

## Origins of Preference

**P**asture and rangeland researchers, as well as nutritionists and ecologists, typically consider foraging only in terms of how plant physical and chemical characteristics influence an animal's ability to achieve high rates of nutrient intake. This view of foraging is reinforced by a strong desire to use mathematics and computers to model and "predict" intake rates. Most literature in nutrition, physiology, psychology, and foraging behavior that relates to eating focuses on how much is eaten rather than what is eaten. The social environment, if it is considered at all, is seen as a nuisance variable that may only slightly moderate a process that is basically physically and chemically driven.

This is an unfortunate oversight because a young animal's interactions with its mother and peers have a lifelong influence on where it goes and what it eats. When managing pastures and rangelands that contain a variety of foods and terrain, managers must understand how social factors influence the foods eaten by creatures and the locations where they forage, both of which influence carrying capacity. As psychologist Paul Rozin points out for humans,

Suppose one wishes to know as much as possible about the foods another person likes and eats and can ask only one question. What should that question be? There is no doubt about it, the question should be, "What is your culture or ethnic group?" There is no other single question that would even approach the informativeness of the answer to this question.

A young herbivore learns what kind of creature it will be through social interactions. The impact of social learning on adaptation helps account for why herbivores of the same species occur in diverse environments and survive on a variety of different foods. The flexibility of the process is illustrated by the variety of possible end points. A calf reared in shrub-dominated deserts of southern Utah is different from a calf reared on grass in the bayous of Louisiana. A bison reared on shrub-dominated ranges in Alaska is different from a bison reared on grasslands in Montana. We typically consider cattle, elk, and bison to be grazers, and goats, deer, antelope, and sheep to be forb eaters and browsers. However, "grazers" can live nicely on diets of shrubs, and "browsers" can survive primarily on grass. This same flexibility occurs for humans, as Rozin points out, "Consider the massive differences between the almost purely carnivorous diet of Eskimos and the plant-dominated diets of many tropical cultures, or between the elaborate cuisines of India or France and the relatively limited amounts of food processing carried out by some hunter-gatherers."

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Fred Provenza

The terrain of Louisiana (above) creates an animal with much different behavior from an animal reared in Utah (below).



Randy Widmeyer

### Goats and blackbrush

We once worked with a group of goats on blackbrush rangeland in southern Utah. The goats were from northern Arizona and they had always been herded. They were familiar with grass, but they had never seen blackbrush. After 90 days, they had hardly moved from along the roadside where we placed them originally. When we measured how much blackbrush the goats had eaten, it was clear their foraging “excursions” had taken them only about one-fifth of the way into the pastures. Needless to say, those goats didn’t fare well on blackbrush: they lost 16% of their initial body weight during the winter. The next year we worked with semi-feral goats from brush-dominated rangeland in South Texas. They were so wild we scarcely saw them during the 90-day season. They foraged throughout the blackbrush pastures and lost only 5% of their initial body weight during the winter. They were the same species—goat—but their previous experiences made them different creatures. The same is true for other domestic and wild herbivores.



Fred Provenza

### The importance of experience to production

To reduce the cost of ranch operation, researchers and producers in the western U.S. are exploring ways to feed low-cost foods like straw to livestock during winter. During a 3-year study, 32 cows—5 to 8 years of age—were fed ammoniated straw from December to May. Some cows performed poorly, while others maintained themselves. Researchers were baffled until they examined the dietary histories of the animals. Half of the cows were exposed to ammoniated straw with their mothers for 60 days during their first 3 months of life, while the other half had never seen straw. Throughout the 3-year study, the experienced cows maintained higher body condition, produced more milk, lost less weight, and bred back sooner than cows with no exposure to straw as calves, even though they had not seen straw for 5 years.

The point of this example is simple to understand, but easy to overlook. Experiences of young animals have lifelong influences that affect the efficiency and profitability of production systems. Animals’ histories must be considered if we wish to improve the efficiency of agricultural production, the welfare of livestock, and the well-being and profitability of managers. Young animals cope with change more readily than adults because their food and habitat preferences are more malleable. Thus, exposing young animals with their mothers to a variety of foods and locations, especially those they will experience later in life, can lessen problems with transitions.



Randy Wiedmeier

### **Mother knows best**

Socializing with mother helps young animals learn about every facet of the environment from the whereabouts of water, shade, and cover to the wide array of hazards to the kinds and locations of nutritious and toxic foods. Learning from mother about foods begins early in life as the flavors of foods mother eats are transferred to her offspring in utero and in her milk. In livestock, the flavor of plants such as onions and garlic is transferred this way; this increases the likelihood that young animals will eat onion and garlic when they begin to forage.

As offspring begin to forage, they learn quickly to eat foods mother eats, and they remember those foods for years. Research shows that lambs fed nutritious foods like wheat with their mothers for 1 hour per day for 5 days eat more wheat than lambs exposed to wheat without their mothers. Even 3 years later, with no additional exposure to wheat, intake of wheat is nearly 10 times higher if lambs are exposed to wheat with their mothers than if inexperienced lambs are exposed alone or not exposed at all. Lambs exposed with their mothers to various foods—grains like barley, forbs like alfalfa, shrubs like serviceberry—eat considerably more of these foods than lambs exposed without their mothers.

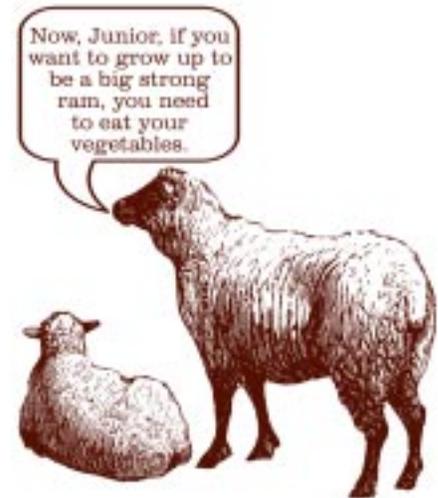
Research also shows that a mother can reduce her offspring's risk of eating toxic foods. If a mother avoids harmful foods and selects nutritious alternatives, the lamb acquires preferences for foods its mother eats and avoids foods its mother avoids. Lambs given a choice of two palatable shrubs like mountain mahogany or serviceberry—one of which their mother was trained to avoid—show a marked preference for the shrub they ate with their mother. Through her actions, mother models appropriate foraging behaviors for her offspring.

In the process of foraging with mother, young animals also learn foraging skills needed to efficiently ingest foods of different forms—grasses, forbs, shrubs. The rate at which goats and sheep are able to ingest grasses and shrubs increases with experience. In one study, bite rates tripled as experience increased during 30 days of browsing the shrub blackbrush. Younger animals 6 months of age learned foraging skills more readily than older animals 18 months of age.

Mother's most important role is helping her offspring become familiar with the environment where they will live so that when offspring encounter new foods or unusual circumstances, they stand out against a familiar background. Young animals who cautiously explore novel foods and circumstances are more likely to survive.

### **The peer group**

As young animals age they interact increasingly with peers, who then become a major influence on one another's behavior.



Lambs exposed to various foods with their mothers, like this pair sampling serviceberry, will eat considerably more of those foods than lambs exposed without their mothers.

Fred Provenza

Young animals encourage one another to explore new foods and environments. Cattle reared in different locations on summer range in Idaho roamed over a much broader area when they foraged together as yearlings, than when they foraged separately at 2 years of age and older.

In the process, adults also learn from offspring because young animals are more likely than adults to eat novel foods. Mature ewes learned to eat Douglas fir seedlings from lambs over a 4-year period as ewes and lambs grazed tree plantations on the West Coast. Initially, neither the ewes nor the lambs ate the seedlings. However, as young animals began to eat the flush of new growth on the trees, the ewes also began eating the trees.

Social influences are strong enough to override food aversions conditioned with high doses of toxins. Lambs and calves can easily be trained to avoid a particular food by administering to them a toxin dose after they ingest the food. After one or two food-toxicosis pairings, the animals no longer eat the food. However, if trained animals subsequently forage with animals that eat the food, the trained animals are much more likely to sample the food they were trained to avoid. When they sample the food and no longer receive a toxin dose, the positive effects of nutrients can quickly override the previously conditioned food aversion and increase preference for the food.



Fred Provenza

"Hey, I dare you guys to eat that." Even foraging animals experience peer pressure. Young animals influence one another to explore new foods and environments.

### Meeting the challenge

So how do young herbivores learn to cope with foraging challenges? There are four facets to the process of adaptation. They involve interactions between social learning from mother and peers and trial-and-error learning by individuals.

- Social interactions enable offspring to learn quickly to identify nutritious foods and to avoid those that are toxic, just as people learn to recognize the many foods in a grocery store.

- In the process of foraging with mother, young animals learn to discriminate the foods mother eats—familiar foods—from the foods mother avoids—novel foods. Young animals learn and remember specific foods, just as humans learn and remember plants in a store or garden.

- Animals are wary of the unfamiliar—unusual foods, places, and individuals of the same or different species. Careless individuals die young. There are simply too many hazards.

- Finally, animals associate the flavors of specific foods with their postingestive consequences. If the consequences are positive—satiating feedback from needed nutrients like energy and protein—animals gradually increase intake until the novel food becomes a part of the diet. If the consequences are negative—nauseating feedback from toxins—herbivores limit intake of the novel food in accord with the concentrations of the toxins in the food.



File Photo

### Advantages of social learning

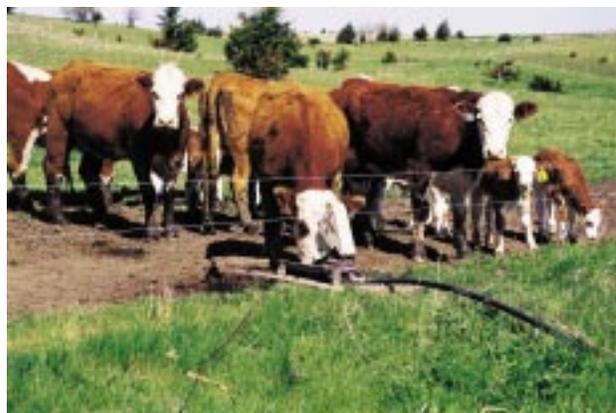
Socializing enhances the learning efficiency of the group. Each creature no longer has to discover everything by itself. When an individual discovers a new resource, everybody benefits. Goats browsing blackbrush-dominated rangelands experience macronutrient (energy and nitrogen) deficiencies. When one goat discovers that the interior chambers of woodrat houses provide a good source of protein, all of the goats benefit. Likewise, when animals must learn to drink from a water device that requires pressing a lever, it takes only one individual to learn how to do it, and in no time all the others are drinking. The same is true for discovering the locations of new food resources in the environment.

### Unfamiliar environments

When managers move animals from familiar to unfamiliar environments they thwart one of the primary ways social creatures learn about environments—transgenerational learning from mother. In a new environment, animals must learn through trial and error about all of its facets—food, water, shelter, and predators—beginning with which foods to eat or avoid and where to forage. In the process, they are more susceptible to hazards. No wonder cattle moved to new areas in Louisiana break through fences and swim canals to return to familiar territory, and sheep have walked up to 150 km (90 miles) in search of familiar territory.

The importance of social interactions, and of the mother as an experienced model for her offspring, is illustrated in instances when wild and domestic animals are moved to unfamiliar environments. Research shows that animals new to an environment spend as much as 25% more time foraging but ingest 40% less food than animals reared in the environment. Inexperienced animals walk longer and farther. They also suffer more from predation, malnutrition, and ingestion of toxic plants. The net effect is greatly diminished reproductive rates and lower weaning weights. Little wonder ranchers often described the time when livestock were introduced into an unfamiliar environment as “the year from hell.”

Ranchers with stocker enterprises accept the implications of placing young inexperienced animals in unfamiliar areas. However, the exploratory nature of these young animals produces a lesser degree of disruption than mature cows experience. Young animals cope with change more readily than adults because their food and habitat preferences are more malleable.



Lynn Betts, USDA Natural Resource Conservation Service

Cattle come together at a nose pump to drink water in this southern Iowa pasture on a farm in Madison County. The cows use their nose to pump water from a nearby farm pond.



Mary Donahue

Butch Little and Khaki Trahan, two southern Louisiana cattle producers, tell how their cattle will swim canals to return to more familiar feeding areas after being moved. Below, left to right, Stuart Gardner, NRCS area range and pasture management specialist; Diane Borden-Billiot, wildlife biologist for the U.S. Fish and Wildlife Service; Johanna Pate, NRCS area range and pasture management specialist; and Clay Midkiff, NRCS district conservationist are the professionals who worked with Butch and Khaki.



Mary Donahue

### Unfamiliar terrain for herbivores and managers

To reduce the high cost of feeding lactating dairy cows in confinement, many producers are using intensively managed pastures as a source of low-cost, high-quality forage. However, dairy cows reared in confinement perform poorly on pasture. Upset, perplexed producers typically report that cows don't eat grass and that milk production plummets. Conversely, livestock moved from pastures or rangelands to drylots or feedlots perform poorly. In both cases, animals have nutritious food freely available, but food intake is low, performance is poor, and animals are more likely to suffer diseases.

What is the problem and what can be done to diminish the adverse effects on performance?

For a dairy cow reared in confinement, the barn is habitat, ingredients from a total-mixed ration are food, and water comes in a trough. Mature dairy cattle reared in confinement on processed foods are at a distinct disadvantage when placed in new environments, like a pasture, and expected to harvest forages they have never seen. Although they may be quite hungry, they lack the knowledge and the skills to eat grass. Little wonder they stand at the gate to the barn and bellow to be fed. Grass isn't food and the pasture isn't home. For a beef cow reared on rangelands in the western U.S., riparian areas and uplands are habitat; a diverse array of grasses, forbs, and shrubs are food; and water comes in streams and ponds. When these animals are moved to feedlots, total-mixed rations aren't food and feedlot pens aren't habitat.

The stress associated with novel foods and environments leads to marked decreases in food intake, which greatly increases the likelihood of illness. During that time, stress is high and intake and performance are poor. Nevertheless, mature cattle gradually increase intake of nutritious novel foods. In the process, they learn foraging skills. Experience increases foraging efficiency, and that means higher rates of food intake and greater production.

Exposing young animals to foods they will encounter later in life can alleviate these problems and increase the efficiency of production. For example, dairy cattle can be exposed to pasture forages early in life before they are expected to forage and produce milk from pastures. Mature dairy cattle reared in confinement should be exposed gradually to pasture forages—either as green chop in confinement or on pastures—before they are expected to forage extensively on pastures. Allowing inexperienced animals to forage with experienced animals can expedite the process provided the animals interact socially.



Mary Donahue

These dairy cows in upstate New York have just been released from the confinement barn and moved onto pasture for the first time. There was a lot of running and not much grazing.

### Easing transitions for herbivores and managers

Chronic stress inhibits immune responses, which increases illness and decreases performance of livestock and humans alike. Being moved from a familiar to an unfamiliar physical environment and placed with animals the individual may or may not know, causes such stress. Harsh handling exacerbates the problem. Lack of familiarity with foods is the final blow. Given this combination of circumstances, animals are much less able to resist diseases than when physical and social stressors are minimized.



Mary Donahue

Social or physical stress can inhibit an animal's resistance to disease.

As a rule, animals with no experience of the foods or environment make the transition to new terrain better when they are moved from resource-poor environments—where plants are scarce, dispersed over rough country, low in nutrients, and high in toxins—to resource-rich environments where nutritious plants are abundant. By the same token, animals reared in high-resource environments are at a distinct disadvantage—compared with animals reared in low-resource environments—when they are moved to low-resource environments.

Animals make transitions from familiar to unfamiliar environments better if they are moved to areas where the foods and terrain are similar to what they have experienced. Some producers buy replacement animals only from areas similar to the ranges their animals inhabit. Still, no matter how similar a new area may be to a traditional area, animals have an affinity for familiar haunts. That's why many ranchers insist on raising their own replacement females—animals bought elsewhere and moved to new areas often are malnourished, lose weight, and reproduce poorly.

Preparing animals for foods they will eat in new environments increases intake and reduces illness. Exposing a young animal with its mother to foods that it will encounter in the feedlot increases efficiency. Young animals given only brief exposure with their mothers—1 hour per day for 5 days—remember foods for at least 3 years. Immediate acceptance of food in the feedlot helps to reduce stress and illness. Pre-conditioning combined with low-stress livestock handling techniques reduces stress on livestock and humans, and that increases performance and economic returns.

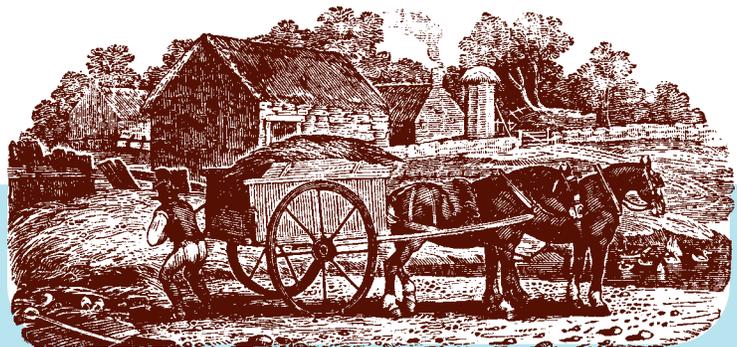


Mary Donahue

An animal raised in the low-resource environment of southwest New Mexico (top) would have an easier time adapting to the high-resource area of upstate New York (lower right) than an eastern animal moving to the West.



Mary Donahue



### A load of hay

How can we help animals make transitions to new environments? In many cases, it is easier than you might think. It simply requires compassion for the plight of others. For example, a young man sold some fine bulls to a man in a neighboring state. After a few weeks, the irate new owner called to cuss and discuss the poor performance of the bulls. The young man was shocked and felt badly. He couldn't understand the problem—the bulls were fine when he sold them.

At that point, his grandfather suggested they take the new owner a load of familiar hay from the home place, a once-common practice. After they did, the condition of the bulls improved, and the bulls—and their new owner—were on their way to making the transition.



File Photo

### The adaptation trough

The only constant in life is change. Unfortunately, change isn't easy. It takes time and it's painful. So why change? Because perpetual changes in physical and social environments require individuals, social groups, and species to adapt.

For the pessimist, change creates frightful problems and concerns—it represents forced adaptation with few alternatives for holding on to the past. For the optimist, change presents invigorating challenges and opportunities—it is a generative process with ample opportunities to create a new future. For both there really is no choice—we must all continually adapt or go extinct.

Changes in grazing regimens affect every facet of the system—soils, plants, herbivores, people—and as many as 3 or more years are required for systems to adapt to changes in management. It takes at least 3 years for soils to adapt to changes from inorganic to organic ways of farming. When rancher Ray Banister changed grazing management practices to enhance and maintain biodiversity of his rangelands in Montana, it took 3 years for his cows to adapt to the new diets they were required to eat and at least that many years for soils and plants to adapt (see sidebar, page 47, *Boom-bust management*). When rancher Bob Budd changed habitat selection patterns of his cattle herd from bottom dwellers in riparian areas to



upland inhabitants, it took at least 3 years for his cows and his rangelands to adapt (see sidebar, pages 39–40, *Using behavior to manage for ecological, cultural, and economic integrity*).

In the end, productivity of each of these systems improved—soils and water were healthier, plant biodiversity was increased, and more animals were produced. During adaptation, however, animal performance—food intake, weight gains, reproductive rates—typically declines before it improves. The degree and duration of the decline depend on the magnitude and direction of change. The greater the change and the more challenging the terrain, the greater the impact.