

Structure, Quality and Skills Interact to Influence Forage Intake



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 correct plant density and height to ensure herbivores 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 herbivores.

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.

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 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. Herbivores must spend more time grazing and increase their bite rate to ingest the same amount of food. If forage is too short, herbivores cannot graze fast enough or long enough to maintain intake and performance.

Differences in the size and physical characteristics of different plant species cause changes in rates of intake by large herbivores. 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.

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 high quality 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 rates. Sheep grazing a grass pasture took smaller bites of forage because they preferred to eat only leaves. They could have maintained higher rates of intake by taking larger bites and eating both leaves and stem. Sheep that took larger bites consumed a lower quality diet than sheep that ate only leaves. In addition, animals prefer foods with lower rates of intake if those foods contain needed nutrients or are higher in nutrients than alternative foods. For example, in one study lambs on a high-protein diet were offered a choice between ground barley and

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alfalfa pellets. Even though intake rates were lower for ground barley than alfalfa pellets, they preferred ground barley because barley is higher than alfalfa in energy relative to protein.

These results have implications for managers of high-producing livestock, such as dairy cows, because the type of forage animals select on pasture is influenced by the nutritional composition of supplements fed in the barn. Dairy cows fed high-protein supplements in the barn spend more time grazing grass and less time grazing clover compared to cows fed a supplement lower in protein even though rates of intake are higher for clover than grass.

Many believe that the rate of food 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, food quality 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 relative to energy. Thus, an animal's current nutritional state and prior postingestive experience with the food both affect rates of intake.

Experience Matters. Small amounts of experience browsing or grazing a food can mean big changes in rates of intake. 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. 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 increas-

ing whereas bite rates for 18-month-old goats had leveled off.

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.

Implications. Intake rate is often thought to be solely dependent on plant structure. However, plant structure, current nutritional state of the animal, prior feedback from nutrients, 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

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