

Mariana Grazing and Livestock Management Academy

Principles of Grazing Management



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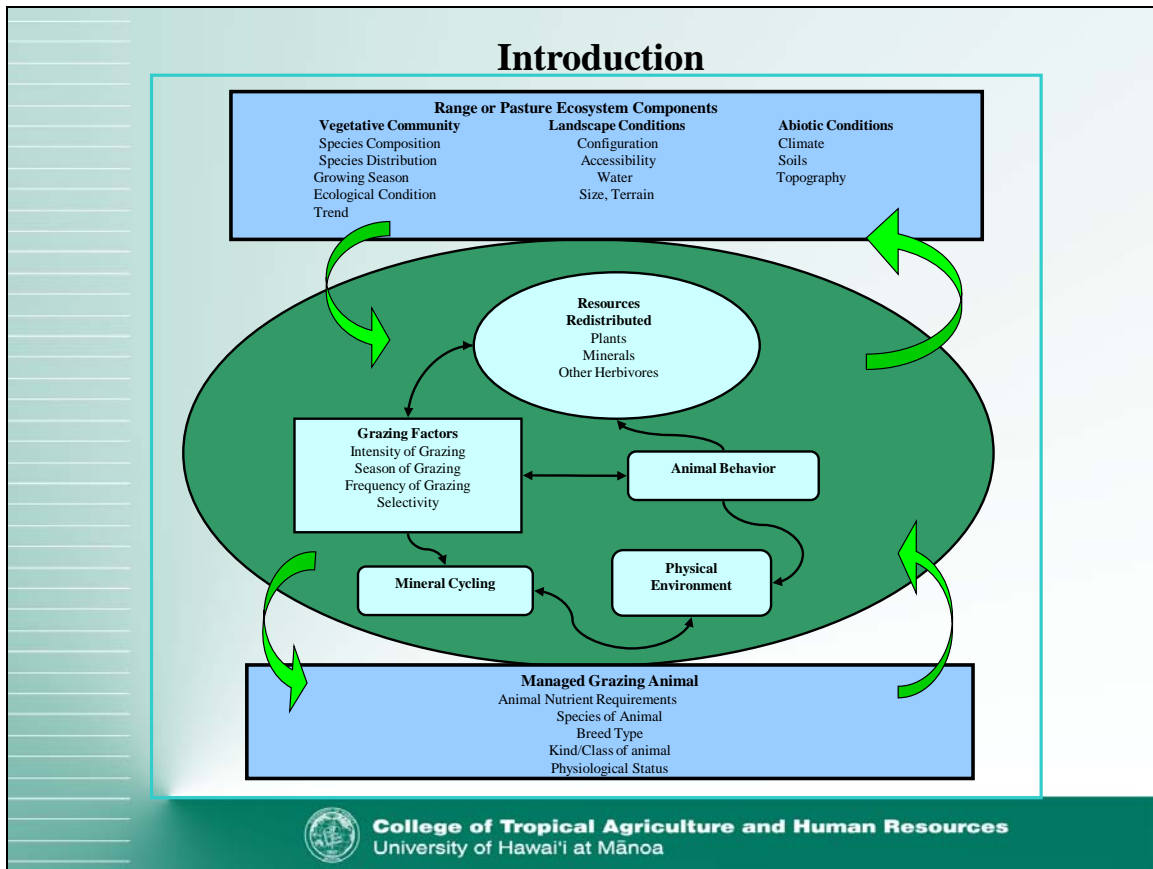
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Principles of Grazing Management – Outline

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 - Affect on animal nutrition
 - Interaction between animal selectivity and plant community dynamics



Introduction (1 of 1)

Heady and Child Diagram

Range/grazing manager has essentially two tools: 1) manipulate grazing factors 2) range improvements

Terms and Definitions

Range Management – The discipline and art of applying scientific and practical knowledge for (1) protection and improvement of basic natural resources, and (2) optimum production of goods and services in combinations needed by society.

Grazing Management – Active manipulation of grazing factors to optimize economic returns per acre and other goals while maintaining or improving long-term natural resource productivity under changing conditions.



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Terms and Definitions (1 of 4)

Range and grazing management defined

Terms and Definitions (cont'd) The Grazing Animal



Terms and Definitions (2 of 4)

The Grazing Animal defined – anything that defoliates or that acts as one or more grazing factors

Livestock: cattle, sheep, goats, horses, and to a lesser degree poultry

Wildlife: insects, feral animals (donkeys, pigs, goats, etc.)

Other: fire, mowing

Terms and Definitions (cont'd)

The Grazing Factors

Grazing Intensity – The proportion of the current season's forage production that is consumed or trampled.

Grazing Frequency – Number of occurrences of herbage removal over a certain period of time.

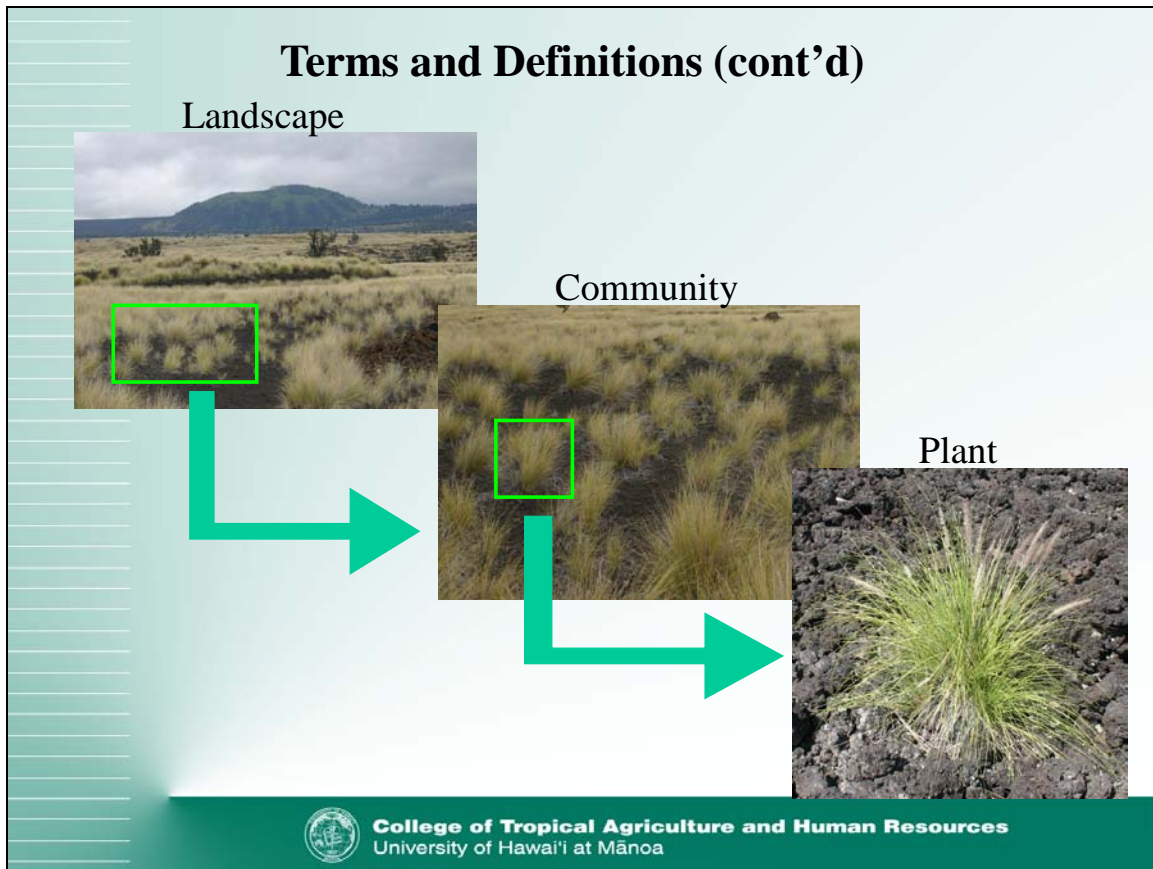
Grazing Season – The period at which grazing occurs in relation to the vegetation's stage of growth.

Animal Selectivity – The degree to which animals consume plants or plant parts in different proportions of the total amount of forage available to them.



Terms and Definitions (3 of 4)

Grazing intensity defined
Grazing frequency defined
Grazing season defined
Animal selectivity defined



Terms and Definitions (4 of 4)

A) Primarily concerned with 3 scales of ecosystem organization:

(1) A landscape is composed of several (2) communities which are assemblages of (3) individual plants.

B) Management time scales also progress from long to short respective to spatial scale.

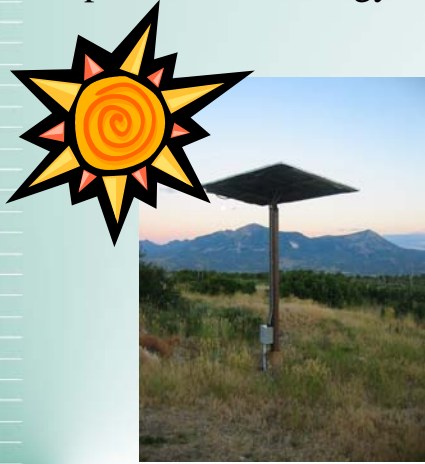
In other words: Management effects on the landscape scale take longer to develop than on the community.

The Four Grazing Factors: Grazing Intensity

Effects on the Individual Plant

Take Half, Leave Half – *WHY?*

Leaves: A plant's solar paneling;
fewer panels = less energy capture



Roots: Food factory run by
energy collected from leaves



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Grazing Intensity: Effects on the Individual Plant (1 of 2)

- A) Old Adage of Grazing Mgmt: Take half, leave half – why?
- B) Leaves are the means of energy capture for plants. Less leaves = less energy for plant use.
- C) Roots use energy from leaves to drive metabolic processes such as growth and reproduction.

The Four Grazing Factors: Grazing Intensity

Effects on the Individual Plant

Intensity	Percent Leaf	Percent Root
	Volume Removed	Growth Stoppage
Low ↓ High	10%	0%
	20%	0%
	30%	0%
	40%	0%
	50%	2-4%
	60%	50%
	70%	78%
	>80%	100%

Adapted from Dietz 1989



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Grazing Intensity: Effects on the Individual Plant (2 of 2)

- Moderate removal of a plant's leaf production during the season (10-50%) has minimal impact on root growth (2-4%) and consequently plant vigor.
- Defoliation above approx. 50% causes plants to use energy reserves in the form of carbohydrates from the roots instead of solar energy to produce leaves and carry on metabolic function.

The Four Grazing Factors: Grazing Intensity

Animal Behavior and Grazing Intensity

Biological and
Physical influences

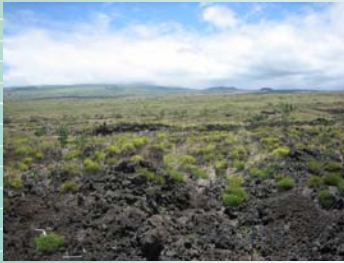


Uneven use of
the landscape



Local variations in
grazing intensity

For example...



Low

Moderate

High

Grazing Intensity



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Grazing Intensity: Animal Behavior and Grazing Intensity (1 of 1)

- Biological factors (hunger, thermal balance, species, etc.) and physical factors (topography, climate, etc.) affect an animal's spatial and temporal use of the landscape.
- This leads to an uneven use across the landscape.
- The result is local variations in grazing intensity, for example:
 - (Low) Steep and rocky terrain
 - (Mod) flat terrain and appropriate stocking density
 - (High) sacrifice areas such as working pens, watering points, or loafing areas.

The Four Grazing Factors: Grazing Frequency

Effects on the Individual Plant

Pasture needs rest following grazing – *WHY?*



Less leaves = less energy captured

Less energy = slower food production

Too frequent defoliation = energy reserves (roots) more heavily tapped into

Less reserves = low vigor and productivity



Low

Frequency

High



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Grazing Frequency: Effects on the Individual Plant (1 of 1)

- Why rest pasture after grazing?
- Again, fewer leaves means reduced (but recoverable) food production.
- Returning to grazed pasture too soon means plants must rely on energy reserves for metabolic function instead of solar energy.
- This can lead to decreased vigor and productivity.

The Four Grazing Factors: Grazing Frequency

Animal Behavior and Grazing Frequency

Livestock have preferred forage species, sometimes called ice cream plants, which they will consume first and return to often during a grazing period.



Koa

Acacia koa



Clover

Trifolium sp.



Kikuyu

*Pennisetum
clandestinum*

Others:

Guinea Grass

Green Panic

Signal Grass

Koa Haole

Glycine

Photos – Forest and Kim Starr (USGS)

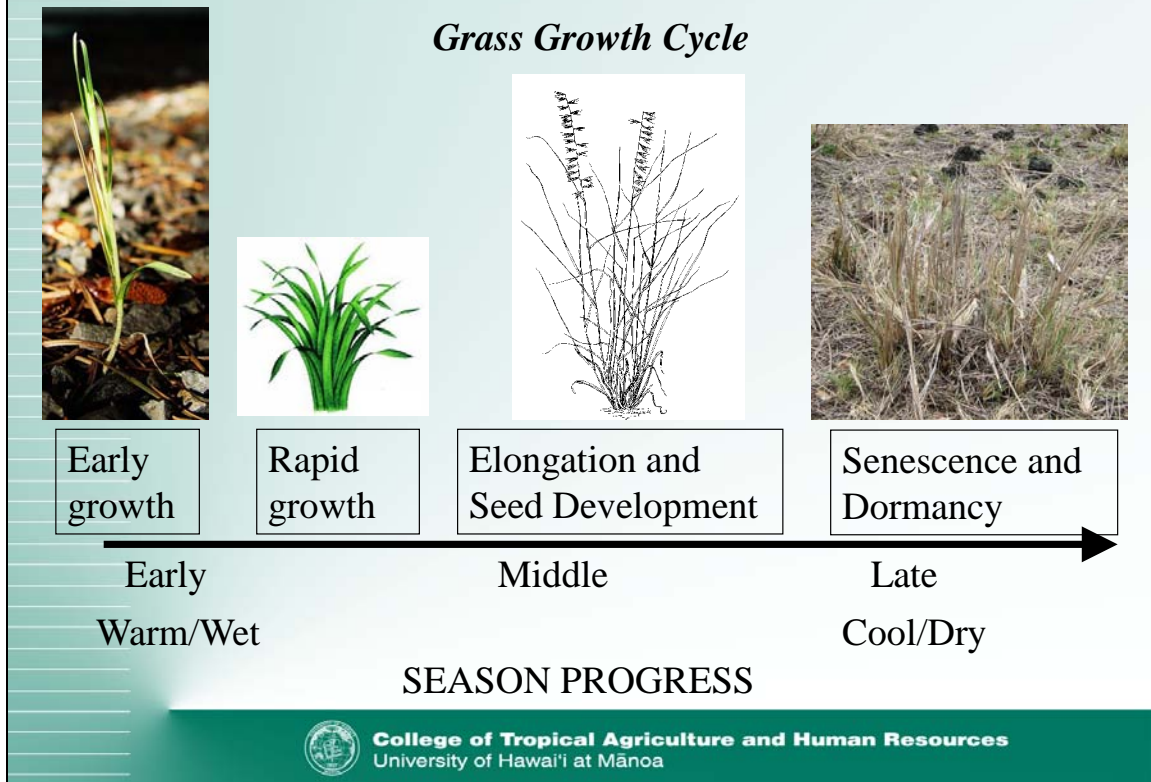


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Grazing Frequency: Animal Behavior and Grazing Frequency (1 of 1)

- Ice cream plants defined (i.e. animals, like people, have preferred species they will consume first and often).
- Examples of ice cream plants.
Koa, clover, kikuyu, guinea, green panic, signal grass, koa haole, glycine

The Four Grazing Factors: Grazing Season



Grazing Season: Grass Growth Cycle (1 of 1)

Grass growth cycle simplified to 4 periods:

- 1) Early growth – Begins with emergence of first leaf when temperature and moisture conditions are right. During this period, the plant relies solely on stored root or seed energy. Slow growth.
- 2) Rapid growth – Once 4-5 leaves are produced, plant can rely on sun for energy needs. About 75-80% of current seasons growth is during this period. Fast growth.
- 3) Elongation and Seed Development – Culms form and growth shifts from leaves to telescoping inflorescences.
- 4) Senescence and Dormancy – Following reproduction, plants cure and go dormant but carry on life through respiration. Energy for respiration relies mostly on stored reserves.

The Four Grazing Factors: Grazing Season

Effects on the Individual Plant

- Plants vary widely in response to season of defoliation.
- In general, plants can tolerate grazing better during the rapid growth period if ceased in time to allow seed formation.
- Seed formation to flowering appears to be the period most sensitive to grazing in many plants.



Grazing Season: Effects on the Individual Plant (1 of 1)

- Plants vary widely in response to season of grazing.
- Rapid growth period best period for defoliation from plant perspective.
- Under moderate intensity and frequency, plants are most sensitive to grazing during the reproductive period.

The Four Grazing Factors: Grazing Season

Animal Behavior and Grazing Season

In general...

- Livestock prefer younger tissue over mature, “woffy” tissue
- Livestock prefer leaves over stems and inflorescences

These preferences/aversions to plant parts and for plant species shift over growing season according to availability

Percentage of diet in late dry season			
Class	Stems	Leaves	Inflor.
Cattle	77	8	15
Sheep	70	19	11

Adapted from Heady and Child 1994



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Grazing Season: Animal Behavior and Grazing Season (1 of 1)

- Livestock prefer younger, more succulent tissue over mature “woffy” tissue. Lignification.
- Livestock prefer leaves over stems.
- Preferences for plants and plant parts may shift as season progresses.

The Four Grazing Factors: Animal Selectivity

Effects on the Individual Plant

- Different kinds (species) and classes (adult, lactating, growing, etc.) of livestock select plants and plant parts for consumption differently.

In general...



Grass



Forbs



Browse



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Animal Selectivity: Effects on the Individual Plant (1 of 2)

- Different kinds and classes of livestock select plants and plant parts differently.
- In general:
 - Cattle and horses prefer grass
 - Sheep prefer forbs
 - Goats prefer browse (shrubs and woody plants)

The Four Grazing Factors: Animal Selectivity

Effects on the Individual Plant

- Several plant attributes alter the acceptability of a particular plant to the grazing animal.
- Some factors affecting plant palatability include:
 - Nutritive value
 - Secondary compounds
 - Fiber content (succulence)
 - External features or structures
- Other factors affecting animal selectivity:
 - Internal animal factors
 - Learned and evolved behavior
 - Environmental influences



Animal Selectivity: Effects on the Individual Plant (2 of 2)

- What affects animal selectivity
- Plant palatability:
 - Nutritive value: relative amounts of N in plant tissue
 - Secondary compounds: presence in degrees of non-metabolic chemicals
 - Fiber/Water content: relative amount of C or lignin and water in plant tissues
 - External features or structures: waxes, spines, hair, etc.
- C) Other Factors (after Heady and Child 1994)
 - Internal Animal Factors – response to basic sensory or physiological cues (sight, taste, touch, hunger, etc.)
 - Learned and evolved behavior – “mother knows best”, trial and error, specialist consumers.
 - Environmental influences – climate, topography, soil, management (i.e. inputs or burning) affect palatability of plants.

The Four Grazing Factors

Simultaneous Interacting Events

One grazing factor does not occur without the others!



These cattle *select* plants to consume to a certain degree or *intensity* during a particular *season* of growth and may *repeat* grazing plants at this patch in the future.



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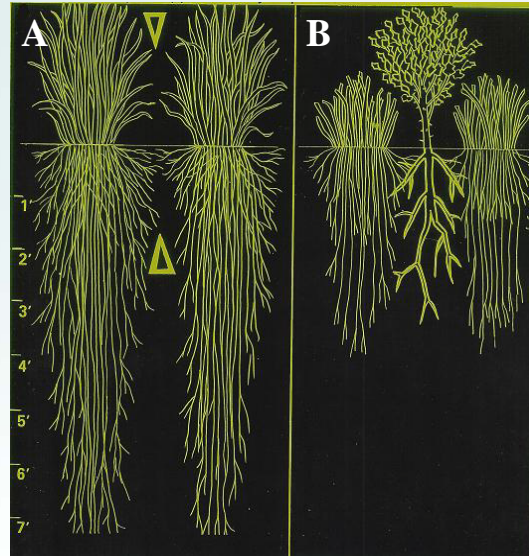
The Four Grazing Factors: Simultaneous Interacting Events (1 of 1)

Grazing factors do not occur in isolation.

The Four Grazing Factors: Effects on the Plant Community

A – Vigorous desirable species resulting from proper management of intensity, frequency, and season of grazing according to known patterns of animal selectivity.

B – Poor management leads to heavy and/or too frequent use of preferred plant species at the wrong time and opens soil and light resources to invaders.



Adapted from Dietz 1989



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The Four Grazing Factors: Effects on the Plant Community (1 of 2)

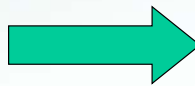
Two significant effects on community composition and productivity

- Appropriate management of 4 factors maintains vigorous (production) plants of desirable species (comp.).
- Poor management can lead to less vigorous desirable species and an increase in quantity of less desirable plants.

The Four Grazing Factors: Effects on the Plant Community (cont'd)



Low vigor of preferred species



Shift in community composition



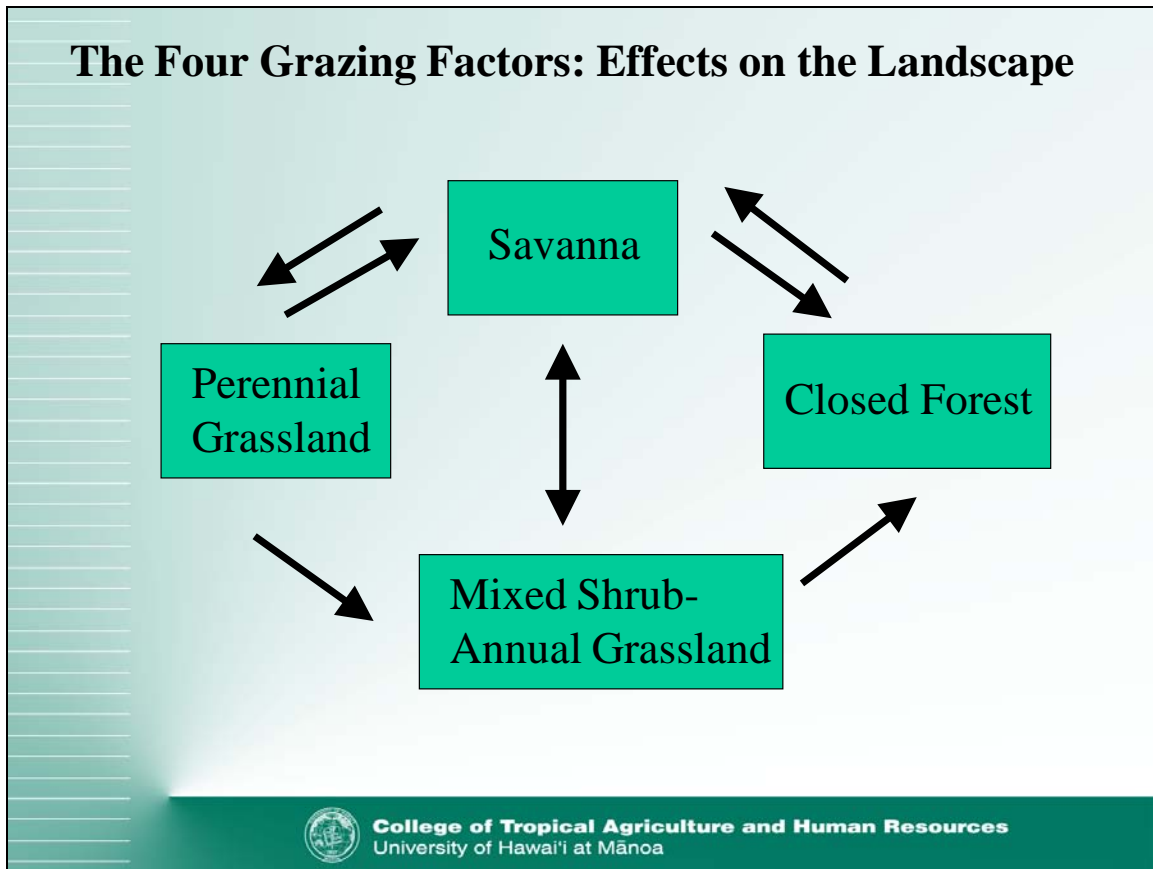
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The Four Grazing Factors: Effects on the Plant Community (2 of 2)

Example: Under-stocked but overgrazed pasture can lead to shifts in species composition.

A) Left side of photo shows a pasture dominated by desirable forage grasses owing to proper control of intensity and frequency of defoliation through rotational grazing.

B) Right side of photo shows a continuous grazing system. Cattle will continue to graze desirable species as soon as there is enough regrowth resulting in less vigorous plants and opening resources to broomsedge.



The Four Grazing Factors: Effects on the Landscape (1 of 1)

- In combination with climate factors (temp. and precip.), grazing management can contribute to broader shifts in vegetation states across the landscape.
- It may require large energy inputs to overcome these shifts, and the effects of such efforts may not be long lived.

Effects on Animal Nutrition: Grazing Intensity

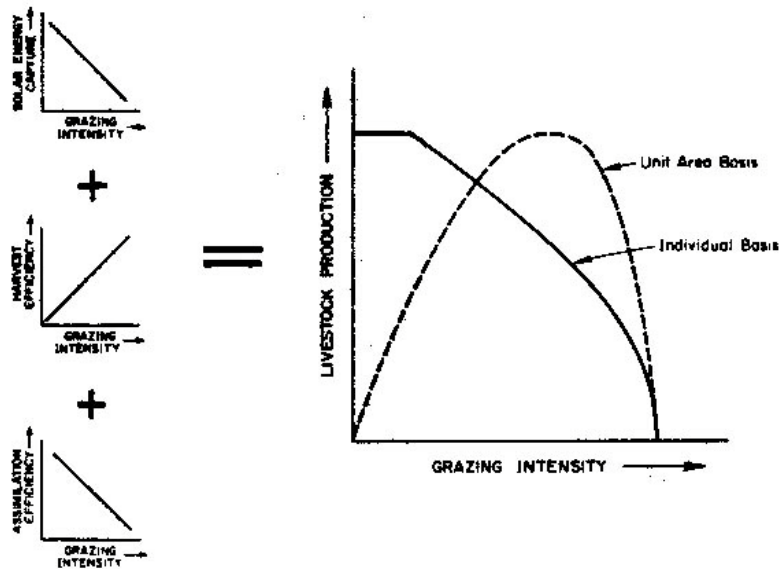


Figure 1.7. Livestock production per individual and per unit area originate from the combined effects of efficient solar energy capture (i.e., primary production), forage harvest efficiency, and conversion efficiency in response to grazing intensity.

From: Heitschmidt and Stuth 1991



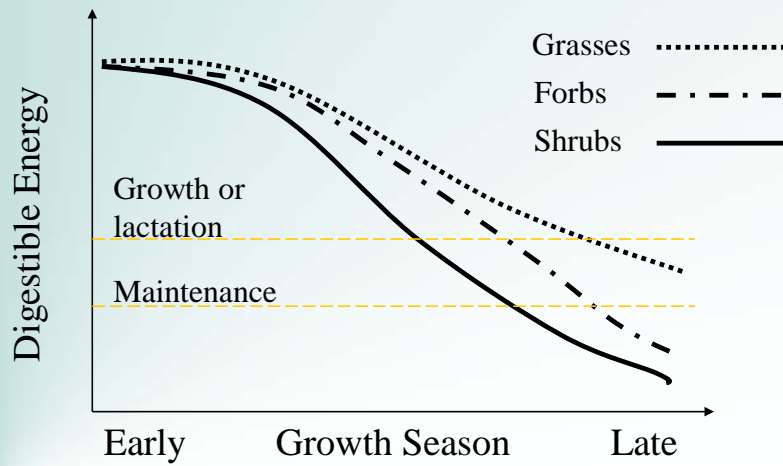
Effects on Animal Nutrition: Grazing Frequency

- Physiologically younger plant material (e.g. new shoots or regrowth) have higher nutritive quality and are digested more efficiently than older growth
- Animals that consume plants at a frequent enough interval will maximize mineral intake and digestibility



Effects on Animal Nutrition: Grazing Season

Forage quality declines as the growth cycle progresses



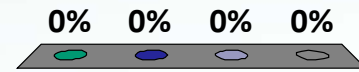
Effects on Animal Nutrition: Selectivity

- Livestock often, but not always, select plants and plant parts of high nutritive quality and/or content
- As forage availability increases, animals can express greater selectivity and perform better
- On ranges that have a mixture of plants, animals select a diet 1.5% to 2.0% higher than what the plant nutrient test reveals
- Moving animals to fresh pasture offers variety which stimulates intake



What are the four grazing factors?

1. Earth, Wind, Fire, and Water
2. Cows, Grass, Water, and Luck
3. Intensity, Frequency, Season, Selectivity
4. Graze tight, often, and continuously and you don't have to worry about choosy animals



Earth, Wind, Fire, and W...

Cows, Grass, Water, and...

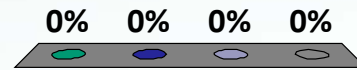
Intensity, Frequency, Se...

Graze tight, often, and c...



Which of these answers best describes Grazing Intensity

1. The amount of current forage production that is eaten or trampled
2. The number of cows in the pasture
3. When cows use all of the pasture
4. Rapid rotation of animals from pasture to pasture



The amount of current ...

The number of cows in ...

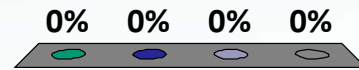
When cows use all of th...

Rapid rotation of animal...



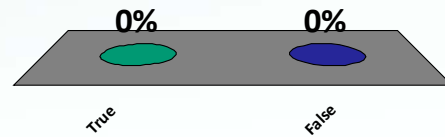
Which of the answers below describes Grazing frequency?

1. Rapid rotation of animals between pastures
2. Many cows grazing an area all at the same time
3. Then number of times a plant is grazed over a certain time period
4. The last opportunity a cow has to graze an area before being moved



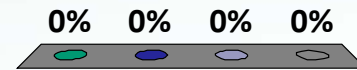
Grazing Season is the period at which grazing occurs in relation to the vegetation's stage of growth.

1. True
2. False



Which statement best describes animal selectivity?

1. Animals choosing to graze one area over another.
2. Choosing an animal from the herd to butcher.
3. When the neighbor's bull breeds your cow.
4. The degree to which animals consume plants or plant parts in different proportions of the total amount of forage available to them.



Animals choosing to graze...

Choosing an animal from...

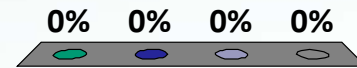
When the neighbor's bul...

The degree to which ani...



When determining the proper grazing intensity, what is the “Rule of Thumb” we use as a guideline?

1. Graze it as long as it is green
2. Graze only the leaves, leave the rest
3. Graze as many cows as you can for as long as you can.
4. Take half, leave half



Graze it as long as it is green

Graze only the leaves, leave the rest

Graze as many cows as you can

Take half, leave half



Break Time



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Principles of Grazing Management

- Because the grazing animal has such a profound impact on the ecology of the range or pasture system it is neither

efficient

nor

appropriate

to view the animal as only a product.



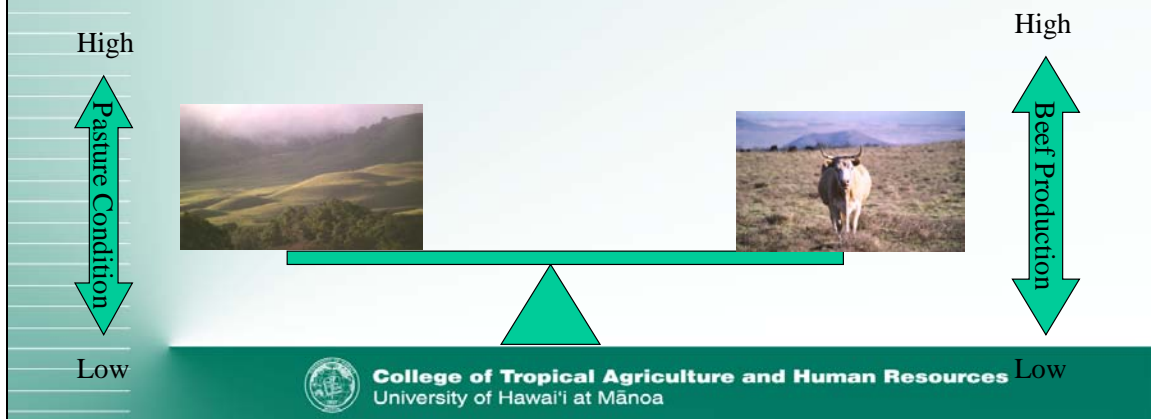
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Grazing animals have a profound impact on the ecology of the range and pasture system

Viewing livestock as only a product is not efficient nor is it appropriate on a management basis

Principles of Grazing Management

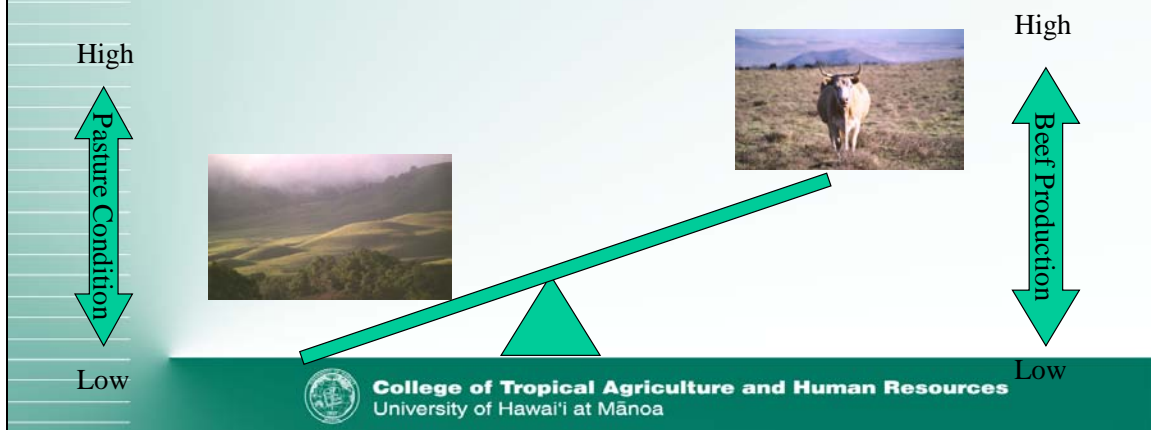
- Efficiency of any system is the result of a proper balance between inputs and outcomes.
- In a grazing system:
 - Outcomes = beef lbs. Produced, # Calves, etc.
 - Inputs = what you return to the land to sustain production of your outcome.



System efficiency depends on a proper balance between inputs and outcomes

Principles of Grazing Management

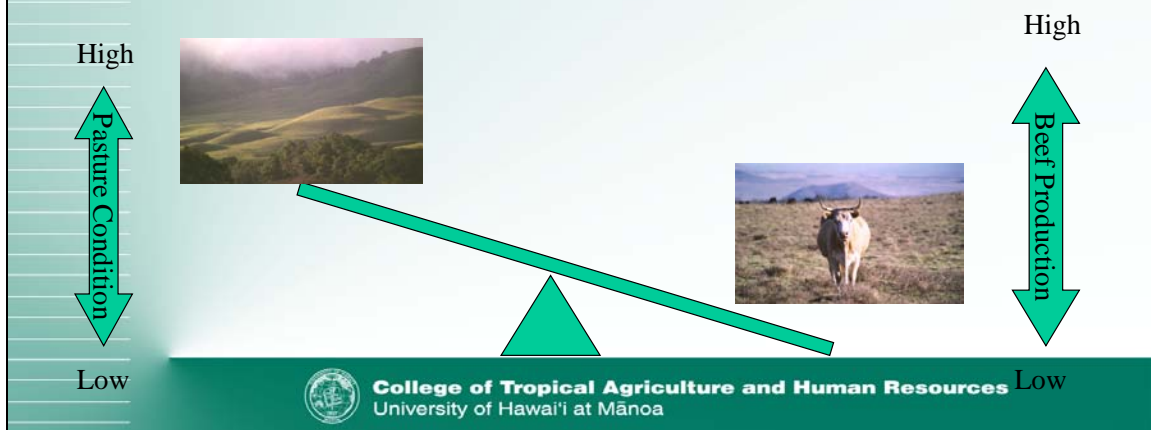
- Concentrating only on the outcome (animal production) could lead to overgrazing and eventually the loss of ecological sustainability of the operation.



Operations that focus primarily on the outcome (products; animal production) often fail because they do not properly manage their inputs (resources).

Principles of Grazing Management

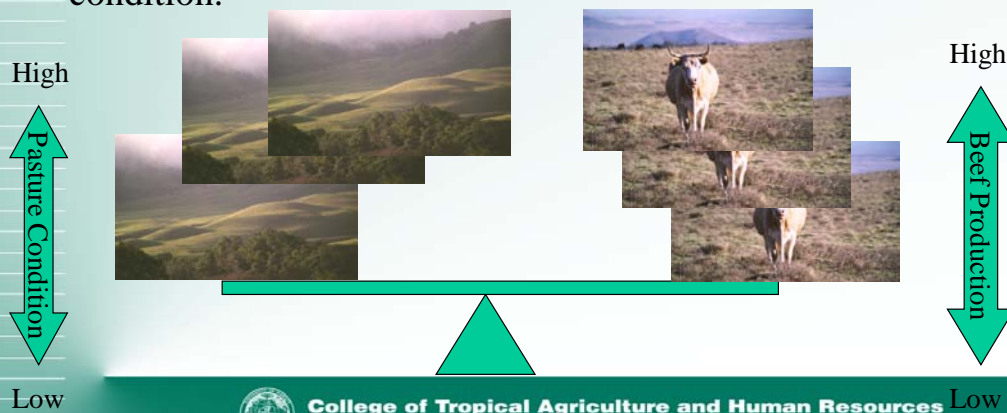
- Concentrating only on the inputs (range or pasture condition) will result in not enough outcome to economically sustain the operation.



Operations that focus too much on maintaining or storing up inputs (resources) fail because of inefficient use of the resource and low production numbers. Thus, they cannot economically sustain the operation.

Principles of Grazing Management

- The ideal is to balance outcomes (beef lbs. Produced, # Calves, etc.) and inputs (things that maintain pasture condition).
- Implementing a sound grazing management plan will lead to a balance between animal production and pasture condition.



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Management planning helps operations find and maintain the proper balance between outcomes and inputs; production and supply, product and resources.

Principles of Grazing Management

- The objective of a grazing management plan is to sustain both the ecological and economic productivity of the livestock operation.
- To achieve a balance between an ecologically and economically sustainable operation the grazing animal needs too be viewed as both a

Tool
and
Product



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The grazing animal should properly be viewed as both a product and a tool.

It is a product in the sense that it produces what you sell – meat

It is a tool in the sense that the grazing animal will help you manage your resources

Principles of Grazing Management

- Tools require goals and objectives to be useful.
- Goals and objectives for managing the grazing animal include:
 - Ecological reasons
 - Improving or sustaining range or pasture condition
 - Weed control
 - Soil management
 - Water management
 - Economic reasons
 - Animal health and condition
 - Parasite control
 - Increase wean weights
 - Personal reasons
 - Tradition
 - Reputation



Tools require objectives to be properly used

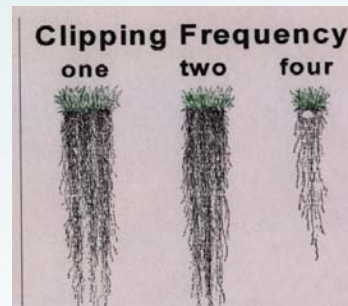
Goals and objectives for managing the grazing animal include ecological (resource conservation), economic, and personal reasons. All are valid and equally important.

Principles of Grazing Management

- Managers achieve goals through grazing management by altering the four grazing factors.

- Grazing Factors:

- Intensity of grazing
- Frequency of grazing
- Season of grazing
- Selectivity



- To do this effectively managers need to understand how grazing affects the ecology of the system.



Managers achieve goals through grazing management by altering the four grazing factors.

Grazing Factors:

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- Season of grazing
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To do this effectively managers need to understand how grazing affects the ecology of the system.

Principles of Grazing Management

- Grazing Management Tools:
 - Manipulating the Stocking Rate:
 - Affects the intensity and frequency of grazing events
 - The most effective and important tool a manager has
 - Kind and Class of Animal
 - Determines grazing behavior
 - Multi-species grazing is often useful
 - Season of Grazing
 - Influences animal selectivity and performance
 - Influences how the forage responds to grazing



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The primary tools in the grazing managers tool box include
Manipulating the stocking rate
Selecting the proper kind and class of animal
adjusting the season of grazing.

Principles of Grazing Management:

Finding the Balance

Carrying Capacity: The average number of livestock that may be sustained on a management unit compatibly with management objectives. It is a function of site characteristics, and management goals and intensity of use.

1. Site Characteristics That Affect Carrying Capacity

- Ecological or Range Site
 - Climate (precipitation, avg. daily temperature, etc.)
 - Elevation
 - Topography
 - Soil types
 - Species composition and relative cover
 - Potential forage production
 - Condition class or seral stage
- Water Sources



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Carrying Capacity: The average number of livestock that may be sustained on a management unit compatibly with management objectives. It is a function of site characteristics, and management goals and intensity of use.

Principles of Grazing Management: Finding the Balance

2. Management Goals That Affect Carrying Capacity
- Maximize livestock production
 - Improve wildlife habitat
 - Improve riparian condition
 - Stabilize soils
 - Weed control
 - Reduce fire fuel loads to minimize fire danger
 - Improve range condition
 - Maintain seral stage
 - Facilitate or enhance nutrient cycling through pasture ecosystem



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Management goals and objectives will influence the carrying capacity of the land for livestock production

Principles of Grazing Management:

Finding the Balance

3. Intensity of Use and Carrying Capacity

- Animal Unit (AU): *Defines forage consumption on the basis of one standard mature 1,000 – pound cow with calf.*
 - Other classes of animals can be related to this standard, i.e. 100 lbs of animal weight = 0.1 AU
- Forage Demand (FD):
 - *One AU will consume 26 lbs of air dry forage per day (AUD)*
 - *One AU will consume 780 lbs of air dry forage per month (AUM)*
- Forage Available (FA):
 - *Forage Production (lbs) / unit area (acres) x % utilization Minus factors that reduce the foraging efficiency of the animal i.e. Slope, distance to water, aspect, adjusting for wildlife use, etc.*
- Grazing pressure: *is the ratio between Forage Demand (FD) to Forage Available (FA) at a given point in time (Grazing Pressure = FD/FA)*



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Animal Unit (AU): *Defines forage consumption on the basis of one standard mature 1,000 – pound cow with calf.*

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Grazing pressure: *is the ratio between Forage Demand (FD) to Forage Available (FA) at a given point in time (Grazing Pressure = FD/FA)*

Principles of Grazing Management:

Finding the Balance

- Animal performance is a function of nutrient requirements and intake.
- Quantity and quality of available forage are primary regulators of nutrient intake of grazing animals.
- Stocking Rate: *The number of specific kinds and classes of animals grazing a unit of land for a specified period.*
- Stocking rate decisions regulate grazing pressure and consequently forage quantity and quality.
- Stocking rates are expressed as
 - Number of AU/unit area (acres)/unit time (months, days, etc)
i.e. AUM/acre or acres/AUM; or AUY/acre or acres/AUY
- Stocking rates must be adjusted to the level of available forage or animal performance will suffer and affect the sustainability of the system.



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• Stocking Rate: *The number of specific kinds and classes of animals grazing a unit of land for a specified period.*

Principles of Grazing Management:

Managing the Balance

“ Sustainable Grazing Management begins with understanding the carrying capacity of the land, operates under sound management principles, and is evaluated via a monitoring program that provides an indication of the condition and trend of the grazed range or pasture ecosystem”

COW POKES

By Ace Reid



"How many head are you plannin' on overstockin' with this summer?"



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Principles of Grazing Management: Managing the Balance

Five essential management concepts:

1. Recovery Time
2. Stocking Rate
3. Stock Density
4. Foraging Efficiency
5. Grazing Pressure



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Five essential management concepts:

Recovery Time

Stocking Rate

Stock Density

Foraging Efficiency

Grazing Pressure

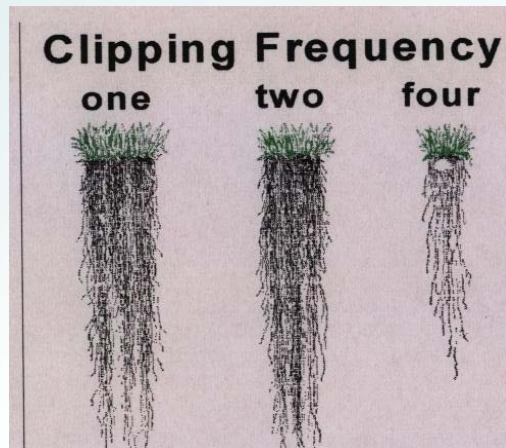
Principles of Grazing Management: Managing the Balance

Recovery time refers to the length of time between grazing events.

Optimizing this recovery time allows plants to replenish energy stores following defoliation and is essential to maintaining healthy plant communities.

Amount of recovery time following a grazing event depends on:

- Rate of plant growth
- Severity of defoliation



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Principles of Grazing Management:

Managing the Balance



Stocking rate is the most critical management factor affecting the grazing system.

The optimum stocking rate is that which the area can sustainably support while maximizing profit.

Optimum stocking rate is a function of the biological relationship between animals and forage resource, variable costs and sale price of the animals.

Optimum stocking rate is driven by the quantity and quality of available forage, the level of animal performance desired, management actions, and the type of livestock (forage preferences).



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Principles of Grazing Management:

Managing the Balance

Understocking means that the animal production system is losing money and thus is not economically sustainable.



Overstocking vs. Overgrazing

Overgrazing happens to individual plants, and is the result of grazing that is too frequent or intense, or recovery periods that are too short, or because of poor animal distribution. If continued it will result in plant death.

Overstocking does not necessarily result in overgrazing. Overstocking will always result in poor animal performance and will cause plant productivity to decrease in the short term, and if chronic, will cause long term decreases in productivity, soil stability, and profitability.



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Principles of Grazing Management:

Managing the Balance

Stocking density is a measure of the number of animals per unit of area at a given point in time (Not the same as stocking rate).

Stocking density is important because of its effects on

- livestock distribution,
- the animals' ability to select a high quality diet,
- the efficiency with which forage is harvested,
- the frequency and intensity of defoliation,
- and the plants' opportunity to regrow.

Foraging Efficiency is the proportion of total forage that is consumed by the grazing animal and usually ranges between 20 and 50%.

Grazing Pressure compares the amount of available forage to the animal demand and affects the quality of the diet that the animal can select.



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Principles of Grazing Management:

Monitoring the Balance

Five basic questions that need to be answered when developing a monitoring program to determine the sustainability of a grazing system.

1. Why do we want to monitor grazing?
2. What do we want to monitor?
3. When do we monitor?
4. Where do we monitor?
5. How do we monitor?



Why do we monitor grazing?

- follow changes or trends in the condition of the range or pasture ecosystem
- determine if grazing activities are achieving desired goals and objectives



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Principles of Grazing Management:

Monitoring the Balance



What do we monitor?

- Determining what to monitor depends on goal and objectives
 - Vegetation characteristics
 - Species composition, diversity, richness etc.
 - Cover, density, or frequency by species or vegetation type
 - Residual biomass following grazing (stubble height)
 - Available biomass before grazing
 - Soil characteristics
 - Soil compaction
 - Signs of erosion, pedestaling, loss of organic matter, changes in fertility, pH, etc.
 - Animal performance
 - Average daily gain, percent calving, breeding success, etc.



Principles of Grazing Management:

Monitoring the Balance

When and Where do we monitor?

- Frequency of monitoring should be such that it provides an adequate amount of time to change or adjust grazing to avoid overgrazing vegetation, soil damage, or loss of animal performance.
- Monitoring should be conducted where grazing is occurring:
 - Where grazing is (indicates current use levels)
 - Where grazing was (indicates total use and growth rate for estimating recovery time)
 - Where grazing will be (indicates grazing readiness)

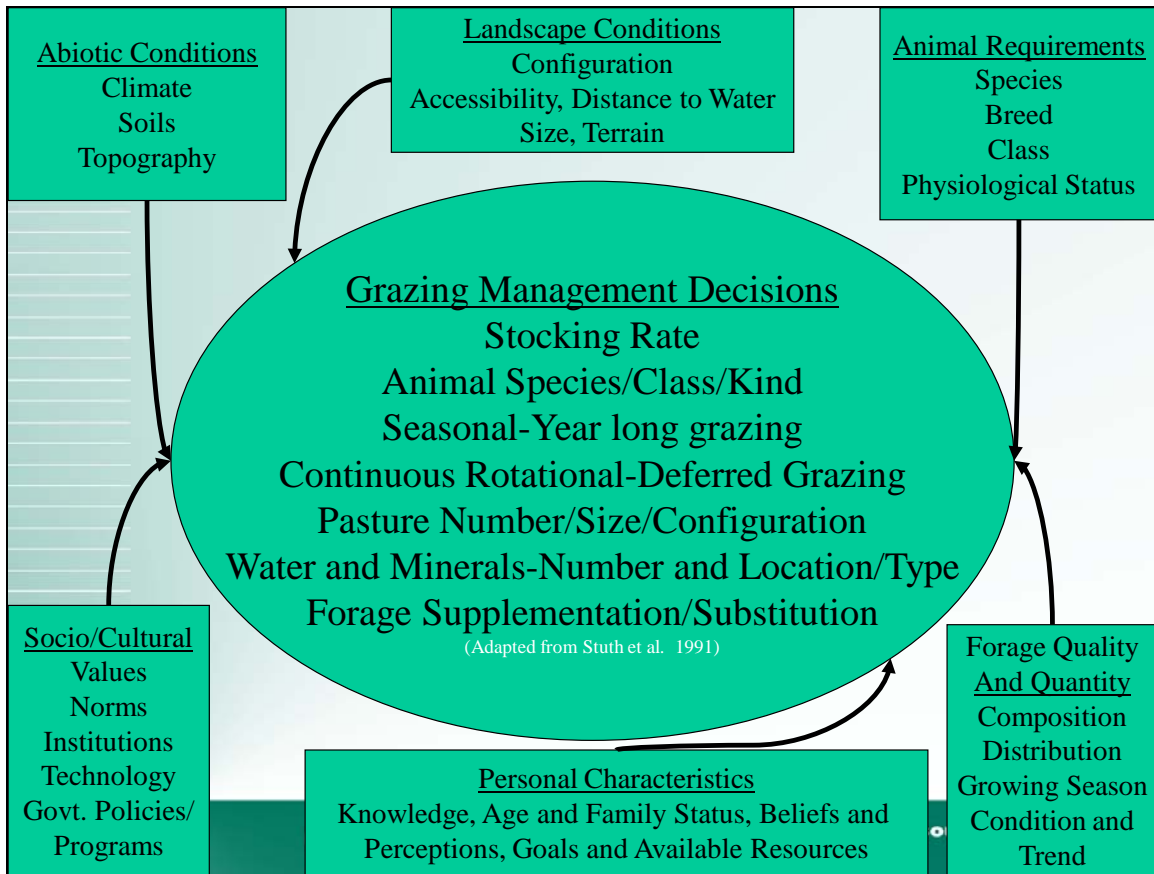


Principles of Grazing Management: Monitoring the Balance

How do we monitor?



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The grazing management environment

Summary:

In this presentation we explored some of the basic principles of grazing Management.

- Key points to remember:

- Four Grazing Factors: intensity, frequency, season, and animal selectivity interact and influence the plant, plant community, the landscape, and the grazing animal
- Proper grazing management requires tools to maintain the balance between animal production and land conservation
- Grazing Management Tools:
 - Manipulating the Stocking Rate
 - Kind and Class of Animal
 - Season of Grazing
- Proper use of the grazing management tools requires planning and monitoring
- Grazing management planning is influenced and directed by ecological, economic, and social constraints

