool-season grass-legume mixtures, Phase 2 is between about 5 and 15 inches height. For tall warm season grasses, Phase 2 may be between 12 to 30 inches.

Three phases of grass growth:
A basic goal of grazing management is to keep as many acres in **Phase 2** as possible. Phase 2 is no longer a relevant concept in high rainfall or irrigated environments. Once per year grazing means most grazing will occur on Phase 3 grass.

On short to mid-grass range, Phase 2 is no longer a relevant concept.

Building a better solar panel on mixed rangeland:
**Difficult to manage:****
- Total ground cover is more important than growth phase
- Focus on increasing biodiversity
- Leave ample residual
- Alternate season of use
- Shorten length of grazing period

Range management is far more about time than numbers.
Range management is far more about time than numbers. Virtually all negative aspects of cattle on range is due to too much time on the pasture, not too many numbers.

Principle #2: Avoid grazing a pasture to Phase 1!

The role of plant diversity:
Greater likelihood of something green and growing more days of the year. Interlaying of different canopies and leaf types increases efficiency of solar capture. More solar energy captured more days of the year.
How do we create greater diversity in pastures?

- Leave adequate residual
- Provide appropriate recovery periods
- Vary season of use
- Interseed other species when appropriate

Grazing and root growth

Repeatedly grazing the plant top short produces shortened root growth

Plant Vigor-Leaves and Roots

Caring for the Green Zone, Riparian Areas and Grazing Management
Alberta Riparian Habitat Management Project, “Cows and Fish Project”

Grazing management & Utilization target

<table>
<thead>
<tr>
<th>Percent leaf removal</th>
<th>Rhodes grass (single clipping)</th>
<th>Rhodes grass (repeated clipping)</th>
<th>Smooth bromegrass</th>
<th>Kentucky bluegrass</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>20</td>
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Grazing to Phase 1 residual may add 15 days to required rest

Residual and Rest

- In a 180 day growing season:
  - If grazing to Phase 2 residual requires 30 day rest period....
  - Then there are 6 harvests annually
  - If 1000 lb forage grazed in each cycle, each acre yields 6000 lb of grazed forage
The fear of wasting grass ....
...do we move them or do we leave them?

Residual and Rest
- In a 180 day growing season....
  If grazing to Phase 1 residual requires 45 day rest period.....
  Then there are only 4 harvests annually
  If 1200 lb forage grazed in each cycle, each acre yields 4800 lb of grazed forage

What does residual affect?
- Forage intake
- Pasture regrowth
- Root development
- Rest period
- Soil organic matter
- Nutrient cycle
- Infiltration and runoff
- Your bottom line

We must leave more post-grazing residual to have healthy landscapes

Principle # 3: Grazing too short is the biggest cause of lost pasture production!

Getting the most out of your pastures
- Step 1: Build a better solar panel
- Step 2: Manage for a healthy water cycle
A healthy water cycle?

- Lack of vegetative cover
- Diminished root growth
- Organic matter declining
- Poor soil structure
- Compacted soil
- Restricted infiltration
- Poor water holding capacity
- Excessive runoff

Building an effective water cycle

- Maintain vegetative cover
- Maintain appropriate litter layer on soil
- Balance use and recovery appropriate to that environment
- Build organic matter
- Avoid animal concentration points
- Avoid soil compaction

Controlling time spent in one area allows for pasture, water, and soil recovery on all other areas

Building of organic matter

Managed grazing leads to more photosynthetic energy capture resulting in more organic matter created in the soil

Plant Vigor-Leaves and Roots

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Alberta Riparian Habitat Management Project, “Cows and Fish Project”

Grazing management & Utilization target

Ungrazed 50% 65-70% Set stock

Long term pasture growth builds soil structure and increases water infiltration rate and soil water holding capacity
### Infiltration and Runoff

3 inches of rainfall in 90 minutes, 10% slope, silt loam soil  
*(University of Nebraska & USDA-SCS, 1937)*

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<tr>
<th>Condition</th>
<th>Ground Cover</th>
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<tr>
<td>Excellent pasture</td>
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<td>Fair pasture</td>
<td>75%</td>
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<td>Poor pasture</td>
<td>50%</td>
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<table>
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<tr>
<th>Soil loss (tons/A)</th>
<th>Percent runoff</th>
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<tr>
<td>8</td>
<td>0</td>
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<tr>
<td>7</td>
<td>10</td>
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<td>6</td>
<td>20</td>
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<td>5</td>
<td>30</td>
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<td>4</td>
<td>40</td>
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<tr>
<td>3</td>
<td>50</td>
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<tr>
<td>2</td>
<td>60</td>
</tr>
<tr>
<td>1</td>
<td>70</td>
</tr>
<tr>
<td>0</td>
<td>80</td>
</tr>
</tbody>
</table>

### Grazing for Riparian Health

- Critical water source for humans, livestock, and wildlife
- Good indicator of overall environmental quality
- Valuable economic resource in many areas

### What are riparian areas?

- Functional ecosystem processes
- Solar energy flow
- Effective water cycle
- Dynamic nutrient cycle
- Biodiversity at all trophic levels
- Clean water flowing to next reach

### What defines riparian health?

- No vegetation on stream bank
- Soil compaction & poor water infiltration
- Soil and manure runoff into water
- Minimal biodiversity

### Poor riparian health
Is this mess the product of grazing livestock?

No, it’s the result of the continuous presence of cattle in the same area for several months! THIS IS OPERATOR ERROR!

Is this healthy riparian zone the product of eliminating grazing?

No, it’s the result of managing grazing!

Time and Timing of grazing are critical management factors

- Continuous grazing is detrimental to riparian health in almost all environments
- Short duration, high stock density grazing has much lower long-term impact
- Season of use has huge ramifications
  - Soil conditions
  - Diet selection
  - Physiological stage of the livestock

Location of water is the #1 factor determining where cattle will spend most of their time

Stock water developments

- Moving stock water away from riparian areas shifts animal concentration away from sensitive areas

Installing a pressurized water system lets you control where animals will spend most of their time
Getting the most out of your pastures

- Step 1: Build a better solar panel
- Step 2: Manage for a healthy water cycle
- Step 3: Create a dynamic mineral cycle

If cattle walk more than ¼ mile to water, up to 65% of manure ends up at shade and water.

* In hot-humid climates

Short grazed pastures with animal concentration in riparian zone is recipe for contamination.

Manure distribution & nutrient cycle less of a concern on rangeland.

.... Soil minerals are rarely limiting in rangeland productivity

This pile may take 25-30 years to decompose in this environment

Nutrient flow in grasslands

Inputs
- mineralization
- atmospheric
- fertilizer
- feed
- mineral
- manure
- legumes (N)

Nutrient Cycle

Exports
- hay
- animals
- loss pathways
Nutrient removal rates:
Hay system

Inputs
- mineralization
- legumes (N)
- fertilizer
- atmospheric

Nutrient Cycle

Exports
- remove 80% of nutrients in hay

Each ton of hay removes:
- 40-60 lb. nitrogen
- 6 lb. P (13 lb. P₂O₅)
- 40-50 lb. K (48 lb. K₂O)

3 tons of hay removes:
- 150 lb. nitrogen
- 18 lb. P (40 lb. P₂O₅)
- 120 lb. K (145 lb. K₂O)

Nutrient removal rates:
Pasture system

Inputs
- mineralization
- manure
- legumes
- (N) fertilizer
- atmospheric
- feed/mineral

Nutrient Cycle

Exports
- calves
- beef
- loss pathways

500 lbs of beef per acre removes:
- 16 lb. nitrogen
- 5 lb. P (10 lb. P₂O₅)
- 1 lb. K (1.4 lb. K₂O)

A basic input-output system

>90% of what goes in front comes out the back end

Mobile vs. Immobile nutrients

- Mobile
  - Nitrogen
  - Sulfur
  - Boron
  - Chlorine

- Immobile
  - Phosphorus
  - Calcium
  - Magnesium
  - Iron
  - Zinc
  - Copper

* Potassium is mobile in sandy soils but immobile in clay
Manure decomposition rate is determined by:
- Fiber digestibility
- Moisture availability
- Temperature
- Microbial population
- Physical disturbance

Manure from high quality pasture decomposes faster... 
so nutrient cycle turns faster

### N fixation in mixed stands

<table>
<thead>
<tr>
<th>Species</th>
<th>N fixed 1st year</th>
<th>(lb/acre) old stand</th>
<th>N from fixation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>70-80</td>
<td>120-230</td>
<td>60 - 94 %</td>
</tr>
<tr>
<td>Red Clover</td>
<td>10-90</td>
<td>130-250</td>
<td>40 - 96 %</td>
</tr>
<tr>
<td>Birdsfoot Trefoil</td>
<td>30-60</td>
<td>80-150</td>
<td>40 - 94 %</td>
</tr>
<tr>
<td>White Clover</td>
<td>10-100</td>
<td>20-240</td>
<td>35 - 100 %</td>
</tr>
</tbody>
</table>

West & Maffurino, 1996

### Effect of protein level on daily N excretion rate

<table>
<thead>
<tr>
<th>Protein content</th>
<th>10%</th>
<th>15%</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow weight</td>
<td>1200</td>
<td>1200</td>
<td>1200 lb</td>
</tr>
<tr>
<td>Intake rate</td>
<td>2.6%</td>
<td>2.6%</td>
<td>2.6% % of liveweight</td>
</tr>
<tr>
<td>Daily consumption</td>
<td>31.2</td>
<td>31.2</td>
<td>31.2 lb/hd/day</td>
</tr>
<tr>
<td>Daily protein consumption</td>
<td>3.12</td>
<td>4.68</td>
<td>6.24 lb/hd/day</td>
</tr>
<tr>
<td>Daily nitrogen consumption</td>
<td>0.50</td>
<td>0.75</td>
<td>1.00 lb/hd/day</td>
</tr>
<tr>
<td>Daily nitrogen excretion</td>
<td>0.47</td>
<td>0.71</td>
<td>0.95 lb/hd/day</td>
</tr>
<tr>
<td>Daily fecal N output</td>
<td>0.24</td>
<td>0.24</td>
<td>0.24 lb/hd/day</td>
</tr>
<tr>
<td>Daily urine N output</td>
<td>0.24</td>
<td>0.47</td>
<td>0.71 lb/hd/day</td>
</tr>
</tbody>
</table>

* Fecal N level remains near constant, excess N is excreted as urine

### Effect of stock density on daily available N return to the soil

<table>
<thead>
<tr>
<th>Stock density</th>
<th>600</th>
<th>1200</th>
<th>4800</th>
<th>24000</th>
<th>48000</th>
<th>96000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein content</td>
<td></td>
<td>lb of available N applied daily</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td>0.1</td>
<td>0.2</td>
<td>0.9</td>
<td>4.7</td>
<td>9.5</td>
<td>19.0</td>
</tr>
<tr>
<td>15%</td>
<td>0.2</td>
<td>0.5</td>
<td>1.9</td>
<td>9.5</td>
<td>19.0</td>
<td>37.0</td>
</tr>
<tr>
<td>20%</td>
<td>0.4</td>
<td>0.7</td>
<td>2.8</td>
<td>14.2</td>
<td>28.5</td>
<td>56.9</td>
</tr>
</tbody>
</table>

* Urine N is nearly all readily available on a daily basis
Effect of stock density on daily available N return to the soil

<table>
<thead>
<tr>
<th>Stock density</th>
<th>600</th>
<th>1200</th>
<th>4800</th>
<th>24000</th>
<th>48000</th>
<th>96000</th>
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<tbody>
<tr>
<td>Protein content 10%</td>
<td>0.1</td>
<td>0.2</td>
<td>0.9</td>
<td>4.7</td>
<td>9.5</td>
<td>19.0</td>
</tr>
<tr>
<td>15%</td>
<td>0.2</td>
<td>0.5</td>
<td>1.9</td>
<td>9.5</td>
<td>19.0</td>
<td>37.0</td>
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<tr>
<td>20%</td>
<td>0.4</td>
<td>0.7</td>
<td>2.8</td>
<td>14.2</td>
<td>28.5</td>
<td>56.9</td>
</tr>
</tbody>
</table>

Management requirements for these stock densities:
- 600 lb/A = continuous graze 2 acre/cow
- 1200 lb/A = continuous graze 1 acre/cow
- 4800 lb/A = rotational graze 10 day grazing period
- 24000 lb/A = rotational graze 3 day grazing period
- 48000 lb/A = rotational graze 1 day grazing period

Manure Distribution

<table>
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<tr>
<th>Rotation Frequency</th>
<th>Years to get 1 pile / sq. yard</th>
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<tr>
<td>Continuous</td>
<td>27</td>
</tr>
<tr>
<td>14 day</td>
<td>7-8</td>
</tr>
<tr>
<td>4 day</td>
<td>4-5</td>
</tr>
<tr>
<td>1 day</td>
<td>1-2</td>
</tr>
</tbody>
</table>

Getting the most out of your pastures
- Step 1: Build a better solar panel
- Step 2: Manage for a healthy water cycle
- Step 3: Create a dynamic mineral cycle
- Step 4: Increase biodiversity

Invasion by noxious weeds is a symptom, not the problem

The problem is cattle were there too long!

Lack of woody species is a symptom, not the problem

The problem is cattle were there at the wrong time!
Cattle use of browse:

• 80% of species in spring
• 30% of species in summer
• <10% of species in autumn

Source: Bob Budd, Red Canyon Ranch, The Nature Conservancy

Winter use can help improve range and riparian conditions as long as cattle have adequate forage available.

STOCK DENSITY:
THE MOST POWERFUL TOOL IN THE GRAZIER’S TOOLBOX

Jim Gerrish
American GrazingLands Services LLC
May, Idaho

Some useful definitions

- **Stocking rate**: The number of animals or animal liveweight assigned to a grazing unit on a seasonal basis.

Stocking rate affects all these factors:

- Forage production
- Forage quality
- Species composition
- Animal performance
- Soil compaction
- Profitability

Stocking rate illustration

- Ten head on ten acres
- Stocking rate = 1 hd/acre
- If cows weigh 1200 lb... stocking rate is 1200 lb/acre
Some useful definitions

- **Stocking rate**: The number of animals or animal live weight assigned to a grazing unit on a seasonal basis.

- **Carrying capacity**: The stocking rate that provides a target level of performance while maintaining the integrity of the resource base.

Carrying capacity of pasture is determined by four factors

\[
\text{Carrying Capacity} = \frac{\text{Forage Production}}{\text{Daily Intake}} \times \frac{\text{Seasonal Utilization Rate}}{\text{Length of the Grazing Season}}
\]

This pasture is stocked beyond its carrying capacity!

Producing about 120-140 CDA

This pasture is stocked near its carrying capacity!

Producing over 300 CDA

Some useful definitions

- **Stocking rate**: The number of animals or animal live weight assigned to a grazing unit on a seasonal basis.

- **Stock density**: The number of animals or animal live weight assigned to a specific pasture area at a specific point in time

Stocking rate and stock density with continuous grazing

- Ten head on ten acres
- Stocking rate = 1 hd/acre
- With continuous grazing:
  - stock density = stocking rate
- Both are still 1200 lb/acre
Pasture subdivision and stock density

- With pasture subdivision stocking rate may not change but stock density does!
- Stock density is 10 hd/2.5 acres or 4800 lb/acre

- Each level of subdivision results in higher stock density
- Stock density is now 12,000 lb/acre

- Stock density is now 24,000 lb/acre
- You’ve got it, right?

- This pasture is stocked beyond its carrying capacity!
- This pasture situation was caused by low stock density!
This pasture is stocked near its carrying capacity!

This pasture situation was created by using high stock density!

So, what's the ‘right’ stock density?

It depends!

Grazier’s Arithmetic

\[
\text{Stock Density} = \frac{\text{Forage Availability}}{\text{Daily Intake}} \times \frac{\text{Temporal Utilization Rate}}{\text{Length of the Grazing Period}}
\]

What is the appropriate stock density?

<table>
<thead>
<tr>
<th>Intake target</th>
<th>2.5%</th>
<th>Utilization target</th>
<th>2.5%</th>
<th>Length of grazing period</th>
<th>2.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available Forage (forage/acre)</td>
<td>Potential Stock Density (lb liveweight/acre)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>32000</td>
<td>1500</td>
<td>48000</td>
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What is the appropriate stock density?

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<th>Utilization target</th>
<th>80%</th>
<th>Length of grazing period</th>
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<td>Available Forage (forage/acre)</td>
<td>Potential Stock Density (lb liveweight/acre)</td>
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Books by Jim Gerrish

<table>
<thead>
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<th>Management-intensive Grazing</th>
<th>KICK the HAY HABIT</th>
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<td>$31</td>
<td>$27</td>
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</table>

Both for $55

Contact information

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