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SCIENTIFIC PERSPECTIVES

Stocking method and terminology in grazing management: Evaluation of assertions from educational, outreach, and engagement programs

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Abstract

We revisited terminology and assertions about grazing management in general, but more specifically the choice of the stocking method, and considered their merit in the context of evidence from the literature, including a chapter entitled Prescribed Grazing on Pasturelands from a National Resource Conservation Service (NRCS) literature synthesis published in 2012 (Nelson, 2012). We framed those assertions in the form of questions. Our objectives were to consider whether these often-stated assertions about grazing management were supported, refuted, or simply not adequately assessed by the body of scientific evidence and to help focus future discussion about the topic.

1 | PREFACE

Assertions about grazing management and grazing systems should be evaluated based on the scientific literature. Grazing management is but one component of a grazing system (Allen et al., 2011), and these terms are not interchangeable. In conversations with colleagues working on educational, outreach, and engagement programs to improve pasture management as well as with livestock and land managers around the country, we have observed that particular terminology and buzzwords arise frequently and can dominate discussions in the realm of grazing management. Some of these words/themes lack clear definition, and this lack of specificity may promote misconceptions, thus hindering the opportunity for critical thinking and ultimately the advancement and improvement of grazing systems.

In this article, we revisited assertions about grazing management in general, but more specifically the choice of the stocking method, and considered their merit in the context of evidence from the scientific literature, including a chapter titled Prescribed Grazing on Pasturelands from a National Resource Conservation Service (NRCS) literature synthesis published in 2012 (Nelson, 2012). We framed those assertions in the form of questions. Our objectives were to consider whether these often-stated assertions about grazing management were supported, refuted, or simply not adequately assessed by the body of scientific evidence and to help focus future discussion about the topic.

2 | DEFINITIONS

For the purposes of this article, and to form a basis for discussion, we provided referenced definitions for several words/themes in the context of grazing systems and grazing management.

Grazing management: The manipulation of grazing in pursuit of a specific objective or set of objectives (Allen et al., 2011).

Grazing system: A defined, integrated combination of soil, plant, animal, social and economic features, stocking

method(s), and management objectives to achieve specific results or goals (Allen et al., 2011).

Holistic planned grazing: A planning process for dealing simply with the great complexity that livestock managers face daily, in integrating livestock production with crop, wildlife, and forest production, while working to ensure continuous land regeneration, animal health and welfare, and profitability (Savory Institute, 2022)

Regenerative grazing: An agricultural practice that uses soil health and adaptive livestock management principles to improve farm profitability, human and ecosystem health, and food system resiliency (Spratt et al., 2021).

Soil health: The continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals, and humans (NRCS, 2022). Indicators of soil health include a variety of soils' physical, chemical, and biological properties and processes; soil organic C and N are often the most utilized indicators in soil health assessments (Franzluebbers et al., 2021).

Grazing intensity: Measures of grazing intensity are animal (e.g., stocking rate) or pasture based (e.g., forage mass, canopy height, and canopy light interception); forage allowance and grazing pressure include both a pasture and animal measure (Sollenberger et al., 2012). These terms have been defined by the Forage and Grazing Terminology Committee (Allen et al., 2011), although the term "grazing intensity" itself was not explicitly defined by Allen et al. (2011).

Grazing frequency: This term was not explicitly defined by Allen et al. (2011) but its definition is directly related to the rest period, i.e., the length of time that a specific land area is not stocked between stocking periods. Hence, we propose to define grazing frequency as the interval between defoliation events of a specific plant, patch, or paddock.

Stocking rate: The relationship between the number of animals and the total area of the land in one or more units utilized over a specified time; an animal-to-land relationship over time (Allen et al., 2011).

Stocking density: The relationship between the number of animals and the specific unit of land being grazed at any one time (i.e., a paddock within a pasture being rotated); an instantaneous measurement of the animal-to-land area relationship (Allen et al., 2011).

Rotational stocking: A method of stocking livestock that utilizes recurring periods of grazing and rest among paddocks in a grazing management unit throughout the time when grazing is allowed (Allen et al., 2011) (Figure 1).

We noted that many proposed "grazing management approaches" are variations of rotational stocking; for example, adaptative multipaddock grazing (Mosier et al., 2022); management intensive grazing (Hancock & Andrae, 2009), and Voisin's rational grazing (Voisin, 1957). The definitions for these "grazing management approaches" are presented and discussed in the following section. This list of grazing approaches is not comprehensive, and we have noted many other terms used in the scientific literature and by colleagues working on educational, outreach, and engagement programs. For example, four options result from combining high and low levels of intensity and frequency (i.e., high-intensity low-frequency, high-intensity high-frequency, low-intensity high-frequency, low-intensity low-frequency) (Vallentine, 1990; Zubieta et al., 2021), high stock density grazing and ultra-high stock density (Aljoe, 2023), and there may be other terms. These approaches are variations of rotational stocking, although defined in general terms. Some of these terms, in fact, are listed in the section "Terms not recommended for use" by Allen et al. (2011).

Core ideas

- Choice of stocking method is only one element of grazing management.
- Grazing management is but one component of a grazing system, and these terms are not interchangeable.
- Often-stated assertions about grazing management should be evaluated based on the body of scientific literature.
- What specific outcomes are improved in rotational versus continuous stocking, and to what extent?
- What are the mechanisms that explain those responses?

Continuous stocking: A method of stocking livestock on a specific unit of land where animals have unrestricted and

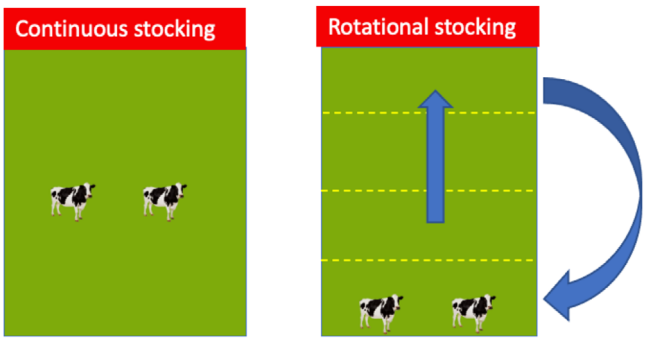

FIGURE 1 Both management scenarios have equivalent grazing intensity (i.e., same stocking rate at 1 animal unit per ha or two 500-kg animals on 1 ha of land), but have different stocking methods (i.e., continuous or rotational stocking). The stocking density is greater for rotational stocking (1 animal unit per 0.25 ha) compared to continuous stocking (1 animal unit per ha). For rotational stocking, yellow lines depict paddock subunits, each grazed sequentially for 7 days and allowed to rest for 21 days before grazing again

uninterrupted access throughout the time when grazing is allowed (Allen et al., 2011) (Figure 1).

3 | CONTEXTUALIZATION OF TERMINOLOGY AND POTENTIAL MISCONCEPTIONS

Grazing management is characterized in terms of intensity, method, timing of grazing, and type and class of livestock (Sollenberger et al., 2012). The choice to use a particular level of any of these management strategies should be objective-driven. The objectives may include achieving or maintaining canopy conditions and forage productivity that results in optimal levels of animal performance, but they can be expanded to include the concept of sustainability and provision of ecosystem services (Lemaire et al., 2011; Sollenberger et al., 2012). We direct the reader to Sollenberger et al. (2019) for a review on how grassland management affects delivery of regulating and supporting ecosystem services.

Terms such as adaptative multipaddock grazing (AMP), management intensive grazing (MiG), and Voisin's rational grazing (VRG), are variations of the rotational stocking method, although defined in general terms. For example, Mosier et al. (2022) indicated that in AMP "dense" cattle herds move quickly over the land followed by "adequate" rest periods for the regrowth of plants. Hancock and Andrae (2009) indicated that MiG is "any" grazing method that utilizes repeating periods of grazing and rest among two or more paddocks or pastures with emphasis on the management. The VRG is focused on adjusting the duration of the rest period based on when the plants are "ready" to be grazed (Voisin, 1957). Some people use the word "adaptative" to advocate for more "flexibility"; however, they may wrongly assume that the land manager implementing rotational stocking is using a rigid system and may have no ability or desire to adjust rest periods, grazing time, stocking rate, or stocking density based on current observations of the landscape. The capacity to adapt to a changing environment has been and must continue to be a daily practice for the land and livestock manager, and this practice is not limited to a specific grazing system or stocking method.

Other terms such as regenerative grazing and holistic planned grazing, while having gained acceptance via the popular press, are also defined in very general terms. Their definitions contain undeniably important concepts, but do not provide actionable items at the farm level. In that sense, they are more similar to the general concept of a grazing system instead of the more specific term of grazing management. As a result of their very general definitions, the elements of a grazing system that must be present for these approaches to be adequately tested, communicated, and implemented are not well-defined, and disagreements exist among advocates. Thus, critical and objective comparisons of these "systems approaches" with control systems are expensive, fraught with difficulty, and essentially non-existent in the scientific literature.

Prior assumptions can limit our ability to achieve constructive dialogue regarding the merits of various stocking methods. These include the assumption that rotational stocking is inherently superior to continuous stocking, regardless of the nature of the overall grazing system, and the presumption that continuous stocking implies overgrazing, defined as "reducing plant growth and soil cover to levels that are not sustainable." To the first point, it is important to recognize that choice of stocking method is only one element of grazing management and grazing management is only one element of a grazing system (Allen et al., 2011). Thus, stocking method is "one piece of a very large pie." Additionally, stocking rate (grazing intensity) is a separate and independent grazing management choice from stocking method, such that both rotationally and continuously stocked pastures can be understocked, overstocked, or optimally stocked. It is unfortunate that choice of stocking method dominates discussions of improving grazing management to the expense of other issues, when in fact grazing intensity has been shown conclusively to be the most important determinant of a wide array of soil, plant, animal, and ecosystem responses (Sollenberger et al., 2012, 2019).

When focusing on the choice of stocking method, several questions arise. For example, what specific outcomes are improved in rotational versus continuous stocking, and to what extent? What are the mechanisms that explain those responses? These topics are addressed in the following section.

4 | EVALUATION OF ASSERTIONS

4.1 | Does choice of rotational stocking ensure well-managed pastures?

Rotational stocking is no guarantee of proper grazing management; thus, overgrazing and its deleterious effects can occur under rotational stocking if stocking rate is excessive. Likewise, continuous stocking is not synonymous with mismanagement. The most important aspects of grazing management are ensuring adequate quantity of forage and soil cover (as a proxy for intensity of grazing; McCartor & Rouquette, 1997) and forage nutritive value (Sollenberger & Vanzant, 2011). There may well be grazing systems with particular forage species, categories of animals, or economic and environmental attributes that cause continuous stocking to be the preferred stocking method. Likewise, rotational stocking may be the best choice in other situations.

4.2 | Does rotational stocking result in greater accumulation of soil carbon than continuous stocking?

There is limited evidence that stocking livestock rotationally promotes better soil condition or soil carbon accumulation compared with continuous stocking. Sollenberger et al. (2012) stated "… essentially no data are available in the scientific literature from the humid region of the USA to support a claim for positive effects of rotational stocking alone, or in comparison with continuous stocking, on soil erosion or soil condition." Implied in this statement is the overriding importance of grazing intensity of the wide array of grassland responses. Soil condition, as referred to by Sollenberger et al. (2012) in the NRCS assessment (Nelson, 2012), most likely equates today with soil health since the term is now defined (NRCS, 2022). Research efforts to compare stocking method effects on below-ground responses must incorporate and report measurements of intensity, frequency, and timing to adequately characterize the grazing environment and to help unveil the mechanisms responsible for observed responses.

We argue that plant growth, including and perhaps especially belowground biomass, and soil cover are key promoters of soil health. Animals are essential tools to impose defoliation, and thus induce tissue turnover, forage regrowth, and recycling of nutrients (Dubeux et al., 2009; Thomas, 1992). Proper grazing management, in that sense, can be achieved independent from the choice of stocking method if the requirements of the grazing system as a whole are considered.

4.3 | Does rotational stocking increase pasture productivity and optimal stocking rate compared with continuous stocking?

Across many published studies, pastureland productivity or average optimal stocking rate increased by an average of 30% for rotational compared with continuous stocking (Sollenberger et al., 2012). Optimal stocking rate in this case is synonymous with carrying capacity as defined by Allen et al. (2011). Greater forage productivity or ability to support a greater optimal stocking rate are attributed to greater efficiency of grazing (i.e., more uniform forage utilization in space and time) (Saul & Chapman, 2002) and greater overall canopy photosynthesis (Parsons et al., 1988) because of a more favorable average leaf-age profile under rotational than continuous stocking.

There is evidence that uniformity of nutrient return can be improved with rotational stocking (Dubeux et al., 2009; White et al., 2001), and this can positively impact pasture production. However, rotational stocking does not offset the need to add nutrients to the system, as natural losses (e.g., leaching, runoff and volatilization) and product removal (e.g., hay, weight gain, milk produced) result in nutrients exiting the system. In fact, grazing animals do not "add nutrients," but recycle them. Nutrients can be added via fertilization (e.g., from mineral or organic sources), supplementation (through the animals), and biological nitrogen fixation. Lightning is another source adding small amounts of nitrogen (Fowler et al., 2013).

4.4 | Does forage nutritive value and individual animal performance increase in rotational versus continuous stocking?

Based on many published studies, the effect of stocking method on forage nutritive value is inconclusive (Sollenberger et al., 2012). Greater pasture productivity under rotational stocking is likely and can support a greater stocking rate (as previously explained). However, if forage quantity is not the limiting factor, rotational stocking is not likely to improve either nutritive value of the pasture or individual animal performance. In fact, at an equal stocking rate, forage nutritive value may be greater on continuously than rotationally stocked pasture. This response is associated with greater opportunity for selection among plant species by the grazing livestock resulting in consumption of less mature forage from frequently visited spots in the pasture (Vallentine, 2001). It is important to note that when we refer to nutritive value, we refer to the forage consumed by the grazing livestock, not the residual forage in the pasture; hence, adequate sampling techniques of pasture are critical.

4.5 | Do pastures "look better" in rotational versus continuous stocking?

Based on our search of the scientific literature, there is no evidence reporting an actual visual preference for rotational stocking by land and livestock managers or on the mechanisms responsible for perceived benefits of rotational versus continuous stocking in pastureland. Yet, a presumed superiority of rotational versus continuous stocking can be easily evidenced by inspecting trends in educational, outreach, and engagement programs and some recently published scientific literature. We hypothesize that, the previously discussed mechanisms explaining greater pasture productivity (i.e., more uniform forage utilization, favorable leaf-age profile, and more uniformity of nutrient returns) and the need to move livestock more frequently (clearly allowing identification of areas that were grazed and to be grazed), may be (disproportionally) acting in the eyes of the land manager to favor rotational versus continuous stocking. As a result, assertions completely obviate the evidence of productivity measurements

from plant and livestock responses. Briske et al. (2008) contended that perceptions and anecdotal interpretations, rather than preponderance of experimental evidence, advocated for the superiority of rotational stocking in the rangeland literature. A good stockperson would check cattle and pastures frequently, independent of the stocking method, and would adjust the grazing plan based on current observations of the landscape.

5 | SUMMARY AND CONCLUSIONS

We noted that terminology and buzzwords, often defined in very general terms, have appeared in the literature and as part of educational, outreach, and engagement programs. Many of these terms appear to be a self-declaration of a "new way" to an already defined stocking method, particularly when implementing rotational stocking. As defined by Allen et al. (2011), stocking method is but one component of grazing management, and grazing management is one component of the overarching grazing system. Sollenberger et al. (2012) stated that stocking method cannot compensate for inappropriate grazing intensity, and defining the optimal intensity of grazing should receive the primary focus in development of grazing recommendations, with stocking method used to fine tune the system. Hence, it is unfortunate that stocking method appears to dominate the discussion for improving grazing management when grazing intensity has been shown conclusively to be the most important determinant of a wide array of soil, plant, animal, and ecosystem responses.

This reflection on stocking method and associated terminology for grazing management adds to the discussion of livestock production systems and, hopefully, brings more clarity to conversations about this topic. Unfortunately, some terminology and concepts get frequently decontextualized, and misconceptions can be prolonged, causing land and livestock managers to lose sight of the actual mechanisms behind the phenomena that are being observed. Educational efforts in pasture management should strive to remain relevant by focusing on experimental evidence. Local (i.e., state or county level) outreach and engagement programs are challenged with providing timely and specific information with implementable guidelines based on frequent observations at the landscape and farm levels. These considerations require use of terms that are clearly defined and well understood by those discussing the principles and strategies in pasture-based livestock systems.

AUTHOR CONTRIBUTIONS

Miguel S. Castillo: Conceptualization; project administration; resources; writing – original draft; writing – review & editing. Marcelo Wallau: Conceptualization; resources; writing – original draft; writing – review & editing.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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