Introduction to the CSSA Symposium—Beyond the Plant: Biodiversity Impacts on the Grazing Animal

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A symposium addressing the impacts of plant species diversity on grazing animal performance and welfare in temperate pastures was sponsored by the Forage and Grazinglands Division (C-6) at the annual meetings of the Crop Science Society of America in November 2005. Consistent with current interest in roles of plant biodiversity in grassland ecosystem processes, the purpose of the symposium was to explore livestock responses to plant species diversity and approaches to management of pastoral systems that meet broad societal requirements. The following papers review current knowledge, understanding, and research questions related to plant–animal interactions, and incorporate perspectives ranging from nutritional ecology, learning, and medicinal value of plant secondary compounds to structure, function, and management of grassland plant communities. A common theme throughout the papers is an appreciation for the numerous opportunities that are available for creative and flexible applications of ecological principles to the design and management of productive and sustainable pasture–livestock systems.

Impacts of increasing species diversity on production dynamics of pastures are not clear or consistent and depend on the interaction of plant functional roles with environmental parameters, resource availability, and grazing management (Kemp et al., 2003; Sanderson et al., 2004). Whether or not species diversity improves the productivity of pasture–livestock systems, the current interest in biodiversity in ecosystem function (Sanderson et al., 2004) is likely to shape the design and management of these systems in the future. The concepts presented in the following papers are therefore relevant to pastoral agriculture given increasing emphasis on multifunctionality of grasslands including sustainable provision of ecosystem services and enhancement of environmental values to society (Clark, 2005; Kemp et al., 2003; Kemp and Michalk, 2005; Sanderson et al., 2004).

In the first paper, Provenza et al. (2007, this issue) establish the conceptual basis for herbivore preference for, and benefits of, mixed diets and the possibilities for nutritional and biochemical complementarity of nutrients and toxins in plant species mixtures; abilities of herbivores to learn postingestive consequences of eating behavior; and medicinal values of plant secondary compounds. They present the satiety hypothesis as an explanation for selection of mixed diets and offer management strategies for capitalizing on variations in forage resources and ingestive behavior. Lastly, they introduce possible applications of fractal geometry to the description of spatial distribution patterns of typically patchy forage plant resources and assessment of the scale dependence of forage resource availability to herbivores.

The second paper by Chapman et al. (2007, this issue) provides an additional overview of factors controlling sheep and cattle ingestive behavioral patterns and diet selection in relation to spatial and temporal heterogeneity within relatively simple grass–clover (Trifolium repens L.) mixtures: reinforces findings that sheep and cattle consume mixed diets when offered choices; and establishes some of the theoretical basis for partial preference for clover. The authors point to common if not universal management problems of imbalance of pasture supply and livestock demand and difficulties of maintaining optimal legume density in grass–clover pasture mixtures. They present excellent examples of how integrating modeling and field experimentation can increase the efficiency with which knowledge gaps are identified and research hypotheses and experimental designs are formulated for understanding interrelationships in complex pasture systems. One case is the use of spatially-separated monocultures of grass and clover as an experimental approach to determining mechanisms of diet selection and as a management tool for greater control of intake rate and agronomic performance of plant species in grazing systems.

The final paper by Soder et al. (2007, this issue) reviews the possible benefits and unrealized potential of managing pasture systems for increased biodiversity, and summarizes responses of grazing livestock and herbage production dynamics to variations in pasture species diversity. They also address theory and applications of grazing by multiple herbivore species; grazing impacts on plant community composition; and the need for improved understanding of plant functional groups and ways in which animal and plant behaviors and interrelationships might be predicted from knowledge of functional groupings.

All presenters emphasize that current understanding of biodiversity impacts on grassland ecosystem processes is limited and that management packages that capitalize on biodiversity in temperate pasture systems are largely yet to be defined. Challenges for the future include better understanding of the optimal level and structure of pasture plant biodiversity, and the need for predictive models and decision aids to facilitate management of potentially more complex systems than those of the past. Understanding linkages and variations among herbivores, the temporal, spatial, and chemical dynamics of forage resources, and plant species responses to