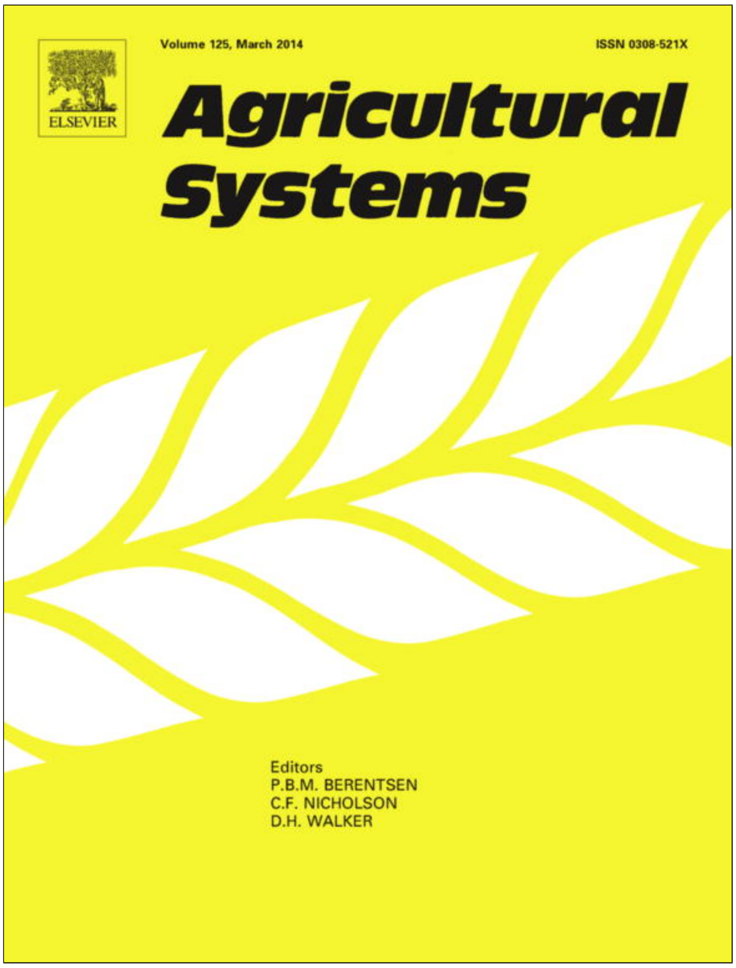

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Short communication

Commentary: A critical assessment of the policy endorsement for holistic management

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ABSTRACT

This commentary summarizes the evidence supporting holistic management (HM) and intensive rotational grazing (IRG) to demonstrate the extent to which Sherren and coauthors (2012) have overstated their policy endorsement of HM for rangeland application. Five major points are presented – distinction between HM and IRG, insufficient evaluation of the contradictory evidence, limitations of the experimental approach, additional costs associated with IRG, and heterogeneous capabilities and goals of graziers' to manage intensive strategies – to justify why this policy endorsement is ill-advised. The vast majority of experimental evidence does not support claims of enhanced ecological benefits in IRG compared to other grazing strategies, including the capacity to increase storage of soil organic carbon.

1. Introduction

The objective of the paper by Sherren et al. (2012) was to evaluate graziers' perceptions of landscape features and the relative importance placed on specific features by contrasting perceptions of graziers that have adopted holistic management (HM) with those who have not. However, they move beyond this evaluation and conclude with the policy recommendation that HM should be broadly adopted to provide public benefits through either the removal of current barriers or the development of government interventions to accelerate adoption. We acknowledge that management strategies based upon adaptive capacity, sound financial planning and recognition of ecological constraints, as broadly espoused by HM, are important in achieving sustainable grazing strategies. However, we find the authors' endorsement of HM disconcerting given that only minimal qualitative data is presented in support of this policy recommendation. Further, their endorsement is based largely on the purported benefits of intensive rotational grazing (IRG), a grazing strategy that is widely advocated by HM, without either investigation or an assessment of the evidence associated with this grazing strategy.

We wish to comment on the evidence addressing HM, and especially IRG, in a more comprehensive and systematic manner to clearly identify the extent to which a policy endorsement of HM and the purported benefits of IRG have been overstated by Sherren et al. (2012). Intensive rotational grazing (syn. cell grazing and time controlled grazing) involves the subdivision of individual paddocks into multiple units – often eight or more – that are grazed successively with a single herd or flock of animals to produce short, intensive periods of grazing followed by longer periods of deferment (Heitschmidt and Taylor, 1991). Successive periods of grazing by livestock concentrated in a single pasture to produce a high grazing pressure (animal demand per forage availability) followed by rest periods – when supported by adaptive management as prescribed by HM – are assumed to provide the ecological benefits attributed by the authors to IRG. We acknowledge that IRG represents one of many viable grazing strategies (Briske et al., 2008; Tanaka et al., 2011), but insufficient evidence exists to support the occurrence of consistent ecological benefits relative to other less intensive grazing strategies.

The debate regarding the relative ecological benefits of IRG compared to other less intensive grazing strategies has been prolonged by misinterpretation of concepts and terminology, evaluation of different response variables, and bioclimatic variability among regions, in addition to inherent intra- and inter-annual variability of rangeland systems (Briske et al., 2008). Rotational grazing or deferment from grazing can be confused with IRG, and grazing management can be considered synonymous with grazing strategy, which obscures the importance of adaptive management (Fazey et al., 2007; Teague et al., 2013). In this regard, the benefits of strategic rest from grazing within a growing season and grazing at different seasons among years on grassland vegetation and soils can be implemented in the absence of IRG (Ash et al., 2011). The

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benefits ascribed to IRG are often confounded with more effective animal distribution within paddocks, which can also be accomplished with paddock subdivision, herding, distribution of water points, and patch burning, in addition to rotation of concentrated herds or flocks of livestock (Briske et al., 2008; Teague et al., 2013).

Monocultures of forage grasses and grass-legume mixtures grown in high precipitation regions, in contrast to rangelands, do show consistently greater plant production (mean of 30%) and persistence of highly palatable species, but not improvements in forage quality or livestock production, in a majority (85%) of comparisons between IRG and continuous grazing (Sollenberger et al., 2012). The mechanism(s) contributing to the distinct responses of IRC in pasture and rangeland systems remains unclear, but these highly productive forage systems are comparable to those investigated by Voisin (1988) who initially developed the concepts supporting rotational grazing in France and Western Europe. Variables in addition to total annual precipitation may contribute to these distinct responses, because investigations in mesic rangelands (800 mm precipitation/yr) have shown both positive (Cassels et al., 1995; Teague et al., 2011) and negative (Gillen et al., 1998; McCollum et al., 1999) plant production and livestock responses to IRG compared to continuous grazing. The important distinction regarding the application of IRC in mesic compared to arid and semiarid systems has been previously identified and addressed (Briske et al., 2008; Teague et al., 2013). The study region investigated by Sherren et al. (2012) had a mean annual precipitation of 600–866 mm which represents a mesic rangeland by global standards, but the wheat-sheep belt region has a mean annual precipitation as low as 300 mm on the dry end. Paddocks in this region have been created through clearing of box gum (predominantly *Eucalyptus albens* and *Eucalyptus melliodora*) grassy woodlands and vary from unfertilized native grassland to fertilized grassland with exotic grasses and forbs. It is unclear how broadly Sherren et al. (2012) were directing their policy recommendations, so here we addresses the purported benefits of IRG as applied to global rangelands and native grasslands distributed along wide precipitation gradients.

2. Primary rebuttal points

This assessment highlights five major points—distinction between HM and IRG, insufficient evaluations of the contradictory evidence, limitations of the experimental approach, additional costs associated with IRG, and heterogeneous capabilities and goals of graziers' to manage intensive strategies—that challenge the policy endorsement of HM by Sherren et al. (2012), and we conclude with a more comprehensive, evidence-based interpretation of HM and IRG. First, it is essential to draw a clear distinction between HM and the closely associated grazing strategy of IRG. A clear contribution of HM is the emphasis on adaptive management – a form of structured decision making that uses measured outcomes of management actions to inform subsequent management objectives and strategies (Allen and Gunderson, 2011). We have previously hypothesized that strong testimonials in support of IRG from some HM managers may have originated from enhanced adaptive management – strategic planning and goal setting, financial rigor, and regular assessment of management outcomes - rather than from the promotion of beneficial ecological processes by IRG (Briske et al., 2011). This hypothesis reconciles, as least in part, the continued support of some managers for IRG, even though a large amount of experimental research has not found IRG to increase plant or livestock production compared to other grazing strategies. The hypothesis that IRG may promote more effective adaptive management requires rigorous evaluation following the comparative approaches of Jacobo et al. (2006) and Teague et al. (2011), but initial findings suggest that adaptive management may be an important component of these divergent interpretations. We are not aware of any reason why emphasis on adaptive management as espoused by HM is specific to only IRG. Adaptive management would appear to benefit all grazing management strategies and more broadly all activities associated with ecosystem management, although these benefits are poorly documented (Fazey et al., 2007; Briske et al., 2011; Teague et al., 2013).

Second, a policy endorsement of HM seems ill-advised when Sherren et al. (2012) explicitly acknowledge 'the lack of conclusive evidence on measurable benefits of HM grazing'. We agree that HM, and more broadly adaptive management, have not been experimentally evaluated in rangeland systems because the human dimensions of ecosystem management have only recently been emphasized (Fazey et al., 2007; Briske et al., 2011). The lack of information regarding the effectiveness of HM is sufficient reason to restrain a policy endorsement. Recent research does suggest that the effectiveness of adaptive management does provide a clear and perhaps overriding contribution to the success of grazing strategies (Jacobo et al., 2006; Pinchak et al., 2010; Teague et al., 2013).

In contrast to HM, IRG has been rigorously evaluated, primarily in the US, by numerous investigators at multiple locations and in a wide range of precipitation zones over a period of several decades. Collectively, these experimental results clearly indicate that IRG does not increase plant or animal production, or improve plant community composition, or benefit, soil surface hydrology compared to other grazing strategies (Briske et al., 2008, 2011). A recent assessment report commissioned by Meat and Livestock Australia (2011) to evaluate grazing strategies in northeastern Australia similarly concluded that no discernible differences in plant species composition or soil surface characteristics existed between IRG and continuous grazing. This assessment was undertaken in sub-tropical and tropical grasslands of north-eastern Australia, rather than in temperate grasslands of south-eastern Australia, but the findings of this assessment are entirely consistent with the conclusions of Briske et al. (2008).

However, recent research has provided evidence of improved plant species composition and, to a less extent, some indication of improved soil quality for IRG compared to continuous grazing in mesic rangelands (Jacobo et al., 2006; Teague et al., 2011). Investigation of a 4- and 8-paddock rotational system also demonstrated improvement in vegetation composition, but not livestock production, and the ability to accumulate fuel so that fire regimes could be incorporated within grazing strategies (Pinchak et al., 2010). Teague and coworkers provide a valuable interpretation of the potential limitations of the results generated by previous grazing experiments and suggest hypotheses that may support greater insight into the effectiveness of grazing strategies (Teague et al., 2013).

Sherren et al. (2012) incorrectly state "The perennial pastures that are encouraged through HM practices have been shown to hold more soil carbon (Sanjari et al., 2008; Teague et al., 2011), contributing to the carbon sequestration that is becoming increasingly important for averting severe climate change." The majority of experimental evidence indicates that grazing strategy has a minimal effect on carbon sequestration, especially in arid and semiarid rangelands where rainfall is a major driver of sequestration, and rangelands act as weak carbon sinks in wet years and weak carbon sources in dry years (Svejcar et al., 2008; Ingram et al., 2008; Zhang et al., 2010; Booker et al., 2013). Further, the authors failed to recognize that Sanjari et al. (2008) did not find more soil organic carbon (*P* value was 0.16, not statistically significant) with time-controlled grazing compared to continuous grazing at the same stocking rate. Similarly, Teague et al. (2011), working in a mesic rangeland with a mean annual precipitation of 820 mm, only observed an increase in soil organic carbon when soil depths from

0 to 90 cm were pooled, there were no statistical differences between the grazing strategies (continuous at light stocking rate and multi-paddock at heavy stocking rate) at any individual soil depth (0–15, 15–30, 30–60 and 60–90 cm).

Data comparing soil organic carbon between IRG and continuous grazing in south-eastern Australian are limited, but Badgery et al. (2013) undertook a comprehensive survey of soil organic carbon across different management histories in grasslands of south-eastern Australia (600–900 mm annual precipitation) and found no difference between set stocking (akin to continuous grazing) and rotational grazing in 36 comparisons. They found that pasture productivity was a more important driver of soil organic carbon than grazing strategy. Similarly, recent research in the Northern Tablelands of New South Wales (Cowie et al., 2013) and in northeastern Australia (Allen et al., 2013) found no clear evidence for greater soil organic carbon in IRG compared to continuous grazing. Allen et al. (2013) identified a small, but significant decrease in soil organic carbon in IRG compared to continuous grazing, while Cowie et al. (2013) identified several indicators of biological soil function that suggest the potential for increased soil organic carbon in IRG compared to continuous grazing. The prevailing view is that management should seek to first conserve existing soil carbon to sustain soil quality and ecosystem function, mitigate for conditions that may accelerate carbon loss from soil into the atmosphere, and sequester additional carbon from the atmosphere as opportunities present themselves (Ingram et al., 2008; Booker et al., 2013). This is particularly the case in Australia where infertile and highly weathered soils and low annual precipitation reduce carbon sequestration rates to the point that they may not offer extensive opportunities as an abatement measure (Lam et al., 2013).

Third, we have methodological concerns with the manner in which the participant interviews were designed and conducted. The participants were divided into HM and non-HM groups for comparison, but the two groups appeared to possess substantial dissimilarities other than whether or not they had HM training. The HM group was much younger and there are suggestions that they were better educated than the non-HM group, yet all of the variation in participant responses was assigned solely to HM training. It is highly likely that HM training accounted only for only a portion of the variation between groups. In addition, the comparisons were made numerically despite the qualitative nature of the study, with much weight given to small differences, and no ability to statistically validate these differences.

Alternative explanations based on human cognition and behavior exists for the results presented by Sherren et al. (2012). Theory of “cognitive dissonance” (Festinger, 1957) holds that people are motivated to behave in ways that are consistent with their beliefs, and even when evidence suggests that such behaviors are unhelpful, they tend to reject the evidence, rather than reject the belief (Tanaka et al., 2011). Research on consumer satisfaction indicates that once a product has been purchased, the act of having adopted a new product or behavior predisposes consumers to a more positive evaluation (Mano and Oliver, 1993; Tanaka et al., 2011).

Fourth, it was inferred by Sherren et al. (2012) that non-HM managers use higher levels of cultural inputs than HM managers. More inputs in the form of fertilization and intensive forage-based systems tend to be used in the higher rainfall sheep-wheat regions of south-eastern Australia regardless of grazing strategy. In contrast, such cultural inputs are not common in more extensive grazing lands in semi-arid regions. Consequently, less intensive, traditional grazing strategies likely operate with fewer cultural inputs and lower costs than IRG as evidenced by the author’s claim that AUD $75 per hectare – to support fencing and water development capable of supporting large numbers of livestock – would be required to convert traditional grazing strategies to IRG. The potential exists for this additional investment in infrastructure – a form of agricultural intensification – to have the unintended consequence of encouraging graziers to increase stocking rates to offset the cost of these investments (Bracy Knight et al., 2011). In addition, fences and water developments can minimize related ecosystem services, including wildlife habitat, recreation, and landscape aesthetics. Fencing is known to cause mortality in grassland birds and other wildlife species by collisions with wire, facilitation of predation, interference with access to resources, and fragmentation of habitats (Owen and Owen, 1980; Connelly et al., 2000; Wolfe et al., 2007).

Fifth, not all managers are comfortable with intensive, multi-paddock grazing strategies so alternatives must be made available to accommodate the capabilities and goals of all managers (Teague et al., 2013). It is generally recognized that IRG requires greater management commitment and expertise than more traditional grazing strategies that do not concentrate and frequently rotate livestock among multiple paddocks. This establishes that IRG should not be implemented in situations where this managerial capacity does not exist, or where it cannot be rapidly developed, because of the risk of exceeding the limits of sustainable livestock production. For example, ranch scale investigations have indicated that effective management is essential to the operation of IRG systems and that it may take up to 2–3 years for both managers and livestock to transition from continuous grazing to IRG (Pinchak et al., 2010; Teague et al., 2013). The management complexity associated with promotion of intensive grazing strategies merits careful attention in policy development given that potential exists for unanticipated negative outcomes.

3. Conclusion

We fully appreciate and endorse the emphasis on adaptive management espoused by HM and that managers may select IRG as a means to pursue desired management outcomes. However, our commentary provides a number of sound reasons for why everyone is not adopting IRG and why HM is a ‘marginal activity’ as indicated by Sherren et al. (2012). A series of viable grazing strategies exists between IRG and continuous grazing and minimal evidence exists to indicate that more intensive strategies yield improved ecological outcomes, including the capacity to increase soil carbon sequestration. Currently, the preponderance of evidence does not justify extensive promotion and adoption of IRG strategies, especially in arid and semiarid systems. We strongly recommend that the full body of evidence, especially regarding the controversial value of IRG, should be consulted when contemplating policy implications regarding HM.

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