Highlights

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Dietary Selection by Domestic Grazing Ruminants in Temperate Pastures: Current State of Knowledge, Methodologies, and Future Direction

Kathy J. Soder, Pablo Gregorini, Guillermo Scaglia, and Andrew J. Rook

This paper reviews the current knowledge and methods used to understand dietary selection and preference by grazing animals. Grazing animals use complex decision-making processes while foraging, which affects animal production and the plant community. Understanding and managing animal grazing behavior can result in greater plant and animal productivity. Key areas where knowledge is lacking and further research is needed are identified.

Learning and Dietary Choice in Herbivores

Juan J. Villalba and Frederick D. Provenza

Animals use the senses of smell, taste, sight, and post-ingestive feedback from previously consumed forages to select their diet. Some secondary plant compounds can deter animal grazing and may decrease animal production when consumed. If grazing animals are provided with and learn to eat a diversity of plants, the negative effects of consuming plant secondary metabolites could be minimized. By combining the concepts of animal learning and food diversity, it will be possible to create sustainable grazing systems with less dependence on fossil fuels and with enhanced benefits for soils, plants, herbivores, and people.

New Approaches and Tools for Grazing Management

Emilio A. Laca

New concepts and tools are being developed for grazing science and management. Traditional grazing management has focused on type and number of animals, and timing and intensity of grazing. New systems should incorporate variability in animal behavior and performance and plant diversity and response over space and time. Learned foraging behavior, plant spatial pattern, pasture size and shape, timing and duration of grazing periods, and number of animals are discussed as tools to manage grazing systems. Allowing for and encouraging dynamic pasture composition and foraging behavior can encourage system stability.

Do Ruminants Alter Their Preference for Pasture Species in Response to the Synchronization of Delivery and Release of Nutrients?

J. Hill, D. F. Chapman, G. P. Cosgrove, and A. J. Parsons

The objective of this paper is to review the role of synchronization of forage composition factors and nutrient release patterns on the processes controlling preference in grazing ruminants. One theory that has been proposed to explain the induction of satiety in grazing ruminants is the rate of release of ammonia from the soluble protein fraction of the forage, and subsequent uptake in the blood. By mixing grass with the clover, the animal is able to increase the duration of the meal, potentially reflecting a "better" dietary balance of energy to soluble protein that controls the rate of accumulation of ammonia in rumen fluid. In light of recent data from in vitro studies examining digestive efficiency, it is clear that direct, real-time information on the relationships between forage physicochemical factors, rumen condition, meal initiation and cessation, and dietary switching is needed to further develop propositions about the control of dietary choices of grazing ruminants.

Opuntia Forage Production Systems: Status and Prospects for Rangeland Application

J. C. Guevara, P. Suassuna, and P. Felker

Slow growth and low protein content of native spiny pricklypear cactus (*Opuntia* spp.) has limited their use as a forage

resource on rangelands. This paper reports recent findings in pricklypear genetics, nutrient fertilization, and cultivation with promise to overcome limitations for pricklypear forage production systems. Combining management options with improved cultivation has the potential to produce 40 $t \cdot ha^{-1} \cdot yr^{-1}$ of dry matter (DM) in marginal arid and semiarid environments with 9% crude protein and 60–70% digestible DM. Furthermore, it appears that a new spineless fast growing pricklypear variety can withstand freezing temperatures to USDA cold hardiness zone 7.

A Case Study Evaluating Economic Implications of Two Grazing Strategies for Cattle Ranches in Northwest Argentina

Raúl E. Quiroga, Lisandro J. Blanco, and Carlos A. Ferrando

In the Argentinean Arid Chaco region, traditional grazing strategy (TGS, continuous grazing and high stocking rate) produces rangeland degradation and low economic return. We compared the effect of TGS and a conservative grazing strategy (CGS, rest rotation grazing and moderate stocking rate) on the economics of a cattle ranch in the region. After the third year of application, CGS increased economic returns. This was mainly associated with an increase in forage productivity. Our results indicate ranchers can improve their earnings by applying a conservative grazing strategy.

Remote Sensing of Spatial and Temporal Vegetation Pattern in Two Grazing Systems

Lisandro J. Blanco, Carlos A. Ferrando, and Fernando N. Biurrun

Accurate and repeatable techniques for discriminating grazing effects from temporal and spatial variability of vegetation are lacking. We used two indexes derived from Normalized Difference of Vegetation Index data to evaluate the effect of "continuous" (C) and "two-paddocks rest-rotation" (TPRR) grazing systems on vegetation cover in a semiarid ecosystem of Argentina. In both grazing systems, upward trend occurred in areas located far away from the watering points, but TPRR showed more improvement in vegetation cover near to watering point than C. We consider this methodology an important tool for monitoring vegetation changes and making management decisions in livestock systems.

Modeling Bare Ground With Classification Trees in Northern Spain

Keith T. Weber, Concepción L. Alados, C. Guillermo Bueno, Bhushan Gokhale, Benjamin Komac, and Yolanda Pueyo

Tracking bare ground is important for monitoring rangeland health. This is difficult in semiarid environments. Classification tree analysis (CTA) and maximum likelihood classifiers were used to model bare ground in the semiarid steppes of the middle Ebro valley, Spain, using Satellite Pour l'Observation de la Terre 4 (SPOT 4) imagery. Topographic data such as elevation, slope, aspect, and a morphometric characterization model were included and important for accurate bare ground estimation. Although the specific layers best suited for each regional model will vary, this study provided an important insight on both bare ground modeling and the potential advantages of CTA.

Wild Ungulate Herbivory of Willow on Two National Forest Allotments in Wyoming

Paul J. Meiman, Mark S. Thorne, Quentin D. Skinner, Michael A. Smith, and Jerrold L. Dodd

Many herbivores feed on willows, but there is limited information about willow browsing by wildlife except in national parks. We estimated wild ungulate herbivory of willow on two US Forest Service allotments in northern Wyoming and compared our estimates to published estimates for national parks. We also compared willow utilization by wildlife between sites dominated by willows of different heights. Wildlife browsing of willow in this study equaled, or exceeded, national park estimates where concern has been expressed about sustainability of willow communities. Generalizations about willow use based on plant height are problematic, so management decisions should be based on monitoring data.

Root Responses to Short-Lived Pulses of Soil Nutrients and Shoot Defoliation in Seedlings of Three Rangeland Grasses

José Tulio Arredondo and Douglas A. Johnson

Roots respond rapidly to soil nutrient pulses through changes in biomass allocation. We examined whether inherent relative growth rate (RGR) and root:shoot (R:S) allocation patterns were related to species' response to short-lived soil nutrient pulses. In species with similar RGR and different R:S ratios, greater allocation to roots did not translate necessarily into higher root proliferation in response to nutrient pulses. Defoliation inhibited proliferation-based root responses more than topological-based responses. A better understanding of root foraging responses to multiple factors such as soil nutrients and defoliation can help identify critical factors for selecting superior genotypes in plant improvement programs.

Influence of Abrams M1A1 Main Battle Tank Disturbance on Tallgrass Prairie Plant Community Structure

Peggy S. Althoff, Mary Beth Kirkham, Timothy C. Todd, Stephen J. Thien, and Philip S. Gipson

Sustainable use of military training lands requires monitoring and rehabilitation of damage resulting from training

activities, particularly those involving tracked vehicles. A replicated small-plot study of tracked vehicle disturbance was conducted on Fort Riley, Kansas, and subsequent recovery of the tallgrass prairie plant community was monitored. Aboveground biomass and community structure required up to 4 years or longer for recovery depending on the severity of the disturbance. The recovery models developed in this study provide a basis for developing guidelines for assessment and management of vehicle impact on military lands in grassland ecosystems.