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It's time to revisit the dichotomy between researchers and producers regarding rotational grazing

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Abstract

In 1998 Norton offered an explanation for why researchers and commercial producers have opposing views on rotational grazing. Most researchers agreed to a lack of evidence of an improvement to forage yield or animal production due to rotational grazing, while producers were generally happy with higher production and income. He attributed this difference to a question of scale: research studies in small paddocks carry the implicit and reasonable assumption that both forage availability and its utilization are spatially homogeneous, whereas those parameters are highly variable across a continuously grazed rangeland landscape. Rotational grazing can ameliorate the patch grazing patterns encountered on extensive rangelands. An unheralded outcome from many grazing trials is that the stocking rate on experimental pastures could be maintained at much higher rates than on commercial properties near the research station, without adverse ecological impacts for either treatment. This appears to be a small-paddock phenomenon. Since 1998, many studies have looked at rotational grazing at a landscape/property scale with mixed results: some positive, some neutral, some negative. However, the adoption of rotational grazing on 130,000 ha of communal rangeland in Central Asia is a testament to its potential benefits to land, livestock and households. Adding to the confusion, recent meta-analyses of grazing studies have generated contrasting conclusions. The key issue appears to be the degree to which the design of a rotation is reflected in the plant/herbivore interface. A disconnect between the intended treatment and its expression in grazing behaviour is evident when defoliation frequency has been measured in grazing trials. We can hypothesize, therefore, that failure of the rotation treatment to be implemented as intended could explain a lack of differentiation between continuous versus rotation treatments. This paper surveys rotational grazing studies to examine this hypothesis.

Introduction

One of the most intriguing aspects of rangeland grazing research is the persistence of opposing views about rotational grazing, one claiming benefits to both forage and livestock production while the other states that the rotation is no better than continuous grazing. Reviews of published research going back to Sampson (1951) and many others since then demonstrate a general disadvantage to rotational grazing management, while reports indicate that commercial producers enjoy higher plant and animal production; their adherence to rotation practices is confirmed by a consensus of higher income. Norton (1998) attempted to resolve this dichotomy by showing that a flaw permeated most grazing trials in the form of research designs that utilized relatively small research paddocks. In those research situations, behavioral limitations on access to the entire pasture on a daily basis did not apply. He argued that on extensive rangelands, rotational grazing could mitigate the patch-grazing patterns that concentrate grazing impacts on focal points from which degradation spreads. There have since been a number of studies of grazing rotations at a commercial station, landscape or ranch scale, but the dichotomy remains.

Meta-analyses of rotational grazing

Among reviews of grazing research studies, the oft-cited analysis by Briske et al. (2008) concluded that continuous grazing was superior or equal to rotational grazing in terms of both plant and livestock production in the vast majority of the 47 papers they reviewed. They employed a simple 'vote count' method of assessment. Wolf (Wolf & Horney 2015, based on Chapter 2 in Wolf's 2016 thesis, University of California, Davis) addressed the same 47 papers but went deeper in a meta-analysis that teased out discreet variables that may not have exhibited significant differences in Briske et al.'s coarse analysis. She used a response ratio to measure the effect size, Rotation/Continuous, and looked at plant production (kg/ha), animal production per head (kg) and animal production per ha (kg/ha). She confirmed the broad conclusions of Briske et al. but also found that rotational grazing performs better in larger rangeland areas, in more seasonally variable environments, in more arid environments, and as grazing periods become longer.

McDonald et al. (2021) conducted a systematic review of global literature (280 studies) that compared ecological and production outcomes of rotational grazing to continuous grazing. Most studies reported no difference or no consistent difference in biodiversity, land condition or production variables, similar to conclusions in reviews by O'Reagain & Turner (1992, >50 studies), Briske et al. (2008) and di Virgilio et al. (2019, 278 publications). However, where differences were observed by McDonald et al., more studies reported positive rather than negative responses under rotational grazing. The exception was livestock weight gain, where 34% reported a negative response.

In a companion report, McDonald et al. (2019, 176 studies) addressed the specific question of how the length of the rest period in rotational grazing systems affects biological outcomes. They found a significant effect: at rest:graze ratios greater than 6:1, plant biomass was greater under the rotation; as rest:graze ratios increased, there was greater weight gain and more livestock production per ha. Meanwhile, plant diversity and species richness declined as rest:graze ratios increased.

In contrast to previously cited meta-analyses, Hawkins (2017), through a meta-analysis of data sets from 1972 to 2016 comparing continuous grazing to the Holistic Planned Grazing™ method of rotational grazing, found no difference in plant basal cover, plant biomass or livestock weight gain.

Rotational grazing on commercial-scale properties

The preference among commercial producers for adopting rotational grazing in place of traditional continuous grazing is evident in the small proportion who have rejected rotations after a trial period (e.g. Bork et al. 2021). There is a relatively small number of commercial enterprise-scale studies of rotational grazing. However, let us look closely at a few cases of grazing at a landscape scale.

On semi-arid, degraded rangeland in Southwest Tajikistan, an IFAD (International Fund for Agricultural Development) project (2014–2019) recommended rotational grazing for households herding livestock on communal village land, with each grazing unit area being grazed only once per year or per season to reverse the pervasive degradation. Impact analyses in 2018 and 2022 of the 400 participating villages managing 130,000 ha of rangeland revealed that cow weights were higher, herds were bigger, milk yield had doubled, and household income substantially increased (Norton 2022). Forage was more abundant. A rest:graze ratio of at least 15 was suggested. A follow-up survey indicated that households continued to practice rotations long after the project concluded, and voluntarily reduced herd numbers.

In Patagonia, Oliva et al. (2021) found that the application of rotational grazing for 3 years (mid-2012–mid-2015) under Holistic Resource Management (HGM) on 13,600 ha divided into five paddocks versus a matching area continuously grazed, caused negative effects on ewe liveweights and lambing rates. The only significant change in vegetation saw cover of the low-palatable tussock grass increase under continuous grazing. Rainfall was below an average 239 mm and declined throughout the study period. Grazing periods ranged from 23–68 days (mean 34), with rest periods of 160–319 days (mean 246).

In the Flooding Pampa region of eastern Argentina at higher rainfall (935 mm), Jacobo et al. (2006) studied rotational grazing for 4 years (1993–1996) at four sites; at each site one cattle farm managed with rotational grazing while the adjacent farm was kept under continuous grazing. The rotations involved 10–12 paddocks occupied by 400–500 breeding cows at a mean stocking rate of 1 AU/ha, 60% above the average for the region, for the continuously grazed farms as well. Grazing periods ranged from 3–15 days, and rest periods 25–90 days, the timing adjusted according to the growth rate of dominant grasses. Rotational grazing promoted high-value forage species such as legumes while low-value species, like prostrate summer grasses, decreased. This benefit was more pronounced in drier years. More litter cover and less bare ground signaled an improving ecological condition.

Augustine et al. (2020) cooperated with a consortium of livestock producers on the short-grass prairie of north-central Colorado – the Collaborative Adaptive Rangeland Management group (CARM) – to implement a grazing experiment on 2600 ha (340 mm average rainfall), evaluating responses of vegetation and cattle performance to multipaddock adaptive rotational grazing and season-long continuous grazing. The 11-member CARM group made decisions on annual stocking rate and the sequence and timing of movements among the rotation paddocks. Ten paired 130-ha paddocks were grazed by a single herd of steers. This design matched a continuous paddock to its rotation counterpart; the continuous grazing herd was spread among the ten paddocks for the grazing season. The herd size started at 214 yearling steers in 2014, but rose steadily to 280 steers by 2018, upon the recommendations of the stakeholder group. This trajectory is consistent with Norton's (1998) perspective on the amplifying effect of moderately small paddocks on carrying capacity. The authors could not find any grazing management effects on grass production, but they observed a 12–16% decline in cattle weight gain each year under the rotation compared to continuous grazing. A following paper (Porensky et al. 2021) documented tiller defoliation frequency and intensity on the dominant western wheatgrass (*Pascopyrum smithii*) within the grazing-system experiment described by Augustine et al. (2020). Roughly two-thirds of grass tillers remained ungrazed under both grazing systems.

Another way of referring to this result is to say that the experimental design was not reflected in the plant-animal interface. This phenomenon, of failure to infer the rotational grazing plan from evidence of livestock defoliation activity when the rotation study is accompanied by data on defoliation patterns, has been reported a number of times: for example, Gammon (1978), Hart et al. (1993), and Heitschmidt et al. (1990). In these examples, the effect of the rotation *per se* on defoliation pattern is weak or absent. As Gammon (1984) observed, if the rotation design cannot be deduced from defoliation patterns alone, the rotation was not implemented as intended.

Conclusion

The lack of congruence in performance between rangelands rotationally grazed and those continuously grazed may be due simply to a failure of the rotation design being expressed in the defoliation behaviour of grazing livestock. In other words, the rotation was not really implemented at all. However, as the rest:graze ratio increases, with longer rest periods and increasingly shorter graze periods, rotations are more likely to exhibit improvements in ecological condition and increases in both forage and livestock production. The range management profession still lacks a clear understanding of how rotational grazing works, and so contradictions in the research record and conflicting recommendations persist.

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