Using Our Knowledge of Livestock Behavior towards Conservation Efforts

Dr. Fred Provenza

Dr. Provenza began his presentation by putting into context the situation in the west specifically and across the United States generally that marginal incomes, high land values and their increasing age are causing ranchers to sell their properties to developers or to people with little understanding of how to manage landscapes. The cultural fabric and livelihoods of many rural communities depend upon agriculture, as does the ecological fabric of landscapes under the threat of development and management by people with little knowledge.

For ranching to be sustainable it must be both profitable and enjoyable. Given the increasing cost of agriculture heavily based on fossil fuels and technology, livestock producers and environmentalists alike are interested in understanding how nature works as a low cost alternative for sustaining landscapes and livelihoods. In addition, many methods once utilized to rejuvenate landscapes — including herbicides, mechanical treatments, and fire — are no longer acceptable ecologically, economically, or socially. Rather, people are interested in healthy landscapes and lifestyles; foods produced organically without fossil fuel-intensive herbicides, chemical fertilizers, synthetic growth hormones, and antibiotics. We need new ways to maintain biodiversity of landscapes and to produce food without fertilizers, hormones, and antibiotics. With regard to livestock grazing, while some traditional practices have been detrimental to landscapes ecologically and to people economically, there is never the less a growing appreciation for the value of managed grazing by livestock to enhance landscapes for the benefit of wild and domestic animals and people. We have tried repeatedly to alter landscapes to suit animals, but have done little to create locally adapted animals suited to landscapes. Nor have we understood how to work with nature to accomplish low cost ways to manage ever-changing landscapes; clearly new mindsets are needed.

Dr. Provenza stressed that during the last three decades scientists in diverse disciplines have gained a better understanding of what it means for plants and animals to become adapted to landscapes. The origins of behavioral adaptation occur as genes are expressed in concert with social and biophysical environments where an individual is conceived and reared, and furthermore their expression varies across generations as environments change. In a very real sense genes learn from the environment. Advances in understanding the origins of food and habitat selection behaviors now offer opportunities to better manage landscapes in ways that blend ecological, economic, and social values to enhance the well being of the land and the creatures that depend upon it for their livelihoods. Unlike rigid command and control tactics, behavior-based management emphasizes ongoing adaptations to ever changing ecological, social, and economic conditions as the low cost solution to managing landscapes in ways that are sustainable. We now have a chance to blend behavior-based management based on scientific understanding with traditional knowledge to better manage landscapes. This involves moving away from a fossil fuels-intensive mind-set toward new views that recognize the value of behavior. This is what BEHAVE institute is all about; BEHAVE is dedicated to integrating

understanding of behavioral principles and processes with indigenous knowledge to enhance social, economic, and environmental values of rural communities and landscapes.

With this topic of grazing for biological conservation in mind, Dr. Provenza focused on selecting for locally adapted creatures, grazing to enhance biological diversity, and the value of enabling individuality. All of these should be considered with the idea of thinking about how nature works; not only the plants and animals, but also the people who come from these landscapes. Local adaptation has to do with the interplay between the individual, the genome, and the social and biophysical environment. This interplay is the topic of great interest and concern to his group. Kit Pharo exemplifies how to do this, claiming that there are three keys to successful and sustainable grazing management. First, ranchers have to manage grazing appropriately to try to maintain cover and biodiversity on the landscape. Secondly, Kit argues that managers have to learn to match animals' needs to seasonally variable forage; something that is easier said than done, but that can significantly reduce costs and labor, and increase profitability. Thirdly, managers must select for creatures that are locally adapted to the landscape, which largely reduces the amount of inputs required. To illustrate the importance of selecting for locally adapted animals Dr. Provenza cited discussions from Sam Bingham's book "The Last Ranch." The book illustrates the movement away from traditional cyclical sheep grazing that mimicked the natural cycles of herbivores in the system. Smaller more muscular animals were required to go upslope from the valleys each spring and then back around and down in the fall. Today significantly larger animals that are not adapted to the local environment have been selected for that cannot endure the traditional cyclical grazing regimes. Some people have attempted to go back to the traditional system, however once local knowledge has been lost it is exceedingly difficult to regain it.

Experiences early in life have life-long influences on food and habitat selection; not just in livestock, but for all creatures. Learning is critical to survival and plays a huge role in determining behaviors throughout life. To exemplify this point, a study was conducted at Utah State University working with a rancher that had cows that he wanted to feed ammoniated straw as the bulk of their diet for December through May in order to reduce feeding costs during the winter. Researchers looked at two groups; one exposed to straw for two months as calves, and the other group having never seen straw. Five years later the effect of this exposure early in life was examined over three years. For all three years animals that had been exposed to straw early in life had higher body weight and condition, and for two out of the three years they demonstrated significantly higher milk production and a shorter post-partum interval. This study clearly demonstrates the power and influence of even limited experiences early in life as having a huge impact years later. The key point is that as management changes we have to realize that the animals have to learn new behavior patterns and this also includes all parts of the system soils, plants, herbivores and people. Typically for herbivores and people it takes a minimum of three to five years to get through this adaptation trough and to learn new behaviors that increase the performance of the system. Desirable diet and habitat selection can be taught, but it takes time. Animals and people can learn new behavior patterns, but it takes time. Furthermore, Dr. Provenza stressed that old dogs learn new tricks, young dogs learn them quicker and how quickly animals learn will depend on the challenges in the new environment or management practice. This fact likely also has important implications for relocating and reintroducing a variety of creatures.

How might prehistoric grazing have differed from grazing during this past century? With livestock, we have come to rely on fences and grazing systems to influence diet and habitat selection and, in turn, ecosystem processes. However, social organization and culture typically are not considered in studies of ecosystem processes. In livestock, extended matriarchacal families form when calves, lambs, and kids are not weaned. In the case of bison, Dr. Provenza wants to investigate two critical questions; do bison live in extended families, and do interactions within and among families lead to rotational grazing without fences? Dr. Provenza stressed the need to know more about social organization and its influence on landscapes. For example, in Southern France, French herders use grazing circuits passed down through generations giving individual herd members choices to meet their individual needs for nutrients and to regulate their intake of toxins. This method allows for the utilization of more plant species and for the maintenance of biodiversity. With that in mind, Dr. Provenza posed the question of what it means to be a matriarch, whether of that species or a herder. Rather than fencing, ranchers can use low-stress techniques to move cattle in circuits that increase their use of weeds. There is huge value in this for enhancing biodiversity.

But how can livestock enhance and maintain landscapes: soil, water, wildlife, and biodiversity for society? Furthermore, can we get a handle on weeds through grazing, and if so, how? To use animals successfully, we must change our thinking from animals as tools to animals as an ongoing integral part of systems and their management. Three topics are critical to better understand in order to control weeds and enhance biodiversity especially in situations with really strong monocultures of a specific plant: learned preferences and aversions, medicines, and nutrients. Animals can be trained. For example, cattle can be trained to eat leafy spurge, knapweed, and thistle to name a few, and sheep have demonstrated that they can be trained to avoid eating grape vines in organic orchards. Medicines help in that all plants contain secondary compounds that at too high a level can be toxic. These secondary compounds limit intake, and cause animals to eat a variety of foods; as long as variety is available, which is critical, animals are in good shape. However, in monocultures medicines can help animals to eat more of a particular target species. Also, research has shown that animals can learn to self medicate with secondary compounds, clays, and charcoal. In the flint hills of Kansas, supplementing cattle with polyethylene glycol can reduce the abundance of the undesirable sericea lespedeza, a species very high in tannins. Nutrients also help the body cope with high levels of secondary metabolites. For example, in sagebrush steppe, supplemental energy and protein can greatly enhance animals' ability to clip and fertilize sagebrush monocultures helping to increase biodiversity. Supplementation was shown to nearly double the intake of sagebrush by both goats and sheep. In 2001 low stock densities and inadequate supplementation lead to a mere twenty-five percent utilization of sagebrush, and in contrast in 2003 high stock densities and adequate supplementation resulted in one hundred percent utilization of sagebrush. The goal is not to get rid of sage but to enhance biodiversity for a wide range of plant and animal species.

Finally, Dr. Provenza stressed the importance of individuality as it relates to biodiversity. Typically, in research and in management we focus on means and populations, but individuals and variation drive systems, not means and populations. We have to realize that even within the

most uniform group you could assemble every individual is different; there is no such thing as an average. The average person has one breast and one testicle, but you don't see many of them running around. The point is that we have to stop focusing on the illusion of means and populations. The need for nutrients and the ability to cope with toxins both vary tremendously within a group of animals. The implication for management is that animals need to be offered choices to increase profitability and performance rather than feeding and supplementation based on the "average" individual. The bottom line is that biodiversity matters, and biochemical diversity enables individuals to regulate their intake of nutrients and toxins. In short, choice and the ability to choose enables the uniqueness of individuals to be manifested, one size does not fit all.

Natural landscapes are diverse mixtures of plant species that are literally nutrition centers and pharmacies with vast arrays of primary (nutrient) and secondary (pharmaceutical) compounds vital in the nutrition and health of plants, herbivores and people. Regrettably, the simplification of agricultural systems to accommodate inexpensive, rapid livestock production, coupled with a view of secondary compounds as toxins, has resulted in selecting for a biochemical balance in forages favoring primary (mainly energy) and nearly eliminating secondary compounds. Ironically, while we were minimizing secondary compounds to maximize yields of crop and pasture plants over the past 30 years, we were learning of their value in plant resistance to environmental stressors, and we are now beginning to appreciate their nutritional and pharmaceutical values for herbivores and people. In their stead, we resorted to fertilizers, herbicides and insecticides to grow and protect plants in monocultures, antibiotics and anthelmintics to maintain the health of herbivores, and nutritional supplements and pharmaceuticals to sustain the wellbeing of humans. This approach degrades the fitness of livestock and humans and the economic and environmental health of ecosystems.

Dr. Provenza's group is currently interested in looking at complementarities amongst secondary metabolites and the health benefits of plant mixtures. They are using natural plant communities as models to develop productive pastures that enhance the sustainability of landscapes. Their goal is to create plant mixtures that provide the full range of benefits — nutrition and health for plants, herbivores and people — without the unsustainable costs of monocultures — fertilizers, herbicides, insecticides, antibiotics and anthelmintics. The key point is that there is much to be learned about the nutrition and health benefits and complementarities of different species on both pastures and rangelands; particularly when we start to consider their secondary compound profiles, typically we focus on nutrients and not secondary metabolites. A better understanding of these is critical to better understand these relationships both from the standpoint of intake and complementarities, as well as from the health benefit standpoint.

From the standpoint of herbivores, grazing management influences the availability of alternatives, which influences diet breadth. Learning and experience are also critical to eating a variety of species, which influences diet and habitat breadth. Continuous grazing at low stock densities allows animals to be incredibly selective, however as you move toward management intensive, high stock density, short duration grazing management, it challenges animals to learn to mix their diets in different ways. This style of grazing management challenges animals to mix the best with

the rest, rather than allowing them to eat the best and leave the rest. With the emphasis on key species and key areas, in conjunction with moderate use of these, managers may have inadvertently trained generations of animals to eat the best and leave the rest. Sheep and goats eat leafy spurge readily, but most people think cattle will not. However, at Rex Ranches the utilization of high stock densities for short periods to encourage cattle to eat a variety of plants has encouraged their use of leafy spurge. Leafy spurge occurs in patches, it does not dominate the landscape, so cattle do not have to eat only leafy spurge. Furthermore, other plants on the ranch compliment leafy spurge, which better enables cattle to eat the spurge. They keep their replacement heifers, so young animals learn to eat leafy spurge from their mothers; it has become part of the culture of the herd.

In summary, behavior is flexible, genes are learning from the environment, which creates opportunities for herbivores to change behavior. The implications of behavior-based management include: eco-ranching, organic farming, conservation biology, forage-reared livestock, and reducing the use of fossil fuels.