Does Holistic Planned Grazing™ work on native rangelands?

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Primary productivity in rangelands depends on the interaction of climate, lithology, animal type and numbers, human intervention and even politics (Bennett et al. 2013). Thus, rangelands are complex socio-ecological systems and have been utilised by humans for animal domestication over the last c. 13 000 years (Thevenon et al. 2010).

Stocking rate (animal units per area on a given amount of land over a certain period) and abiotic factors are important in determining rangeland productivity (e.g. Derner et al. 2008), while the importance of management approach is still a matter of debate. It is important we resolve this debate because rangelands, a source of biodiversity and agricultural products, are under threat globally. In general, any management approach that is adaptive can be expected to sustainably manage rangeland resources by considering both ecological processes and livelihoods. Holistic Management™ (HM; Savory 1983) or the Holistic Management™ Framework (Savory and Butterfield 2016) is one such approach and the value of such a framework for goal-setting and decision-making is not contested. In this issue, Morris (2017) reviews the most recent third edition of the book Holistic Management – A Commonsense Revolution to Restore Our Environment (Savory and Butterfield 2016). While the adaptive approach of HM is not contentious, the livestock management part of this framework has been the subject of debate since the 1980s. Holistic Planned Grazing™ (HPG; Butterfield et al. 2006) and its synonyms describes an intensive, rotational, time-controlled approach much like short duration-, cell-, multi-paddock- and mob-grazing. In South Africa it is commonly called high-density, short-duration stocking (Skovlin 1987). In the interest of brevity, we refer to these approaches as HPG here.

During HPG, livestock are kept at high densities using fences or herders with the intention of mimicking free-moving herds of herbivores that are migrating or bunched by predators, and grazing rather than fire is generally favoured as a way of recycling soil nutrients. It is claimed that increased primary production, secondary production and various changes in soil characteristics occur due to trampling, and dung and urine inputs from densely bunched animals (animal impact), or extremely bunched animals (the herd effect). The general HPG debate was revived recently when Savory claimed that HPG can increase productivity in rangelands and reverse climate change while doubling the stocking rate (Savory 2013) and ‘heavy trampling over a short period leads to establishment of plants and litter that protect the soil’ (Savory and Butterfield 2016: 213). Given the renewed and fierce debate around intensive grazing approaches, and what stands to be gained or lost in our rangelands under threat, this Special Issue evaluates existing and new evidence in the hope of improving consensus among scientists, conservationists and land-users.

In this Special Issue, we compiled research and reviews of several aspects of HPG. Previous reviews (Briske et al. 2008) and the balance of papers in this Special Issue show that how Holistic Planned Grazing™ is managed and where it is used impacts the efficacy of the approach. While we will do well to develop more mechanistic models that can identify these thresholds and test them in real-life situations, it is certain that broad generalisations will not do. We can neither dismiss Holistic Planned Grazing out of hand nor claim that it will work anywhere. Both land-users and scientists should consider the evidence at hand along with their management goals (production, conservation or restoration) before deciding what livestock management approach is appropriate.

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al 2008, 2011) thoroughly review the impact of rotational grazing (including HPG) on net primary and animal production but no quantitative reviews exist. Hawkins’ (2017) meta-analysis of the effect sizes of HPG versus season-long grazing provides a quantitative overview of evidence to date. Teague and Barnes (2017) and Fynn et al. (2017) each provide an overview of rangeland management systems in the context of both our understanding of mechanistic processes and a systems overview, or farmer’s-eye perspective. The two papers by Chamane et al. (2017a, 2017b) examine the effects of actual farming practices, including HPG, through fence-line contrasts as well as examining the influence of high-density grazing on forb populations in a simulated grazing experiment in mesic grasslands. Hagan et al. (2017) examine a less-understood aspect of grazing: the influence of grazing on soil nutrient distribution and how this affects termite populations in semi-arid shrublands. Finally, Badgery (2017) tested another little-studied aspect of grazing management, namely the resting period, as well as flexible grazing strategies.

**Synthesis of the debate around intensive grazing**

The starting point for the debate is Hawkins’ position paper ‘A global assessment of Holistic Planned Grazing compared with season-long continuous grazing: meta-analysis findings’. This paper, the first quantitative analysis on this topic, finds no difference in primary or secondary production, and the study concludes ‘From the evidence available, Holistic Planned Grazing does not improve production and thus does not warrant the additional inputs (infrastructure and labour) that the approach requires’ (Hawkins 2017: 73). This result was independent of the scale or duration of the trial or camp size. That said, the paper suggests that ‘only some rangelands have the resources to support HPG’, because some areas with higher rainfall had increased primary production and, quite likely, our knowledge can be deepened by a more detailed enquiry across different climates, lithologies and vegetation types. The paper also challenges two of the main criticisms of scientific findings by Savory and supporters, i.e. (1) most studies are irrelevant to real-world farms because they do not use adaptive management that responds to changes in resource availability but instead use fixed stocking and rotations, and (2) what is being tested is not actually HPG as described by Savory. The position paper convincingly lays to rest issue (1) because, firstly, the ‘holistic goal’ during scientific trials is usually to improve both net primary and animal production, thus reducing the holistic goal-setting process to a constant, allowing the grazing practice itself to be tested. Secondly, all of the studies included in the meta-analysis used adaptive management of livestock, either explicitly or as revealed by a careful read of the Methods section. Given that Savory developed HM as a concept over time, some of the older papers naturally do not mention HM specifically. Issue (2) is more challenging and is discussed further in the context of the response papers.

Finally, the paper acknowledges that the perceived benefits of HPG may lie more in the realm of socio-ecology. Farmers using this approach gain benefits such as increased learning and adaptive behaviour because of an increased ‘social capital’ within a defined social group (de Villiers et al. 2014). In addition, the daily moving of camps and/or herding provides the opportunity for decision-making, early observation of sick animals or broken infrastructure, while the formation of camps allows for diverse management objectives on one farm such as restoration, conservation and production. In summary, the position paper (1) challenges the idea that scientific studies have not tested HPG properly; (2) shows that intensive grazing and season-long continuous grazing result in similar primary and secondary production from the available evidence; but that (3) future studies should consider rangelands across a diversity of conditions; and that (4) the socio-ecological aspects of rangeland management deserve more detailed studies. The response papers that follow provide the invited authors with an opportunity to support or contest the lines of evidence and argument provided by the position paper, and add to our knowledge by broadening the scope of the discussion.

A key starting point is the issue mentioned previously, i.e. whether scientific studies are actually testing HPG and its synonyms, as all discussion will depend on this. The claim that HPG is not practiced ‘properly’ has some basis. As noted by Fynn et al. (2017), HPG is a moving target and ‘may once have favoured the high utilisation/non-selective grazing approach but now advocates moderate defoliation (Savory and Butterfield 2016)’. Farming and studies that differ widely in animal densities and recovery periods and number of camps, and thus how aggressively the forage base is used, may all be referred to as HPG. Animal densities above 6 animal units (AU) ha\(^{-1}\) increases the positive effect of HPG on plant basal cover (Hawkins 2017) and practitioners maintain that animal densities in HPG need to be at least 20 AU ha\(^{-1}\) (J Lambrechts, pers. comm., 2015). Thus, it is likely that animal density drives the efficacy of HPG. Keeping plant recovery periods relatively short (57 d) in a fast, flexible 20-paddock approach yielded similar per head sheep performance, higher plant biomass and desirable quality compared with continuous season-long grazing (Badgery 2017). Badgery notes that grazing time should be altered to ensure live plant biomass does not drop below 500 kg ha\(^{-1}\) to allow selective grazing, with higher levels needed, when pasture quality is lower or animal requirements are higher. This approach is similar in concept to that of Venter and Drewes (1969), where plants in camps are sequentially allowed to regain photosynthetic material for carbohydrate synthesis (Tomlinson and O’Connor 2004), and potentially to reseed. Clearly, recovery periods also drive forage quantity and quality. To test how much recovery drives the efficacy of HPG requires knowing not just the number of days the rangeland is left to recover, but also how well this amount of time matches the growth rates of that vegetation type, and very few scientific studies have tested a range of recovery periods in a range of habitats.

Acknowledging that the available evidence is incomplete, the invited papers largely agree with the findings of the position paper, with some important exceptions and caveats concerning plant biomass. The findings of Chamane et al. (2017a) support the position paper as
the authors observed no difference in plant basal cover between high- and low-density stocking in a long-term fence-line contrast, where each management approach had been in place for more than 17 years. Both Badgery (2017) and Chamane et al. (2017a) recorded higher live and dead (mori bund) plant biomass under intensive grazing, whereas the balance of studies in the position paper’s meta-analysis observed no difference between intensive and continuous season-long grazing. Importantly, both papers differentiate between live and moribund plant biomass, whereas the position paper does not. Although the Chamane et al. study can be criticised for confounding grazing management with fire and stocking rate, it nevertheless provides a valuable comparison of low-density grazing compared with higher-density HPG approaches as they are practiced by land-users. The Badgery study does not confound treatments and their findings support those of Chamane et al., i.e. dead standing plant matter increased with intensive grazing, but also demonstrates that this is a matter of thresholds because only relatively slow rotation (114 d recovery) resulted in moribund standing biomass. The Badgery paper illustrates that if these thresholds are managed during HPG (flexible and relatively fast rotation based on a 500 kg ha⁻¹ benchmark of standing green biomass) then living plant biomass and cover increases while forage quality is maintained. Fynn et al. (2017) support this idea, stressing that it is the timing, amount of grazing and recovery that determines whether a rangeland remains productive or passes a threshold towards decline. These authors go further to maintain that recovery should allow not only plant regrowth but should comprise an entire wet season to include peaks in nutrient mineralisation and root extension. This paper uses a theoretical model to propose that grass swards are maintained in an immature, actively growing state during season-long grazing, resulting in higher productivity than any of the various rotational grazing approaches tested. This model depends upon a ‘maturation–growth rate concept’, which describes thresholds in primary productivity brought about by either too much grazing (removes photosynthetic leaf material) or too little grazing (allows shading through leaf and litter material, and a lack of compensatory leaf growth that is normally stimulated by grazing). The Badgery, Chamane et al. and Fynn et al. papers thus all speak to the importance of how HPG is managed for plant cover, biomass and quality when considering the efficacy thereof.

Fence-line studies by Chamane et al. (2017a) showed that HPG increased plant diversity and evenness, as hypothesised by Savory and Butterfield (2016), regardless of whether fire was a component of the control group or not. However, as this paper notes, plant compositional differences and functional groupings are more important than diversity indices, for both production and conservation. The HPG favoured less palatable over more palatable grasses, and prostrate, grazing-tolerant forbs over cauline, erect habits. In a paper focused on the short-term impacts on forbs in mesic grasslands, Chamane et al. (2017b) show that grazing and/or trampling during simulated HPG damaged most forb species, and reduced the abundance of some forbs and grass, especially so-called Decreasers species, whereas some invasive or ‘problem’ plants increased in abundance. Chamane and co-authors warn that intensive grazing may be unsuitable for mesic grasslands where plants with certain traits may decline or even be extirpated in the long term, e.g. ‘tall-statured forbs may be more apparent, and if palatable, would be selected for, while forbs with fleshy stems or leaves may be susceptible to the trampling impact’. Plant compositional changes that occurred after six years of applying treatments depended on the ‘production zone’ (the term used to delineate different areas in the landscape by primary productivity; Badgery 2017). Badgery also notes that more time is required to judge whether changes in abundance persist because plants that have apparently disappeared may resprout from underground structures.

Badgery (2017) observed that grazing management did not impact animal performance, in agreement with the position paper. While the theoretical model by Fynn et al. (2017) found that relatively low-intensity grazing aimed at maintaining a short, immature grass sward resulted in higher-quality forage and greater animal production than HPG, the general lack of impact of HPG on animal performance is the most consistent finding amongst scientific studies, and of great importance to land-users because animal production forms one part of their net profit.

Badgery (2017), Chamane et al. (2017a) and Hagan et al. (2017) provide valuable insights into the impact of grazing on soil characteristics. Both Badgery (2017) and Chamane et al. (2017a) observed an increase in plant litter during HPG and this may very well find an application for the restoration of areas with low plant cover. Despite the increase in plant litter with intensive grazing, both studies found that soil compaction increased. Hagan et al. (2017) observed higher soil compaction in grazed (>75 years) versus ungrazed areas. These findings do not support the claim that litter accumulation during intensive grazing results in increased soil moisture and rainfall infiltration while reducing soil erosion and compaction (Savory 1983). However, increased litter may well lead to increases in soil organic matter, and Hagan and co-authors suggest that partial feeding by herbivores and the distribution of dung and litter by their hooves provides additional soil resources. Termite mound density was increased with grazing versus no grazing, presumably because termites were provided with enough food resources so that the space they required for foraging was reduced and allowed for increased co-existence (Hagan et al. 2017). Although these authors do not test HPG, their results support the idea of nutrient cycling due to trampling and grazing. While Chamane et al. (2017a) observed no difference in soil nitrogen, phosphorus and carbon percentages or pH, Hagan et al. (2017) found that soil organic matter increased slightly, whereas magnesium and calcium decreased with the presence of grazing in general. Keeping animals densely grouped in temporary corrals is routinely used to repair eroded areas or prepare an area for cropping at the Africa Centre for Holistic Management in Zimbabwe (A Savory, pers. comm., 2013) and a similar approach is being tested on communal rangelands in South Africa (Conservation South Africa, pers. comm., 2017). It is even possible that areas where soil is bare and the structure may have changed (e.g. post-alien invasive plant removal), that
the addition of dung and urine together with trampling by livestock in these mobile corrals may subsequently produce productive grazing lawns. Such grazing lawns produced by short-term corrals have persisted for years in the savanna (van der Waal et al. 2011; Porensky and Veblen 2015).

Research gaps and practical implications

The use of simulation modelling should be further developed to allow us to understand the impact of site history (grazing, temperature and rainfall), which has lagged effects on the present year of productivity (Fynn et al. 2017), and can confound results from short-term natural experiments. Modelling will also help disentangle the impact of management factors (herd size, animal density, camp size and recovery periods), biotic factors (browsers, grazers, and large and small stock) and abiotic factors (climate and lithology) on the efficacy of any one grazing approach. Researchers and managers could also consider testing how different grazing and fire management approaches will impact a range of small stock, large stock, grazers and browsers, i.e. in the context of ‘rewilding’ rangelands (Svenning 2016). Combining our understanding of mechanistic processes behind management variables (e.g. animal density or recovery period) at multiple scales and sites with varying conditions of climate, soil and livestock will allow us to develop improved models, and test model predictions using real-world observations (Figure 1).

Importantly, we should not shy away from research on working farms, for example ‘partnering with innovative land managers on real operations, applying adaptive treatments, and combining field studies with modelling’ (Teague and Barnes 2017). Poor or no replication on working farms, natural experiments and long-term trials is a common obstacle but can be overcome using the appropriate sampling and statistical treatment (see Hagan et al. 2017).

Another gap in our knowledge is whether HPG indeed changes animal behaviour to limit selective grazing or increase animal impact. Many practitioners and scientists have observed heavy soil disturbance by animals in a corral, or around feed troughs or licks (Mr J Lambrechts, pers. comm., 2016) but there is no scientific evidence on how many animals are required to produce an animal impact or herd effect, nor, indeed, a consensus on what constitutes a herd effect. Consensus among practitioners on animal density numbers in high-density and ultra-high-density grazing provides a starting point for further studies (Hawkins 2016), and a combination of technologies such as remote sensing, GPS collars and accelerometers should help to track animal behaviour. It is also questionable whether reduced grazing selectivity is desirable for animal performance because resource heterogeneity (e.g. pyric herbivory) improves animal performance (Fuhlendorf et al. 2009) and biodiversity (Becerra et al. 2017). Grazing and fire also interact with the resource availability of the area, e.g. Hempson et al. (2015) suggest that only high-nutrient areas with moderate rainfall that are dominated by a variety and abundance of large herbivore species, including large migrating herds, have evolved in the way Savory suggests. Other areas were either low-nutrient, high-rainfall areas that relied on fire and were dominated by bulk grazers, or were otherwise resource-limited resulting in naturally low densities of herbivores.

Finally, the balance of papers in this Special Issue show that how HPG is managed and where it is used impacts the efficacy of the approach. While we will do well to develop more mechanistic models that can identify these thresholds (Figure 1) and test them in real-life situations,
it is certain that broad generalisations will not do. We can neither dismiss HPG out of hand nor claim that it will work anywhere. Both land-users and scientists should consider the evidence at hand along with their management goals (production, conservation or restoration) before deciding what livestock management approach is appropriate.

References


