Technology/Methods

What Exactly Are Your Sheep Eating?

Extend the grazing season and reduce supplementation needs of your range flock in just 60 minutes a day.

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Resurrecting the Range: The Shrub Solution

Various shrub and grass communities occupy much of our western rangelands. The seasonal quality and amount of forage varies considerably among all communities. In some situations, attempts have been made to increase the abundance and seasonal quality of the forage by replacing or altering the species composition. An estimated 12.4 million acres of the total 94 million acres of sagebrush-grass range have been seeded to crested wheatgrass as a means to improve forage conditions, control weed invasion, and reduce the incidence of wildfires. Planting a diverse array of species has been recognized as a means to improve forage quality and extend the grazing periods.

Most shrubs, including species of sagebrush that dominate extensive regions in the West, vary greatly in palatability. Many shrubs are nutritious and are used by livestock and wildlife. For example, black sagebrush is highly regarded as palatable forage for livestock and big game and is especially important to sage grouse. The sagebrushes vary greatly in palatability, though they are quite nutritious. Differences in palatability and selection by grazing animals have been reported for different species of big sagebrush, fourwing saltbush, antelope bitter brush, and many other woody species as well as forbs and grasses.

Researchers have selected highly nutritious shrubs and broadleaf forbs species for a variety of local growing conditions. For example, plant breeding and rigorous selection programs have produced improved varieties and ecotypes of big sagebrush, winterfat, antelope bitterbrush, fourwing saltbush, and numerous broadleaf forbs and grasses. Not all selections have been thoroughly tested for acceptance by livestock as seasonal forage. Some selections may fall short as livestock forage because of the grazing preferences of particular animals.

What We Are Still Wondering: How Much Does Sheep Shrub Selection Shift With Season?

Ranchers need to know the plants being used under free-ranging conditions as well as in controlled pastures and whether supplements are needed. From the sheep rancher's viewpoint, sheep nutrient requirements fluctuate with breed, age, and physiological condition. Similarly, the nutrient content of range grasses and shrubs changes with season and stage of development. Fortunately, sheep have the ability to adjust to these changes and make sound nutritional decisions based on the quantity and quality of available forage. Howery showed that range sheep pick and choose to make a diet more nutritious than the average available.[1] Unlike with confined animals, there is no way for ranchers to know what the daily food choices of the range-fed flock are. However, ranchers may need to feed appropriate supplements for specific periods to sustain animals. Underfeeding or overfeeding the flock can impair performance or waste money. If range sheep managers could accurately calculate the voluntary intake by grazing animals, they may minimize the use of expensive supplements while maintaining animal performance.

Since sheep preferences for shrubs and grasses change throughout the year, scientists have been working on ways to track these changes. Studies of preferences for shrubs have shown in nearly every case that supplementation can be reduced but not eliminated when shrubs are part of the pasture. But reduced by how much? Few studies actually present useful calculations. Even if they did, such numbers would not be universally applicable.

Having faced these obstacles firsthand in a study of sheep forage preferences, we have concluded that while scientists can help in determining methods of data collection and analysis, those who are on the ground with the animals themselves should do the collection of animal preference data. Yes, we are suggesting that livestock producers collect the data themselves. Animal behavior is too often affected by caution induced by unfamiliarity. Much of the variability inherent in behavior studies could be eliminated by using the framework already in place on a working sheep ranch. On the ranch, the nutrient needs of the flock are known, and the nutritional characteristics of the range can be easily deter-

mined by sending samples to a local plant analysis laboratory for routine testing. After a few basic supplies are collected and placed in the glove box or saddlebag, calculation of the range flock ration and any need for supplementation is only minutes away.

The How-To

In animal preference studies, either esophageally fistulated animals or fecal material collected in bags attached to the rear of the animal are needed. Obviously, these techniques are not practical for use by ranchers. But 2 methods of direct observation have been shown to give similar results and are easily adapted to use by almost anyone who happens to be standing in a pasture while sheep are grazing, provided the sheep are accustomed to being watched. Researchers refer to these methods as "focal-animal sampling" and "instantaneous-scan sampling."[2]

A few generalities in using either method should be mentioned. Decide which observation method will be used, then use it consistently in every sampling session. Researchers have found that sheep consistently graze in the early morning or late evening. Observations recorded during 3 morning and 3 evening sampling sessions provide enough data to draw accurate conclusions. Sampling days should be consecutive. If supplementation requirements are to be determined, sampling days must correspond to the time of year when the nutrient content of range forage is known. To obtain reliable data, the observer would select a group of at least 10 sheep from the flock and be able to identify them individually each observation period. Or, if the flock is already divided into separate groups (such as a wether band or a breeding ewe band), a sample of 10 "new" sheep from the same group could be used for each observation session to obtain good data.

Focal-Animal Sampling

In studies of livestock forage preference, this method is alternately referred to as "bite counting." With this method, you can accurately measure what is being consumed by observing only 1 animal (the focal animal) at a time. Researchers often tally the bites of the focal animal for a 5-minute period, recording the number of grass bites, shrub bites, forb bites, and so on. Then another sheep is observed for the next 5 minutes. If the focal sheep stops grazing or is lost from view, the stopwatch is stopped and resumed after grazing commences or the view is unobstructed.

After 10 sheep and 30 minutes, the detailed account of individual sheep grazing activity provides estimates of the percentage of time spent grazing each forage class (shrub, grass, or forb), the bite rate attained in each forage class, and the actual composition of the diet by forage class. Since every bite (the visible and audible taking of food) is counted, it is necessary to approach close enough to individual animals to identify what their mouth is touching. This becomes much simpler if the available forage classes are as structurally different as possible (ie, grass vs shrub), allowing quick identification from a distance. Field glasses may be useful in identifying preference shown by the animals. Instead of using a handheld tally device, a tape recorder may be used and the information transferred to paper at a later time.

Obviously, to get the data in a timely manner, the sheep must be approachable and easily observed regardless of terrain and pasture size. One of the biggest challenges in the use of this method is the gregarious grazing nature of sheep. They may pack so closely as to make it impossible to view them one at a time. It is hoped that this social grazing may be alleviated when sheep are familiar with each other, the pasture, the vegetation, and the observer. In the event that bite counting isn't possible, instantaneous-scan sampling may be the better choice.

Instantaneous-Scan Sampling

This method is slightly less demanding (a handheld tally device is not needed) and can be done at a distance if plants and sheep can be identified accurately. Here, the entire sample of 10 sheep is quickly scanned, and their behavioral states (grazing grass or forb or browsing shrub) are recorded at several predetermined points in time.

Things you need to know: 1) the nutrient needs of your sheep based on their stage of growth, 2) the names of the plants growing in your area, 3) the protein and energy contained in these plants, and 4) how much of each forage your sheep voluntarily eat.

Things you need: 1) paper and pencil, 2) clipboard, 3) stopwatch, 4) handheld tally device or small pocket-size tape recorder, 5) simple 4-function calculator, and 6) 30 minutes at dawn and dusk a few days each season.

Using these items, the observer would set a stopwatch to beep at 1-minute intervals for about 30 minutes' duration. At each minute mark, the observer would record the foraging state of each sheep using symbols of choice. The effect is comparable to that of taking a snapshot of the group with the passing of each minute. In the end, a record of the percentage of time spent in each forage class is determined.

Crunching the Numbers

Table 1 is an example of the kind of information that can be determined from this effort. Once you have determined the nutrient requirements of the sheep sampled (Table 2) and the nutrient content of the range forages for the observation days and obtained an estimate of the proportion of the diet composed of each forage class, an estimate of supplemental feed needs can be calculated.

Simple Dietary Calculations

The percentage, or the ratio (eg, 17%, or 0.17), of each forage class in the diet, whether obtained by counting bites or minutes in each forage class, can be calculated using these simple equations:

$$\%\ \text{shrub} = [\text{shrub} \div (\text{shrub} + \text{grass} + \text{forb})] \times 100 \quad [\text{Eq. 1}]$$

% grass = [grass ÷ (shrub + grass + forb)] × 100 [Eq. 2]
% forb = [forb ÷ (shrub + grass + forb)] × 100 [Eq. 3]

In Equations 1, 2, and 3, shrub, grass, and forb may be expressed as bites (focal-animal sampling) or minutes (instantaneous-scan sampling), depending on the method used to determine preference.

The contribution of each forage class to fulfilling sheep dietary requirements may be calculated thusly:

(% shrub in diet ÷ 100) × (% protein in shrub, grass, or forb ÷ 100) × 100 = contribution to fulfilling protein requirement [Eq. 4]

This formula can be used for each nutrient of interest (eg, protein, metabolizable energy, phosphorus, and calcium).

Next, a comparison of the calculated contribution of the forage and the nutrient requirement of the sheep indicates needed supplement (Table 1). For example, in the spring of 2000, we determined that fourwing saltbush composed 17% of the sheep diet by using the previous calculation. Memmott has shown that shrubs, at this stage of develop-

Table 1. The contribution of grass, shrub, and supplement to fulfilling sheep nutrient requirements for a 150-pound ewe with a single lamb at different stages of production based on the nutrient content of forages and selection measured in each trial of a sheep preference study conducted at the Brigham Young University Sam and Aline Skaggs Research Ranch near Malta, Idaho, from 2000 to 2001

% Crude protein				
Production stage	Requirement	From grass	From shrub	From supplement†
Early or late lactation	13.4* or 10.7**			
Spring 2000		10.94	4.59	0.00
Spring 2001		11.48	3.45	0.00
Maintenance	9.42			
Summer 2000		4.06	5.94	0.00
Summer 2001		5.51	1.32	2.59
Early gestation	9.30			
Winter 2001		3.12	1.97	4.21
Metabolizable energy (Mcal/kg)				
Production stage	Requirement	From grass	From shrub	From supplement†
Early or late lactation	2.40* or 2.10**			
Spring 2000		1.66	0.41	0.03
Spring 2001		1.74	0.31	0.05
Maintenance	2.00			
Summer 2000		1.17	0.68	0.15
Summer 2001		1.59	0.15	0.26
Early gestation	2.00			
Winter 2001		1.26	0.32	0.42

*Early in the lactation period.
**Late in the lactation period.
†Supplement calculations are based on late lactation. For early lactation, required supplementation would be higher.

Table 2. Protein and energy requirements of a 150-pound ewe at various production stages

Stage	% Protein	Metabolizable energy (Mcal/lb)*
Early lactation	13.4	1.10
Late lactation	10.7	0.95
Maintenance	9.4	0.91
Early gestation	9.3	0.91

*Megacalories per pound.

ment, contained 27% crude protein.[3] A simple dietary calculation ([17% shrub ÷ 100] × [27% protein ÷ 100] × 100) reveals a contribution of 4.59% toward the protein requirement of 13.4% for a 150-pound ewe in early lactation or a requirement of 10.7% for a 150-pound ewe in late lactation suckling a single lamb.[4] The shrub contribution added to the grass contribution of 10.94% ([83% grass ÷ 100] × [13.18% protein ÷ 100] × 100) (Table 1) fulfills the protein requirement completely, leaving no need for supplementation. If instead this field were a grass monoculture, the percentage of crude protein in the diet would not be sufficient, and supplementation would be required.

Shrubs Do Contribute to Reduced Supplementation Needs

As illustrated in Table 1, inclusion of shrubs in grass monocultures does reduce the need for supplemental feed. In this example, reductions ranged from 7.5% to 57%. Just how much shrubs may be benefiting you remains to be determined using the methods outlined. Is it worth it? You decide.

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