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Role of Herbivore Impact and Subsequent Timing and Extent of Recovery Periods in Rangelands☆,☆☆

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ABSTRACT

The productivity and stability of cattle production on rangelands depends on the maintenance of a dense and productive perennial grass—dominated resource base, which is contingent on appropriate grazing and recovery periods. We investigated the effect of simulated trampling, dung inputs, frequency of defoliation in the previous growing season (grazing history), and timing of recovery periods on various grassland functional responses in two experiments in western and northwestern Botswana. A field-based clipping experiment at the individual tuft scale demonstrated that perennial grasses are most productive when rested for a full growing season, but that productivity of the highly palatable soft leaved *Brachiaria nigropedata* Ficalho & Hiern. decreases exponentially with increasing clipping frequency in the previous season (a lagged effect of grazing history). This species was also more productive in the next season when rested during the early than late growing season. The less palatable needle-leaved *Stipagrostis uniplumis* Licht. ex Roem. & Schult. was less resistant to defoliation than *B. nigropedata* and decreased equally at each clipping frequency regardless of season. A second field-based experiment at the plot scale demonstrated that a full-season recovery period increased tuft densities while its combination with dung increased cover. The effects of hoof trampling on sandy nutrient-poor grasslands appear to be less significant compared with grasslands on fertile soils. Thus, optimal livestock management strategies should aim to promote season-long grazing of both palatable and unpalatable species to disadvantage the less grazing-tolerant unpalatable species and full growing season recovery periods to ensure optimal recovery and future productivity.

Introduction

The effect of grazing on aboveground net primary productivity (ANPP) has been the subject of much debate for a long time (Westoby 1985; McNaughton 1985, 1993; Belsky et al. 1993; Dyer et al. 1993; Painter and Belsky 1993; Hiernaux and Turner 1996; Knapp et al. 2012). While several studies worldwide demonstrated that large herbivore grazing stimulates grassland productivity, otherwise referred to as *overcompensation* (McNaughton 1979, 1984; Noy-Meiyer et al. 1989; Turner et al. 1993; Frank et al. 1998), others argued that evidence supporting the concept of overcompensation in grazed swards is inadequate (Westoby 1985; Painter and Belsky 1993; Hiernaux and Turner 1996; Knapp et al. 2012).

However, the nature and effect of grazing are not monodimensional or linear but vary according to the degree of selectivity by grazers (Morris et al. 1992; Fynn 2012), the intensity of grazing (Briske et al. 2008), the nature and evolutionary history of the grasses (tufted versus creeping; long-term history of herbivory) (Milchunas and Lauenroth 1993; Fynn 2012), and the spatial and temporal scales at which grazing occurs (Frank et al. 1998; Fynn 2012). Thus the effects of grazing on grassland productivity cannot be reliably predicted without knowing specific details of the spatial and temporal scale at which grazing occurs and the types of grasses being grazed. For example, moderate levels of grazing generally stimulate grassland productivity in large-scale migratory ecosystems where the effects of grazing are concentrated and transient (McNaughton 1985; Frank et al. 1998) but reduce productivity (undercompensation) in nonmigratory ecosystems where grazing is often nonseasonal and continuous (Milchunas and Lauenroth 1993; Knapp et al. 2012). Nevertheless, at very high levels, grazing generally reduces productivity irrespective of its spatial and temporal scale across

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