AgriLIFE EXTENSION
Texas A&M System

7 Things Every Small Producer Should Know

Rick Machen, PhD
Professor & Specialist
Animal & Natural Resource Management

Top Eleven

6. You cannot starve a profit out of cows.
7. Too often, cattle operations suffer from ‘hardware’ disease.
8. A ranch seldom runs as many cattle (sustainably) as the realtor indicated.
9. Black cattle are not the cure for all ills.
10. Eliminating a practice that costs $2/head will not pay for a $40,000 pickup.
11. You cannot start a Longhorn breeding program with a trophy steer.

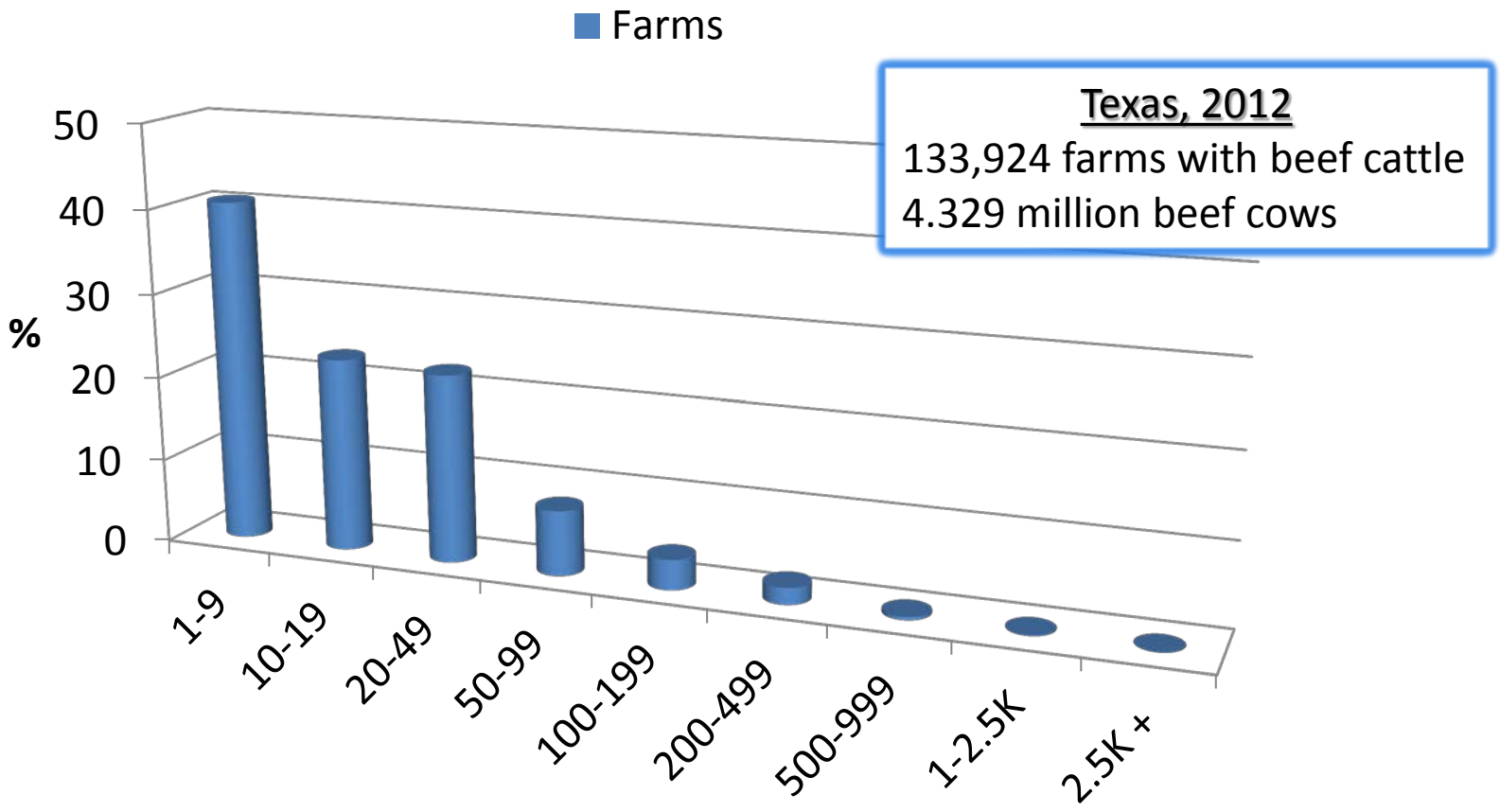
Top Eleven

1. Working cattle is the leading cause of domestic disturbances among ranch families.
2. Treat ranching as a **hobby** or a **BUSINESS**, but not both. Results from the two differ vastly.
3. The ***romance*** in owning cows is reserved for the movies.
4. One can go bankrupt avoiding property taxes.
5. Profit shortfalls are seldom overcome by simply adding more cows.

Define ‘small’ producer

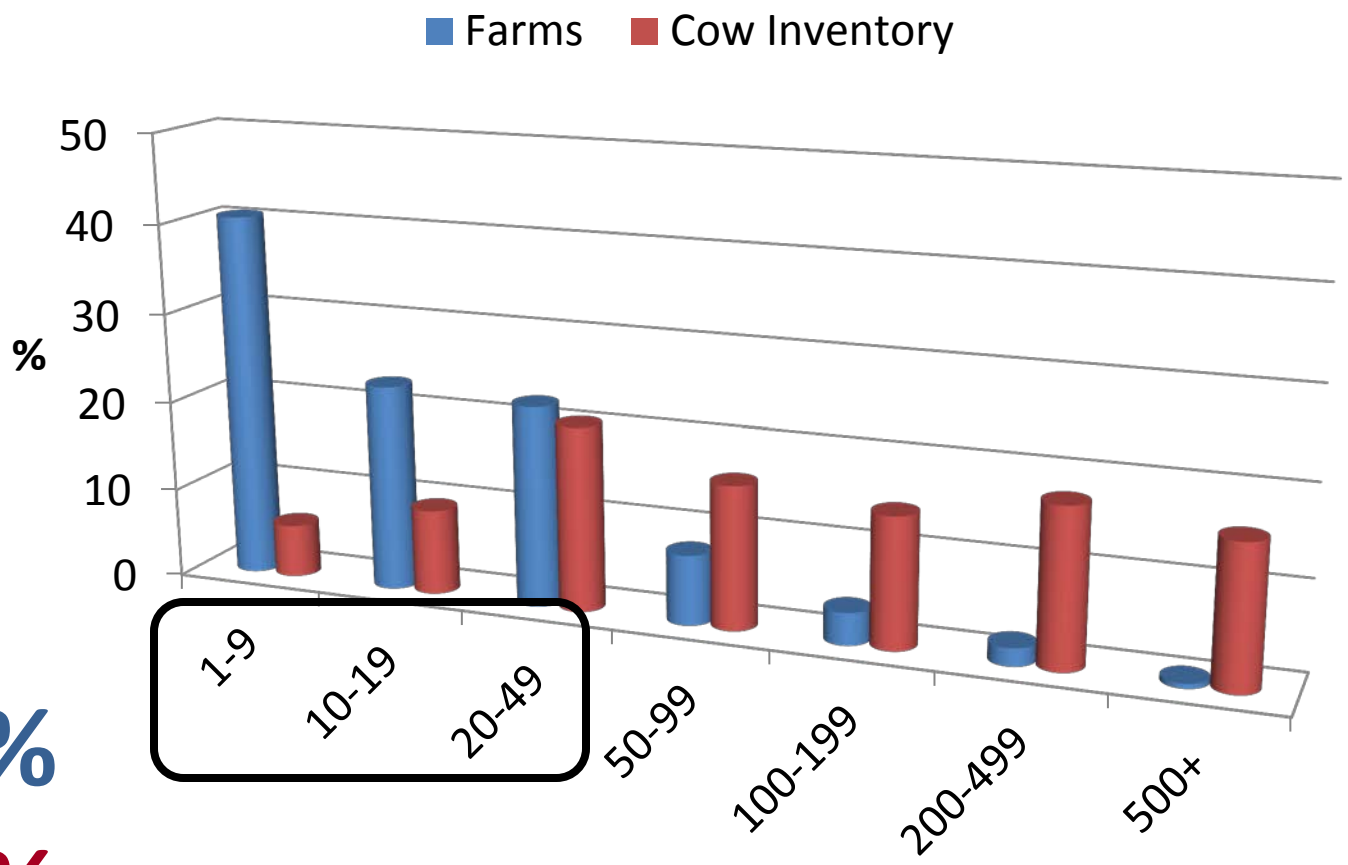
“Every domestic agricultural producer contributes to the safest, most wholesome food supply in the world and is obligated to share their personal story of quality assurance and stewardship.”

Texas Beef Cow Demographics



2012 USDA Census of Agriculture

Texas Beef Cow Demographics



86%

36%

2012 USDA Census of Agriculture

#1

STEWARDSHIP
IS
JOB ONE.

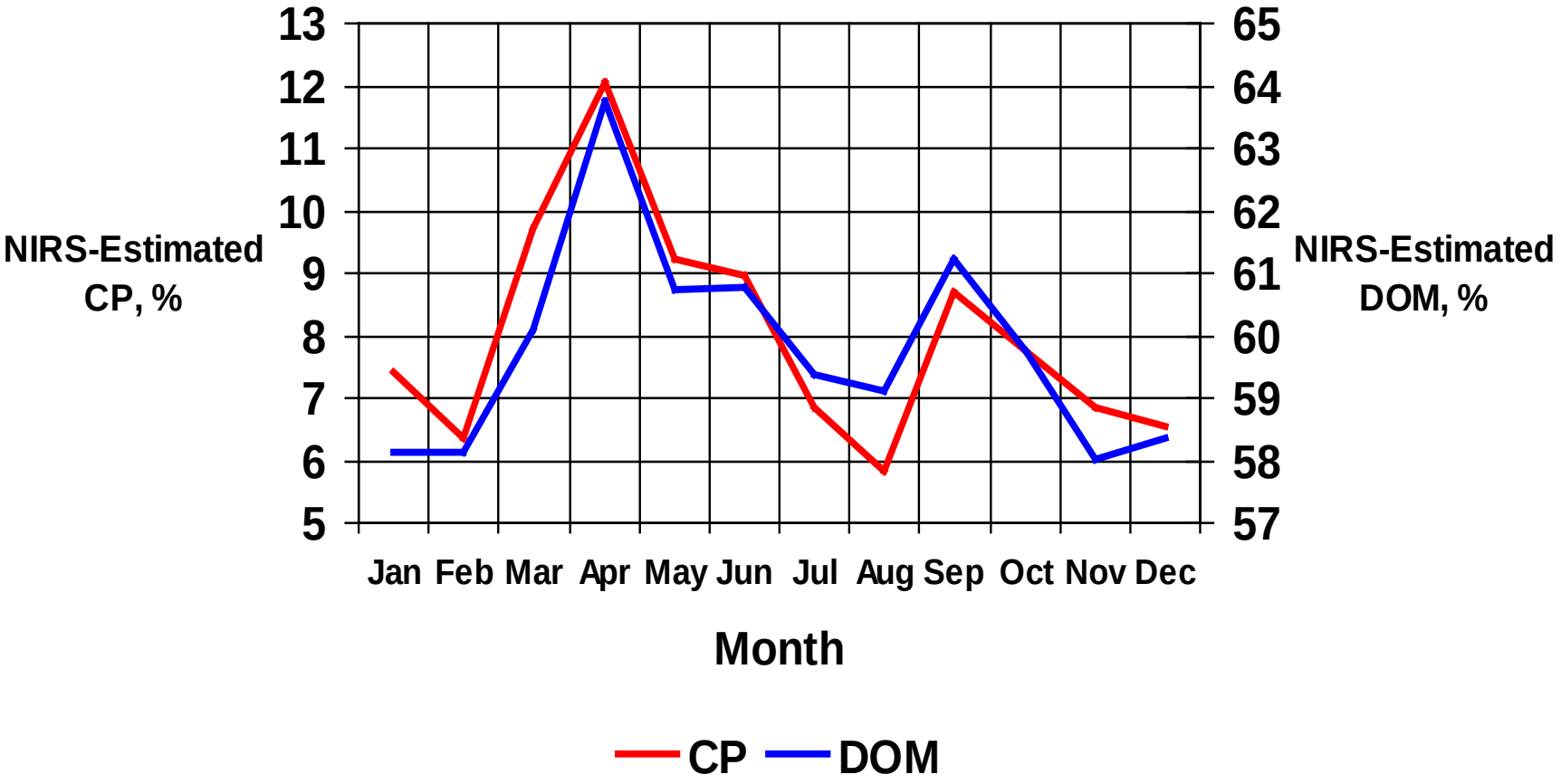

As natural resource stewards,
we have three primary responsibilities.

Stewardship

Soil Forage Water

Gillespie County Average Diet Quality

2 Ranches, 3 years



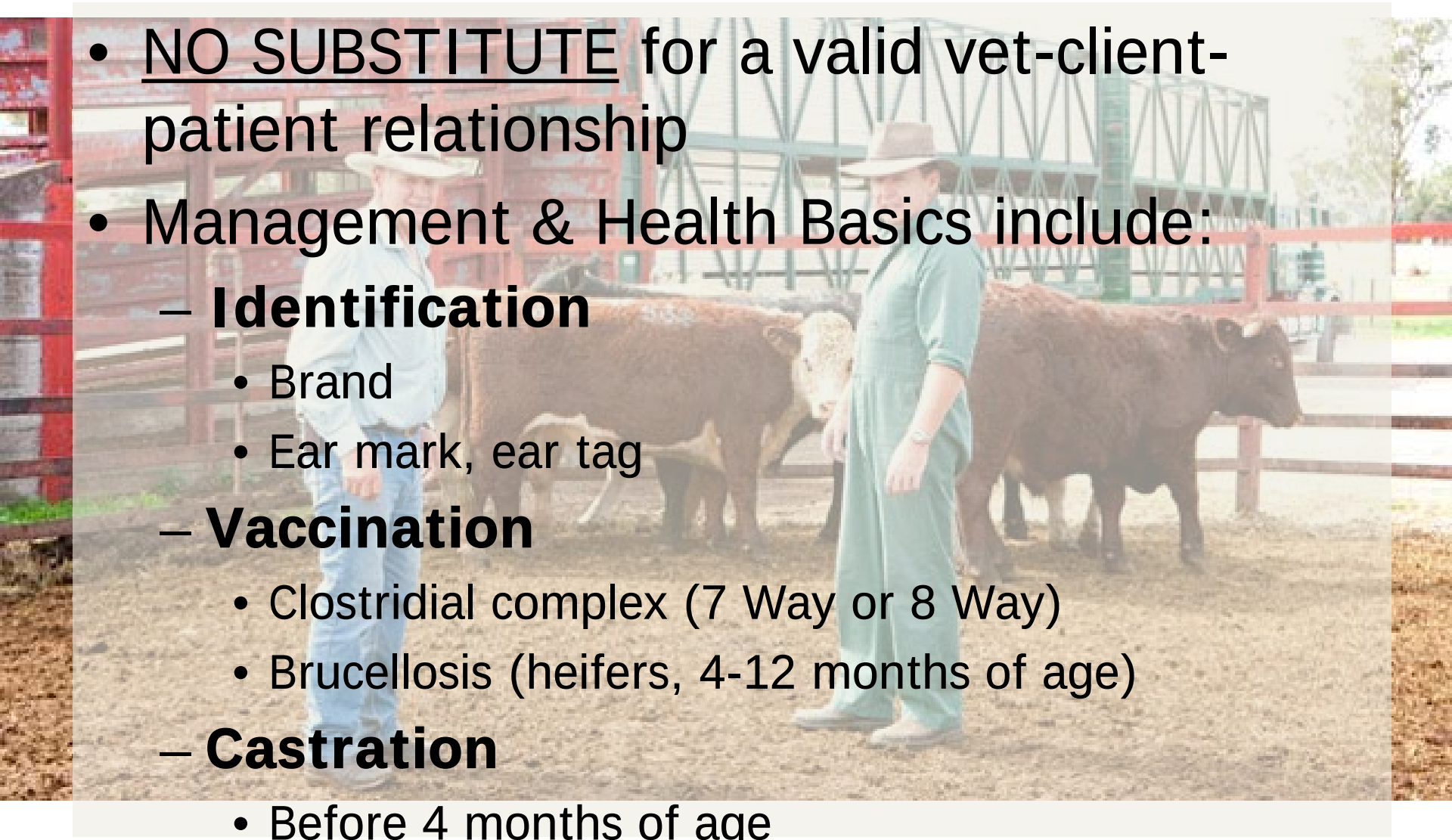
R. Lyons and R .Machen data


SCHOOL BUS

#2

A PREVENTATIVE HERD HEALTH PLAN IS ESSENTIAL.

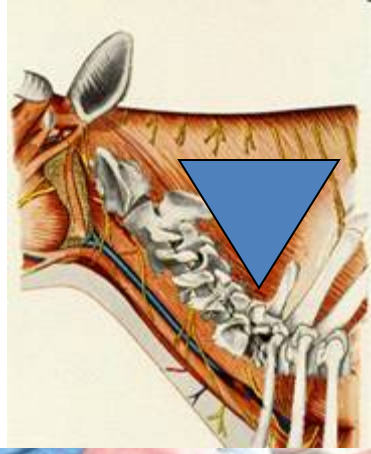
Preventative Herd Health Plan



- NO SUBSTITUTE for a valid vet-client-patient relationship
- Management & Health Basics include:
  - **Identification**
    - Brand
    - Ear mark, ear tag
  - **Vaccination**
    - Clostridial complex (7 Way or 8 Way)
    - Brucellosis (heifers, 4-12 months of age)
  - **Castration**
    - Before 4 months of age

Depending on risk...

Always follow the label



- **Clostridial complex**

- **Brucellosis** (Vet. Supervision)
- **Trichomoniasis** (cows, heifers)

- **Repro complex** (Lepto, Vibrio)
- **Viral respiratory complex**
  - IBR, PI3, BVD, BRSV
  - MLV or Killed?
- **Anthrax**

#3

ARE MY COWS GETTING ENOUGH TO EAT?

AgriLIFE EXTENSION
Texas A&M System

B-6037

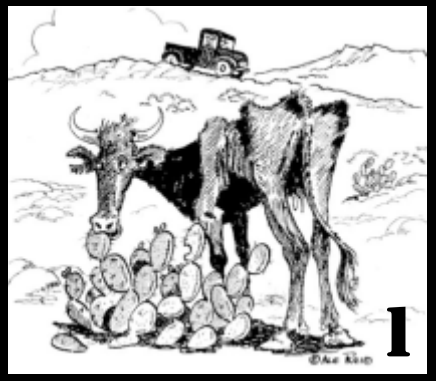
What Range Herbivores Eat—and Why

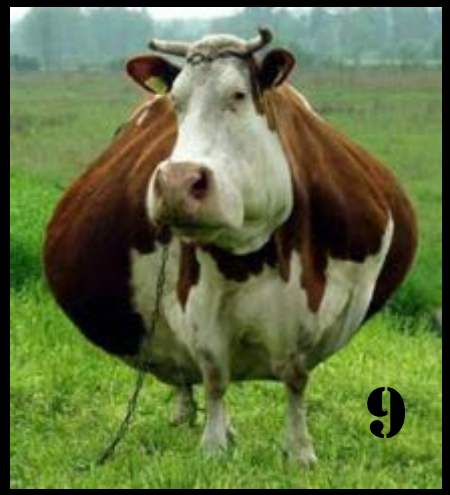
Texas Agricultu ... Station, Texas

http://animalscience.tamu.edu

Body Condition Score

4





5

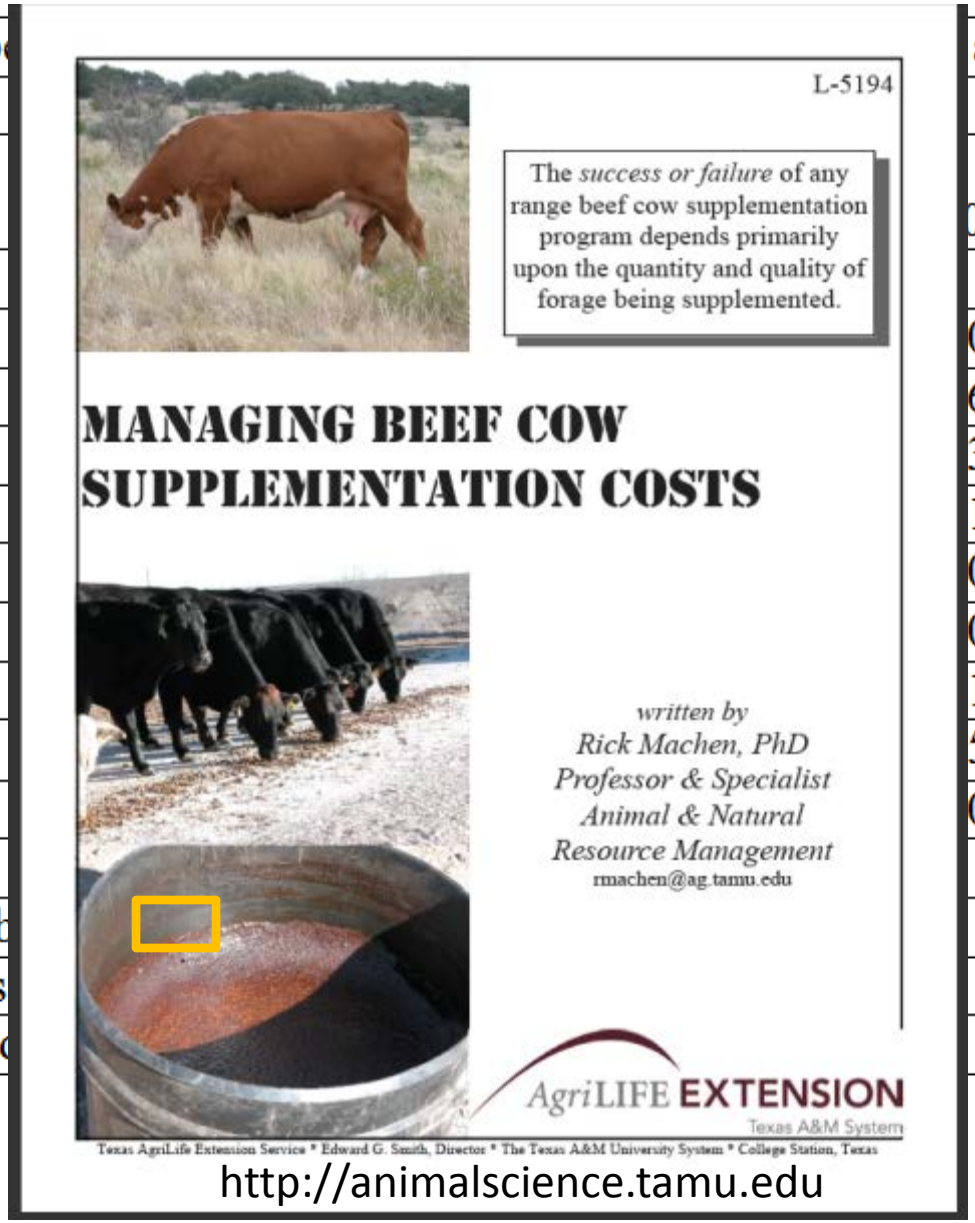
6

Grazing Behavior

#4

REPRODUCTIVE PERFORMANCE IS HUGE IN THE PROFITABILITY PICTURE.

Table 1. Relationship b				at weaning	
% calves weaned*	200			0	700
100	.40			0	1.40
95	.42			6	1.47
90	.44			3	1.56
85	.47			1	1.65
80	.50			0	1.75
75	.53			0	1.87
70	.57			1	2.00
65	.62			5	2.15
60	.67			0	2.33
Calf weaning weight, lb					
*Calculated as # calves					
**Market price required					



http://animalscience.tamu.edu

#5

HAY –
HOW TO GET YOUR MONEY'S WORTH.

Hay

- Why feed hay?
- Raise or buy?
- Quantity vs Quality?
  - plant maturity effect
- Questions to ask…
  - What kind?
  - Bale weight?
  - Age when cut?
  - Nutrient analysis?

Relationship between Bale Weight and Cost per Ton

	Bale Weight, lb						
	600	700	800	900	1000	1100	1200
Cost, $	*Cost per Ton, $*						
50	167	143	125	111	100	91	83
75	250	214	188	167	150	136	125
100	333	286	250	222	200	182	167
125	417	357	313	278	250	227	208
150	500	429	375	333	300	273	250
175	583	500	438	389	350	318	292

Relationship between Bale Weight and Cost per Ton

	Bale Weight, lb						
	50	60	70	80	90	100	110
Cost, $	*Cost per Ton, $*						
6	240	200	171	150	133	120	109
8	320	267	229	200	178	160	145
10	400	333	286	250	222	200	182
12	480	400	343	300	267	240	218
14	560	467	400	350	311	280	255
16	640	533	457	400	356	320	291
18	720	600	514	450	400	360	327
20	800	667	571	500	444	400	364

Animal Performance

How much difference in hay consumption and cattle performance can there be?

1250 lb in avg. body condition
6 years old
Late gestation
Average milk production
Goal: maintain weight

Coastal Bermudagrass
Two qualities
- Poor
- Good

Intake…… 20 lb/day
Weight….. -3 lb/day
-1 BCS in 28 days

Poor
4.5% crude protein, 42% TDN

Good
11% crude protein, 54% TDN

Intake…… 27 lb/day
Weight….. -0.2 lb/day

HAY FOR SALE

$45/bale

Avg. bale weight 600 lb

$150/ton

20 lb/day costs $1.50

$65/bale

Avg. bale weight 900 lb

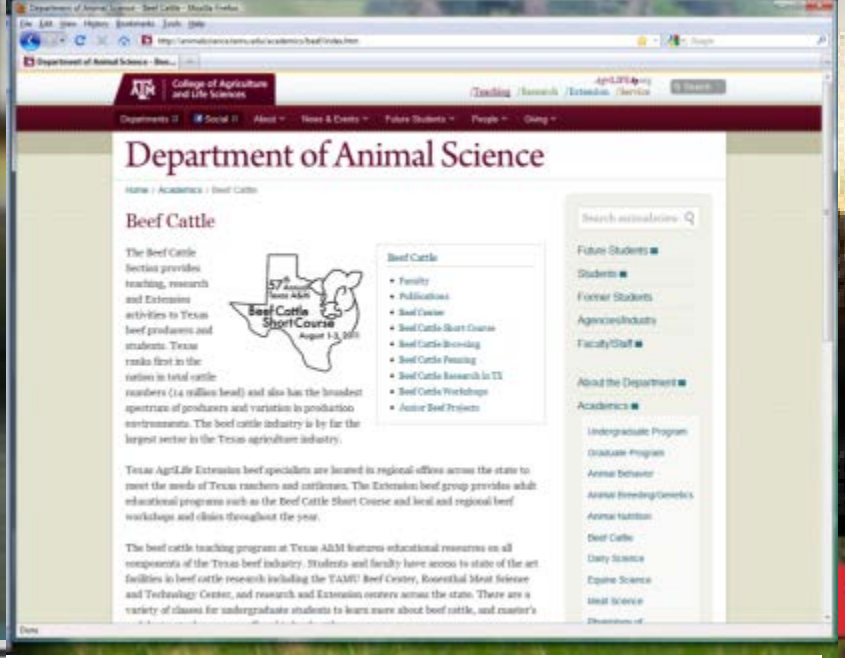
$145/ton

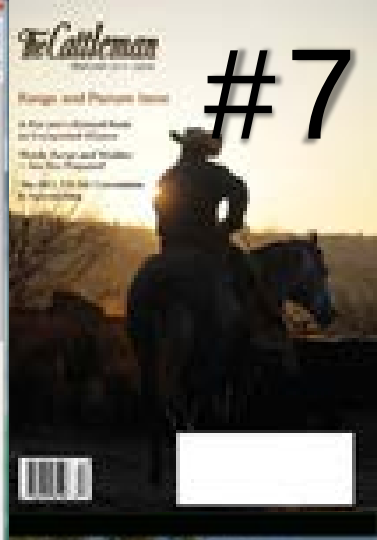
27 lb/day costs $1.96

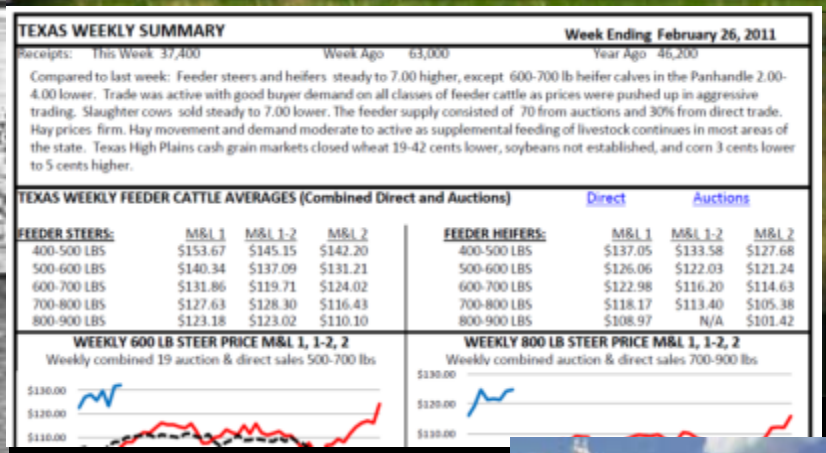
17 lb hay
10 lb 20% cubes
Total Cost …… $2.93/day

OSU Cowculator
http://beefextension.com/new%20site%202/cccalc.html


Facilities
Equipment
Labor
Purchasing
Services
Freight
Marketing
#6
THE ECONOMY OF SCALE
WORKS *AGAINST* SMALL PRODUCERS.







We ever know enough.
Be ever observant. Compare notes. Ask questions.

7 *(of several)* things producers need to know

- Stewardship is Job One.
- Preventative Herd Health plan is essential.
- Are my cows getting enough to eat??
- Reproductive performance - #1 in profit picture.
- Hay – How to get your money's worth.
- Economy of Scale works against small producers.
- You never know enough.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WHOLE HERD HEALTH

August 3-5, 2015
College Station

Home Page

http:/beefcattleshortcourse.com

Held August 3-5, 2015 at Texas A&M University - **2014 Final Schedule!**

Seven Things Every Small Producer Should Know

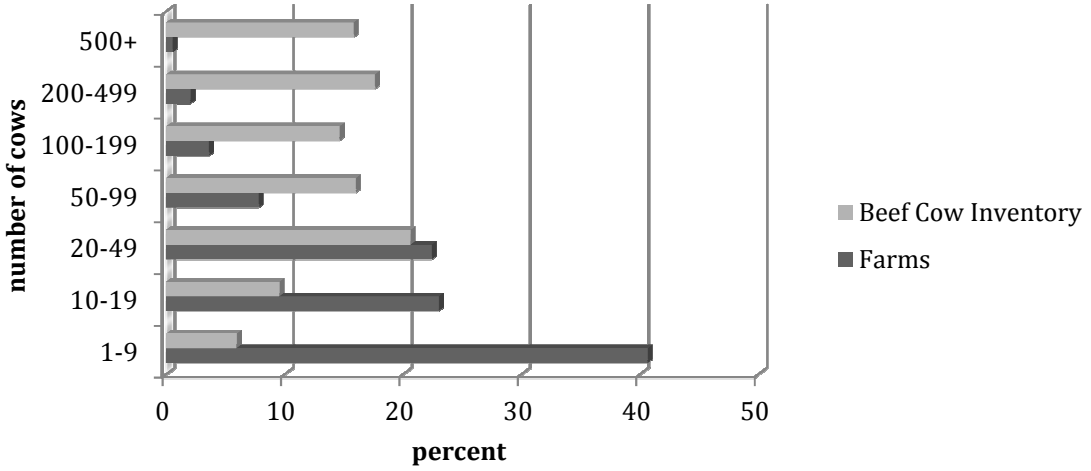
2015 TSCRA Ranching 101

Size is relative, so a definition of "small" is warranted here. For the purpose of this discussion, small beef cattle operations are defined as those maintaining a cowherd inventory of less than 100 head.

The reader should not equate "small" with insignificant or unimportant. Every domestic agricultural producer contributes to the safest, most wholesome food supply in the world and is obligated to share their personal story of quality assurance and stewardship.

According to the most recent USDA Census of Agriculture (2012), 86% of Texas' cow/calf operations had 100 head or less (see Figure 1). The six percent of Texas' farms with herds of 100 cows or more accounted for 48% of Texas' total beef cow inventory.

Figure 1. Demographics of the Texas Beef Cow Herd (2012)



Environmental Stewardship is Job One.

Regardless of the size (acres) of an operation or the number of cattle involved, managers are called to first be stewards of the resources entrusted to them. Natural resource (soil, water, flora and fauna both domestic and native) stewardship is a responsibility, not an elective. If managers neglect to care for the resources, the ultimate losses are topsoil and water infiltration, degradation of the flora and the demise of the fauna.

As stewards of Texas ranges and pastures, stockmen manage the quality and quantity of water infiltrating Texas aquifers and impact the runoff supplying Texas streams, rivers and lakes. As Texas' population continues to grow, water quality and availability will become all the more important.

A Preventative Herd Health Plan is essential.

Nowhere is the old saying "*An ounce of prevention is worth a pound of cure*." more true than with regard to animal health management. Small producers are often hesitant to engage the services of an animal health professional because of the associated expenses. Veterinarians are often used as a last resort – often in a 'raise the dead' scenario.

The significance/relevance of a preventative herd health plan is largely a function of potential health risks. Risk or exposure differs across operations and can differ over time. As the bare minimum, cattlemen should vaccinate calves against the clostridial complex. It is the responsibility of the cow/calf producer to castrate bull calves, preferably before four months of age. In addition, it is in the owner's best interest to identify all cattle as a means of establishing ownership, deterring theft and for record-keeping purposes.

Are my cows getting enough to eat?

One of the most frequent concerns voiced by small producers relates to nutrition. Body condition score is the most practical assessment of nutritional status. However, frequent observation of cattle often results in subtle condition changes being overlooked. In addition, body condition reflects the previous nutritional status of cattle; current and future nutritional wellbeing requires consideration of the available forage supply and physiological status of the herd.

Look at the grass. Does it look like there is enough to sustain the number of cows in the pasture? If cow's hooves are consistently visible from a distance of twenty-five feet or more or the forage is less than four inches tall, cattle are likely not able to harvest all they want to eat.

Other practical indicators of forage availability include:

Plant selection – Cattle by nature are grazers with a strong preference for grass. If cattle are browsing the leaves on shrubs, bushes and trees, then grass supply is restricted.

Grazing behavior – Cattle typically have two major grazing events daily, one in the morning and another in the afternoon/evening. Grazing activity is also affected by weather conditions. During the hot summer months, cattle will usually defer their activity to the cooler times of the day (or night). Cattle grazing during the heat of the day and those grazing continuously throughout the daylight hours are indicators of restricted forage supply.

Gut fill – The rumen is the largest of the four stomach compartments and is the fermentation vat wherein microbial digestion of forage occurs. The rumen is positioned on the animal's left side and when full, will occupy the space between the last rib and the pelvis or hipbone. A hollowed or sunken appearance between the last rib and hip on a cow's left side is an indicator of restricted forage availability.

Never overlook the importance of drinking water. Water is the most important nutrient. Restrictions in water intake will result in reduced forage/feed consumption and compromised performance. Water depravation during periods of cold weather will result in a very rapid erosion of cattle condition. Clean water troughs facilitate water consumption, especially among young cattle, and are an indication of good stockmanship and responsible stewardship.

Reproductive performance is huge in the profitability picture.
Reproductive performance is calculated:

number of calves weaned / number of cows exposed to a bull

Of the factors affecting profitability in a cow/calf enterprise (production costs, weaning weight, shrink, market price, etc.), reproductive performance is traditionally the single most important. Consider Table 1 and note that as production costs rise, reproductive performance becomes all the more influential.

Table 1. Relationship between % calf crop weaned and breakeven value at weaning

	Production Cost, $/cow/year					
% calves weaned*	200	300	400	500	600	700
	*Calf breakeven price, $/lb.***					
100	.40	.60	.80	1.00	1.20	1.40
95	.42	.63	.84	1.05	1.26	1.47
90	.44	.67	.89	1.11	1.33	1.56
85	.47	.71	.94	1.18	1.41	1.65
80	.50	.75	1.00	1.25	1.50	1.75
75	.53	.80	1.07	1.33	1.60	1.87
70	.57	.86	1.14	1.43	1.71	2.00
65	.62	.92	1.23	1.54	1.85	2.15
60	.67	1.00	1.33	1.67	2.00	2.33
Calf weaning weight, lb……. 500						
*Calculated as # calves weaned / # cows exposed to a bull						
**Market price required to cover production costs only.						

Hay – How to get your money's worth.

Hay is a replacement for forage rooted in the pasture. Hay is fed for one of two reasons: a) the producer cost-effectively grew more grass in the spring/summer/early fall than a sustainable [annually] number of cattle could efficiently harvest or b) the natural resource is overstocked.

Hay is expensive, whether raised or purchased. Hay growers continually consider the tradeoffs between tonnage (number of bales) and quality (digestibility and nutrient content). Hay baled to sell often has lower bale weights and lower nutrient content than hay harvested by the person who will ultimately feed it. When purchasing grass hay, consider these variables:

Bale weight – At the very least, hay buyers should be provided an accurate average bale weight. An illustration of the relationship between bale weight and cost per ton of hay is shown in Table 2.

Potential waste – Unprotected loose (lacking density) bales stored outside in poorly drained areas may contain 30% or more waste (the outer eight inches of a five foot diameter bale is 25% of the bale's content). Mature sudangrass hay containing large

stems and seed heads, baled grain sorghum stubble or baled corn stalks will also have appreciable wastage.

Plant maturity at harvest – As forages mature nutrient content (protein, energy) and digestibility declines. Optimum age for cutting bermudagrass is 21-28 days. To achieve a balance of quality and tonnage, sorghum sudangrass (haygrazer) type forages should be cut just as the plants begin to form a seed head. Alfalfa is of such high quality most any age including full bloom is excellent cow hay.

Management – Nitrogen fertilization is essential to produce bermudagrass or sudangrass hay of both high quality and quantity. However, "highly fertilized" is a relative term and does not guarantee quality. Weed content should be minimal. Ideally, the hay was cut, raked and baled without being rained on.

Color/Smell – High quality hay will generally be green and have a pleasant aroma. Leached hay that is gray or straw colored or dark brown hay (characteristic of hay baled with excessive moisture) is generally of lesser quality.

Table 2. Relationship between bale weight and cost per ton of hay.

	Bale Weight, lb.						
	600	700	800	900	1000	1100	1200
Cost/bale, $	*Cost per Ton, $*						
30	100	86	75	67	60	55	50
40	133	114	100	89	80	73	67
50	167	143	125	111	100	91	83
60	200	171	150	133	120	109	100
70	233	200	175	156	140	127	117
80	267	229	200	178	160	145	133
90	300	257	225	200	180	164	150
100	333	286	250	222	200	182	167

The economy of scale works against small producers.

Beef producers' most formidable competitor is not an ocean away, across a national border or producing another species of livestock. They are the beef producer just across the fence. Cost of production is the name of the game – if the competitors can consistently and profitably produce beef for less than your breakeven cost of production, they win, you lose.

Small producers (a cowherd of less than 100 head) typically cannot assemble a load lot (48,000 pounds) of like weight and quality of weaned calves, even if they mix steers and heifers. As a result, small producers find it difficult to individually take advantage of forward contracting, direct or video marketing. Comingled feeder calf sales are available as is the opportunity to sort similar calves into uniform lots and thereby take advantage of marketing calves in groups.

Purchasing in bulk or large quantities offers discounted pricing. Cost per unit (pharmaceuticals, ear tags, supplemental feed, hay, etc) is lower for larger operators. Equipment required for handling bulk supplements, commodities or large bales of hay can be cost prohibitive for profit-minded small producers. Cooperation among small producers affords the opportunity to realize large producer pricing.

You never know enough. Be ever observant. Compare notes. Ask questions.

When asked what he would do differently, a ranch-raised Trans-Pecos stock farmer said he would: 1) Find an older, experienced, successful farmer and follow him around for a year – even if he had to pay for the experience and, 2) Buy newer equipment.

The beef production arena is ever changing. Public policy, weather, markets, production costs, animal health regulations, environmental concerns, land fragmentation and urban sprawl are dynamic factors that shape and impact the business of animal agriculture. Successful cattlemen keep up with the changing times.

Be a part of something larger than yourself. Choose and support (both physically and financially) an agriculture industry organization that:

- represents your interests in Austin and Washington,
- keeps you informed of changes with potential to impact your operation,
- facilitates interaction with other beef producers,
- calls attention to opportunities for enhancing production efficiency, lowering cost of production, adding value or improving marketability and
- offers relevant goods and services that might be either unavailable or unaffordable for individuals.

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TEXAS A&M AGRILIFE EXTENSION

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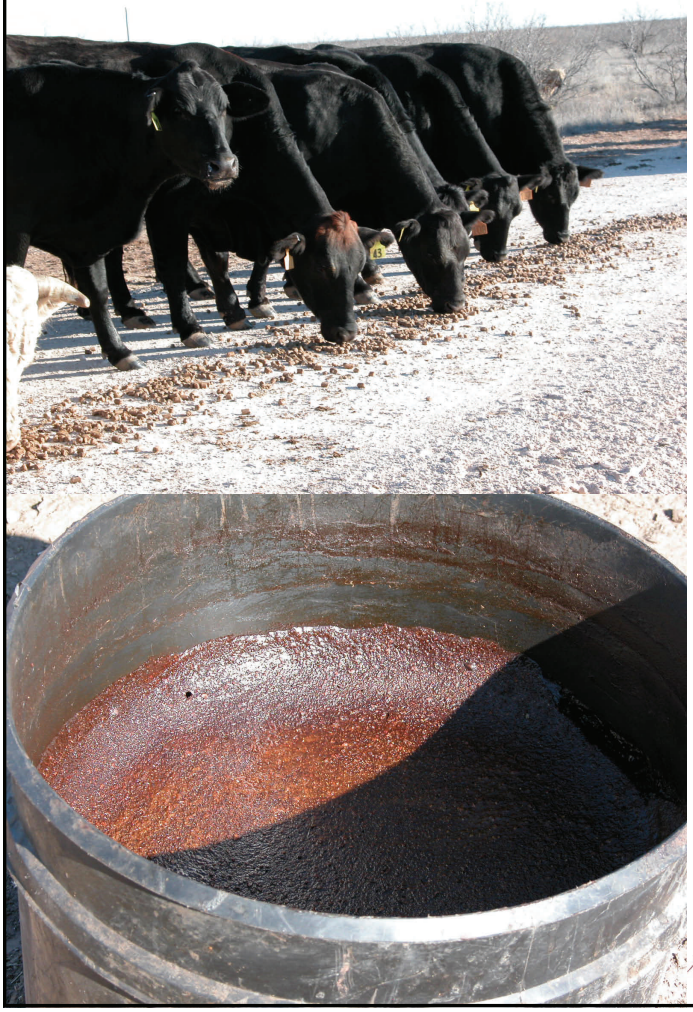
The *success or failure* of any range beef cow supplementation program depends primarily upon the quantity and quality of forage being supplemented.

MANAGING BEEF COW SUPPLEMENTATION COSTS



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AgriLIFE EXTENSION
Texas A&M System

Texas AgriLife Extension Service * Edward G. Smith, Director * The Texas A&M University System * College Station, Texas

Review the list of all production expenses for commercial cow/calf operations and you'll find supplementation expense among the top five; feed costs often occupy the #1 position on the out-of-pocket (variable cost) expense list. Large expense categories often receive the initial attention when it comes time to tighten the belt. Following is a ***prioritized*** **list** of suggestions to consider when developing a supplementation program for the cow herd.

1. An appropriate stocking rate is essential if efficiency and economy are expected of the supplementation program.

The purpose of supplementing grazing cattle is to correct a nutrient deficiency of the diet. The quantity and quality of available forage have as much or more to do with the success or failure of a feeding program as the characteristics of the supplement.

Cattlemen must also be good stewards of the natural resources entrusted to them. Long-term heavy stocking rates weaken the forage resource, subject the soil to erosion, reduce the efficiency of rainfall capture and use, and reduce the quality of water harvested from range and pasture watersheds.

2. Nutrient requirements of the cow must be matched with productivity of the environment.

Genotype x environment interaction is a critical management consideration with significant impact on the success of a supplementation program. Results of a Nebraska study indicate that, under liberal feed conditions and/or in the presence of a stress-free environment, larger mature size, heavier milking cows are more efficient that moderate size cows. However, when feed supply is restricted and/or environmental stress is present, moderate-size and moderate-milking cows are more efficient producers. Cows with smaller nutrient demands have a greater chance of achieving their biological production potential in any given environment.

3. For the commercial cow/calf producer, the production period with the greatest nutrient demand (calving, lactation) and the period of greatest expected nutrient availability should coincide.

Forage maturity and quality are inversely related, while maturity and quantity are typically directly related. Native range forages traditionally exhibit their highest quality during the spring and early summer; hence one of the reasons a large portion of the cows in the Southwest calve during that time of year. Management decisions which ignore this nutrient supply: demand relationship may result in supplementation programs with reduced efficiency and increased costs. Production and/or marketing objectives for summer, fall, or early winter calving programs may compensate for this loss of efficiency.

4. Sort cows by physiological condition to improve supplementation efficiency and reduce costs.

The first 60-80 days post-calving is the period of greatest nutrient demand experienced by a cow during the production year. During this period, cows are trying to recover from calving, reach and maintain peak lactation, cycle and rebreed and thereby deserve more attention. Heifers with their first calf at side and going through this process demand special consideration if high conception rates for the second calf are a priority. Body condition adjustments are most efficiently made during the second and third trimesters of pregnancy.

Under today's production parameters (high feed costs, high fuel and overhead costs), open cows are a significant leech on the profitability of a cow/calf enterprise (see Table 1). Therefore, if possible, sort cows by age and expected calving date. Implementation of a 90-110 day breeding season greatly facilitates this sorting process.

5. Initiation and termination of the supplementation program are critical decisions.

A frequently asked question is "When should I start feeding?" The theoretical answer is as soon as the cows begin to experience a nutrient deficiency. Maintaining body weight is tough enough - attempting to replace lost weight/ condition and subsequently improve condition is economically inefficient. In reality, if cows are in "better than necessary" condition, some weight loss is tolerable and will result in feed savings. Tardy initiation and/or an unwarranted continuation of supplementation result in increased costs.

Computer modeling technology developed by Texas A&M offers cattlemen an opportunity to estimate the nutritional status of grazing cattle. The program, called NUTBAL (Nutritional Balance Analyzer), involves fecal analysis to predict nutrient intake and comparison of this intake with calculated requirements to yield an estimate of the nutrient balance of the grazing animal.

6. Nutrient content of the supplement has a significant impact on the response observed.

Protein is often the first-limiting nutrient for cattle grazing dormant forages or consuming poor quality hay. When compared to energy, protein is commonly the more expensive component. Feed purchasing decisions should be based on a $ per pound of nutrient (usually protein) basis, not simply on a $/cwt or ton basis. Comparing two feeds of differing nutrient content strictly on price per unit weight is like comparing apples and oranges.

High protein supplements (those >30% crude protein), fed at 0.1-0.3% of body weight per day, stimulate forage intake - research results indicate the intake improvement can be as large as 60%. Increases in forage intake provide a large boost in energy and demonstrate why correcting a protein deficiency is usually the first priority in supplementation programs.

Generally, crude protein content and cost *per unit of protein* are inversely related. Comparing extremes on a cost per unit of protein basis, the difference between whole shelled corn (10% CP, $180/ton) and cottonseed meal (44% CP, $300/ton) can be as large as 260% (the $/lb CP for corn can be as much

as 2.6 times higher than for cottonseed meal).

In contrast, starchy, high-energy supplements (i.e. cereal grains) tend to reduce forage intake and digestibility, a phenomenon referred to as negative associative effect - the net effect can be a reduction in performance. Energy supplements (10-18% crude protein), when fed at 0.7-1.0% of body weight daily, can be used to extend a limited forage or hay supply without reducing performance.

In between the high protein and energy supplements are the "general purpose" feeds, of which the 20% crude protein formulation is perhaps the most popular. Supplements of this type are an excellent choice when attempting to maintain forage intake and improve performance (body condition). Recommended feeding rates are 0.3-0.5% of body weight per day.

7. Purchasing and provision decisions also offer opportunities for reducing supplementation costs.

By-Products - Distillers grains are a significant by-product of the ethanol industry. The high moisture content of distillers grains makes long distance transportation economically unfeasible. However, as more ethanol plants come on line across the country, distiller grains will warrant consideration by an ever-increasing number of cattlemen.

By-products (ex. Distillers grains, corn gluten, soybean hulls, wheat mids, etc.) are often overlooked by cattlemen for several reasons: sourcing, purchasing and payment challenges, necessity of using troughs or bunks, handling equipment and storage requirements, etc. *If high corn and protein prices persist, producers may need to take a closer look at by-products*. Many ranches have the equipment (tractor with front-end loader) to handle bulk commodities. If the cost of storage and feeding equipment is amortized over its useful life, the use of by-products as supplements for beef cattle becomes much more appealing.

Forward contracting - Traditionally, feed prices are the lowest in mid to late summer and highest in the winter. Contracting feed in late summer for use the following winter can result in substantial savings. Forward contracts are typically confined to larger volumes of feed and may not be applicable for smaller operations. In addition, cash flow restrictions may prohibit some cattlemen from forward contracting.

Bulk feed - Handling feed in bulk reduces labor inputs and generally results in a $5-20 per ton reduction compared to sacked prices. Again, bulk handling may not be applicable to smaller operations and does require some up-front investment in storage and feeding equipment.

Reduce feeding frequency - Research results from several universities indicate little or no difference in performance of cows supplemented 2 or 3 times per week compared to those fed daily. Recent studies would indicate that feeding once a week yields results comparable to those fed more frequently. Reduced feeding frequency saves labor, fuel and equipment wear.

High protein supplements (>30% CP) perform well when offered infrequently. However, high-energy supplements (10-18% CP) perform best when offered frequently and in small amounts. Infrequent feeding of large amounts of grain/high energy feeds can cause serious illness.

Reproductive performance (% calf crop weaned) is the key to survival during tough times. The profit margin (if any) per cow is small; therefore it takes the production of several cows to pay the expenses associated with non-productive cows. Cows can generate income in one of two ways: wean a marketable calf or go to market as a cull cow.

As previously mentioned, large expense categories often draw the most attention when it comes time to tighten the belt. However, those expenses that directly influence productivity must be evaluated with care. Sustainable grazing management systems, cost effective supplementation programs and an effective preventative herd health plan are fundamental requirements for achieving performance goals.

Calculating $/lb of crude protein:

1. % crude protein x volume of feed (cwt, ton) = lb crude protein
2. feed cost ($/volume of feed) / lb crude protein = $/lb crude protein

Example - A 20% CP feed costing $200/ton. What is the $/lb CP?

1. 20% x 2000 lb = 400 lb crude protein
2. $200 / 400 lb = $0.50/lb crude protein

Table 2 compares eight different supplements over a range of costs from $175 to $900 per ton.

To convert cost per 50 pound bag to dollars per ton, multiply by 40.

To convert dollars per hundredweight to dollars per ton, multiply by 20.

Table 1.
Relationship Between % Calf Crop Weaned and Breakeven Value at Weaning

	Productions Cost, $/cow/year*					
% Calves Weaned	150	200	250	300	350	400
	calf breakeven price, $/lb *					
100	.30	.40	.50	.60	.70	.80
95	.32	.42	.53	.63	.74	.84
90	.33	.44	.56	.67	.78	.89
85	.35	.47	.59	.71	.82	.94
80	.38	.50	.63	.75	.88	1.00
75	.40	.53	.67	.80	.93	1.07
70	.43	.57	.71	.86	1.00	1.14
65	.46	.62	.77	.92	1.08	1.23
60	.50	.67	.83	1.00	1.17	1.33

Calf Weaning Weight, lb …… 500

***Calculated as # calves weaned/# cows exposed to a bull**

****Market price required to cover production costs only**

Table 2.	**Calculating Cost per Pound of Crude Protein**						
	% crude protein in supplement						
$/ton	15%	20%	25%	30%	35%	40%	45%
	$ per pound of crude protein						
175	.58	.44	.35	.29	.25	.22	.19
200	.67	.50	.40	.33	.29	.25	.22
250	.83	.63	.50	.42	.36	.31	.28
300	1.00	.75	.60	.50	.43	.38	.33
350	1.17	.88	.70	.58	.50	.44	.39
400	1.33	1.00	.80	.67	.57	.50	.44
450	1.50	1.13	.90	.75	.64	.56	.50
500	1.67	1.25	1.00	.83	.71	.63	.56
700	2.33	1.75	1.40	1.17	1.00	.88	.78
900	3.00	2.25	1.80	1.50	1.29	1.13	1.00

B-6037

Texas Agricultural Extension Service
The Texas A&M University System

What Range Herbivores Eat—and Why

Texas Agricultural Extension Service • Zerle L. Carpenter, Director • The Texas A&M University System • College Station, Texas

What Range Herbivores Eat—and Why

Robert K. Lyons, T.D.A. Forbes, and Rick Machen*

Different range animals have different diets—some eat grass, some eat browse (leaves from woody plants) and forbs (wildflowers, weeds, etc.), and some eat all three. The differences in their diets allow many types of range animals to coexist on the same range.

For many years, the major herbivores on Texas ranges were cattle, sheep, goats, deer, and horses. Recently, however, several new herbivore species (such as axis and fallow deer) have been introduced to Texas from Asia and Africa, and there is some isolated interest in reintroducing the American bison. With the introduction of new species and possible reintroduction of native species, it is important to understand the diets of different animals to determine which ones best fit different range habitats.

Although a herbivore is, by definition, a plant-eating animal, herbivores do not eat just any plant. For example, if a deer, which is adapted to eat forbs and browse, is forced to eat large amounts of grass, it will probably not perform as well as deer that eat forbs and browse.

The type of diet selected by range herbivores is determined by their mouth parts and the anatomy of their digestive systems. A sound understanding of what range herbivores eat and why will allow the landowner to use the rangeland resource more wisely and enable the animals to perform better.

What Range Herbivores Eat

The diets of range herbivores vary among different species (Figure 1, page 2) and within the same species by season of the year (Figures 2 and 3, pages 4 and 5).

On an annual basis, bison eat mostly grass, a few forbs, and little browse (Figure 1). Cattle eat less grass, but more forbs and browse than bison. Horses are similar to bison and cattle in that they eat mostly grass and only small amounts of forbs and browse. Sheep eat less grass than either bison or cattle, slightly more forbs than cattle, and more than three times as much browse as cattle.

Goats eat about equal amounts of grass and browse and about the same amount of forbs as cattle. Because Spanish goats are more efficient browsers than Angora goats, they can maintain more browse in their diets than Angoras when browse is scarce. Spanish goats are more efficient browsers because

- they are taller and can browse at greater heights.
- they have less hair to get caught in denser brush.

Of the Texas range herbivores, deer—both white-tailed and mule—eat the most browse. Although mule deer appear to eat more browse and less forbs than white-tailed deer (Figures 1 & 3), these differences are probably due to the kinds of forage available. Diets often reflect availability of forage types: for example, deer prefer forbs, but browse is probably a more readily available food source during tough times.

Diets also vary from season to season. For example, cattle eat more grass in winter and less in spring; more forbs in spring and less in fall and winter; and more browse in fall and less in spring (Figure 2). In comparison, white-tailed deer consume more or less the same amount of grass across all seasons; more forbs in spring and less in winter; and more browse in winter and less in spring (Figure 3). The diets of some animals, like bison, are relatively stable across seasons (Figure 3).

Differences in the types of forages consumed by range herbivores are due to both internal (digestive system) and external (such as mouth size) physical differences among these animals. These physical differences have been used to classify herbivores into different feeding types.

Herbivore Feeding Types

Animal digestive systems lack the enzymes required to break down or digest the chemical bonds found in the cell walls of plant material (cellulose). Animals that use cellulose can do so because they have microorganisms in their digestive systems that have the chemicals needed to digest it. Cellulose is digested by fermentation. Fermentation requires time and a conducive environment in the digestive system

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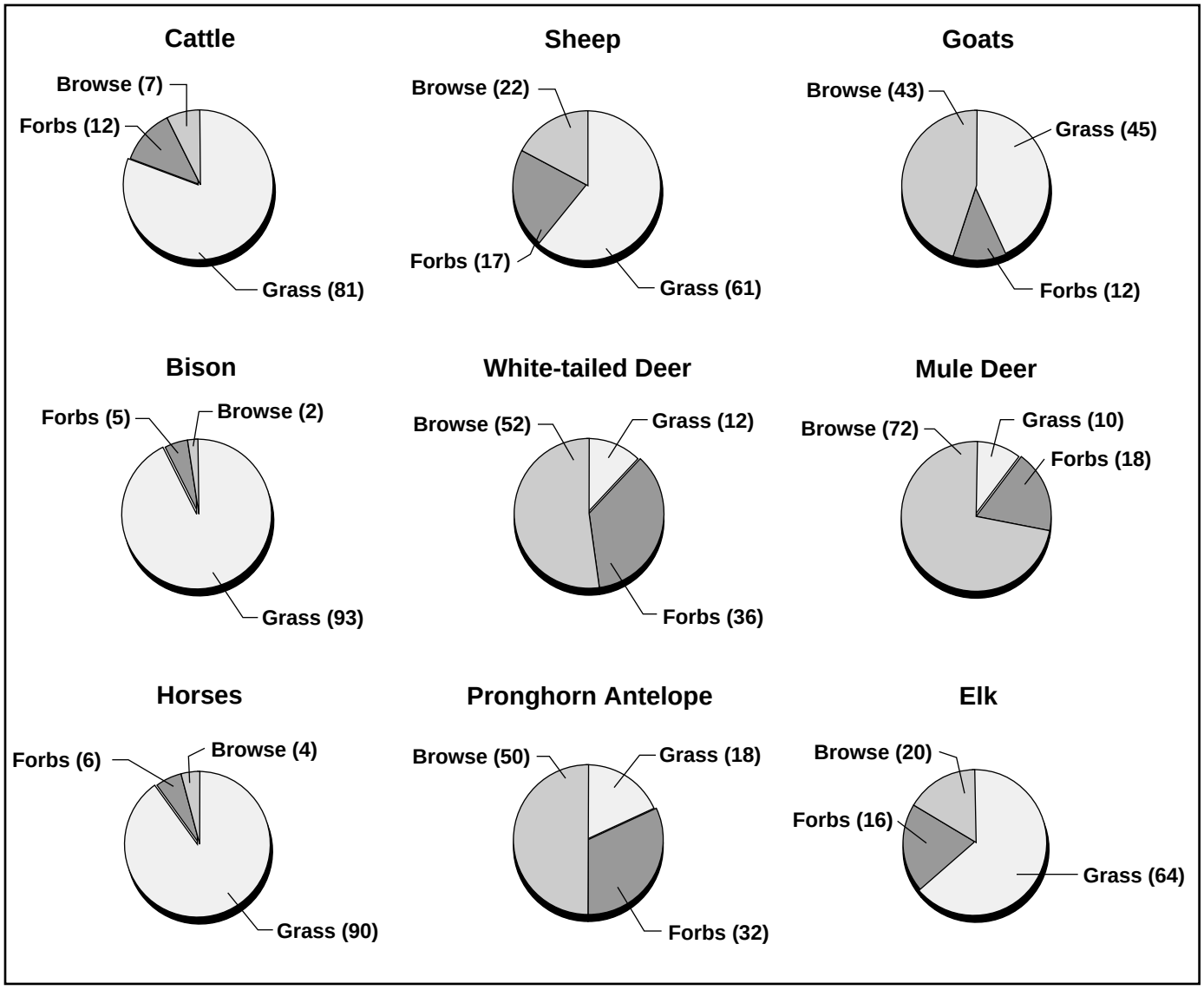


Figure 1. Average annual diet composition by percent grass, forbs (wildflowers, weeds, etc.) and browse (leaves of woody plants) for cattle (Edwards Plateau and South Texas), sheep (Edwards Plateau), goats (Edwards Plateau), bison (Colorado), white-tailed deer (Edwards Plateau and South Texas), mule deer (western United States), horses (western United States), pronghorn antelope (western United States), and elk (western United States) on rangeland (adapted from Vallentine 1990).

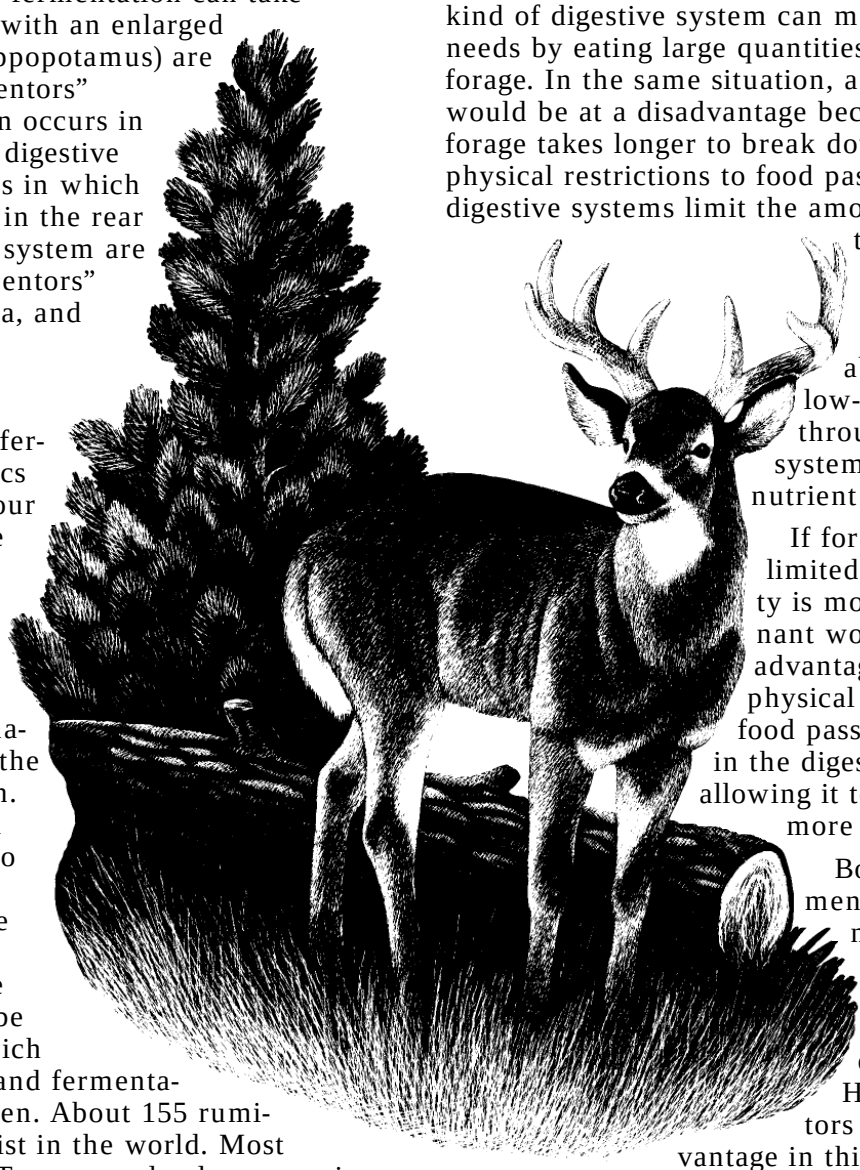
where food can be held long enough for the microorganisms to break down the cellulose.

Monogastrics

Animals with one simple stomach, like horses and swine, are called "monogastrics." Most monogastrics do not use cellulose because they do not have a specialized part of the digestive system where fermentation can take place. Some monogastrics (like horses, rabbits) have either an enlarged stomach or areas in the large intestine and/or cecum where fermentation can take place. Monogastrics with an enlarged stomach (like the hippopotamus) are called "foregut fermentors" because fermentation occurs in the front part of the digestive system. Monogastrics in which fermentation occurs in the rear part of the digestive system are called "hindgut fermentors" (like the horse, zebra, and rhinoceros).

Ruminants

Ruminants are different from monogastrics because they have four compartments in the front part of their digestive systems and because they chew their cud. One of these compartments, the abomasum, is the same as the monogastric stomach. The rumen creates a physical restriction to the passage of food through the digestive system. For food to leave the rumen, the food particles must be small and heavy, which requires rechewing and fermentation time in the rumen. About 155 ruminant species now exist in the world. Most large herbivores on Texas rangelands are ruminants (cattle, sheep, goats, and deer). Although camels and llamas chew their cud, they are not true ruminants because they lack one of the four compartments of a ruminant stomach.



Feeding Type and Forage Availability

Depending on the quality and quantity of the forage available, there are advantages and disadvantages to being a ruminant or hindgut fermentor.

If forage quality is low but forage quantity is abundant, hindgut fermentors have the advantage because there are no physical restrictions to food passage in their digestive systems—this allows food to move through the digestive system quickly. Consequently, animals with this kind of digestive system can meet their nutrient needs by eating large quantities of low-quality forage. In the same situation, a ruminant animal would be at a disadvantage because low-quality forage takes longer to break down, and the physical restrictions to food passage in their digestive systems limit the amount of forage they can eat. Therefore, a ruminant animal would not be able to get enough low-quality forage through its digestive system to meet its nutrient needs.

If forage quantity is limited and forage quality is moderate, a ruminant would have the advantage because the physical restrictions to food passage hold forage in the digestive tract longer, allowing it to be digested more completely.

Both hindgut fermentors and ruminants could be at a disadvantage if both forage quantity and quality are low. Hindgut fermentors are at a disadvantage in this situation because they do not efficiently digest the forage, which passes rapidly through their digestive systems, and the limited forage supply may not allow them to eat enough to make up for the incomplete digestion. Because of the limited forage supply and the physical restrictions of the rumen, ruminants too may not be able to eat enough to meet their nutrient requirements.

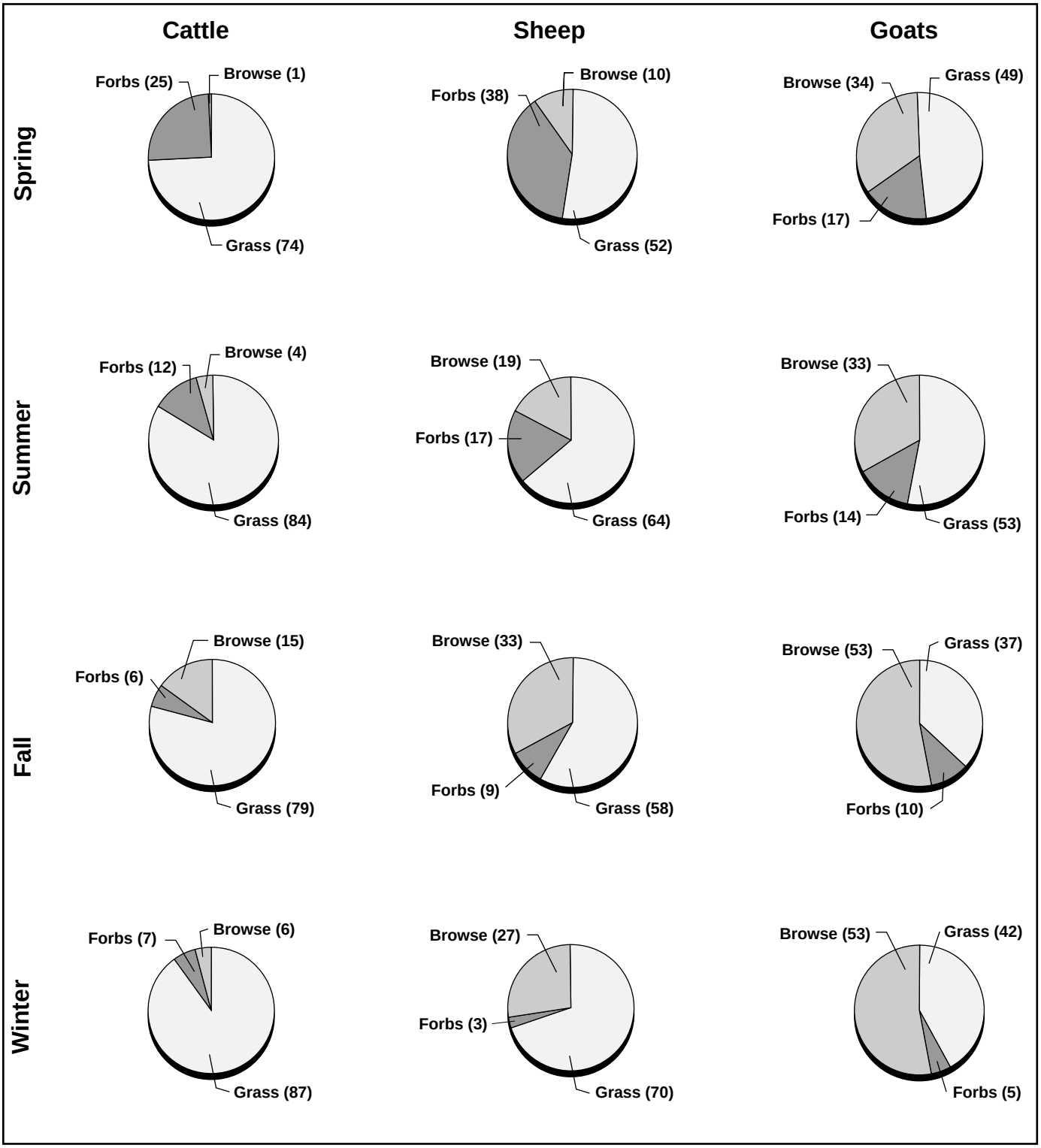


Figure 2. Average seasonal diet composition by percent grass, forbs (wildflowers, weeds, etc.) and browse (leaves of woody plants) for cattle (Edwards Plateau and South Texas), sheep (Edwards Plateau), and goats (Edwards Plateau), on rangeland (adapted from Vallentine 1990).

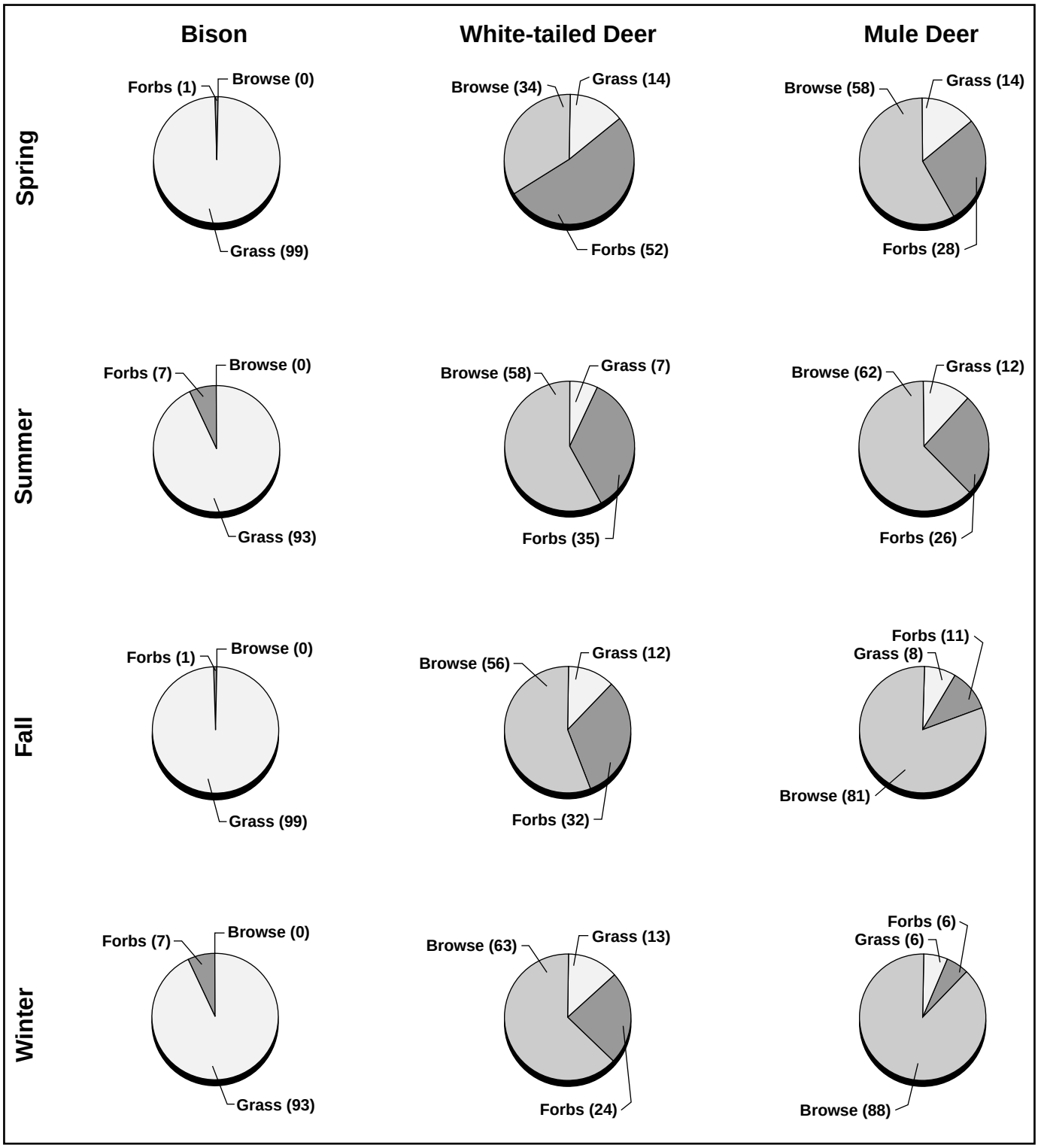


Figure 3. Average seasonal diet composition by percent grass, forbs (wildflowers, weeds, etc.) and browse (leaves of woody plants) for bison (Colorado), white-tailed deer (Edwards Plateau and South Texas), and mule deer (western United States) on rangeland (adapted from Vallentine 1990).

In summary, different forage situations place hindgut fermentors and ruminants at relative advantages or disadvantages: hindgut fermentors have an advantage with high forage quantity and low quality; ruminants have an advantage with low quantity and moderate quality; and both are at a disadvantage with low quantity and low quality.

Not all ruminants are alike. Therefore, this group of herbivores deserves separate attention based on research findings of the past few years.

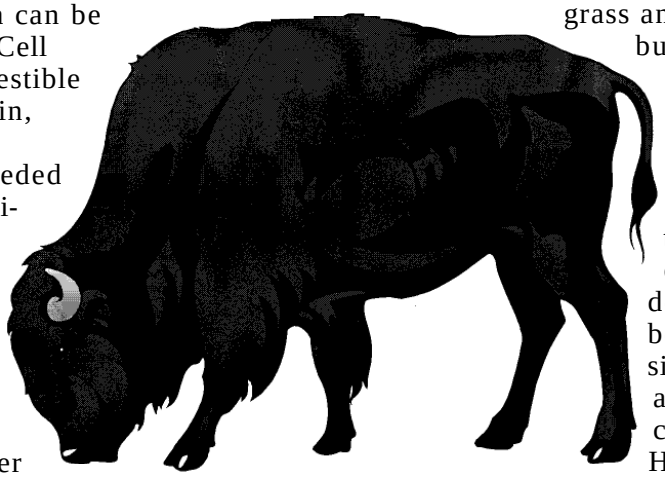
Ruminant Feeding Types

Until recently, information about ruminant digestive systems came mostly from research on cattle and sheep and a few goat studies. Other ruminants were assumed to be similar to these domestic ruminants. Studies involving African ruminants with different diets have led to a better understanding of why these animals eat what they do. These studies indicate that diet selection by ruminants is closely related to differences in the anatomy of their digestive systems, beginning at the mouth and continuing to the hindgut. These studies have led to a classification system for ruminant feeding types.

Understanding this feeding type classification requires an understanding of how plant cells are constructed and the kinds of cells found in different plants. Plant cells have a cell wall and material (the cell contents) inside the cell. The cell wall holds the cell together and contains fiber which includes:

- Chemical compounds (cellulose and hemicellulose) that must be broken down by microorganisms before they can be used by animals.
- Compounds that cannot be digested (lignin).

If broken down, the digestible part of the cell wall provides sugars which can be used for animal nutrition. Cell contents contain easily digestible materials like starch, protein, sugars, fats, and oils. Microorganisms are not needed to break down these materials. Grasses, especially grass stems, older grass plants, and tropical grasses, contain large amounts of cell wall material, so they are difficult to digest. Forbs and woody plant leaves (browse) have thinner cell walls compared to grasses and contain more cell contents, making them easier to digest.



The ruminant feeding types incorporate three overlapping categories. First, **browsers** are animals that eat plants and plant parts high in easily digestible cell contents (forbs and browse). About 40 percent of ruminants worldwide can be placed in this feeding type. Examples of this group on Texas rangelands include white-tailed and mule deer.

A second group, **grazers**, depends on fiber-containing plants like grasses; about 25 percent of all ruminants fall into this category. Texas examples of this group are cattle, bison, and blackbuck.

A third group, **intermediate feeders**, shifts its diet among grasses, forbs, and browse over the year and within seasons. About 35 percent of ruminants can be placed in this group. Texas examples of this group include pronghorn antelope, elk, goats, fallow deer, and nilgai.

Table 1 compares parts of the digestive systems of grazers and browsers. These differences determine the kinds of forage that animals within each category are adapted to use. For each comparison, Table 1 also indicates the importance of these differences to the feeding types.

Competition Between Ruminant Types

Figure 4 illustrates that many ruminants do not fit completely within these three categories but may, in fact, overlap another category. Within Figure 4, the farther to the right of the figure a species name appears, the more grass that species is expected to eat. On the other hand, the farther to the left a species name appears, the more forbs and browse that species is expected to eat.

Ruminants in the intermediate feeder category are expected to eat about equal amounts of grass and browse and/or forbs, but these animals may overlap either grazers or browsers. For example, nilgai overlap with grazers, which indicates their diets would be expected to be more like that of cattle than white-tailed deer. The more overlap between species, the more similar their expected diets are and the more expected competition for forage. Horses, for example, which

Table 1. Comparison of Anatomy of Mouths and Digestive Systems of Browsers and Grazers (adapted from Hofmann 1986,1988).

Comparison	Browsers	Grazers	Significance
Mouth opening	large, narrow	small, wide	Larger mouth opening allows stripping of twigs and gnawing of flowers and fruit.
Lips	flexible	rigid	Flexible lips allow more selectivity of plant parts eaten.
Tongue	slender	thick	Browser uses slender tongue with lips to select individual plant parts. Grazers wrap tongue around clumps of forage, not efficient for individual leaf selection.
Taste buds	few	many	Smell is probably more important in browser food selection and taste avoidance is probably more important in grazers.
Teeth	sharp	flat	Browsers can puncture plant material quickly releasing easily fermented cell contents. Grazers grind food, cell walls freed for microbial digestion.
Jaw muscles	light	heavy	Heavy grazer muscles needed in grinding fibrous plant material.
Salivary glands	large	small	Browsers need more saliva to keep rumen pH from becoming too acidic from fermentation of large quantities of rapidly fermented cell contents.
Rumen	simple	subdivided	Allows food in the browser rumen to leave rapidly, a disadvantage on high fiber forages like grass which require more fermentation time. Grazers are able to hold food in rumen longer allowing high fiber forages more time to ferment.
	small	large	Browsers cannot hold large quantities of food. Grazers can store larger quantities of forage in the rumen which is an advantage with slower fermenting high fiber forages.
Rumen muscles	light	heavy	Heavy muscles allow grazers to handle larger amounts of forage held in rumen.
Rumen papillae	cover rumen wall	lower rumen	With an increase in these structures, absorption occurs over a greater portion of the rumen in browsers allowing acids produced during fermentation to exit the rumen quickly and help control rumen pH.
Reticulum			
size	large	small	Small size, many and deep subdivisions hold forage in the grazer rumen longer allowing more time for fermentation.
subdivisions	few shallow	many deep	
Omasum	small	large	Larger size provides more absorption surface.
Liver	large	small	Larger liver is needed to absorb more rapidly fermented cell contents from browser rumens and to detoxify chemicals in browse.
Hindgut volume	large	small	Larger volume indicates that hindgut fermentation is more important in browsers. Less-digestible plant material which quickly exits the browser rumen and undergoes additional fermentation in the hindgut providing additional energy.

are non-ruminant grazers, would be very competitive with either bison or cattle grazing the same area because their diets are so similar. Because of their flexible diets, intermediate feeders are very competitive with both browsers and grazers. The impact of this competition is especially great for smaller animals.

Smaller animals have higher relative nutrient requirements and must, therefore, consume higher-quality diets. A small browser with high nutrient requirements and little flexibility in the diet to which it can adapt faces potential problems when it shares the same habitat and food source with an extremely flexible and competi-

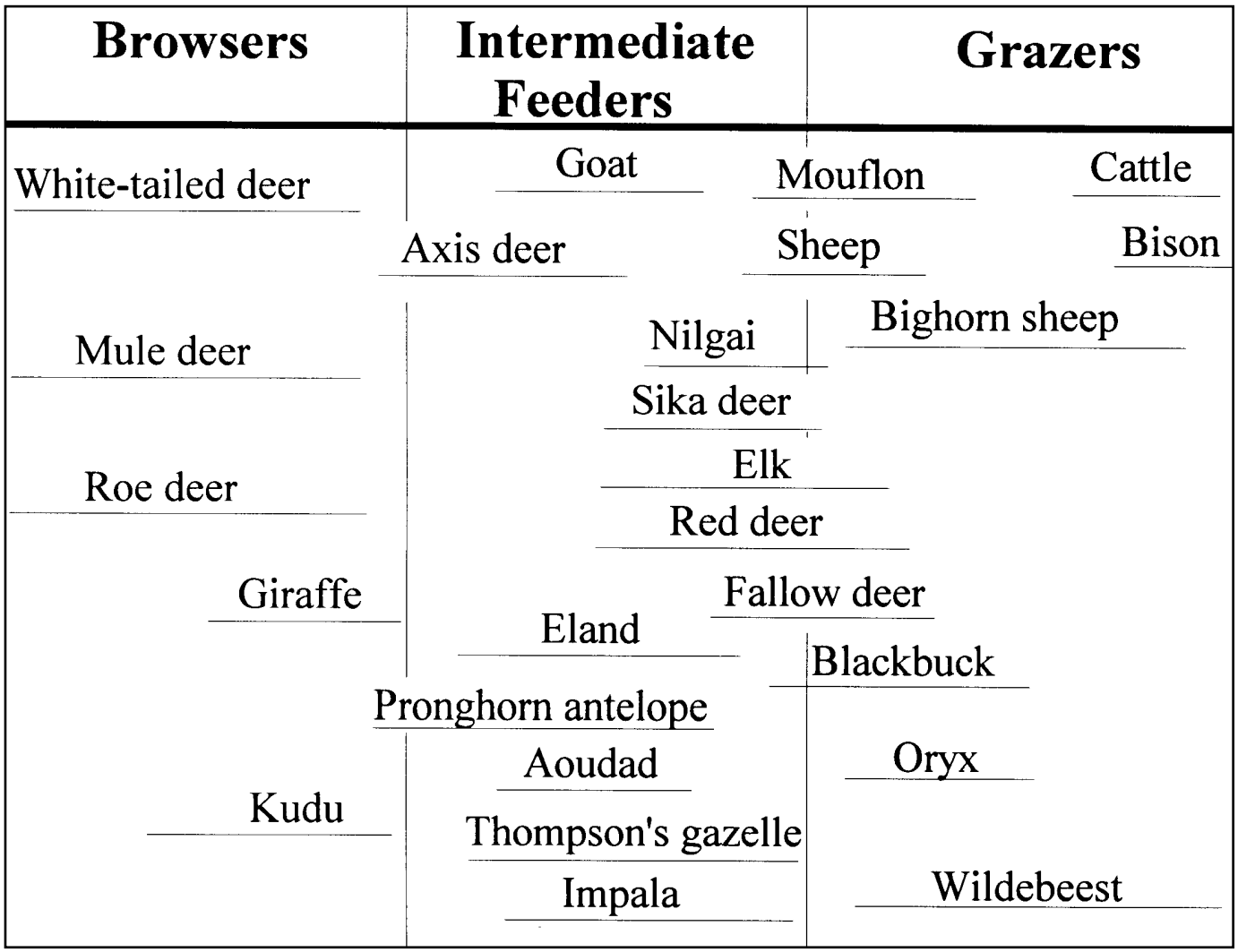


Figure 4. Feeding type classification for domestic livestock and native, Asian, and African wild ruminants. Some species overlap feeding types. The farther to the right a species name appears within a column, the more grass expected in the diet. The farther to the left a species name appears, the more forbs (wildflowers, weed, etc.) and browse (leaves form woody plants) expected in the diet. Intermediate feeders tend to shift their diets among grasses, forbs, and browse over the year and within seasons (Adapted from Hofmann 1986,1988; Mungall and Sheffield 1994).

tive intermediate feeder. One study illustrating this point was conducted at the Kerr Wildlife Area (Armstrong 1984). White-tailed deer (browsers) and sika deer (intermediate feeders) were placed in an enclosed pasture. At the end of the study, white-tailed deer were nonexistent and sika deer were abundant. When browse and forbs were significantly reduced in the pasture, white-tailed deer had no alternative forage source. Sika deer, however, were able to shift their diet to grass and survive.

Conclusions

Range herbivores differ widely in the kinds of forages they are adapted to use. These differences are largely based on the anatomy of the animals. Most of the economically important range herbivores in Texas are ruminants.

In ruminants, the degree to which an animal can adapt to different diets is related to its feeding type, which is determined by its digestive anatomy. The least-adaptable ruminants are the browsers and grazers. Between these two groups are the intermediate feeders, which are extremely flexible in their diets and, therefore, the habitats they can use. Although grazers will eat browse and browsers will eat grass, they will not perform well when forced to shift their diets to these extremes. Understanding these differences in feeding types and which food sources are suitable for which animals can improve the landowner's ability to successfully manage different range herbivores.

For More Information

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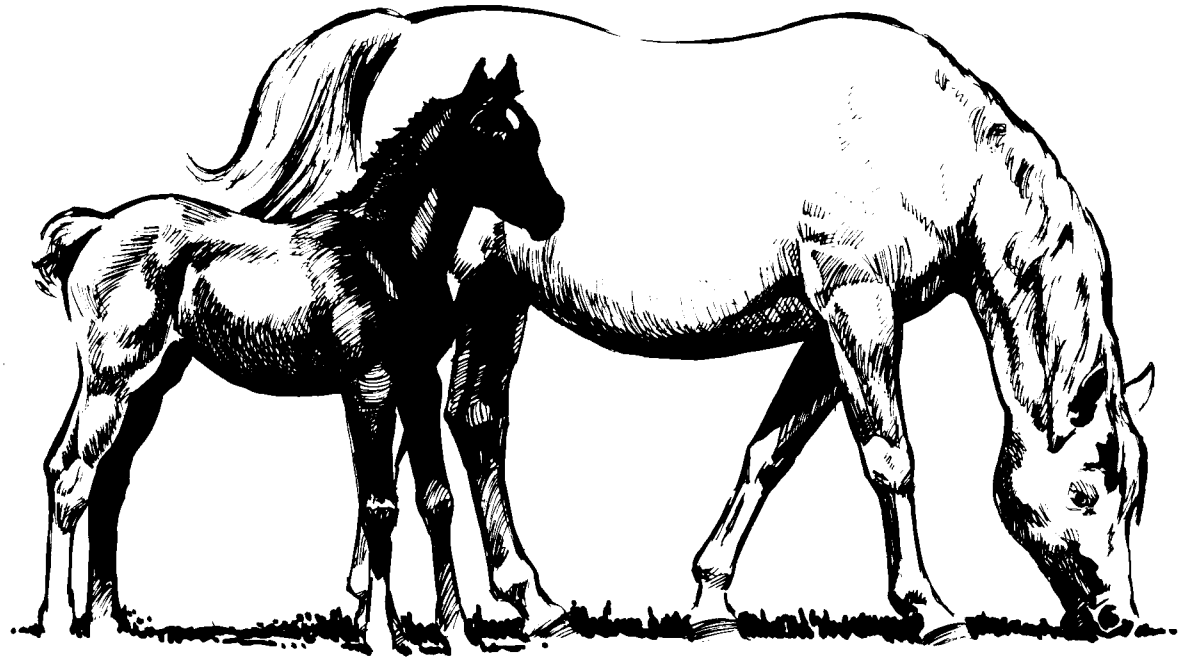

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