# Understanding Diet Selection in Temperate Biodiverse Pasture Systems

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The first decade of the 21st century has been dominated by unprecedented environmental challenges. These challenges are associated with intense public awareness and interest in constructive environmental solutions. There is increasing interest by both consumers and producers of agricultural products in the development of a more sustainable agriculture system, with less dependence on external finite resources. Biodiverse pasture systems have the potential to serve agriculture in this regard. Thus, a symposium addressing contemporary, interdisciplinary research on plant–herbivore interactions, animal responses, and grazing management in temperate biodiverse pasture systems was sponsored by the American Society of Animal Science at the annual meetings of the society in July 2007. The resulting articles appear in this Special Feature of *Rangeland Ecology & Management*.

Although increased plant species diversity has been linked to improvements in ecosystem function through improved primary productivity, the effects of increased diversity on secondary productivity have not been well explored. Historically, pasture-based research has mainly concentrated on total dry-matter intake of the grazing animal with less emphasis on diet selectivity. This outcome was likely a consequence of what animals had typically available for consumption: monotonous, single-species diets, or monocultures rich in energy and protein with low concentrations of deleterious plant secondary compounds (PSCs). However, under rangeland and typical pasture conditions characterized by greater plant diversity, animals meet their nutrient requirements, cope with diverse PSCs, and likely benefit from PSC in their diets. The processes of locating, identifying, and consuming a suitable combination of plant species and parts are the main determinants of secondary productivity and livestock impact on ecosystems.

There is a renewed interest in grazing management and the role of grazing animals that is motivated by the need to rethink and restructure food and energy systems at a global scale. Livestock feeding operations currently compete for grain with the energy and food sector, and produce greenhouse gases. Livestock producers have a growing interest in finding low-cost and renewable production methods, such as grazing, that reduce the need for high-cost energy and chemical inputs. There is a simultaneous need to boost farm income through capturing high-value markets and premium prices. Consumers in the developed world increasingly demand products that are both clean and green, in support of grass-fed beef and environmentally friendly production methods.

A comprehensive understanding of primary and secondary productivity in diverse forage production systems is complex. Reliable knowledge concerning plant species and specific plant parts selected by herbivores, as well as why, how, and when specific plants are selected, is still in its infancy. Moreover, even if we knew exactly how ruminant diet selection works, we would not necessarily be able to forecast or estimate dietary habits any better. Assume for a moment that animals select a diet based exclusively on their previous experience. In order to make effective predictions, we would have to know the personal dietary history of each individual animal. Thus, our current ability to predict diet selection in diverse plant communities is limited, and requires ongoing research to identify best management practices that utilize and manipulate diet selection to increase the productivity, efficiency, environmental sustainability, and profitability of pasture-based enterprises. We know that plants, animals, and soils interact at different levels of aggregation and that such interactions impact both primary and secondary productivity and associated ecosystem services. We know that grazing intake and diet selection exhibit a great deal of variation among individual animals and that they affect the productivity and environmental impact of grazing. However, can we effectively manage or manipulate ruminant intake and diet selection? What are the recent discoveries that create new opportunities for solutions to obtaining the clean and green products society demands from biodiverse pasture systems such as rangelands? The articles in this Special Feature present a brief summary of the current state of the art and challenges for future research in this relevant and challenging area.

In the first article Soder et al. (this issue) present the current state of knowledge and research methodologies related to diet selection of grazing domestic ruminants, including current understanding of the complex decision-making process a ruminant faces while grazing, and the associated links to primary and secondary productivity. Villalba and Provenza (this issue) establish the conceptual basis for herbivore preferences, the benefits of mixed diets and medicinal values of PSC in pastures, and the abilities of herbivores to learn based on associations between a food's flavor and its postingestive consequences, as well as from social models. In the third paper, Laca argues that traditional grazing management methods are based on a static paradigm of equilibrium that ignores scaling effects in time and space. A new paradigm incorporates 1) spatial heterogeneity of resources, 2) event-driven dynamics, whereby behavior of grazing systems can be better understood as a series of responses to specifically timed events, and 3) nonlinear scaling effects of pasture size and animal numbers. Laca (this issue) postulates specific management options to control

livestock diets and impacts, including spatial planting patterns and operant conditioning of animals. In the final paper, Hill et al. (this issue) propose a physiological explanation for partial preferences in herbivores when grazing grass–clover pastures. They hypothesize that by mixing grass with the clover (instead of preferring 100% of the higher-quality clover), the animal is able to increase the duration of the meal, potentially reflecting a better dietary balance of energy to soluble protein, which in turn controls the rate of accumulation of ammonia in rumen fluid.

In summary, the articles presented address the current state of knowledge regarding livestock responses to plant species diversity, and stimulate the reader with new ideas aimed at better understanding this complex system and creating novel and innovative management approaches that promote and capitalize on biodiversity in temperate pasture systems.