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What Range Herbivores Eat—and Why

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What Range Herbivores Eat—and Why

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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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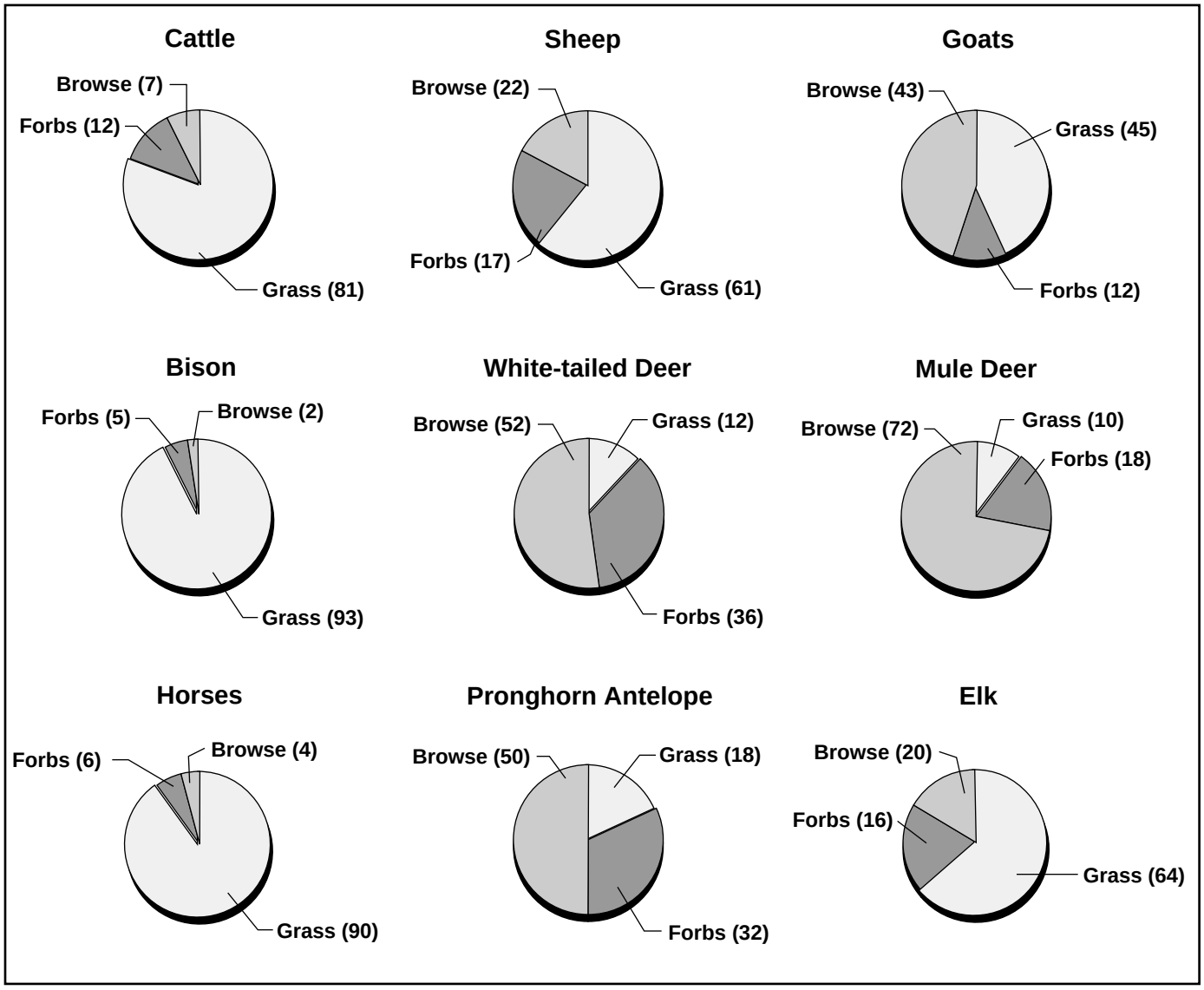


Figure 1. Average annual diet composition by percent grass, forbs (wildflowers, weeds, etc.) and browse (leaves of woody plants) for cattle (Edwards Plateau and South Texas), sheep (Edwards Plateau), goats (Edwards Plateau), bison (Colorado), white-tailed deer (Edwards Plateau and South Texas), mule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

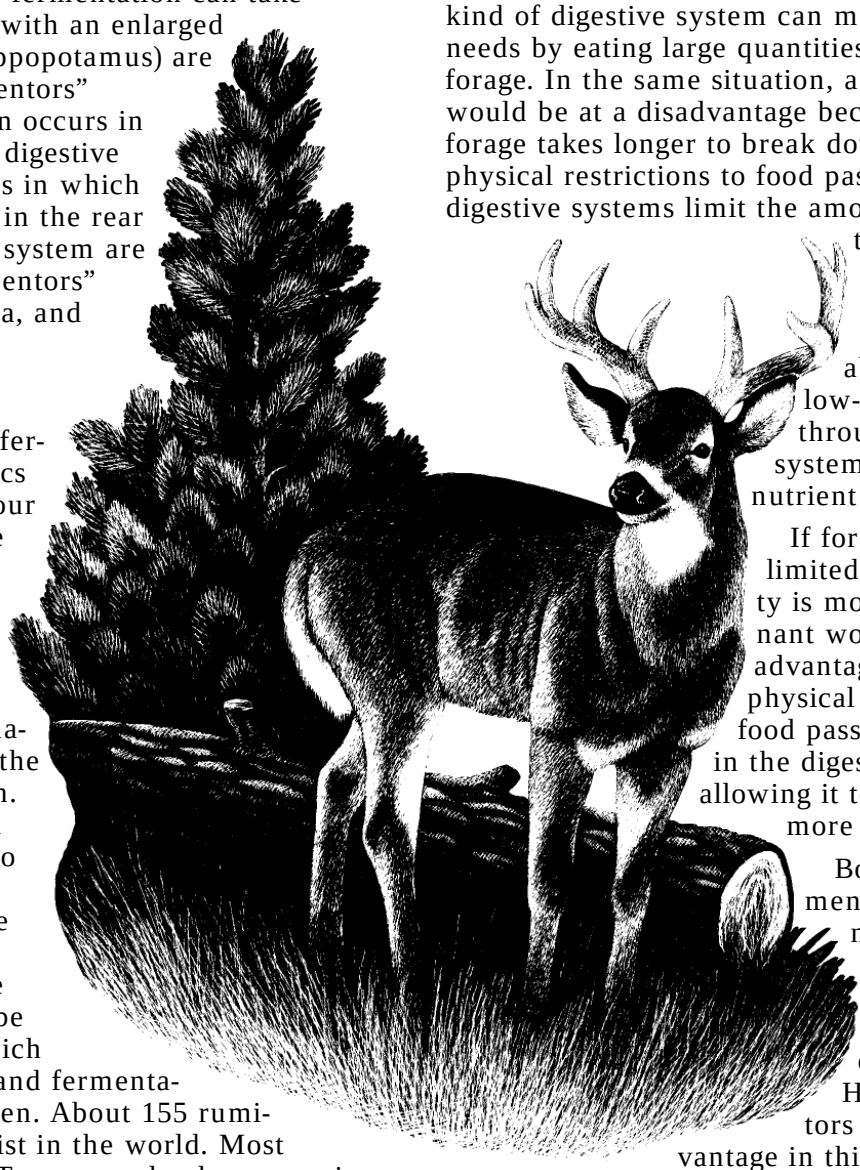
where food can be held long enough for the microorganisms to break down the cellulose.

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.

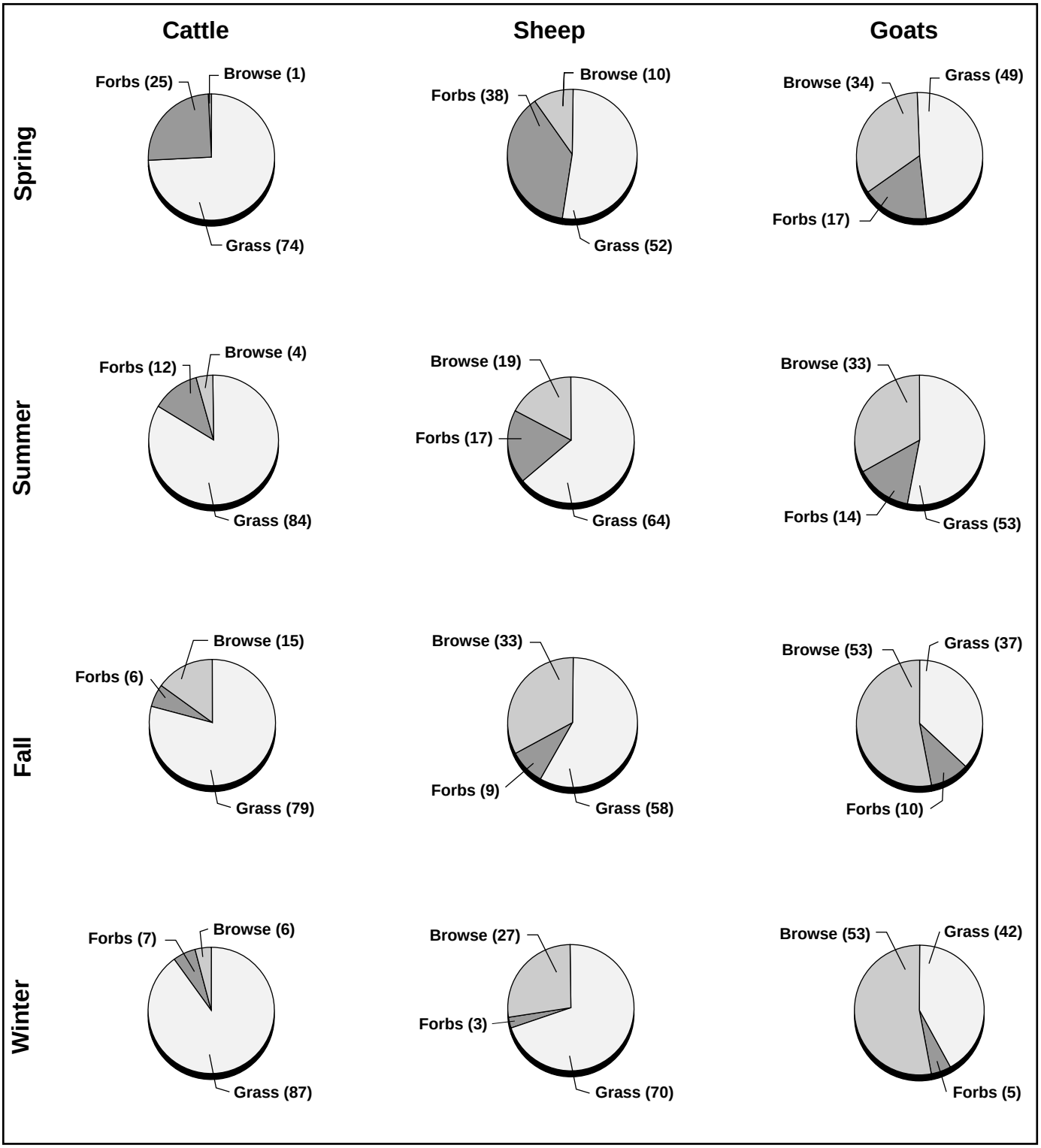


Figure 2. Average seasonal diet composition by percent grass, forbs (wildflowers, weeds, etc.) and browse (leaves of woody plants) for cattle (Edwards Plateau and South Texas), sheep (Edwards Plateau), and goats (Edwards Plateau), on rangeland (adapted from Vallentine 1990).

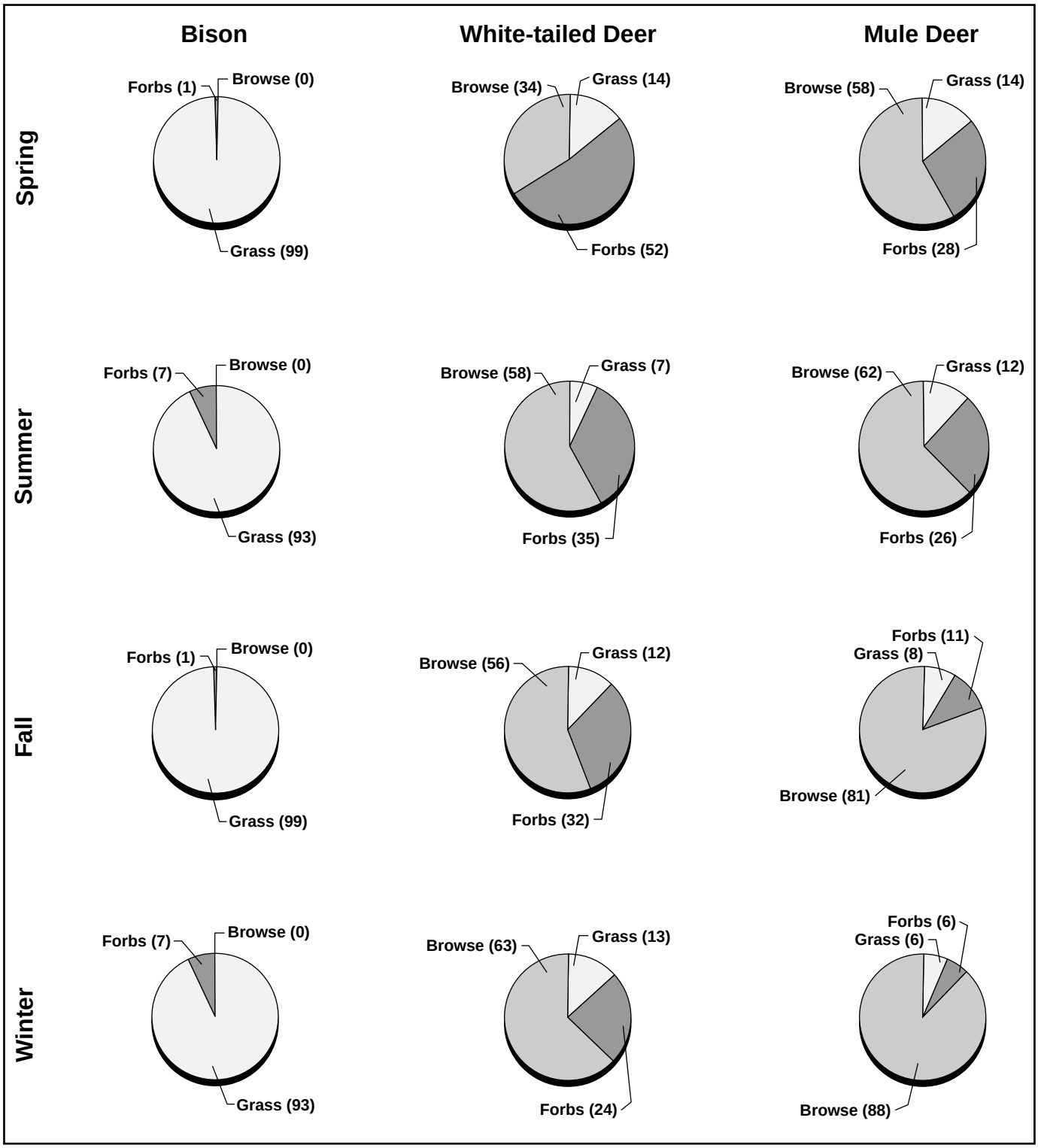


Figure 3. Average seasonal diet composition by percent grass, forbs (wildflowers, weeds, etc.) and browse (leaves of woody plants) for bison (Colorado), white-tailed deer (Edwards Plateau and South Texas), and mule deer (western United States) on rangeland (adapted from Vallentine 1990).

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.

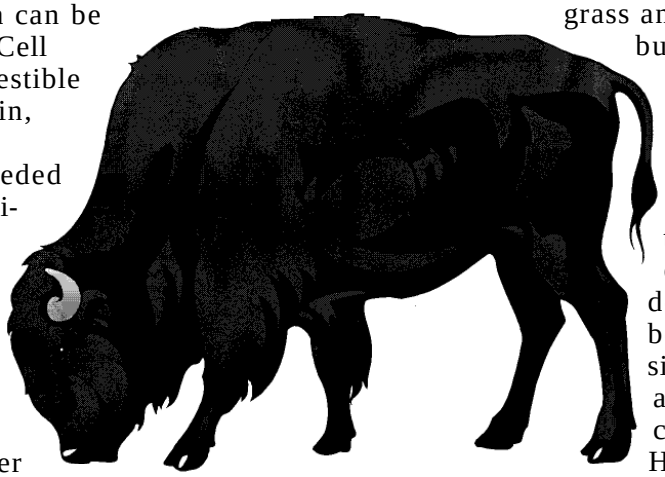
Ruminant Feeding Types

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-

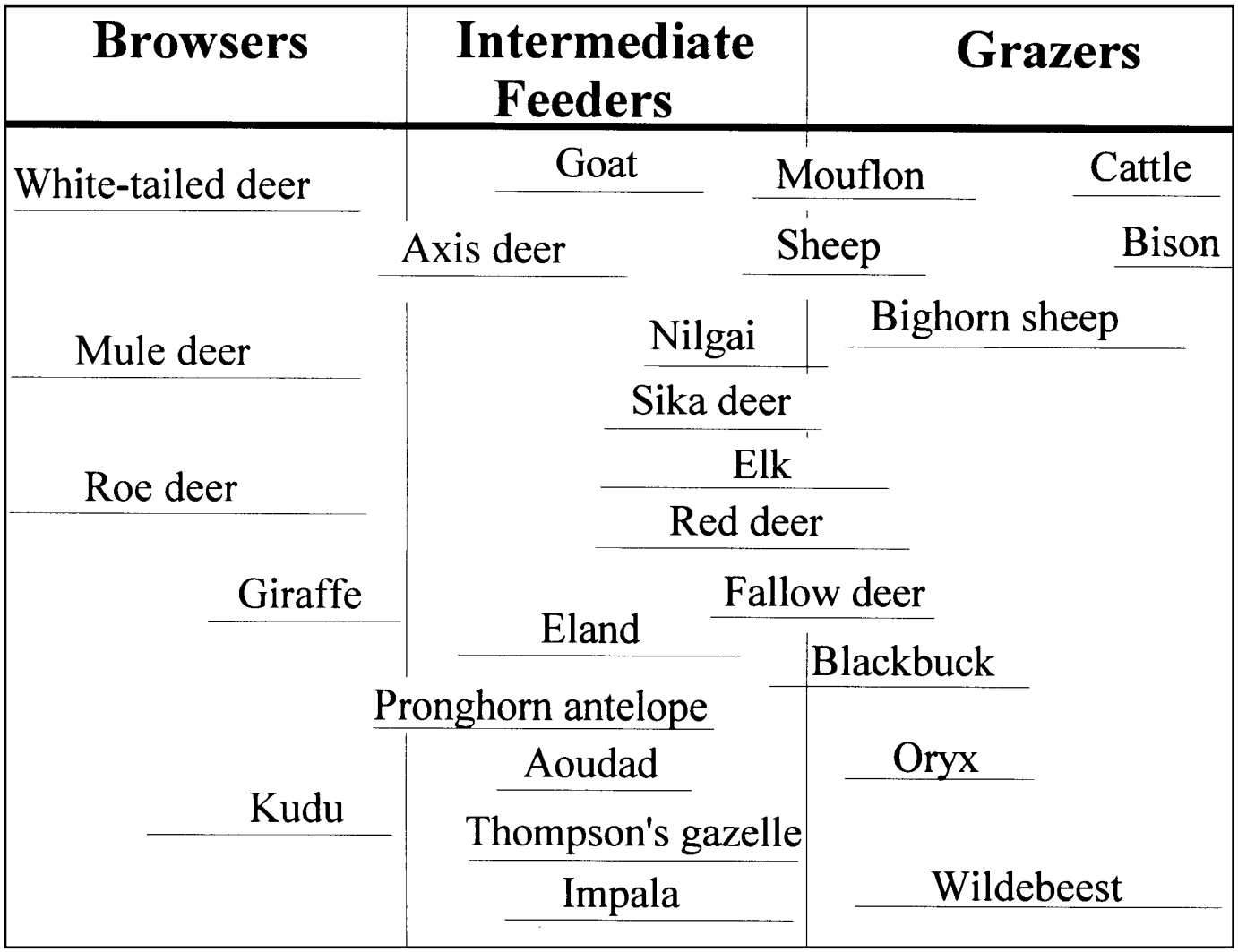


Figure 4. Feeding type classification for domestic livestock and native, Asian, and African wild ruminants. Some species overlap feeding types. The farther to the right a species name appears within a column, the more grass expected in the diet. The farther to the left a species name appears, the more 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

Some information in this publication is taken from these sources:

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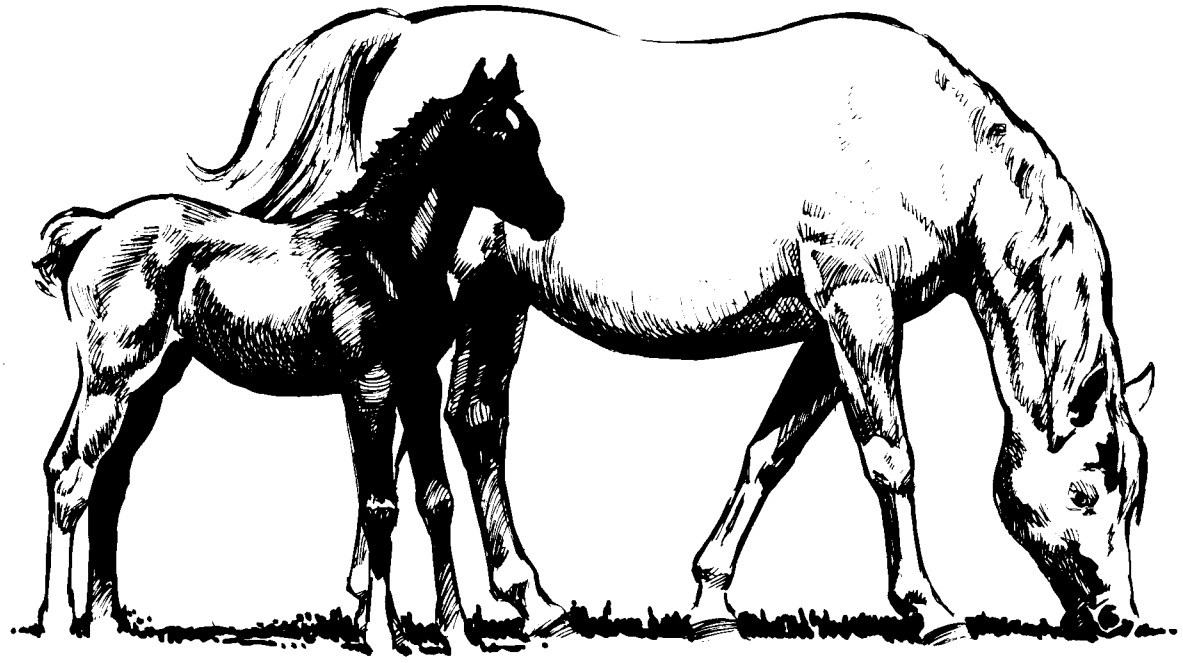

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