Synthesis Paper

Rotational Grazing on Rangelands: Reconciliation of Perception and Experimental Evidence

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Abstract

In spite of overwhelming experimental evidence to the contrary, rotational grazing continues to be promoted and implemented as the only viable grazing strategy. The goals of this synthesis are to 1) reevaluate the complexity, underlying assumptions, and ecological processes of grazed ecosystems, 2) summarize plant and animal production responses to rotational and continuous grazing, 3) characterize the prevailing perceptions influencing the assessment of rotational and continuous grazing, and 4) attempt to direct the profession toward a reconciliation of perceptions advocating support for rotational grazing systems with that of the experimental evidence. The ecological relationships of grazing systems have been reasonably well resolved, at the scales investigated, and a continuation of costly grazing experiments adhering to conventional research protocols will yield little additional information. Plant production was equal or greater in continuous compared to rotational grazing in 87% (20 of 23) of the experiments. Similarly, animal production per head and per area were equal or greater in continuous compared to rotational grazing in 92% (35 of 38) and 84% (27 of 32) of the experiments, respectively. These experimental data demonstrate that a set of potentially effective grazing strategies exist, none of which have unique properties that set one apart from the other in terms of ecological effectiveness. The performance of rangeland grazing strategies are similarly constrained by several ecological variables establishing that differences among them are dependent on the effectiveness of management models, rather than the occurrence of unique ecological phenomena. Continued advocacy for rotational grazing as a superior strategy of grazing on rangelands is founded on perception and anecdotal interpretations, rather than an objective assessment of the vast experimental evidence. We recommend that these evidence-based conclusions be explicitly incorporated into management and policy decisions addressing this predominant land use on rangelands.

Resumen

A pesar de la abrumadora evidencia experimental en contra, el apacentamiento rotacional continua siendo promovido e implementado como la única estrategia viable de apacentamiento. Las metas de esta síntesis son para: 1) reevaluar la complejidad, los supuestos fundamentales, y los procesos ecológicos de los ecosistemas apacentados, 2) resumir las respuestas de producción vegetal y animal al apacentamiento rotacional y continuo, 3) caracterizar las percepciones prevalecientes que influyen en la evaluación del apacentamiento rotacional y continuo, 4) intentar dirigir la profesión hacia una reconciliación de las percepciones que abogan por apoyo para los sistemas rotacionales de apacentamiento con las de la evidencia experimental. Las relaciones ecológicas de los sistemas de apacentamiento han sido razonablemente bien resueltas, a las escalas investigadas, y una continuación de experimentos costosos de apacentamientos, adheridos a los protocolos convencionales, producirán poca información adicional. La producción vegetal fue igual o mayor en el apacentamiento continuo en comparación con el rotacional en 87% (20 de 23) de los experimentos. Similarmente, la producción animal por cabeza y por área fueron iguales o mayores en el apacentamiento continuo en comparación con el rotacional en el 92% (35 de 38) y 84% (27 de 32) de los experimentos, respectivamente. Estos datos experimentales demuestran que existe un grupo de estrategias de apacentamiento potencialmente efectivas, ninguna de las cuales tiene propiedades únicas que separen una de las otras en términos de efectividad ecológica. El comportamiento de las estrategias de apacentamiento del pastizal están limitadas en forma similar por varias variables ecológicas, que establecen que las diferencias entre ellas son dependientes de la efectividad de los modelos de manejo, mas que de la ocurrencia de un fenómeno ecológico único. El continuo abogar por el apacentamiento rotacional como estrategia superior de apacentamiento de los pastizales esta fundado en la percepción de interpretaciones anecdóticas mas que en una evaluación objetiva de la vasta evidencia experimental. Recomendamos que estas

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conclusiones basadas en evidencia sean incorporadas explícitamente en el manejo y las políticas de decisión que abordan este uso predominante de los pastizales.

Key Words: continuous grazing, domestic herbivores, grazed ecosystems, grazing management, grazing systems, rangeland management

INTRODUCTION: THE DILEMMA OF GRAZING SYSTEMS

The principle of rotational grazing was described by James Anderson near the end of the 18th century in Scotland (Voisin 1959), but implementation of rotational grazing systems on rangelands is a relatively recent phenomenon. Grazing systems progressed during the 20th century from simple deferred systems (Sampson 1913), to more sophisticated rotational systems (Merrill 1954; Hormay and Evanko 1958; Vallentine 1967; Tainton et al. 1999), and most recently to intensive short duration systems (Savory 1978, 1983, 1988; Savory and Parsons 1980). The general goal of grazing systems was to increase production by ensuring that key plant species captured sufficient resources (e.g., light, water, nutrients) to enhance growth and by enabling livestock to harvest available forage more efficiently. The specific objectives by which grazing systems were purported to increase production were to 1) improve species composition or productivity by ensuring key plant species a rest period during the growing season, 2) reduce animal selectivity by increasing stock density (i.e., animals per land unit) to overcome small-scale heterogeneity (i.e., patch grazing), and 3) ensure more uniform animal distribution within large heterogeneous management units by improving water distribution and/or cross-fencing. We subscribe to a broad definition of grazing systems as a specialization of grazing management that defines reoccurring periods of grazing, rest, and deferment for two or more pastures (Heitschmidt and Taylor 1991). The basic types of rotational grazing systems are described in Table 1.

The preponderance of evidence generated from grazing experiments over the past 60 years has consistently indicated that rotational grazing is not superior to continuous grazing on rangelands (Table 2). This was true for the initial grazing experiments (Sampson 1951; Heady 1961), numerous investigations conducted throughout the 1970–1980s (O'Reagain and Turner 1992; Holechek et al. 2001; Norton 2003), and several rigorously designed recent investigations (Hart et al. 1993a, 1993b; Manley et al. 1997; Gillen et al. 1998; McCollum et al. 1999; Derner and Hart 2007). Yet, in spite of clear and consistent experimental evidence demonstrating that rotational grazing and continuous grazing have similar effectiveness on rangelands, rotational grazing continues to be promoted and implemented as a superior grazing system (Norton 1998, 2003; Tainton et al. 1999; Teague et al. 2004). Strong perceptions must exist to maintain advocacy for rotational grazing systems over continuous grazing in the presence of overwhelming experimental evidence to the contrary. Heady (1961) observed that the perceived benefits of rotational grazing developed early in the profession when researchers offered explanations as to why their results failed to support rotational grazing systems, rather than directly concluding that there were no differences between rotational and continuous grazing.

The specific objectives of this synthesis are to 1) reevaluate the complexity, underlying assumptions, and ecological processes governing the response of grazed ecosystems, 2) summarize plant and animal production responses to rotational and continuous grazing, 3) characterize the prevailing perceptions influencing the assessment of rotational and continuous grazing, and 4) attempt to direct the profession toward a reconciliation of perceptions advocating support for rotational grazing systems with that of the experimental evidence. This assessment is specific to the application of commercial grazing operations, and it does not explicitly consider grazing dynamics associated with herding, migratory grazing, or transhumance.

PRIMARY SOURCES OF COMPLEXITY AND CONFUSION

The absence of consistent management and policy recommendations concerning the adoption of grazing systems after several decades of experimental research and commercial application is a testament to the complexity of this task. The complexity resides in the broad array of confounding variables that make a direct, valid comparison between grazing systems and continuous grazing all but impossible (Heady 1961). Consider the wide range of ecological variation associated with rainfall regime (i.e., amount, seasonality, and intra- and interannual variability), vegetation structure, composition, productivity, prior land use, and livestock characteristics (i.e., breeds, prior conditioning, care, and handling). This tremendous ecological variability is paralleled by variability associated with the commitment, ability, goals (i.e., production vs. conservation), and opportunities (i.e., land ownership, alterna-

Table 1. Characteristics of basic rotational grazing systems implemented on rangelands.

Grazing system	Stock density	No. of herds	Length of grazing	Length of rest	Tactic
Deferred rotation	Moderate	Single	Long	Moderate	HPG[1]
Rest rotation	Moderate	Multiple	Long	Short	HUG[2]
Rest rotation	High	Single	Short	Long	HPG
High intensity–low frequency	High	Single	Moderate	Long	HUG
Short duration	High	Single	Short	Moderate	HPG

[1]High-performance grazing strategy that enables selective grazing of preferred plants.
[2]High-utilization grazing strategy that affects heavy utilization of both preferred and nonpreferred plants (adapted from Heitschmidt and Taylor 1991).