

HIGHLIGHTS

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Land Management History of Canadian Grasslands and the Impact on Soil Carbon Storage

Xiaoyu Wang, A. J. VandenBygaart, and Brian C. McConkey

Canadian grasslands are important reservoirs for soil carbon storage. We compiled historical rangeland management data to determine the effect of management on soil carbon storage. During recent decades grazing lands have accumulated an average 0.2 Mg C/ha (0.08 ton per acre) per year in the top 15 cm (6 inches). The storage potential greatly depends on grassland management. Management practices that protect soils, water, and air tend to support soil carbon sequestration. Deferred grazing during sensitive or vulnerable periods, or periodic complete rest, can help maintain grassland health and increase soil carbon storage.

Natural Regeneration Processes in Big Sagebrush (*Artemisia tridentata*)

Daniel R. Schlaepfer, William K. Lauenroth, and John B. Bradford

Limited understanding of the natural regeneration of big sagebrush (*Artemisia tridentata*) restricts both current management decisions and projections of how this species will respond to increasing disturbance frequency and global change. We identified and characterized the controls of seed production, germination, and natural establishment. Research gaps include variation in seed production and germination; responses to frost events, CO₂ concentration, and nutrients in combination with water availability; suitability of microsite relative to site conditions; competitive ability; and differences among subspecies and ecoregions. A greater understanding of big sagebrush regeneration will assist both management and conservation decisions.

Of Grouse and Golden Eggs: Can Ecosystems Be Managed Within a Species-Based Regulatory Framework?

Chad S. Boyd, Dustin D. Johnson, Jay D. Kerby, Tony J. Svejcar, and Kirk W. Davies

Concurrent declines in greater sage-grouse (*Centrocercus urophasianus*) populations and the sagebrush habitats they require have prompted examination of the merits of species-centric regulation vs. ecosystem management. We discuss the types of problems facing sage-grouse conservation and argue that complex ecosystem problems associated with this challenge will be difficult to address under the regulatory framework established by the Endangered Species Act. We develop an alternative approach that represents a unified vision of conservation success that honors a commitment to sage-grouse conservation by maintaining the capacity of ecosystems to produce critical habitat while expanding the diversity of stakeholder participation.

Seasonal Resource Selection and Distributional Response by Elk to Development of a Natural Gas Field

Clay B. Buchanan, Jeffrey L. Beck, Thomas E. Bills, and Scott N. Miller

Increased global energy demand has expanded the overlap of energy development activities and wildlife populations, thus increasing the need to document development impacts on wildlife. We developed resource selection functions to evaluate elk (*Cervus elaphus*) response to disturbance associated with natural gas development in summer and winter. Elk used distance and escape cover to minimize exposure to roads that resulted in an indirect loss of high-use areas by 43% and 50% in summer and winter, respectively. Our results suggest reducing traffic, protecting woody escape cover, and maintaining undeveloped refugia within the energy development footprint to reduce impacts to elk.

Monitoring British Upland Ecosystems With the Use of Landscape Structure as an Indicator for State-and-Transition Models

Dylan Young, Humberto L. Perotto-Baldivieso, Tim Brewer, Rachel Homer, and Sandra A. Santos

UK upland grazing habitats have been subjected to multiple land management pressures over long time periods. A state-and-transition model based on disturbance scales (i.e., stocking rates) was combined with remote sensing data to establish if thresholds between stable and degraded states could be detected. Our results suggest that when the scale of the disturbance processes is considered, the spatial structure of vegetation could be a useful indicator for resilience management. Our study provides an approach to inform the development of state-and-transition models, which can be integrated with traditional ground-based assessments to assist monitoring of important habitats.

A 40-Year Record of Tree Establishment Following Chaining and Prescribed Fire Treatments in Singleleaf Pinyon (*Pinus monophylla*) and Utah Juniper (*Juniperus osteosperma*) Woodlands

Nathan A. Bristow, Peter J. Weisberg, and Robin J. Tausch

Chaining and prescribed burning have been widely applied in pinyon–juniper woodlands, but with very limited monitoring of long-term effectiveness. We resampled plots in chained and burns woodlands 40 years after initial sampling to compare the long-term trends in tree establishment across treatments. Tree recolonization at chained sites was rapid and achieved pretreatment densities within a few decades, whereas prescribed burns proved resistant to tree recolonization. On chained sites, initial juniper (*Juniperus osteosperma*) dominance (first 15 years) was followed by pinyon (*Pinus monophylla*) dominance. Chaining treatments without follow-up retreatment will not only be rapidly recolonized by trees, but can amplify landscape-level shifts in tree species composition.

Plant Community Response Following Removal of *Juniperus virginiana* From Tallgrass Prairie: Testing for Restoration Limitations

Ryan F. Limb, David M. Engle, Aaron L. Alford, and Eric C. Hellgren

Woody plant encroachment in grasslands is widespread and alters vegetation composition, suppresses herbaceous productivity, and may limit the potential for grassland restoration. We removed eastern red cedar (*Juniperus virginiana*) from tallgrass prairie sites that had a wide range of canopy cover and followed subsequent grassland succession. Herbaceous productivity on sites from which juniper was removed

matched production on juniper-free grassland within 2 years, and had similar species composition within 5 years. No levels of juniper canopy cover up to 76% limited grassland restoration.

Aminopyralid Constrains Seed Production of the Invasive Annual Grasses Medusahead and *Ventenata*

Matthew J. Rinella, Susan E. Bellows, and Aaron D. Roth

Invasive annual grasses, such as medusahead (*Taeniatherum caput-medusae*) and ventenata (*Ventenata dubia*) are negatively impacting US rangelands. We tested the ability of the growth regulator herbicide aminopyralid to sterilize medusahead and ventenata. Medusahead seed production was reduced to nearly zero by each tested aminopyralid rate and application growth stage. With ventenata, aminopyralid applied at the seedling stage reduced seed production 95% to 99%. Beyond the seedling stage, however, ventenata responses to aminopyralid were highly variable. It may be possible to use growth regulators to control certain invasive annual grasses by depleting their short-lived seedbanks.

Cattle Grazing and Vegetation Succession on Burned Sagebrush Steppe

Jonathan D. Bates and Kirk W. Davies

Information is limited on the effects of cattle grazing to long-term plant community dynamics and herbage production following fire in sagebrush steppe. We evaluated vegetation response to light, moderate, and high stocking of cattle over 7 years on burned Wyoming big sagebrush (*Artemisia tridentata* subsp. *wyomingensis*) steppe in eastern Oregon. High stocking resulted in lower herbage cover and production than light and moderate stocking treatments and ungrazed burned controls. Herbage production, canopy cover, and density did not differ among light and moderate stocking and ungrazed burned controls. Light to moderate stocking rates are compatible for sustainable grazing of burned sagebrush steppe rangelands.

Diet Quality Modifies Germination of *Dichrostachys cinerea* and *Acacia nilotica* Seeds Fed to Ruminants

Julius Tjelele, David Ward, and Luthando Dziba

The dispersal of seeds that remain intact and can potentially germinate after excretion is of particular concern when animals consume seeds of encroaching or invasive woody plants. We studied the effects of animal species, hay quality, and seed characteristics (size and density) on the germination of *Dichrostachys cinerea* and *Acacia nilotica* seeds in South Africa. There was higher germination of seeds

that passed through cattle than those that passed through sheep or goats. Seeds took about 9 days to pass through the animals. Seeds consumed along with high-quality hay were more likely to pass through the digestive tract intact and remain viable.

Grazing Protection Influences Soil Mesofauna in Ungrazed and Grazed Riparian and Upland Pastures

Jim J. Miller, Jeffrey P. Battigelli, and Walter D. Willms

The influence of grazing protection by stream-bank fencing on soil mesofauna density is unknown. We determined if

grazing protection (ungrazed vs. grazed), location (upland vs. riparian pasture), and season (spring vs. fall) had a significant influence on soil mesofauna. Grazing protection decreased *Astigmata* mite densities compared to grazing on upland pasture, and it increased *Oribatida* mites and total *Collembola*, and *Hypogastruridae* and *Onychiuridae* springtails on both pastures. Grazing protection influenced certain soil mesofauna in pastures associated with stream-bank fencing, and this may influence decomposition of soil organic matter, nutrient cycling, and soil structure in associated pastures.

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