

Ignoring Variation: Are We Missing Opportunities?



Noted biochemist Roger Williams was convinced that each individual is “built in a distinctive way in every particular, and that this was the basis of individuality.” Williams understood that each person functions differently: “Stomachs vary in size, shape and contour...They also vary in operation...A Mayo Foundation study of about 5000 people who had no known stomach ailment showed that the gastric juices varied at least a thousand fold in pepsin content.... Such differences are partly responsible for the fact that we tend not to eat with equal frequency or in equal amounts, nor to choose the same foods... In fact, marked variations in normal anatomy are found wherever we look for them...Our nervous systems also show distinctiveness...Since our nerve endings are our only source of information from the outside world, this means that the world is different for each of us.”

Unfortunately, researchers focus on designing experiments to determine the response of the “average” individual to a particular treatment. While such experiments may help us better understand biological processes, they ignore the importance of variation. What opportunities might we miss when we boil down complex systems to a few numbers, when we view systems in terms of the average?

Individuals are unique. Studies of nutrition or toxicology show great variation among herbivores. Variations in dental structure affect foraging abilities, as do differences in organ size and how an animal metabolizes nutrients. Lambs uniform in age, sex, and breed vary in their preferences for foods. Some prefer foods high in energy. Others prefer foods with medium or even low concentrations of energy.

Amounts of energy that condition preferences in some lambs cause aversions in others. These differences aren't necessarily bad, they simply reflect differences in needs due to how individuals are built and function. Allowing animals to choose between alternative foods enables them to meet individual needs.

Responses to toxins also vary. For example, some sheep fed a high dose of the plant goatsrue failed to show any symptoms of toxicity while others were killed by a low dose. Goats and cattle also vary in their susceptibility to toxins. Individual differences in anatomy and physiology affect food preferences and provide a basis for natural and artificial selection.

Despite the overwhelming evidence that each individual is unique, we typically determine nutritional needs and formulate rations for animals in confinement or make predictions about food preferences for animals on rangelands based on the average. The same is true for habitat use. We commonly calculate the carrying capacity of pastures and rangelands based on the “average” member of the herd. We calculate “means” but there is no “mean” weather, soil, plant, herbivore, or person.

Individuals choose different diets.

When feeding animals in confinement why do we feed a total mixed ration formulated for the average animal instead of letting each animal chose its own ration? It's often because we believe livestock will eat too much grain and can't balance their own rations. What would happen to food intake, weight gain, and the

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cost of gain if animals could choose their diets from a variety of concentrates and roughages?

In a recent study, cattle fed barley, corn, alfalfa, and corn silage were compared with animals fed a chopped and mixed ration of those ingredients. Throughout the 63-day trial, food selection varied widely among individuals offered a choice of the four ingredients. Intake of dry matter, energy, and protein all changed from day to day, as did ratios of protein to energy for animals given a choice. On 21 of the 63 days, animals offered a choice had protein-to-energy ratios higher than animals fed the total-mixed ration. On two days the ratios were equal. On 40 of the 63 days they had protein-to-energy ratios lower than animals fed the total-mixed ration. No animal given a choice selected a diet similar to the total-mixed ration, and none consistently chose the same foods day after day. Yet each animal apparently selected a diet that met its needs.

Choice costs less. Averaged throughout the trial, animals offered the mixed-ration ate slightly more food than animals given a choice but they did not gain at a faster rate. Gain per unit food consumed was similar for both groups. However, daily food costs were less for animals offered a choice than for those fed the mixed-ration because animals offered a choice ate less, and they ate less grain. Cost/lb gain was 19% less for the choice group than for the mixed-ration group.

These findings suggest that: (1) animals can meet their needs for energy and protein more efficiently when offered a choice among foods than when fed a mixed-ration, even if the ration is "nutritionally balanced"; (2) offering animals a choice of foods may reduce feeding costs; and (3) allowing individuals to choose their own diet may be less stressful for animals reducing illness and improving performance.

Breeding weed eaters. Animals also vary in their ability to cope with toxic plants. Understanding this may allow producers to breed herds of animals designed to control the spread of weeds and unpalatable plants. For example, in southern Utah goats browsing blackbrush typically prefer old growth blackbrush to current season's growth blackbrush even though old growth is lower in nutrients than current growth. However, current growth contains

higher levels of tannins than old growth, and blackbrush tannins cause food aversions. Interestingly, about 10% of goats eat much more current growth than the rest of the herd presumably because they detoxify tannins better than other goats. Identifying and breeding individuals that consume a higher proportion of their diets in noxious weeds without signs of toxicosis may provide herds of animals that will control invasive species. Some cattle producers also keep replacement females whose mothers can graze endophyte-infected tall fescue without showing signs of fescue toxicity.

Conclusions. So what do managers sacrifice when they see animals as a group rather than individuals? Allowing animals to select their own diet, either on pasture or in confinement may reduce stress, improve production, and reduce costs. Recognizing that animals are individuals may allow producers to select animals better suited to a particular area or to perform a particular task. The challenge for managers is to devise management systems that give animals a choice.

Reference

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