

Dietary Composition and Conflicts of Livestock and Wildlife on Rangeland



Derek Scasta, Assistant Professor and Extension Rangeland Specialist

INTRODUCTION

The interaction of livestock and wildlife on rangeland is an issue of concern not only for ranchers and wildlife managers, but the general public. Recently, the public interest in the ecological impacts and well-being of wild horses on western rangelands has raised additional concerns. In particular, competition for food resources can help guide decisions for grazing timing, duration, and location. The preferential selection of certain types of plants by livestock and wildlife is largely influenced by animal physiology and morphology. Specifically, the type of digestive system and size and shape of the mouth features. Plant selection is also influenced by precipitation and the relative availability and nutritional quality of plants.

A summary of data from western North America compares diet composition of wild horses, beef cattle, domestic sheep, elk, pronghorn, and mule deer across

spring, summer, fall, and winter. The data presented here represent a summary of 33 different scientific studies with 208 unique samples. All studies were identified by searching scientific journals and came from interior rangelands in western North America. The locations of the studies were Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, South Dakota, Texas, Utah, Wyoming, and Alberta, Canada. All used similar fecal microhistological methods for quantifying diet composition. The fecal microhistological technique uses microscopes (typically 100x or 200x magnification) to compare plant fragments in the feces of grazing animals to plant fragments collected on a site that are used as references. We chose this method because it has been around since the 1930s, has been found to accurately represent range herbivore diet composition, and has been used widely in research projects across the west.

GENERAL CONCEPTS OF LIVESTOCK AND WILDLIFE GRAZING

PLANT TYPES

Graminoids: These plants include grasses and plants that are a lot like grasses such as sedges and rushes. These herbaceous plants typically have narrow leaves with parallel veins. Example of grasses are blue grama (*Bouteloua gracilis*), needle-and-thread (*Stipa comata*), and threadleaf sedge (*Carex filifolia*). Often referred to as 'grasses' or 'grass' in general.

Forbs: These herbaceous plants typically have showy flowers and net-like veins on the leaves. Examples of forbs are scarlet globemallow (*Sphaeralcea coccinea*) and indian paintbrush (*Castilleja* spp.).

Shrubs: These are small woody plants with multiple stems that typically do not have the form of a tall single-stemmed tree. Examples of shrubs are sagebrush (*Artemisia* spp.), antelope bitterbrush (*Purshia tridentata*), and true mountain mahogany (*Cercocarpus montanus*).

MOUTH STRUCTURE

The structure and function of the teeth, lips, and tongue influence how an animal selects plant parts, grasps and moves plant material into the mouth, and physically begins to break down plant material.

Teeth (Figure 1): Incisors are teeth at the front of the mouth used for biting, clipping, tearing, and/or pulling plant material. Molars are teeth at the back of the mouth used for grinding plant material. Ruminant animals (cattle, deer, elk, pronghorn, and sheep) only have incisors on the bottom jaw and a dental pad on the top jaw. Hindgut fermenters such as horses have incisors on the top and bottom jaws. Cattle, deer, elk, pronghorn, sheep and horses have molars in the upper and lower jaw.

Lips and tongue (Photo 1): The lips and the tongue are the primary prehensile structures. Prehensile is defined as "capable of grasping." Animals that consume

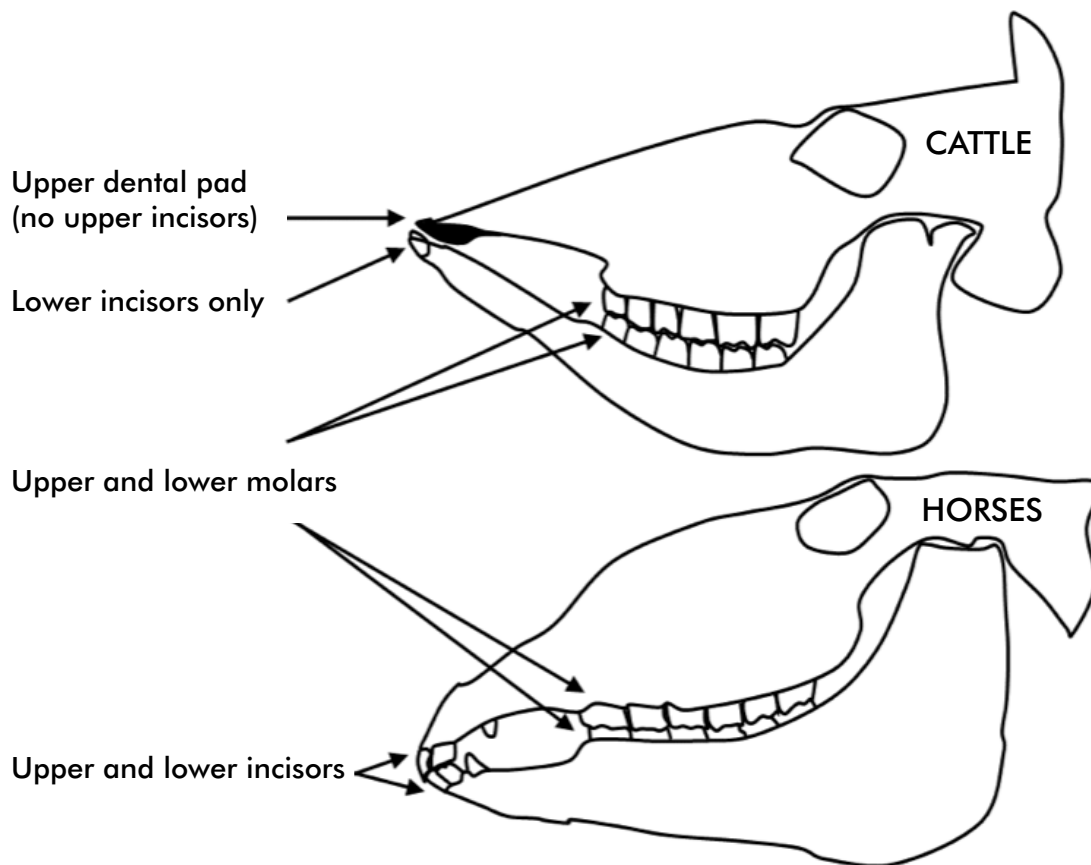


Figure 1. Incisors are teeth at the front of the mouth that are used for biting or tearing. Molars are teeth at the back of the mouth that are used for grinding plant material. Ruminant animals (cattle, deer, elk, pronghorn, and sheep) only have incisors on the bottom jaw and a dental pad on the top jaw. Hindgut fermenters, such as horses, have incisors on the top and bottom jaws. Cattle, deer, elk, pronghorn, sheep and horses have molars in the upper and lower jaw.



Photo 1. An example of cattle using the tongue, not the lips, as the primary prehensile structure for grasping and pulling plant material into the mouth.

forbs and woody browse have very agile lips and tongues that can be used for very selective and discrete selection of plant material (example deer). Animals that forage more exclusively on graminoids have very large and rigid mouths that are designed for non-selective grazing and the tongue is the primary prehensile agent (example cattle).

DIGESTIVE SYSTEM

Livestock and wildlife on rangelands generally have two types of digestive systems. These systems differ in how plant material is broken down, to what degree it is digested, and how rapidly the plant material passes through the digestive system (Figures 2a and 2b).

Foregut fermentation (Figure 2a): Also called pre-gastric fermentation, these animals are considered to be true ruminants as they have a multi-chambered stomach (the rumen, reticulum, and omasum) followed by the true stomach or abomasum. Plant material is subject to microbial fermentation in the rumen and reticulum, and these animals are more efficient than hindgut fermenters at extracting nutrients from plants. Microbes in the foregut convert non-protein sources of nitrogen to protein. Microbial protein is then available to the ruminant as it passes into the abomasum. Thus, foregut fermentation is an advantage when plant material is low in quality.

Hindgut fermentation (Figure 2b): Also called post-gastric fermentation, these animals are not considered ruminants because they are monogastric with a one-chambered stomach and a large intestine that comprises a high percentage of the digestive tract. Microbes are stored in the caecum for fermentation and then plant material passes to the large intestine. Hindgut fermentation is not as efficient as foregut fermentation but is faster. Hindgut fermentation is an advantage when plant material is high in both quality and quantity.

TYPE OF GRAZER

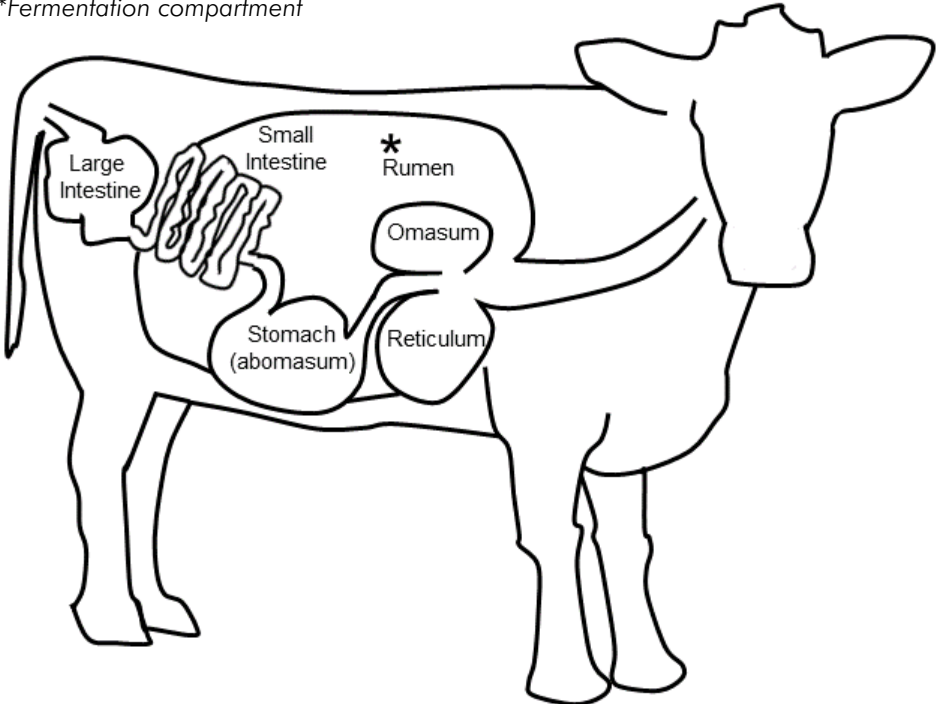
Concentrate selector or browser: Animals that select the highly nutritious parts of the plant that are often low in fiber, typically parts of shrubs such as leaves or buds. This requires very selective lips that allow the animal to nibble with precision (example deer).

Bulk roughage selectors: Animals that intake large amounts of low-energy plant parts that are often high in fiber, typically graminoids. This requires less selective mouth structures (example cattle).

Mixed or intermediate selectors: Animals that are able to select and use plant parts used by concentrate selectors and bulk roughage selectors. They tend to be very adaptable and able to shift consumption (example sheep).

A. Foregut fermentation digestive system (example: beef cow)

*Fermentation compartment



B. Hindgut fermentation digestive system (example: horse)

*Fermentation compartment

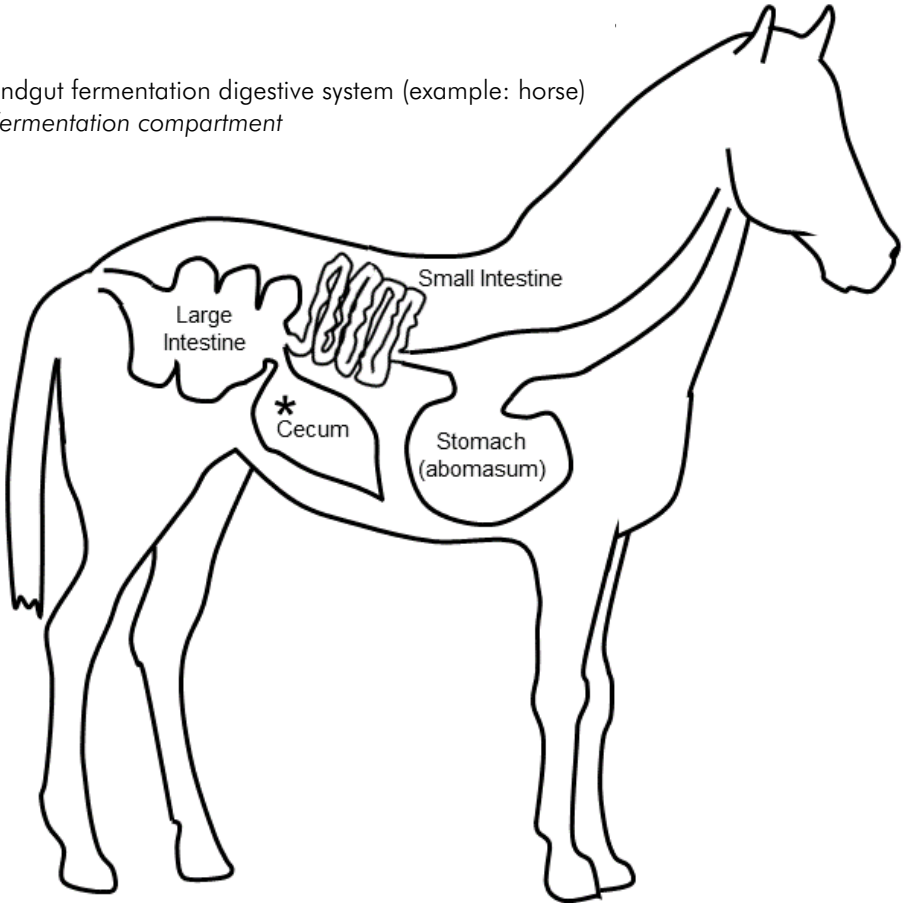


Figure 2. Digestive tract for A) foregut fermentation and B) hindgut fermentation. Note the location of the fermentation compartment is the rumen in cattle, and it occurs before the small and large intestines (i.e., foregut). Note the location of the fermentation is the cecum in the horse, and it occurs after the small intestines (i.e., hindgut).

DESCRIPTIONS OF LIVESTOCK AND WILDLIFE SPECIES

(Refer to Figures 3 and 4)

WILD HORSES (*Equus ferus*)

Horses have upper and lower incisors, a selective lip structure, and are hindgut fermenters. Hindgut fermentation classifies horses as non-ruminants and affects the ability of horses to efficiently use fibrous plant material of low quality and results in rapid passage through the digestive tract compared to ruminants. Wild horses strongly select for graminoids, and their diets are 74% to 86% grass/grasslike plants depending on the season. Grass consumption by horses typically equals or exceeds that of beef cattle and is greater than sheep, elk, pronghorn and mule deer. Horses generally consume less than 15% forbs and less than 10% shrubs regardless of season; however, one study in New Mexico reported 43% shrub composition in a wild horse diet during winter.



BEEF CATTLE (*Bos taurus*)

Cattle are bulk roughage selectors that use foregut fermentation and are considered a true ruminant. Cattle only have lower incisors and an upper dental pad at the front of the mouth and a tongue that is the primary selective structure as the lips are rigid. Cattle strongly select for graminoids with diets consisting of 61% to 81% grass/grasslike plants, depending on season. Cattle also consume more grass than sheep, elk, pronghorn, and mule deer. Additionally, cattle can shift their diet to utilize forbs and shrubs and winter diets on average consist of 18% forbs and 21% shrubs.



DOMESTIC SHEEP (*Ovis aries*)

Sheep only have lower incisors and an upper dental pad at the front of the mouth. The lips and tongues of sheep are moderately agile and selective. Sheep are considered to be mixed or intermediate selectors, typically making use of all plant functional groups, and use foregut fermentation like cattle. Sheep diets can consist of 27% to 63% graminoids with the highest and lowest use in summer and winter, respectively. Sheep diets can consist on average of 47% forbs and 26% shrubs in the winter, and forbs comprise a higher portion of sheep diets than that of any other livestock or wildlife species in this bulletin.



ELK (*Cervus canadensis*)

Elk have lower incisors and an upper dental pad, upper canine teeth called ivories in both sexes, and moderately selective lips and tongue. Elk are often considered to be bulk roughage selectors in general; however, elk are able to make use of all plant functional groups with the ability to shift their diets in response to seasonal fluctuations (more similar to a mixed or intermediate selector). Elk are foregut fermenting ruminants such as cattle and sheep. Elk diets can consist of 25% to 58% graminoids with the lowest and highest use in summer and fall, respectively. Elk diets consist of 11% to 32% forbs with the highest forb use in the summer. Shrub use by elk is the highest in winter, averaging 44% of their diet.



MULE DEER (*Odocoileus hemionus*)

Mule deer are concentrate selectors that have selective lip structures and agile tongues for discrete bites. Mule deer have lower incisors and an upper dental pad. Mule deer are foregut fermenting ruminants like cattle and sheep. Diets of mule deer are comprised largely of shrubs, ranging from 65% to 80%, with some studies reporting up to 97%. Grass use by mule deer is low and ranges from 3% to 7% with an average of 6%. On average, forbs can make up 15% to 24% of a mule deer's diet, with higher consumption in summer.

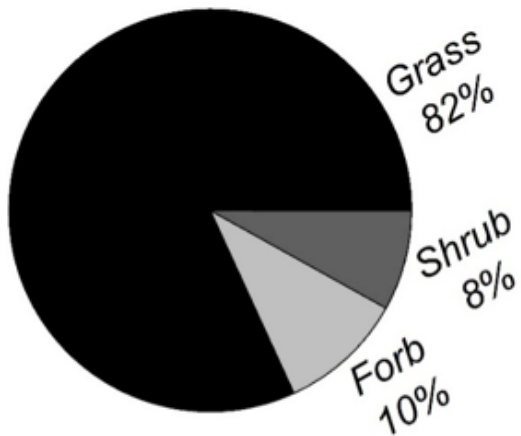


PRONGHORN (*Antilocapra americana*)

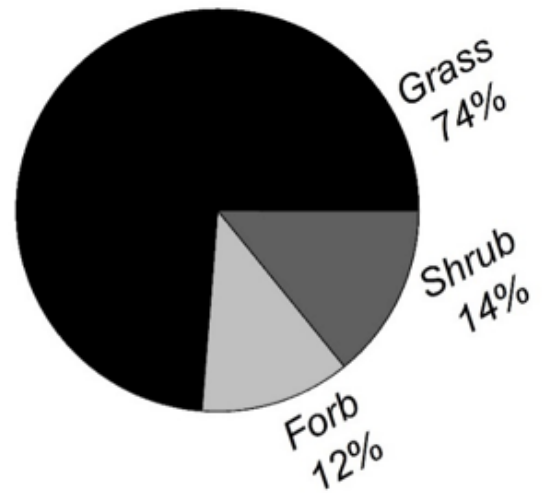
Pronghorn are also concentrate selectors with selective lip structures and agile tongues for discrete bites. Like mule deer, pronghorn lack upper incisor teeth. Pronghorn are foregut fermenting ruminants like cattle and sheep. Diets of pronghorn are comprised largely of shrubs but also can have a high component of forbs. Shrub composition ranges from 44% to 63% with the highest in the fall, with some studies reporting up to 91%. Grass use by pronghorn is also low and ranges from 5% to 10%. On average, forbs can make up 25% to 42% of pronghorn diet with some studies reporting much higher numbers.



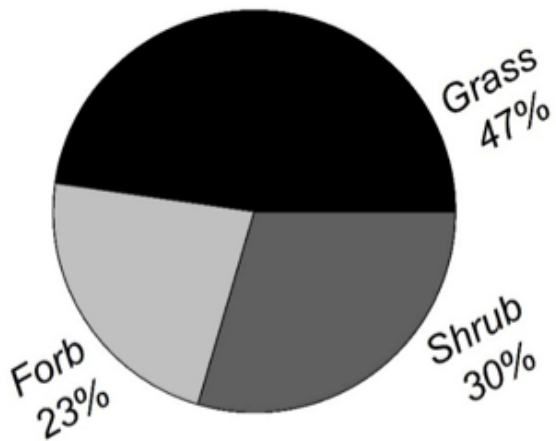
WILD HORSE



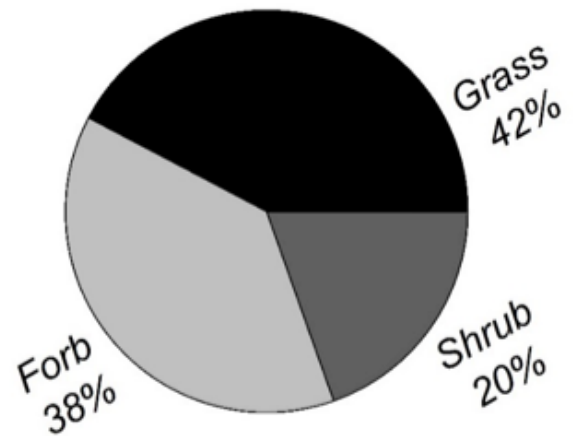
BEEF CATTLE



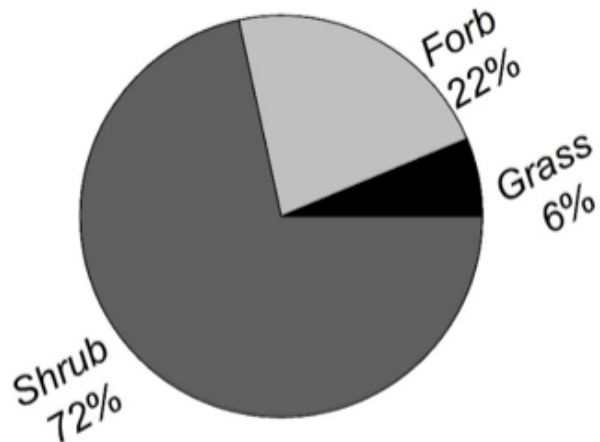
ELK



DOMESTIC SHEEP



MULE DEER



PRONGHORN

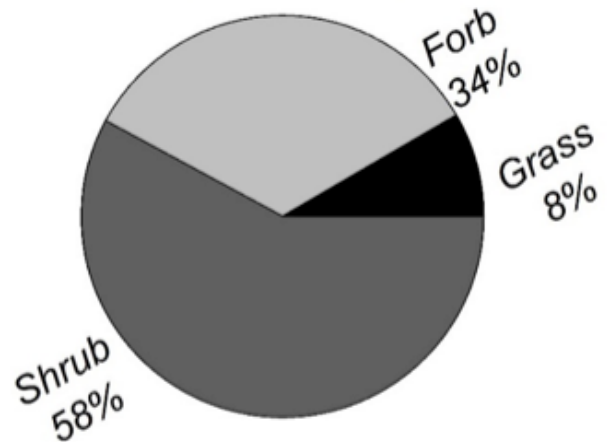


Figure 3. Annual diet composition for livestock and wildlife on western North American rangelands.

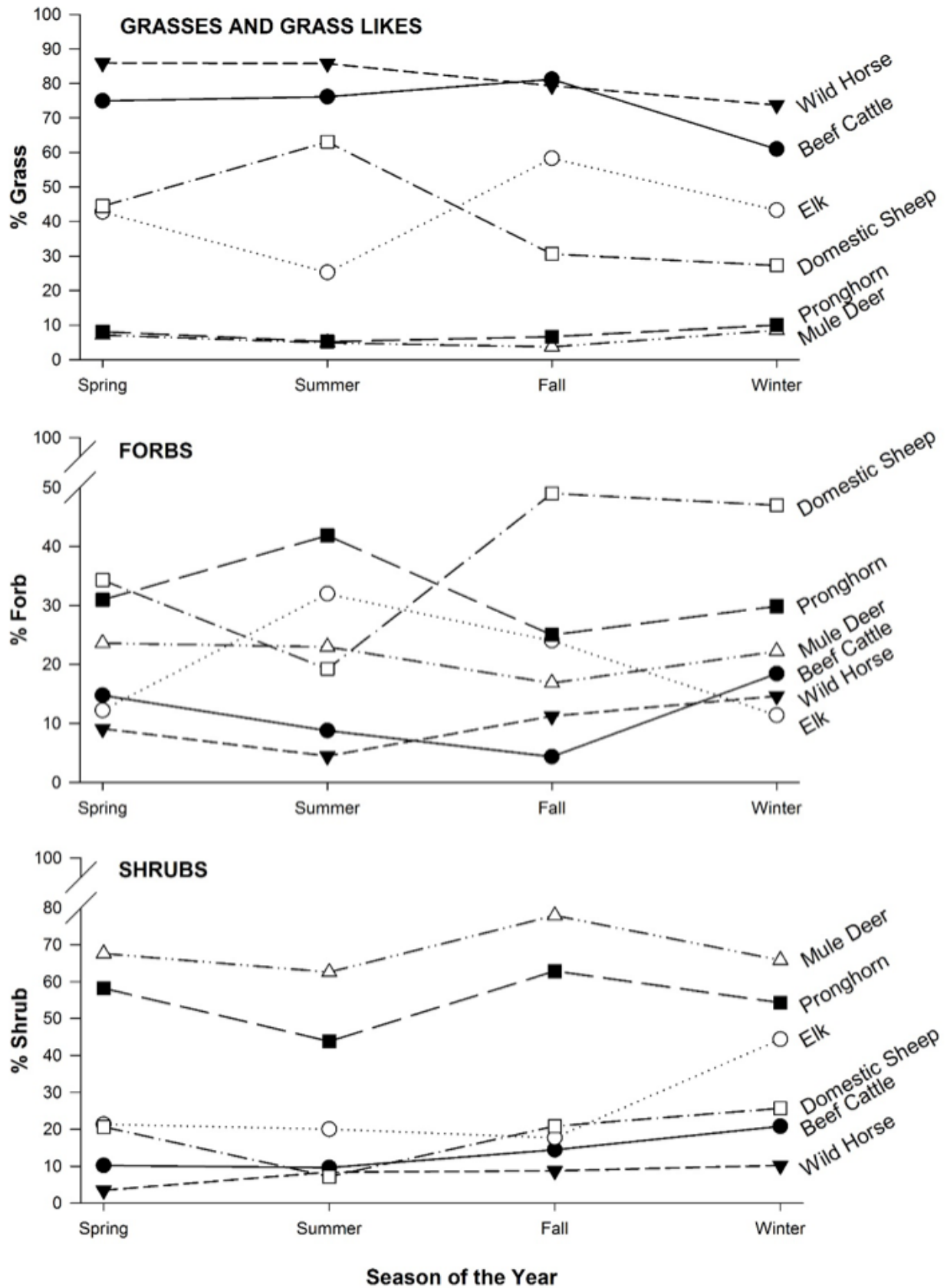


Figure 4. Seasonal changes in diet composition for livestock and wildlife on western North American rangelands.

FACTORS LEADING TO DIETARY OVERLAP

Understanding the dietary composition of wildlife and livestock on western rangelands is critical for balancing livestock production and wildlife conservation. It is important to realize dietary conflict between these animal species can be high or low depending on the following factors.

First, these animals may or may not occupy the same areas during the same times of the year (Photo 2). This will depend on resource needs of wildlife and management decisions of livestock producers. An example would be moving sheep to higher elevation range in summer or elk moving to lower elevations in the winter.

Second, the potential for dietary overlap may also change over time. For example, in some areas elk populations have expanded, and seasonal occupancy has changed from summer only to year-round occupation. Third, the relative availability and nutritional quality of plants may fluctuate with moisture availability, season of the year, and ecological site. A primary example is the

high quality of graminoids in the spring and early summer and subsequent decline in quality as plants mature through the summer into the fall. Cattle and horses do not generally respond to this change by shifting dietary selection, but sheep can. Therefore, competition for graminoids may be higher between sheep and other animals when forage quality is high but may diminish when forage quality is low.

Finally, past management may also influence the relative availability of certain types of plants and may enhance or limit the resource selection options of animals. For example, if livestock grazing was excessive, the availability of perennial grasses may be low and the competition for that resource may increase in riparian areas. Also, if shrubs that rely on seedling recruitment, such as most sagebrush species, have been sprayed or burned, it may take decades to re-establish the shrub component vital for some species.



Photo 2. Pronghorn and elk in a sagebrush ecological site in southwestern Wyoming.

CONCLUSIONS

Understanding dietary preferences and selection by a species is primarily a function of animal physiology and morphology is important. The type of digestive system and size and shape of the mouth features will determine what plants and plant parts an animal is able to select and digest. Annual dietary conflict potential is greatest between 1) wild horses and cattle, 2) elk and domestic sheep, and 3) mule deer and pronghorn.

Understanding the developmental adaptations of each animal species will help guide the strategic use of livestock and wildlife grazing for specific management objectives. Management objectives might include enhancing wildlife habitat with livestock grazing, targeted grazing for invasive plant management, understanding the response of wildlife to rangeland improvement projects, and managing for multiple species and multiple objectives.

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