

HIGHLIGHTS

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Litter Decomposition in Semiarid Grassland of Inner Mongolia, China

Ping Liu, Jianhui Huang, Xingguo Han, and Osbert J. Sun

Long-term overgrazing has significantly changed plant species composition in rangeland ecosystems, and this structural change may substantially alter ecosystem function. Decomposition rates and nutrient dynamics of litter derived from individual species and species mixtures were investigated in degraded semiarid rangelands of northern China for 1 year. Nonadditive effects were found in six out of nine aboveground litter mixtures. Our results indicate that the cycling of nutrients, such as nitrogen and phosphorus, may be altered significantly due to different litter mixtures following modification of plant species composition, which is associated with rangeland degradation due to overgrazing in the arid and semiarid grassland of northern China.

Can Shallow Plowing and Harrowing Facilitate Restoration of *Leymus chinensis* Grassland? Results From a 24-Year Monitoring Program

Taogetao Baoyin and Frank Yonghong Li

Long-term effects of shallow plowing and harrowing were studied to determine their feasibility in assisting restoration of extensive grasslands in semiarid Inner Mongolia that have been degraded by chronic severe grazing. Degraded grasslands were found to be resilient; they recovered naturally after excluding grazing animals. Harrowing significantly accelerated the recovery of both grassland production and community structure towards that of a less disturbed community. Shallow plowing induced rapid recovery of herbage mass, but slowed ecological restoration towards the species composition of a less disturbed ecosystem. Harrowing is a recommended measure for aiding grassland restoration, while shallow plowing may only be applied for quick restoration of herbage production.

Grazing Density Effects on Cover, Species Composition, and Nitrogen Fixation of Biological Soil Crust in an Inner Mongolia Steppe

Huajie Liu, Xingguo Han, Linghao Li, Jianhui Huang, Hongsheng Liu, and Xin Li

To elucidate grazing effects on epigenic nonvascular plants in Inner Mongolia grasslands, we measured abundance, composition, and nitrogen (N) fixation of biological soil crusts after 16 years of grazing with six densities of grazing animals (0, 4, 8, 12, 16, and 20 sheep/ha). Increasing animal density significantly reduced the importance of biological crusts in N input and soil stabilization. This decrease resulted from a shift in the biological soil crust community characterized by a high coverage of an attached group to low coverage of a vagrant group. Management for lower animal densities is likely a preferred practice for conserving biological soil crusts and the ecological services that they provide, including N fixation and soil stabilization.

Grazing Intensity on Vegetation Dynamics of a Typical Steppe in Northeast Inner Mongolia

Yan Liang, Guodong Han, He Zhou, Mengli Zhao, Hennie A. Snyman, Dan Shan, and Kris M. Havstad

Vegetation dynamics were quantified along a grazing intensity gradient in an arid steppe rangeland in the Keshiketeng Banner, Chifeng Prefecture in northeastern Inner Mongolia in 2004 and 2006. Vegetation changed from the original dominant grass *Leymus chinensis* to a semi-subshrub species *Artemisia frigida* while moving from ungrazed communities to areas near settlements. Canopy coverage, aboveground productivity, and the number of perennial species declined along this gradient as well, but root biomass in the top 1 m of soil did not vary ($P > 0.05$). Light grazing did not exceed the tolerance limits of these ecosystems, but vegetation dynamics on the heavily grazed sites indicate that it is not a sustainable practice.

Response of Seed Germination and Seedling Growth to Sand Burial of Two Dominant Perennial Grasses in Mu-U's Sandy Grassland, Semiarid China

Yajuan Zhu, Ming Dong, and Zhenying Huang

Experiments were conducted in the Mu-U's Sandy Grassland of North China to determine the effects of sand burial on seed germination and seedling growth of the dominant perennial grasses *Psammochloa villosa* and *Leymus secalinus*. Small, medium, and large seeds of *P. villosa* and small and large seeds of *L. secalinus* were buried to 0-, 1-, 2-, 4-, 6-, and 8-cm depths in sand. Emergence percentages for large seeds were higher than those for smaller seeds, and seeds that did not germinate were forced into dormancy to form a soil seed bank. One-week-old and 2-week-old seedlings of *P. villosa* seedlings tolerated 75% and 100% shoot height burial, respectively, while *L. secalinus* seedlings only tolerated up to 75% shoot height burial. Growth of *L. secalinus* seedlings was inhibited by sand burial to a greater extent than *P. villosa* seedlings due to decreased biomass and slow shoot elongation.

Differences in Net Primary Productivity Among Contrasting Habitats in *Artemisia ordosica* Rangeland of Northern China

Chunping Li, Osbert Jianxin Sun, Chunwang Xiao, and Xingguo Han

Artemisia ordosica is a semishrub native to the Ordos Plateau of Inner Mongolia and forms a unique vegetation type in the sandland region. We investigated net primary production (NPP), fine root turnover, soil microbial carbon (C_{mic}), and soil organic carbon density (SOC_d) on sand dunes differing in mobility (i.e., fixed, semifixed, and shifting sand dunes) in Mu-U's sandland. NPP, SOC_d , C_{mic} , and fine root turnover rates all increased on an areal basis with increasing vegetation cover. Total NPP varied markedly among habitats and ranged from $18.3 \text{ g} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$ for communities on shifting dunes to $293.8 \text{ g} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$ for communities on fixed dunes, while the rates of fine root turnover varied from 0.16 per year to 0.54 per year. Our study demonstrated that habitat change in sandland has significant impacts on ecosystem productivity by affecting many related aspects of NPP.

Are Natural Resources Conservation Service Range Management Investments Working at Cross-Purposes With Wildlife Habitat Goals on Western United States Rangelands?

Theodore P. Toombs and Martha G. Roberts

We evaluated the occurrence of livestock distribution-oriented grazing management in the spending and applied

practices of the Natural Resources Conservation Service (NRCS), which is charged with assisting private landowners with implementation of USDA conservation programs. Both applied practices and spending suggest an emphasis on livestock distribution and associated structures, with almost 20 million ha of prescribed grazing systems; 10,000 km of fence; and 127,000 water facilities implemented in 17 western states with NRCS assistance between 2004 and 2007. Ninety percent of funding for the 2005 Conservation Security Program grazing enhancements supported investments or management related to livestock distribution. We suggest that increasing emphasis of NRCS conservation programs and financial assistance toward compositional and structural heterogeneity of vegetation, rather than on livestock distribution, could provide an approach that unifies livestock production and wildlife habitat objectives.

Fine-Scale Spatial Genetic Structure in Perennial Grasses in Three Environments

Steven E. Smith, Tulio Arredondo, Martin Aguiar, Elisabeth Huber-Sannwald, Angel Alpuche, Armando Aguado, Oscar A. Grageda, Kandres Halbrook, and Cecilia Bottini

Livestock grazing may cause genetic changes in the populations of the plants they graze in rangeland environments. In field experiments with favored forage plants in Arizona, Mexico, and Argentina, we investigated how these genetic changes may occur over relatively small distances. We showed that plants close together were generally closely related genetically compared to those farther away in the same population. Our results suggest that livestock may affect genetic homogeneity within a given population.

Nutritive Quality of Highbush Blackberry (*Rubus argutus*) Exposed to Tropospheric Ozone

Stephen S. Ditchkoff, John S. Lewis, John C. Lin, Russell B. Muntifering, and Arthur H. Chappelka

We examined the effects of ozone (O_3) on biomass production and nutritive quality of highbush blackberry (*Rubus argutus*) May–August 2004. Plants were exposed to the following three treatments: carbon-filtered air, characteristic of clean air quality; non-filtered air, representative of air quality in Auburn, Alabama; and air with double the ambient concentration of O_3 . Although biomass production was not influenced by O_3 exposure, nutritive quality of plants was associated negatively with O_3 concentration. Similarly, in vitro dry matter digestibility tended to be less in plants exposed to elevated O_3 . These data suggest that elevated concentrations of ground level O_3 could have implications for diet selection of herbivorous mammals.

Assessment of Best-Management Practice Effects on Rangeland Stream Water Quality Using Multivariate Statistical Techniques

Christopher A. Ellison, Quentin D. Skinner, and Larry S. Hicks

A situation presented itself where mutual respect, cooperation, and self-determination among landowners/permittees, nongovernmental entities, and local, state, and federal agencies were able to address resource concerns and opportunities in a voluntary collaborative manner through the Wyoming Coordinated Resource Management program,

which encompasses the 280,000-acre Upper Muddy Creek Watershed. Grazing Best Management Practices, primarily rotational grazing systems that adjust time and season of use on riparian areas, were implemented with upland water developments, fire, fence, and herding. Benefits include improved water quality, aquatic habitat, and maintenance of elk, mule deer, and antelope populations at or above herd objective levels, and an increase in the actual number of federal and private animal unit months. The implications of this project are that “carrots provide greater results than hammers” and “people support what they help create.”