Does short duration grazing work in grasslands?

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In the last year and a half, Allan Savory and the Holistic Management approach (HM, Savory 1983; Savory and Butterworth 1988; Butterfield et al 2006) have received renewed interest. This is partly in response to a TED talk (Technology, Entertainment and Design, www.ted.com) in February 2013 that has received ca. 2.6 million views to date. In this talk Savory makes claims that are seen as controversial by many scientists but plausible to many practioners. The establishment of 'Savory Hubs' in different countries is also responsible for renewed attention (for example, the recent conference in London: 'Putting Grasslands to Work" http://london.savoryinstitute.org/). There has been heated debate in the popular media, for example two articles in The Guardian: "Eat more meat and save the world: the latest implausible farming miracle, 4th August 2014" and its recent rebuttal "Why Georg Monbiot is wrong: Livestock can save the world, 19th August 2014" (http://www.theguardian.com).

The Savory Institute claims that HM and specifically, Holistic Planned Grazing (HPG, also previously known as the Savory Grazing Method, Holistic Resource Management and other synonyms), can reduce desertification and reverse climate change (Savory 2013). Specifically it was originally claimed that HPG will permit a doubling of the recommended stocking rate without a decrease in animal gain ha-1, and at the same time will improve range condition and forage production (Savory 1983), something which is largely contradicted by the scientific literature (e.g. Hart et al 1988, McCollum et al 1999; Tainton et al 2013; Briske et al 2008, 2011). Allan Savory claims that the only option to reduce desertification and restore rangelands is to use livestock, bunched and moving as a proxy for the apparently non-selective grazing/browsing of former herds and predators. This attractive but unsubstantiated theory describes how herded animals contribute nutrients (dung and urine) while periodic trampling ensures good soil cover via intermediate disturbance of soil (stimulating germination of grass seeds), and biological decay of grasses. According to Savory, without the animals and biological decay, grasses can only be broken down by the relatively slow process of oxidation, hindering new growth and eventually resulting in grasses being outcompeted by more woody vegetation. The resultant bare soil will then lose water and carbon. Fire is rejected as a way to remove dead organic material and return nutrients to the soil as it also releases carbon. There is evidence that long term hoof action can cause both decreased compaction (Teague et al 2011) and increased compaction (Booker at al 2013). Even if this assumption around hoof action is correct, it implies the questionable assumption that grazing/browsing animals mostly moved in this bunched fashion on a huge scale (think Serengeti) in most places in the world and that this bunched movement of animal herds is required for healthy ecosystems. This simply does not apply to all areas, especially outside Africa. Another controversial assertion is that biological crusts (algae, lichen), which are common to many arid ecosystems and function to increase productivity and reduce erosion, are really indicators of degradation.

It is important to separate the management and practice aspects of HM. A holistic management approach was first alluded to in 1926 by Jan Smuts. In Holistic Management, a holistic goal setting process is used to define the desired quality of life, form of production and future resource base for a land owner. These goals, should they include rangeland restoration and improvement, will use existing tools (technology, fire, rest and organisms) and two other 'new' ones (grazing and animal impact; Savory 1983; Savory and Butterworth 1988; Butterfield et al 2006). Part of HM is HPG, which is synonymous (see below) with short duration, intensive rotational, cell, and time-controlled grazing. Generally, individual paddocks are divided into multiple units, usually 8 or more, that are grazed successively in a particular order in accordance with the planning process, using a single herd or flock of animals at moderate or high stocking rates to produce short, intensive periods of grazing followed by longer periods of 'recovery' or deferment (Heidschmidt and Taylor 1991).

Before any claims can be addressed it is essential to understand that many studies testing short duration and cell grazing are completely synonymous with HPG or any of the other names for this approach over the years. Repeatedly it has been emphasized by Savory that HPG is 'time-controlled', i.e. animals are moved depending on forage growth (Savory 1983). Countless studies have been discounted by Savory who claims that short duration, cell grazing, etc. is not synonymous with HPG. However this is exactly how short duration grazing is defined: Short duration rotation grazing is a form of rotational grazing, in which the time grazing animals spend in each pasture and the time each camp is rested vary with growth rate of the forage and the amount of forage in the camp (e.g. Heidschmidt et al 1982; Kothmann 1984; Tiedeman 1986). Savory himself defined short duration grazing in this way (Savory 1978) before changing the name. Another aspect that Savory claims is never incorporated into studies is the goal setting and adaptive management within HM. This may or may not be the case, as adaptive management as a whole is likely untest-able, being constantly in flux. However, it is the time-control/forage growth element that is the main feature of the adaptive management within HM, and this certainly is testable and has been tested. Finally on this point, the one trial that is repeatedly quoted by Savory and supporters as being a true representation of HM is the seven-year Charter Trial in Zimbabwe. This trial included an animal production (Worthington, 1984), economic (Parsons 1984), and botanical (Clatworthy, 1984) analysis. Animals were moved based on forage supply and animal condition (Worthington 1984) but not specifically according to HM management i.e., the trial was very similar in its approach to the very studies that Savory rejects as invalid.

Although claims around HM have been controversial for decades, the recent TED talk in 2013 introduced a new dramatic claim that HM can return atmospheric carbon to pre-industrial levels. In that talk and other promotional videos it has been also claimed that this approach has already restored ca. 15 million hectares of previously desertified land across 5 continents. This claim is especially topical since it has been recommended that all policy constraints be removed to enable the wide-scale adoption of HM (Sherren et al 2012). In light of these claims, and our interest in giving the best possible evidence-based advice to farming communities in SA that we work with, a meta-analysis of the available literature dealing with HPG/short duration grazing was conducted (see Methodology for more details). For the purposes of this proposal the term SDG will be used as synonymous with HPG.

From the studies available, we could compare basal cover (%, Fig. 1) and animal production (gain ha^{-1}, Fig. 2). For details of the meta-analysis methodology, please refer to Methodology.

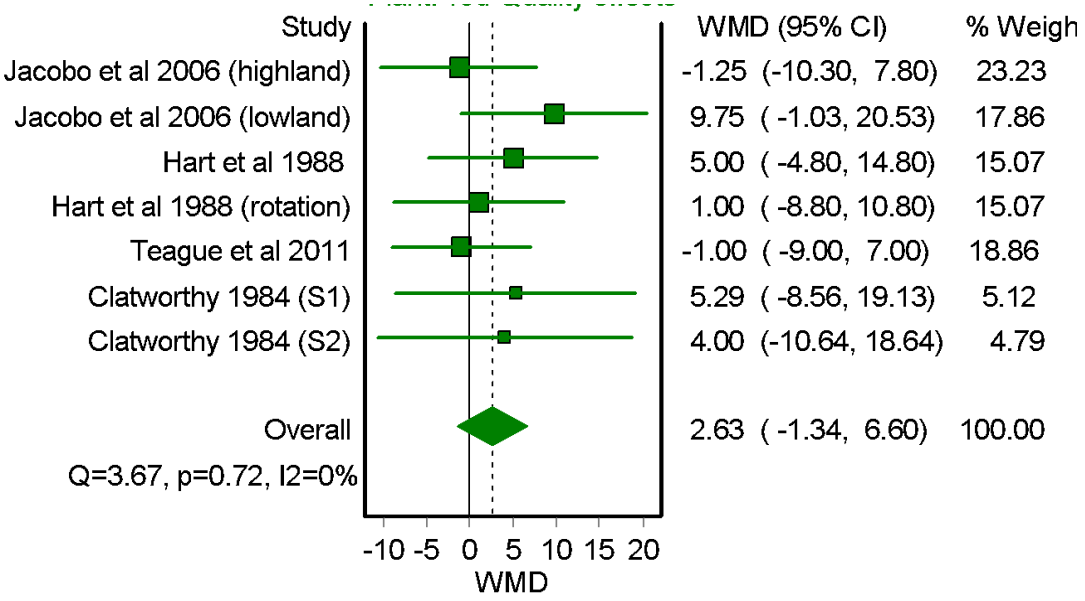

Fig. 1. Forest plot of plant basal cover (%) in 7 studies comparing short duration grazing with continuous grazing using the weighted mean difference (WMD) method and Quality Effects model (Doi and Thalib 2008; 2009) in MetaXL (v. 2.0, Epigear International). Studies are shown on the left, the forest plot in the middle where studies >0 and <0 showed a positive or negative effect, respectively. CI is confidence intervals and Weight shows the weight (%) that the study was given based on the quality score (Table 1, see Methodology).

The meta-analysis of basal cover, while by no means exhaustive, clearly agreed with other systematic reviews (Briske et al 2008; 2011; Carter et al 2014) in that there was no significant difference (p = 0.72, Fig. 1) in basal cover between SDG and continuous grazing. Several studies (e.g. Sanjari et al 2008; references in Fig 2) indicated that litter cover increased with SDG. Indeed I have personally observed this to be the most obvious visible effect of SDG (e.g. at the Africa Centre for Holistic Management).

Although many people have perceived there to be an increase in plant biodiversity with SDG (Stinner et al 1997) and assume that grasses will senesce and die if not grazed by livestock, studies of many long-term rested sites, and paired grazed and ungrazed sites have shown that natural plant communities, particularly bunchgrasses in arid areas, are sustained by rest from livestock grazing (Carter et al 2014).

There are many studies on the effects of SDG on plant composition as well and these show that sometimes there is a change in plant composition and sometimes not (Briske et al 2008). Where there has been change there is often an increase in annuals or early succession perennials. Indeed we find it very interesting that the SDG approach was originally developed for planted pasture systems (Voisin 1988), and it was by the latter early agronomist that Savory was inspired to extend the approach to natural rangelands. A review of the effects of SDG compared to continuous grazing in pasture lands found that monocultures of forage grasses and grass-legume mixtures grown in high precipitation regions do have greater plant production (ca. 30%) and persistence of palatable species, but not improvements in forage quality or livestock production, in a majority (85%) (Sollenberger et

al., 2012). Apparently the disturbance created by SDG favours both pasture species and annual /early successional perennials in rangelands (Gillen et al 1998).

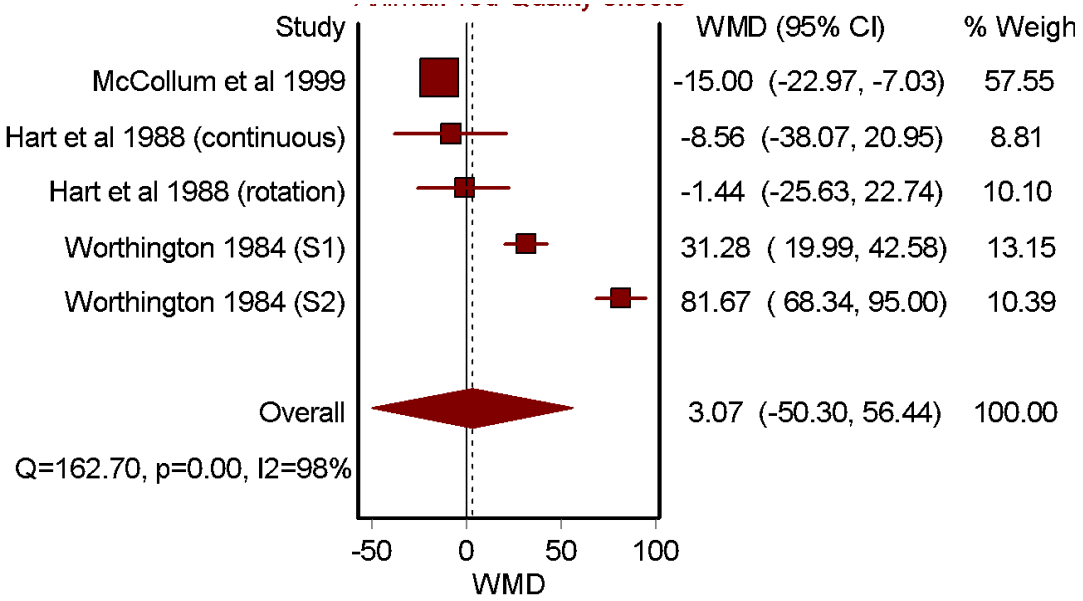

Fig. 1. Forest plot of animal gain (kg ha^{-1}) in 5 studies comparing short duration grazing with continuous or deferred rotational grazing (with a continuous grazing component for part of the year) using the weighted mean difference (WMD) method and Quality Effects model (Doi and Thalib 2008; 2009) in MetaXL (v. 2.0, Epigear International). Studies are shown on the left, the forest plot in the middle where studies >0 and <0 showed a positive or negative effect, respectively. CI is confidence intervals and Weight shows the weight (%) that the study was given based on the quality score (Table 1, see Methodology).

In terms of animal production, a meta-analysis of 5 studies showed that SDG had both positive and negative effects on the average gain per hectare (Fig. 2). The number of studies in this analysis clearly needs to be increased considering the variability. Nevertheless, the analysis shows that there was an overall neutral effect of SDG on animal gain per hectare ($p < 0.001$, Fig. 2), which is also in agreement with systematic reviews (Briske et al 2008; 2011; Carter et al 2014). Most of the positive weight for the analysis was due to the Charter Estate grazing trial in Zimbabwe(Worthington 1984) where more costly and less costly SDG options (so-called 'Richman Savory' and 'Poorman Savory') were compared with their respective controls. This trial was commendable in its length (7 years), record keeping and useful discussions. However stocking rate and grazing method were confounded.

Also, although the overall animal gain in kg ha-1 was higher in the Charter Estate trial, conception rates and the weight of suckling cows was reduced, presumably due to the increased movement between camps and subsequent energy use and stress due to double to triple stocking rates (Worthington 1984).

Meta-analyses of economics, surface hydrology, plant biodiversity or soil carbon were not possible as these aspects were only represented by a few studies mentioned here. For example, both Parsons (1984) and McCollum et al (1998) found that SDG was more profitable per hectare than continuous or rotational grazing, while Hart et al (1988) found the opposite. As noted by the latter author, there

is a real need to consider all the externalities of SDG including fencing (if present), labour (e.g. herders, management of moving herds and plans), feed (if present), vaccinations, etc. as well as the condition and price per animal.

There is also little evidence from non-confounded trials that that SDG results in improved soil surface hydrology (Briske et al 2008; 2011). There is evidence that long term hoof action can result in decreased compaction (Teague et al 2011), have no effect (Sanjari et al 2008) or increased compaction (Booker at al 2013). There is intriguing evidence that SDG results in increased soil microbe activity, especially of fungi (Teague et al 2011), which merits further research regarding the relationship between microbial diversity and ecosystem function in terms of nutrient cycling and soil physical characteristics like aggregation.

To date there is no/little scientific evidence for claims that HM will reduce desertification or reverse climate change. In the TED talk and other non-peer reviewed media (Unnamed 2013), dramatic before/after photographs show increases in vegetation cover, but whether these differences are caused by the HM approach or differences in rainfall, seasonality or other factors is unclear. To date calculations demonstrating that the approach could return atmospheric carbon to pre-industrial times (through sequestration of soil carbon) have only been published online and have been refuted with alternative calculations (also online).

Finally the literature generally indicates that stocking rate is more important than any grazing method in determining the fundamental balance between plant growth and forage consumption by livestock, and hence on livestock production (Briske et al 2008, 2011). Particularly this may be the case when rainfall is unpredictable or limited since forage recovery periods may coincide with limited plant growth (due to lack of rain) and so result in minimal benefit to plants. This would mean that the impacts of increased grazing pressure during short grazing periods may not be offset during subsequent rest periods. In a trophic cascade effect, animal biodiversity and abundance (e.g. birds and mammals) decreases with increased stocking rates (Briske et al 2011).