Livestock as Ecosystem Engineers for Grassland Bird Habitat in the Western Great Plains of North America
Justin D. Derner, William K. Lauenroth, Paul Stapp, and David J. Augustine

Prevailing grazing management practices largely emphasize livestock production and uniform use of vegetation. We introduce the utility of livestock as ecosystem engineers and address potential benefits and consequences associated with heterogeneity-based management practices for conservation grazing in the western North American Great Plains. Specific examples are illustrated where engineering effects of livestock could alter vegetation heterogeneity at within-pasture (<100 ha) and among-pasture (~100 ha to thousands of hectares) scales to improve habitat for declining native grassland birds. Using livestock as ecosystem engineers to alter vegetation heterogeneity provides land managers important tools to achieve desired contemporary objectives and outcomes.

Sheep and Goat Grazing Effects on Three Atlantic Heathland Types
Berta M. Jáuregui, Urcesino García, Koldo Osoro, and Rafael Celaya

The abandonment and subsequent shrub encroachment in heathlands has promoted the incidence of wildfires in northwestern Spain, which threatens biodiversity. Sheep and goat grazing effects on the vegetation of three heathland types (e.g., previously burned grass [Ulex gallii Planchon]–dominated and unburned heather–dominated shrublands) were compared. Goats controlled shrub encroachment more than sheep in any heathland type with increased herbaceous cover. Goat grazing was more effective at early successional stages after a fire. Goat grazing could be an efficient tool for reducing woody combustible material and thus reducing fire risk in heathlands.

Effects of Stocking Rate and Heather Supplementation on Gastrointestinal Nematode Infections and Host Performance in Naturally Infected Cashmere Goats
Koldo Osoro, Rafael Celaya, Javier Moreno-Gonzalo, Luis M. M. Ferreira, Urcesino García, Pilar Frutos, Luis M. Ortega-Mora, and Ignacio Ferre

The effect of two management factors, stocking rate and heather (Calluna vulgaris) supplementation, on gastrointestinal parasite infection and performance in Cashmere goats was studied. Fecal egg count was affected by stocking rate, and the interaction between stocking rate and heather supplementation was also significant. Goats gained more live weight under low stocking rate and when they were supplemented with heather. The high stocking rate increased the infection risk at pasture, and the supplementation of grazing goats with tannin-containing heather improved the animals’ performance, but was not able to reduce the fecal egg count under the dry climatic conditions of the study year.

Hysteretic Responses to Grazing in a Semiarid Rangeland
Kate R. Searle, Iain J. Gordon, and Chris J. Stokes

Semi-arid rangelands show strong links between patterns of vegetation and ecological processes such as water and nutrient dynamics; however, grazing can disrupt these linkages, impairing ecological stability and function. This disruption may be exacerbated by time lags in the response of different ecological processes—a phenomenon called hysteresis. We tested for these lags in an Australian rangeland and demonstrated uncoupling of vegetation and hydrological processes under intense grazing. We showed that recovery of ecological function can lag behind structural recovery of vegetation such that the true state can only be captured by spatial comparison ecohydrological properties of both vegetation and soil.
**Relationships Between Nutritional Condition of Adult Females and Relative Carrying Capacity for Rocky Mountain Elk**

Jessica R. Piasecke and Louis C. Bender

Estimating habitat quality is difficult for wild ungulates because high forage quality requirements render traditional quantity-based methods inappropriate. Because lactation has significant energetic costs to individuals, body condition of lactating elk (Cervus elaphus nelsoni) cows may provide a sensitive index of habitat quality. Models of differential accrual of body fat between lactating and dry elk cows indicated that elk experienced no negative effects of reproduction on condition when habitat conditions allowed lactating cows to accrue $\geq 13.7\%$ body fat by autumn. Conversely, when lactating cows accrue $\leq 7.9\%$ body fat, elk are strongly nutritionally stressed, and habitat conditions are probably limiting population performance.

**Sustainability in Spanish Extensive Farms (Dehesas): An Economic and Management Indicator-based Evaluation**

P. Gaspar, F. J. Mesías, M. Escribano, and F. Pulido

The present work classifies, describes, and evaluates the sustainability of livestock farming systems in southwestern Spain by applying a methodological adaptation of the framework for the evaluation of management systems incorporating sustainability index. We obtained an overall value of sustainability from a technical–economic perspective for a representative sample of operations. The mixed systems (beef cattle–sheep–Iberian pig) have been found to be the most sustainable in general terms. The sheep operations with a high stocking rate are the least sustainable, although they have been shown to be the most profitable.

**Forage Production of the Argentine Pampa Region Based on Land Use and Long-Term Normalized Difference Vegetation Index Data**


Forage production description over a large region, taking into account spatial, seasonal, and interannual variability, represents the major challenge to sustainable and successful rangeland management. We used vegetation indices (NDVI) calculated from a large time series of NOAA satellite images to support field information. We defined homogeneous zones based on land use and production characteristics. The subpixel model was used to discriminate among land uses and to cover spectral information. Annual integrated NDVI, a surrogate of primary production, and stocking rate were positively associated with increasing precipitation. Temporal detection of forage production across the region allows the rational use of natural resources.

**Minimal Plant Responsiveness to Summer Water Pulses: Ecophysiological Constraints of Three Species of Semiarid Patagonia**

Rodolfo A. Golluscio, Valeria Sigal Escalada, and Juliana Pérez

In arid ecosystems, large summer rains frequently differentiate wet from dry years. In the Patagonian steppe, leaf water potential of shallow- and deep-rooted species increased in response to watering, but stomatal conductance only increased in the shallow-rooted grass *Stipa speciosa*. In contrast, stomatal conductance did not increase in the xerophytic shallow-rooted subshrub *Nassawia glomerulosa* because it was in a phenological resting stage, or in the deep-rooted shrub *Mulinum spinosum* because unwatered plants had a favorable water status. The constraints imposed by rooting depth, phenology, and xerophytism may explain the minimal responsiveness of semiarid vegetation to infrequent, large rainfall events.

**Survival of Sprouting Shrubs Following Summer Fire: Effects of Morphological and Spatial Characteristics**

Emily C. Dacy and Timothy E. Fulbright

Understanding relationships between shrub morphology and spatial distribution and post-fire mortality or recovery may help land managers use fire to reduce shrub densities. We focused on three shrubs common in southern Texas and Mexico: *brasil* (*Condalia hookeri*), huisache (*Acacia farnesiana*), and spiny hackberry (*Celtis ehrenbergiana*). Mortality of *brasil* was 26 times greater on burned sites than on control sites. Postburn height and number of sprouts increased with preburn shrub height and number of stems. Shorter intervals of time between prescribed fires may reduce post-fire recovery rates of shrubs. Potential for losing valuable shrubs for wildlife, such as *brasil*, should be considered in planning warm-season prescribed burns.

**A Process-Based Application of State-and-Transition Models: A Case Study of Western Juniper (Juniperus occidentalis) Encroachment**

Steven L. Petersen, Tamzen K. Stringham, and Bruce A. Roundy

In juniper-encroached ecosystems, ecological structure and processes are impaired during woodland expansion. Degrading structure and process can facilitate the transition of a site across both biotic and abiotic thresholds. In a western juniper (*Juniperus occidentalis*)–dominated landscape, intercanopy plant cover, percent bare ground, and
infiltration rate were measured in relation to juniper canopy cover. These data were analyzed using hierarchical agglomerative cluster analyses to predict threshold occurrence. Results indicate that thresholds can be predicted from environmental variables over a heterogeneous landscape. Land managers can use the general relationships determined in this study to identify and anticipate thresholds at various landscape positions in juniper-dominated ecosystems.

**Fecal Near-Infrared Reflectance Spectroscopy to Predict Leymus chinensis of Diets from Penned Sheep in North China**

Bin Shu, Yingjun Zhang, Lijun Lin, Hailing Luo, and Hai Wang

This study was conducted to determine the ability of fecal Near-Infrared Reflectance Spectroscopy (NIRS) to predict the percent consumption of *Leymus chinensis*, a dominant species in north China, by sheep (*Ovis aries*). The calibration data set consisted of 47 diets of known *L. chinensis* composition paired with corresponding fecal spectra. Partial least-squares regression resulted in better calibration than stepwise regression, but when the calibration dataset was small, stepwise regression improved the precision and accuracy of predictions. Results of the present study show that a fecal NIRS equation developed from a restricted feeding trial could be used to predict the percentages of *L. chinensis* in fecal materials collected from voluntary feeding trials.

**A Technique for Estimating Riparian Root Production**

Chad S. Boyd and Tony J. Svejcar

We investigated the field utility of a root in-growth sampling technique for measuring root production in four riparian sites in southeastern Oregon. Two 7.6-cm-diameter, sand-filled in-growth cores were place in four plots on each site in September of 2004. In September of 2005, cores were harvested using a vacuum sampling technique in which a 5.1-cm-diameter, camphored polyvinyl chloride casing was driven into the center of the root core, and sand and root materials were suctioned out. Our index-to-root production by weight was consistent with previous estimates of annual root production reported in the literature. Our sampling technique proved to be a practical solution for root sampling in riparian environments and helps overcome some of the difficulties in sequential coring of saturated soils.