



Structure, Quality, and Skills Interact to Influence Forage Intake

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In general, the more livestock eat, the more weight they gain or milk they produce. Thus, forage intake is key to animal performance. Agronomists manage for plant density and height to ensure livestock maximize intake. While plant structure is important, intake is not dictated by structure alone. Forage quality, current nutritional state, and experience also affect forage intake by livestock.

Calculating Intake

Daily intake can be calculated using the following equation: $\text{Intake} = \text{BS} \times \text{BR} \times \text{GT}$ where BS = bite size or the amount of forage per bite; BR = bite rate or the amount of forage eaten over time; and GT = grazing time or the amount of time herbivores spend grazing during in a 24 hour period (Kenny and Black, 1984).

Structure Matters

According to a number of research studies bite size has the greatest effect on intake. Managers can maximize bite size by maintaining pastures in a vegetative state, immature and leafy, and by keeping plant height at no more than 6 - 8 inches and no less than 2 to 2.5 inches. When forage grows above 6 to 8 inches, nutritional quality declines as the proportion of stems relative to leaves increases; bite size also decreases as animals attempt to select leaves over stems. When forage height drops below 2.5 inches, bite size declines due to a decrease in forage availability. Livestock must spend more time grazing and increase their bite rate to eat the same amount of forage. If forage is too short, livestock cannot graze fast enough or long enough to maintain intake and performance (Kenny and Black, 1984).

Differences in the size and physical characteristics of different plant species cause changes in rates of intake by livestock and wildlife. Intake rates in deer and elk

increase as their diet changes from grasses to mixed forages and browse because increasing leaf size allows for bigger bites (Wickstrom et al., 1984).

Nutritional Quality Matters

Studies of plant structure rarely consider how nutritional quality affects intake because forages used in these studies are typically kept in a highly nutritious state, immature and leafy. In studies where quality and structure both vary, the effects of structure and quality cannot be separated because forages high in nutrients are typically leafy with few stems and easy to eat, while foods low in nutrients are stemmy or woody and difficult to eat.

In cases where structure and quality have been separated, researchers found that diet selection is influenced by the nutrient content of the food as well as by intake rate. Cattle preferred vegetative to reproductive stands of grass, even though intake rates on reproductive stands of grass were higher. Vegetative stands were higher in nutritional quality than reproductive stands. Cattle increased their grazing time and biting rate of vegetative growth to maintain total intake and diet digestibility (Giane et al., 2003). In addition, animals often prefer foods with lower rates of intake if those foods contain needed nutrients or are higher in nutrients than other foods. For example, in one study lambs on a high-protein diet were offered a choice between ground barley and alfalfa pellets. Even though intake rates were lower for ground barley than alfalfa pellets, they preferred ground barley because barley is higher in energy than alfalfa (Villalba and Provenza, 1999).

These results have implications for managers of high-producing livestock, such as grass-fed dairy cows, because the type of forage animals selects on pasture is

influenced by the nutritional composition of supplements fed in the barn. Dairy cows fed high-protein supplements in the barn spent more time grazing grass and less time grazing clover compared to cows fed a supplement lower in protein even though rates of intake are normally higher for clover than grass.

Many believe that the rate of forage intake is fixed, and determined solely by bite size and rates of chewing and swallowing, which are determined by plant density, height, and toughness. However, the nutritional quality of forage is a key factor influencing intake rates. For example, when sheep were given a solution of starch and water with a stomach tube every time they ate long wheat straw, bite size, bite rate and intake all increased. Thus, structure alone does not determine intake. Likewise, lambs fed a high-energy diet ate high-energy barley more slowly than lambs maintained on a diet high in protein. Thus, an animal's current nutritional state and prior post-ingestive experience with the forage affect rates of intake (Villalba and Provenza, 2000).

Experience Matters

Small amounts of experience browsing or grazing a plant can mean big changes in intake rates. Naive lambs fed chopped serviceberry in boxes were compared with lambs with 30 hours experience browsing serviceberry. Experienced lambs had faster bite rates and intake rates were 27% higher compared with naive lambs. Naive lambs took larger bites than experienced lambs but could not make up for their slower bite rate. In addition, naive lambs had more difficulty nipping bites off the plant than experienced lambs (Flores et al., 1989).

Young animals learn foraging skills more quickly than older animals. Six-month-old goats browsing blackbrush had faster bite rates than 18-month-old goats even though both groups of goats had browsed the shrub for 30 days. In addition, after 30 days bite rates for 6-month-old goats were still increasing, whereas bite rates for 18-month-old goats had leveled off (Ortega-Reyes and Provenza, 1993a).

To some degree, skills acquired by lambs on one type of plant - grass or shrub - are specific to that plant form. Lambs experienced browsing shrubs are more efficient at harvesting shrubs than lambs experienced grazing grass, and vice versa. Nevertheless, skills transfer from

one shrub to another. Goats with experience browsing blackbrush were more efficient at harvesting oak leaves than goats without browsing experience (Ortega-Reyes and Provenza, 1993b).

Implications

Intake rate is often thought to be solely dependent on plant structure. However, plant structure, current nutritional state of the animal, prior experience with the plant, and the acquisition of foraging skills interact to influence rates of intake. Managers can improve intake rates in their animals by keeping pastures at the correct height, feeding foods in the barn that complement the nutritional composition of forages in pastures and exposing young animals to the forages they will be required to eat later in life.

References

- Flores, E.R., F.D. Provenza, and D.F. Balph. 1989. Role of experience in the development of foraging skills of lambs browsing the shrub serviceberry. *Appl. Anim. Behav. Sci.* 23: 271-278.
- Ginane, C., M. Petit, and P. D'Hour. 2003. How do grazing heifers choose between maturing reproductive and tall or short vegetative swards? *Appl. Anim. Behav. Sci.* 83:15-37
- Kenney, P.A., and J.L. Black. 1984. Factors affecting diet selection by sheep. I. Potential intake rate and acceptability of food. *Aust. J. Agric. Res.* 35:551-63.
- Ortega-Reyes, L., and F.D. Provenza. 1993a. Amount of experience and age affect the development of foraging skills of goats browsing blackbrush (*Coleogyne ramosissima*). *Appl. Anim. Behav. Sci.* 36:169-183.
- Ortega-Reyes, L., and F.D. Provenza. 1993b. Experience with blackbrush affects ingestion of shrub live oak by goats. *J. Anim. Sci.* 71:380-383.
- Villalba, J.J., and F.D. Provenza. 1999. Effects of food structure and nutritional quality and animal nutritional state on intake behaviour and food preferences of sheep. *Appl. Anim. Behav. Sci.* 63:145-163.
- Villalba, J.J., and F.D. Provenza. 2000. Postingestive feedback from starch influences the ingestive behavior of sheep consuming wheat straw. *Appl. Anim. Behav. Sci.* 66:49-63.
- Wickstrom, M. L., C. T. Robbins, T. A. Hanley, D. E. Spalinger, and S. M. Parish. 1984. Food intake and foraging energetics of elk and mule deer. *J. Wild.*

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