Forages: What does it all mean?

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Extension Program Specialist

TEXAS A&M AGRILIFE EXTENSION

What is a forage?

- According to Merriam-Webster a forage is food for animals especially when taken by browsing or grazing.

What role do forages play?

Forages: They're Good For Life

Dr. Larry A. Redmon
Texas Agricultural Extension Service

Forages play a vital role in the lives of everyone. Forages are leafy plants that can be divided into sub-classes of grasses and legumes. These plants are primarily used as food for grazing animals, but also contribute significantly to the lives of urban populations. Grasses comprise the largest class of forages. Legumes play an important role because of nitrogen fixation capability. Below are some of the critical roles that forage plants play in our everyday lives.

1) Forages reduce atmospheric CO_2. There is some scientific evidence that global warming may be occurring. Forages play a vital role in reducing CO_2 levels, a *greenhouse gas* thought to be responsible for increasing the earth's temperature under a global warming scenario. Forages use CO_2 and produce oxygen during photosynthesis as they produce their own energy sources. Forages, therefore, help sustain our environment.

2) Forages improve air quality. Wind blowing across bare landscapes picks up soil particles contributing to erosion and air pollution. Permanent cover provided by forage plants substantially reduces wind erosion and helps improve the quality of the air we breathe.

3) Forages provide areas of recreation. Recreational areas in which forage plants are used include sports turf, golf, hiking, hunting, bird watching, and camping. In fact, many professional sport organizations are shifting from Astroturf back to grass to reduce injury and enhance aesthetics. Water development, such as lakes and ponds, creates thousands of small wetland environments providing habitat for many game and non-game species. These environments also offer recreation in the form of fishing, boating, etc.

4) Forages provide cleaner water. Bare landscapes are also subject to erosion by water. Forages reduce raindrop impact on soils, slow overland movement of water, and allow rainfall to move *into* the soil, instead of *across* the soil, where precious topsoil is removed. Without forage plants, soil particles are transported by water out of fields and re-deposited in lakes and streams. These soil particles, or sediment, reduce the quality of water for drinking, recreational activities, and for sustainable fish and wildlife. The quantity and dependability of our total water supply can be adversely affected by areas not covered by forage plants.

Finally, another positive aspect of having forage plants on the landscape is a decreased incidence of flooding.

5) Forages provide alternatives to coal, oil, and gas for energy production. Coal, oil, and gas (fossil fuels) are used to generate energy around the world. These non-renewable fuels are in limited supply and alternative sources of energy are needed to provide electricity for lights, heating, cooling, etc. Research indicates the use of forage plants for energy generation results in less air pollutants compared with using fossil fuels. These biofuels could provide an endless supply of energy into the foreseeable future and beyond.

6) Forages provide habitat for wildlife species. Forages provide habitat for two-thirds of our game, non-game and endangered wildlife species in the US. From the thatch layer in the lawn providing homes for insects, to bunchgrasses serving as nesting habitat for birds, to grasses and legumes furnishing

Forages Sequester Atmospheric CO_2

- Forages use CO_2 and produce O_2 during photosynthesis.
- Thus, forages help sustain the environment.

Forages Improve Air Quality

Forages Provide Recreation Areas

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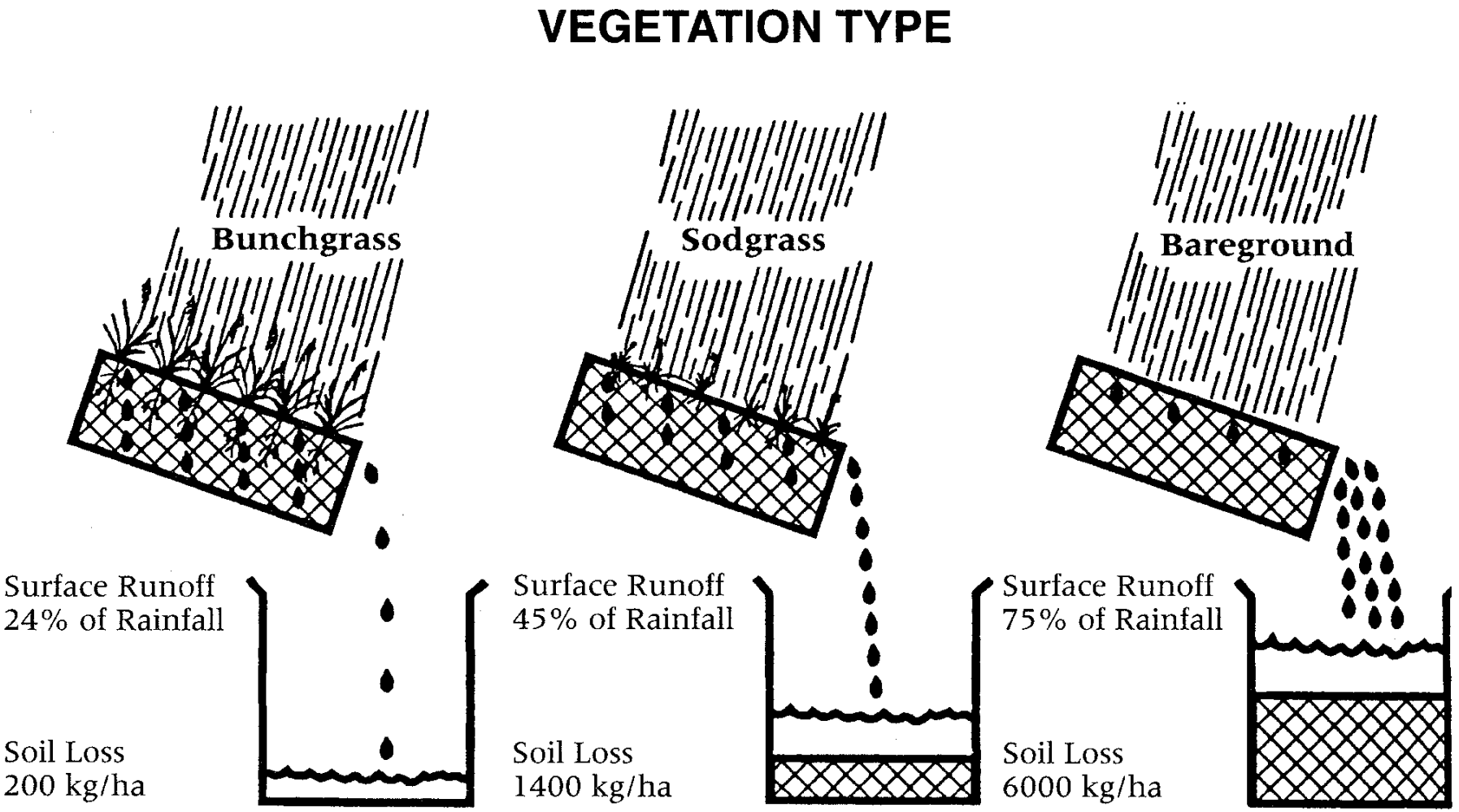
Forages Provide Cleaner Water



Filter Strip Effectiveness in Reducing Fecal Coliform Levels

Figure 3. Effectiveness of filter strips in reducing fecal coliform levels under varying conditions

Fecal Coliform Reduction	Slope	Buffer Length	Runoff Source	Reference
94.8% – 99.9%	5% - 35%	.1 – 2.1m	Grazing cattle	Tate et al. 2006
43% - 74%	9%	9m	Poultry litter on no-till cropland	Coyne et al. 1995
64% - 87%	4%	9m	Manure	Fajardo et al. 2001
>99%	4%	1 - 25m	Manure on pastureland	Sullivan et al. 2007

Forages May Serve as Alternative Fuels

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Forages Provide Wildlife Habitat

Other Important Societal Aspects of Forages

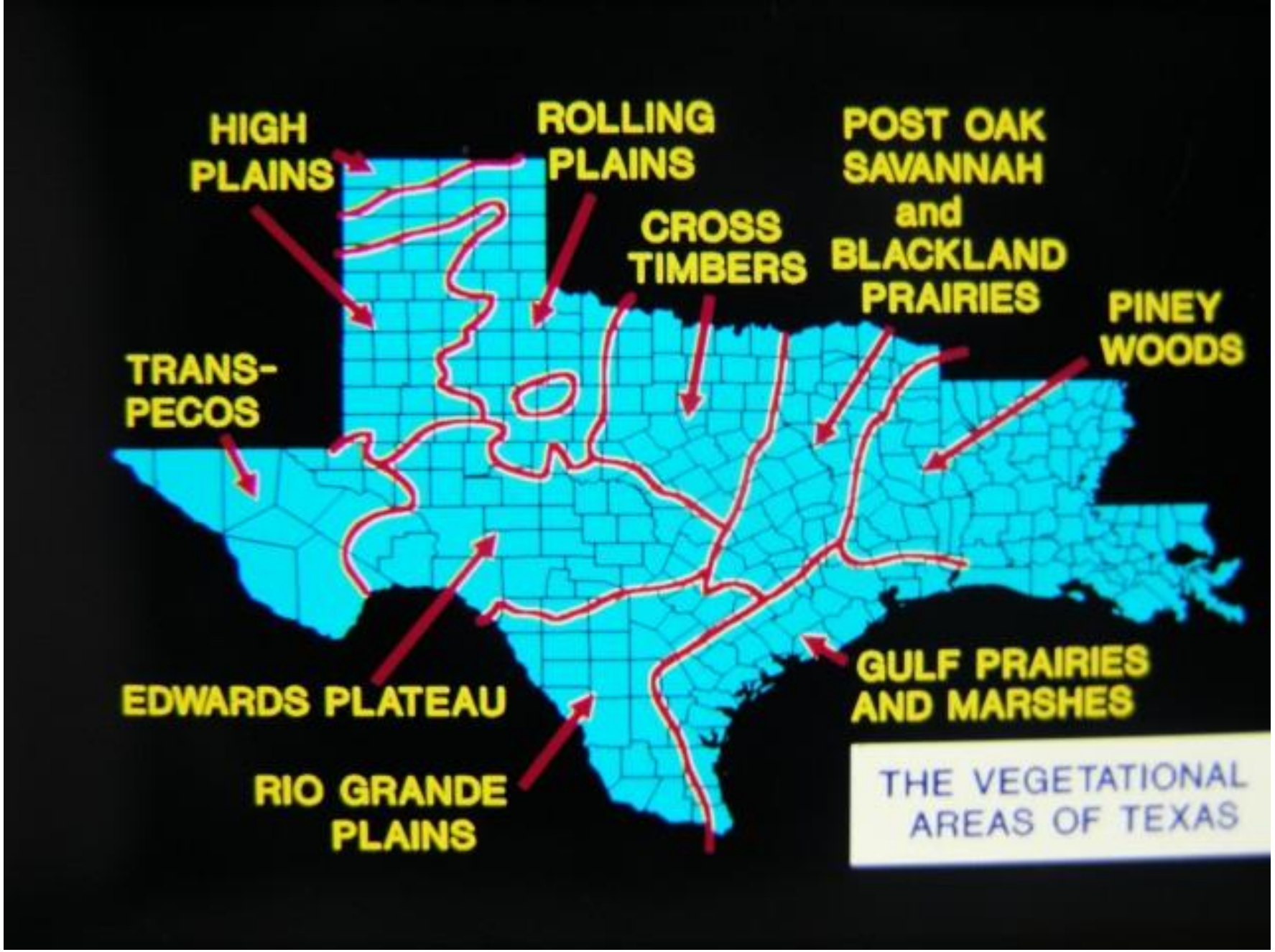
- Forages help improve the quality of life for rural Americans
- Forages maintain and/or improve site productivity
- Forages moderate temperatures
- Forages moderate noise

Forages Convert Solar Energy into Meat, Milk, and Fiber

Forages Create Areas of Aesthetic Beauty

Forage Species

- W-S Perennials
  - Bermudagrass
  - Bahiagrass
  - Old World Bluestem
  - Kleingrass
  - Dallisgrass
- W-S Annuals
  - Grass
    - Crabgrass
    - Sorghum
    - Millet
    - Teff
  - Legumes
    - Cowpea
    - Lablab
- C-S Annuals
  - Wheat
  - Oat
  - Barley
  - Ryegrass
  - Other small grains
- Forage Legumes
  - Clovers
  - Medics
  - Winter Pea
  - Alfalfa



Source: Native Plant Society of Texas

Fertility is needed with grazing or hay

Nutrient Uptake by Coastal Bermudagrass/2 Tons DM

	Nutrient	lbs/acre
Primary	Nitrogen	100
	Phosphorus	28
	Potassium	96
Secondary	Calcium	16
	Magnesium	6
	Sulfur	8
Micro's	Copper	0.05
	Manganese	0.05
	Zinc	0.10

Nutrient removal from a grazed pasture by growing beef cattle[1]

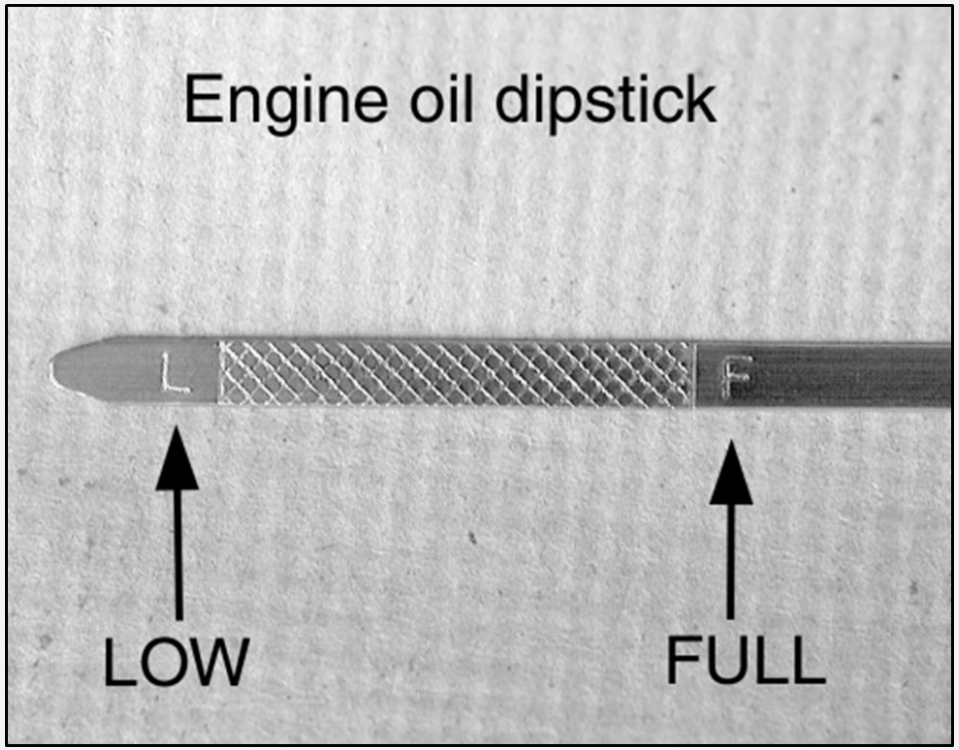
Nutrient	%	500-lb calf	lbs/acre[2]	Hay/acre
N	2.72	13.6	2.7	100
P	0.68	3.4	0.7	28
K	0.15	0.75	0.15	96
S	0.15	0.75	0.15	8
Ca	1.28	6.4	1.3	16
Mg	0.04	0.2	0.04	6

[1] Adapted from Mathews et al., 1996

[2] Assumes 5 acre/AU stocking rate

Soil Test

- Soil test is the "**dip stick**" that tests the level of critical soil nutrients
  - Used to determine level of and need for
    - **P, K**, other soil nutrients, **soil pH**
  - Would you add a quart of oil to your truck without checking the dipstick?
- Use soil test to determine **annual** P, K, and limestone requirements



Brazos County

Area Represented: not provided

Laboratory Number: 271597

Customer Sample ID: McGuill 6-12

Crop Grown: IMPROVED AND HYBRID BERMUDA GRASS (3 HAY CUTTINGS-2 TONS/A AVG.)

Analysis	Results	CL*	Units	ExLow VLow Low Mod High VHigh Excess	Fertilizer Recommended
pH	6.5	(5.8)	-	Slightly Acid	
Conductivity	80	(-)	umho/cm	None	
Nitrate-N	0	(-)	ppm		95 lbs N/acre
Phosphorus	4	(50)	ppm		110 lbs P2O5/acre
Potassium	27	(150)	ppm		200 lbs K2O/acre
Calcium	1,038	(180)	ppm		0 lbs Ca/acre
Magnesium	109	(5[illegible]	ppm		0 lbs Mg/acre
Sulfur	13	(1[illegible]	ppm		5 lbs S/acre
Sodium	195	(-)	ppm		
Iron					
Zinc					
Manganese					
Copper					
Boron					
Limestone Requirement					0.00 tons 100ECCE/acre

*CL=Critical level is the point which no additional nutrient (excluding nitrate-N, sodium and conductivity) is recommended.

Always apply what is recommended…

Nitrogen Apply an additional 100 lbs/A of nitrogen for each subsequent hay cuttings.

Potassium: Split apply potassium fertilizer if recommendation is for more than 75 lbs K2O per acre.

Sulfur: Available sulfur may be found deeper in soil profile, thus limiting any response to added sulfur.

REDMON'S RULES

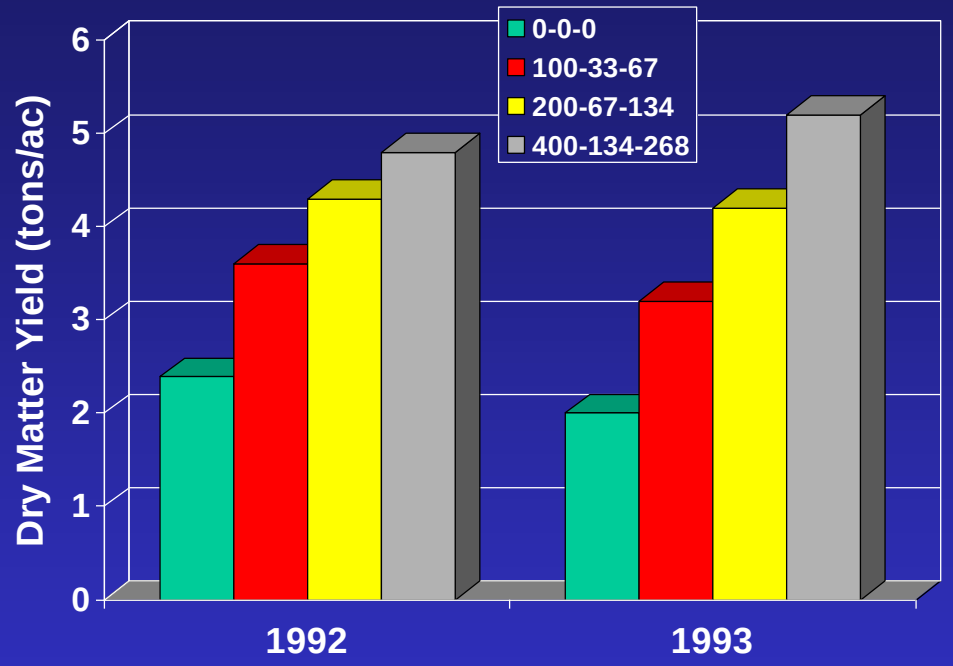
Appropriate fertility provides both increased dry matter production and elevated crude protein levels.

Fertilizer Nutrients

Nitrogen is important for:

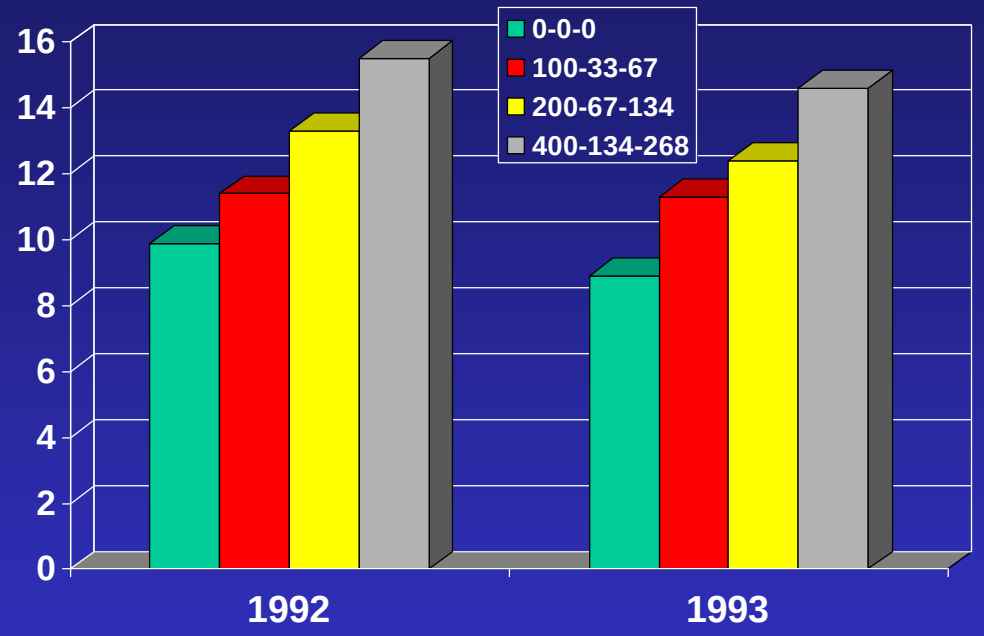
- Growth
  - ✓ N is part of the chlorophyll molecule
  - ✓ N is part of essential amino acids
- Significantly increases crude protein in W-S grasses.
- Increases digestibility

Effect of nitrogen fertilization rate on ‘Coastal’ bermudagrass dry matter (DM) production. [1]



[1] Evers, 1998

Effect of nitrogen fertilization rate on ‘Coastal’ bermudagrass crude protein (CP) content.[1]



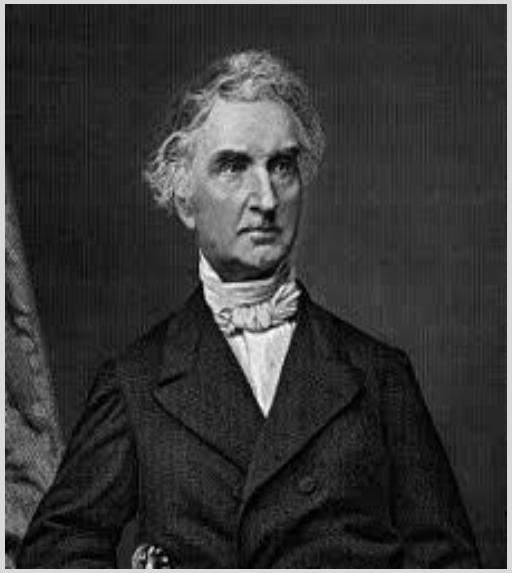
[1] Evers, 1998

Nitrogen Sources

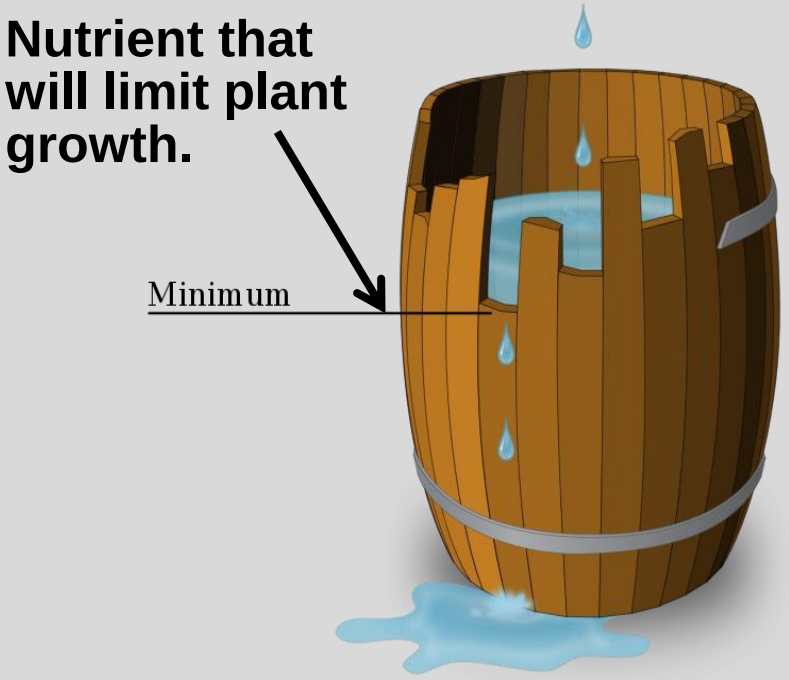
1. Urea (46-0-0)
2. Ammonium nitrate (34-0-0)
3. Ammonium sulfate (21-0-0)
4. Urea ammonium nitrate (32-0-0)
5. Anhydrous ammonia (82-0-0)
6. Atmospheric N via legumes
7. Broiler litter (60-60-40 lbs/ton)
8. Class A Biosolids

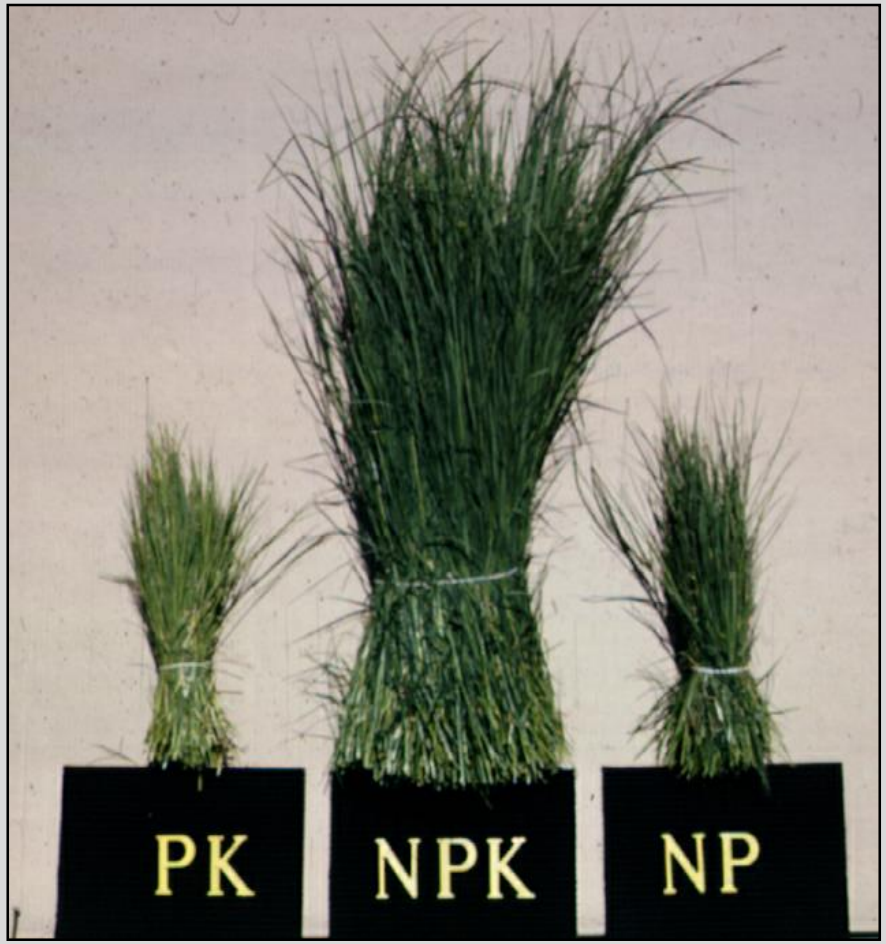
Depending on where you live, urea or ammonium nitrate may be your only source. Broiler litter, where available, may be an excellent buy.

Don’t forget P and K…



Liebig's Law of the Minimum (*circa* 1828)





Managing for grazing

Rangeland Health

* The degree to which the integrity of the soil, vegetation, water, and air, as well as the ecological processes are balanced and sustained.

* Structure and Function of the System

Forage Quality and Livestock Nutrition

* Nutrient Intake
* Health
* Production & Maintenance
* Habitat

Physiologic status

- Open or bred cows in mid gestation - low req.
- Bred cows in late gestation – higher req.
- Bred cows with calves – highest req.
- Developing heifers and bred heifers – treat as bred cows with calves

Forage High in Nutritive Value

* High Palatability
* Optimum Levels of Nutrients In Proper Ratios
* High Digestibility
* Optimal Proportions of Energy-Producing Fatty Acids
* Adequate Levels of Minerals and Trace Elements

Characteristics and Requirements of The Cow

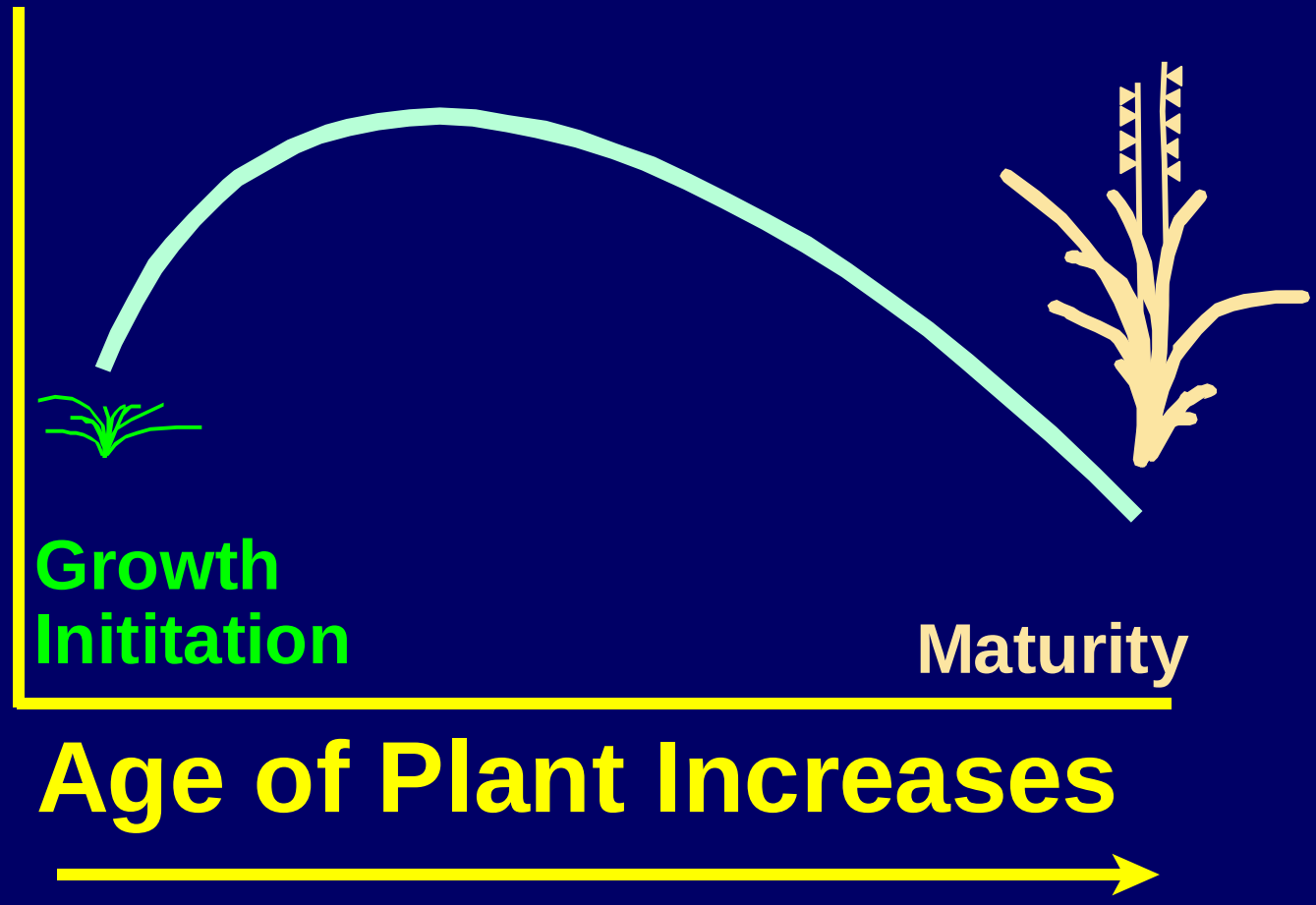
- Diet Quantity and Quality

  >> 2% -3% of Body Weight of Dried Forage Daily

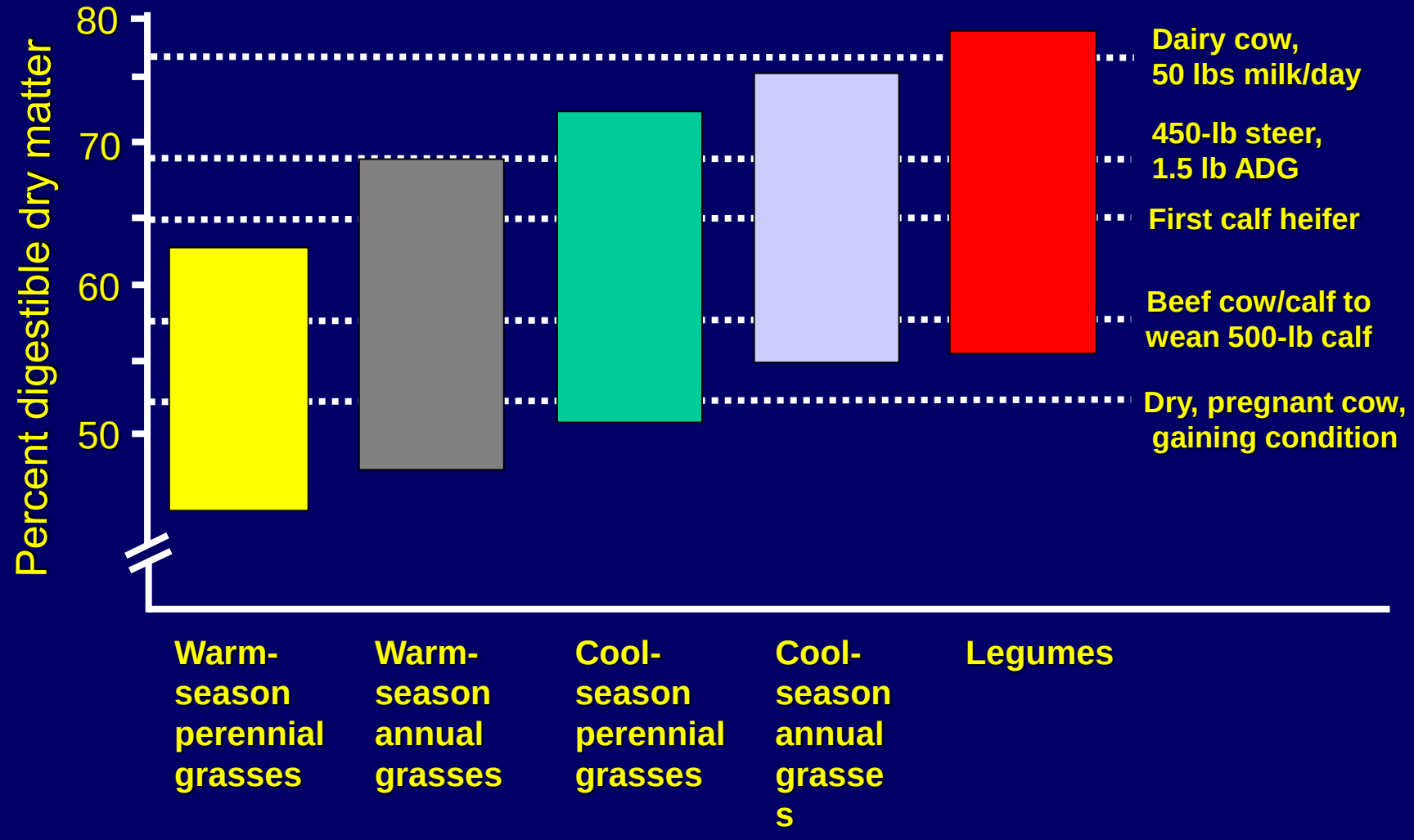
  - Body weight = 1000 lbs; 2% = 20 lb; 3% = 30 lb.

  - Body weight = 1200 lbs; 2% = 24 lbs; 3% = 36 lbs

Maturity Affects Quantity and Nutritive Value



Forage digestibility ranges and their suitability for different classes of livestock.



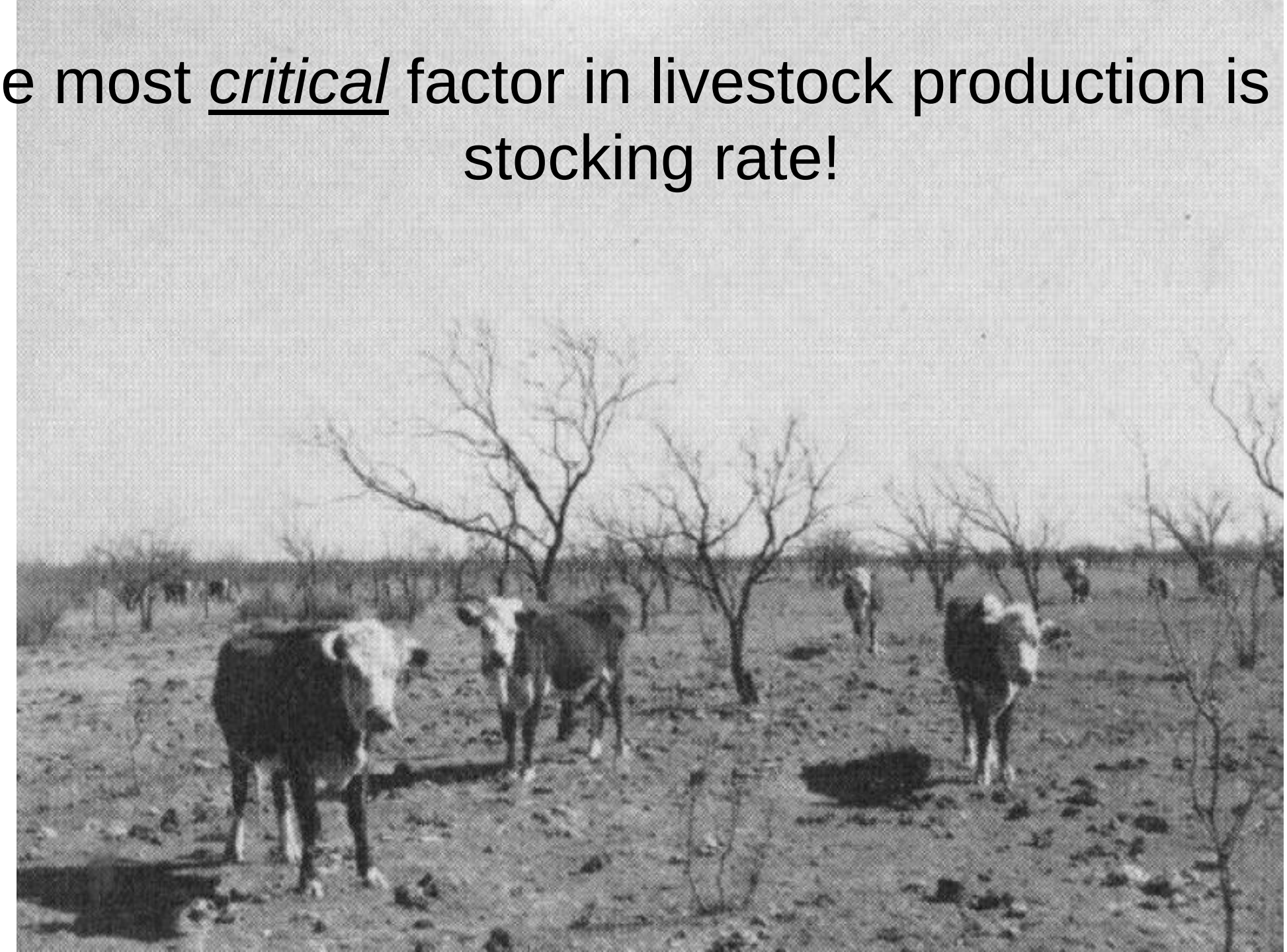
Adapted from: H. Lippke and M.E. Riewe. 1976. Texas Agric. Exp. Stn. Res. Monograph RMGC:169-206.

Forage Nutritive Value Changes

- Plant Parts (leaves, stem, etc.)
- Plant Age
- Plant Group
- Season of Growth
- Soils/Sites
- Stocking Rate
- Secondary Compounds
- Livestock/Wildlife Species

Water and Fences: Basic to Grazing Management

The most *critical* factor in livestock production is the stocking rate!



Many operations are overstocked…

- Inadequate ground cover leads to loss of:
  - **Topsoil**
    - Hundreds to > 1,000 years to create 1”
  - **Fertilizer nutrients**
    - Money *literally* goes down the creek
  - **Organic matter**
  - **Pesticides**
  - **Bacteria**

What Causes Overstocking?

- Increased cattle size

Larger cattle size = increased DM intake = increased forage demand

- Granddad's cattle
- Dad's cattle
- Today's cattle
- Same # head but an increased SR

1200 lbs = 31 lbs/day

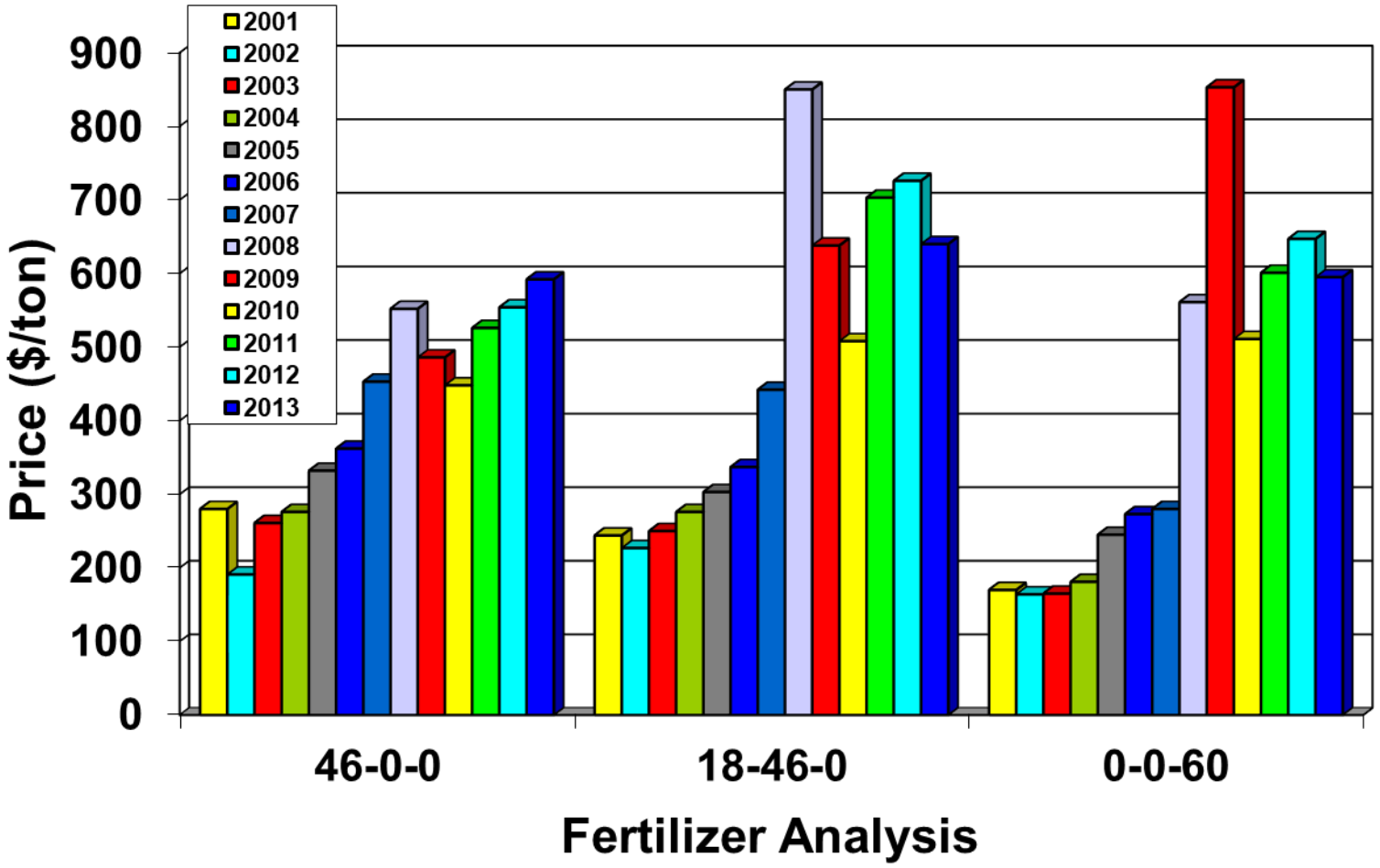
1000 lbs = 26 lbs/day

800 lbs = 21 lbs/day

What Causes Overstocking?

- Increased cattle size
- Lack of fertility on introduced pastures

Fertilizer Price Changes



What Causes Overstocking?

- Increased cattle size
- Lack of fertility on introduced pastures
- Lack of weed/brush control


Whether weeds, or


Brush
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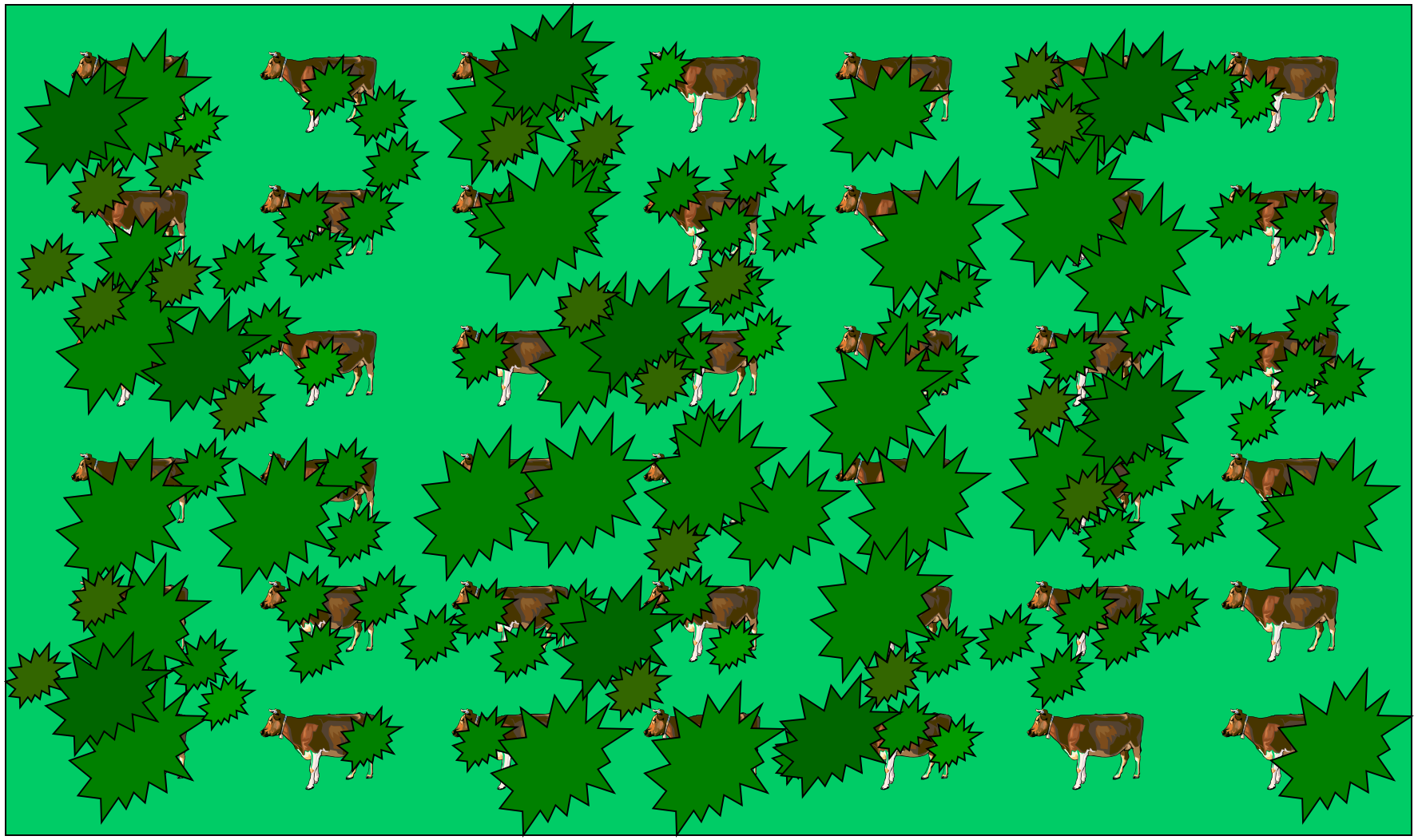
Brush

Brush Effect on Stocking Rate



What Causes Overstocking?

- Increased cattle size
- Lack of fertility on introduced pastures
- Lack of weed/brush control
- Anything that reduces grazeable acres…
  - Relates to animal behavior…

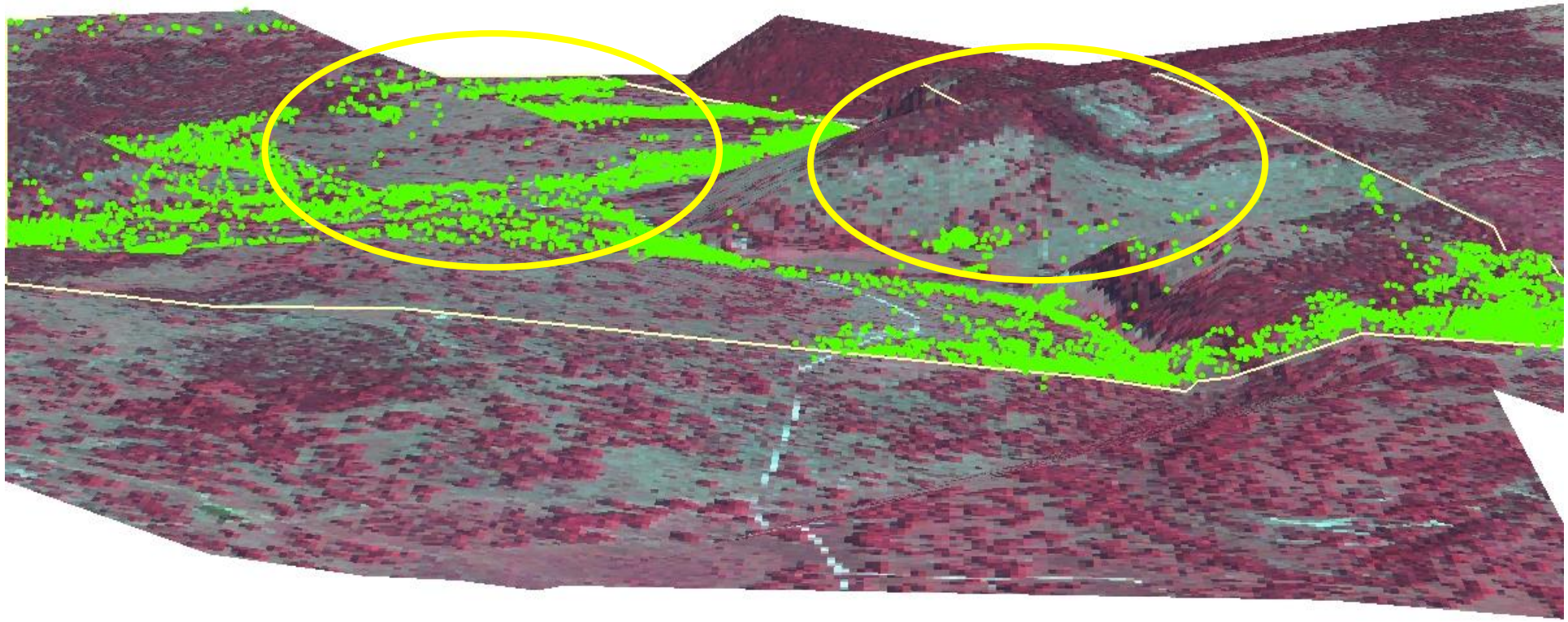
Factors That Affect Grazeable Acres

- Water source >1 mile
- Rock cover >30%
- Brush density scores ≥4
- Slope >10%
- Dormant or unpalatable forage species >30%???
- Easy access

You must adjust stocking rate for any of the above factors…

Edwards Plateau Ranch 3-D View w/ GPS Locations

- 39% area used
- 41% GPS points on 9% area
- SR: 21 ac/cow
- Effective SR: 9 ac/cow



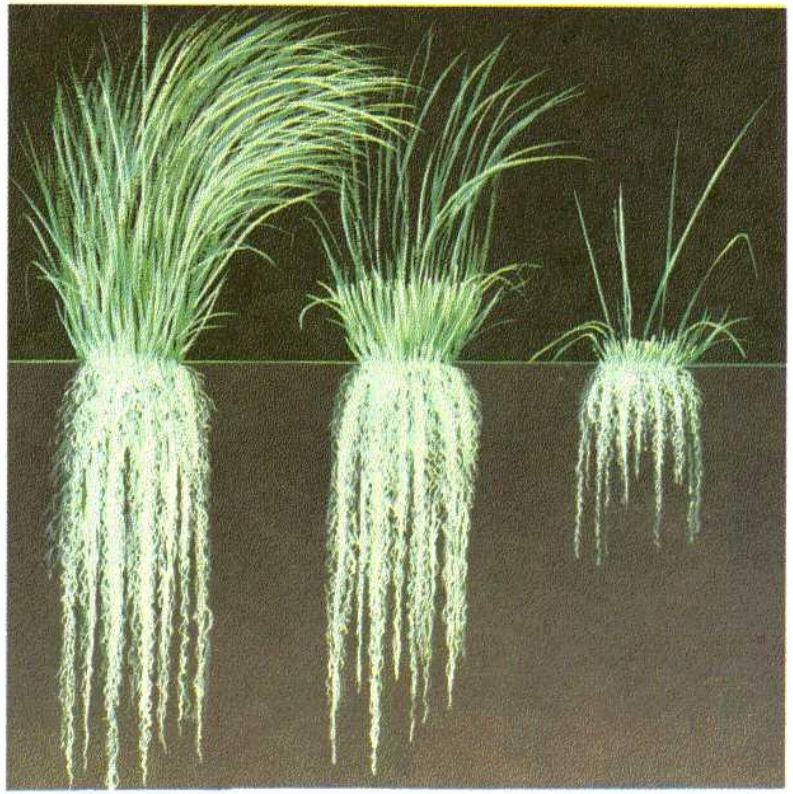
So, if we are overstocked,
what happens…?

Overstocking Adversely Affects:

- Forage production and persistence

Defoliation Affects Root Systems

% Leaf Volume Removed	% Root Growth Stoppage
10%	0%
20%	0%
30%	0%
40%	0%
50%	2-4%
60%	50%
70%	78%
80%	100%
90%	100%



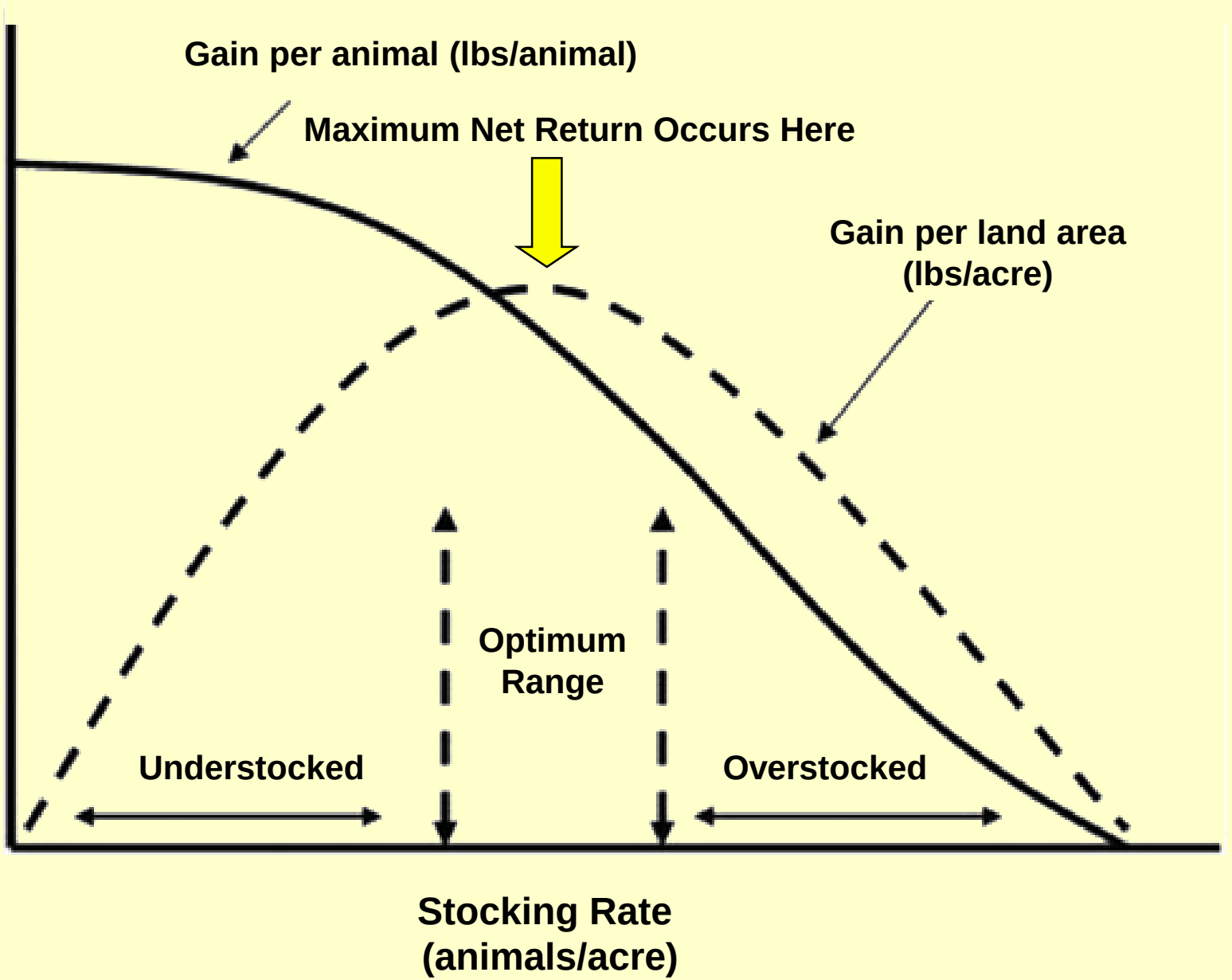
Overstocking Adversely Affects:

- Forage production and persistence
- Animal production and performance

Note the forage residue remaining in these pastures…

Overstocking Adversely Affects:

- Forage production and persistence
- Animal production and performance
- Profitability


Gain per animal (lbs/animal)
Maximum Net Return Occurs Here
Gain per land area
(lbs/acre)
Optimum
Range
Understocked
Overstocked
Stocking Rate
(animals/acre)

Overstocking Adversely Affects:

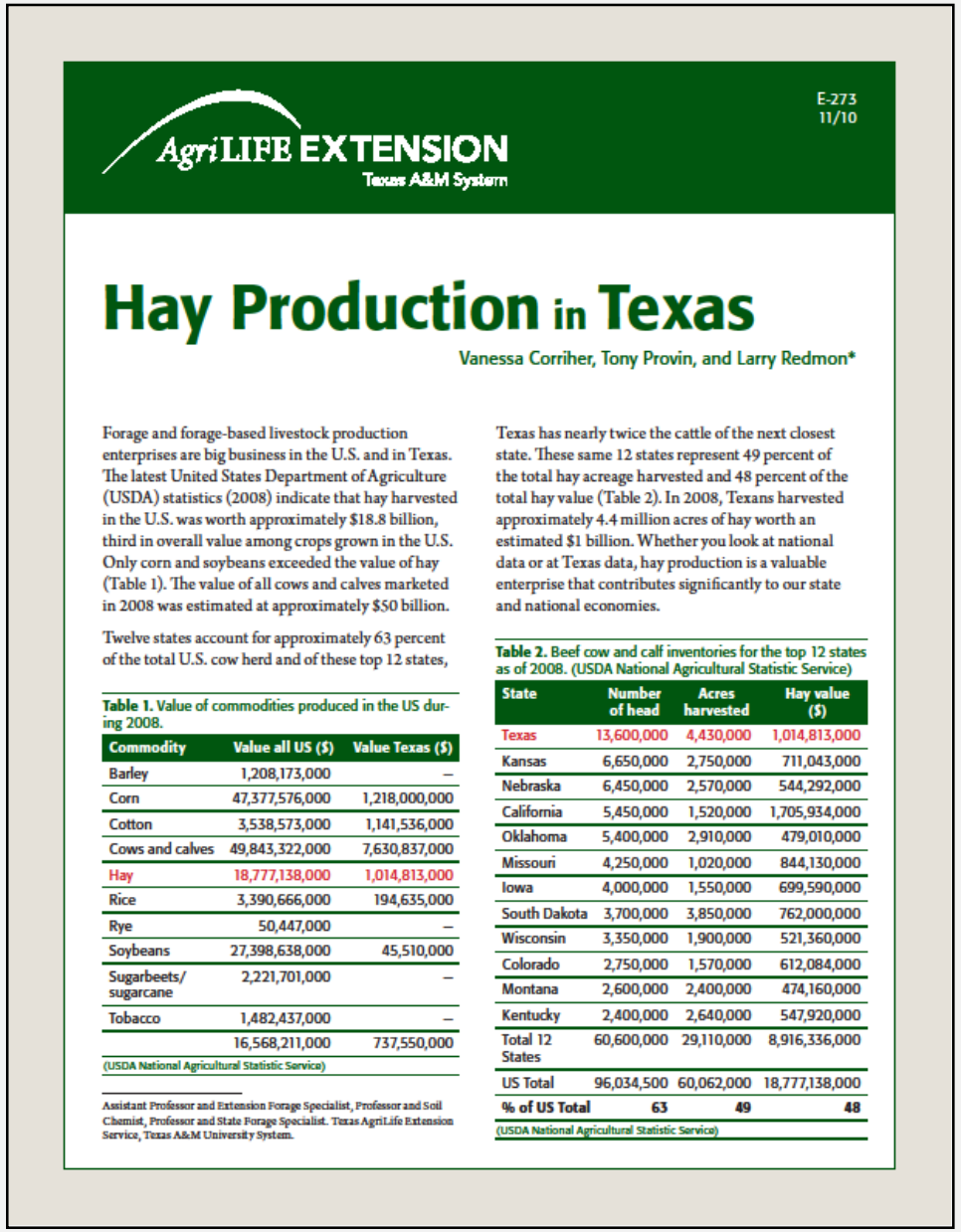
- Forage production and persistence
- Animal production and performance
- Profitability
- The environment

The Importance of Ground Cover

http://forages.tamu.edu

Texas AgriLife Bookstore

https://agrilifebookstore.org



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Hay Production in Texas

Vanessa Corriher, Tony Provin, and Larry Redmon*

Forage and forage-based livestock production enterprises are big business in the U.S. and in Texas. The latest United States Department of Agriculture (USDA) statistics (2008) indicate that hay harvested in the U.S. was worth approximately $18.8 billion, third in overall value among crops grown in the U.S. Only corn and soybeans exceeded the value of hay (Table 1). The value of all cows and calves marketed in 2008 was estimated at approximately $50 billion.

Twelve states account for approximately 63 percent of the total U.S. cow herd and of these top 12 states, Texas has nearly twice the cattle of the next closest state. These same 12 states represent 49 percent of the total hay acreage harvested and 48 percent of the total hay value (Table 2). In 2008, Texans harvested approximately 4.4 million acres of hay worth an estimated $1 billion. Whether you look at national data or at Texas data, hay production is a valuable enterprise that contributes significantly to our state and national economies.

Table 1. Value of commodities produced in the US during 2008.

Commodity	Value all US ($)	Value Texas ($)
Barley	1,208,173,000	–
Corn	47,377,576,000	1,218,000,000
Cotton	3,538,573,000	1,141,536,000
Cows and calves	49,843,322,000	7,630,837,000
Hay	18,777,138,000	1,014,813,000
Rice	3,390,666,000	194,635,000
Rye	50,447,000	–
Soybeans	27,398,638,000	45,510,000
Sugarbeets/ sugarcane	2,221,701,000	–
Tobacco	1,482,437,000	–
	16,568,211,000	737,550,000

(USDA National Agricultural Statistic Service)

Table 2. Beef cow and calf inventories for the top 12 states as of 2008. (USDA National Agricultural Statistic Service)

State	Number of head	Acres harvested	Hay value ($)
Texas	13,600,000	4,430,000	1,014,813,000
Kansas	6,650,000	2,750,000	711,043,000
Nebraska	6,450,000	2,570,000	544,292,000
California	5,450,000	1,520,000	1,705,934,000
Oklahoma	5,400,000	2,910,000	479,010,000
Missouri	4,250,000	1,020,000	844,130,000
Iowa	4,000,000	1,550,000	699,590,000
South Dakota	3,700,000	3,850,000	762,000,000
Wisconsin	3,350,000	1,900,000	521,360,000
Colorado	2,750,000	1,570,000	612,084,000
Montana	2,600,000	2,400,000	474,160,000
Kentucky	2,400,000	2,640,000	547,920,000
Total 12 States	60,600,000	29,110,000	8,916,336,000
US Total	96,034,500	60,062,000	18,777,138,000
% of US Total	63	49	48

(USDA National Agricultural Statistic Service)

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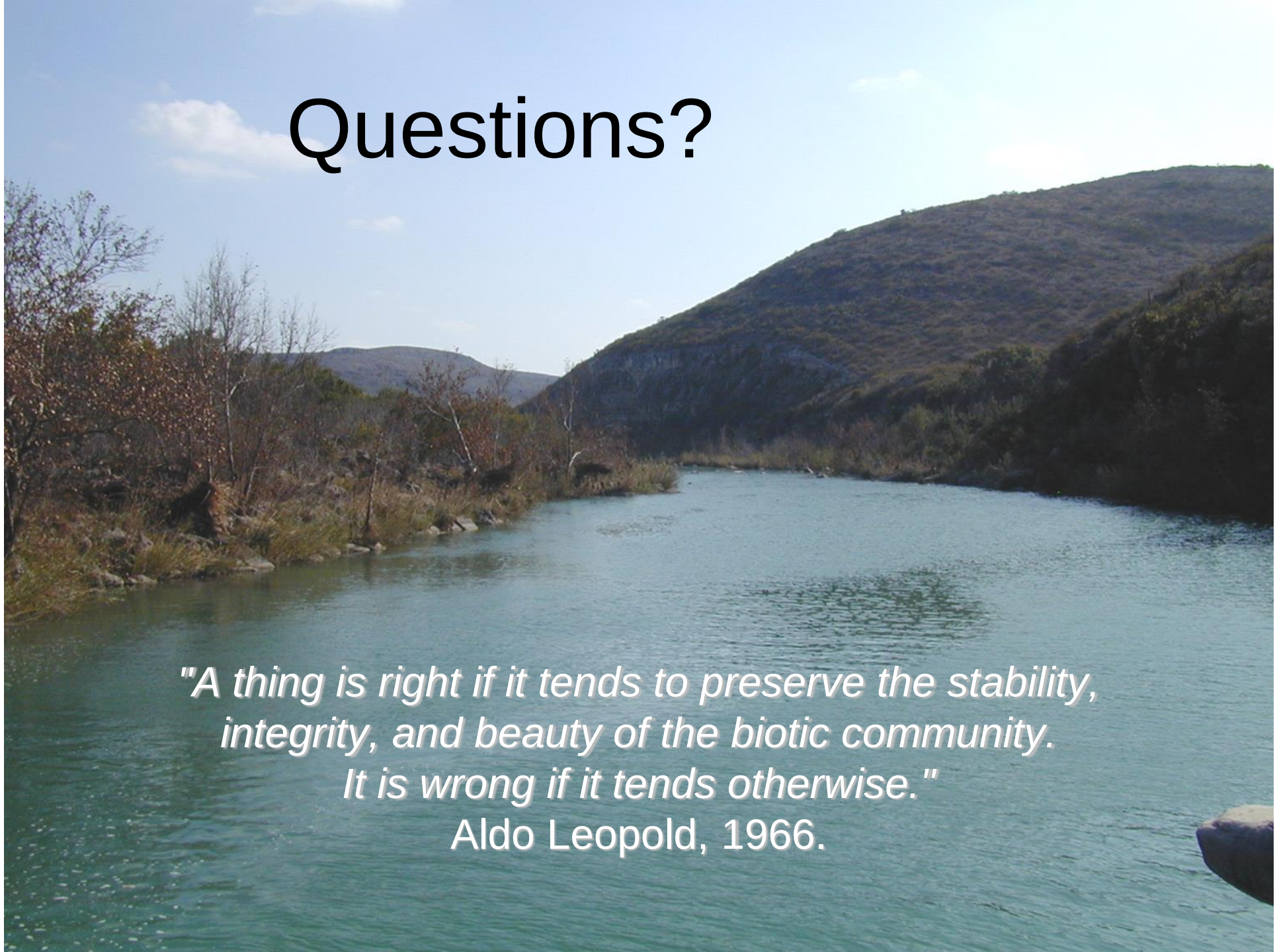
Questions?



"A thing is right if it tends to preserve the stability, integrity, and beauty of the biotic community. It is wrong if it tends otherwise."

Aldo Leopold, 1966.