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REGULAR ARTICLE

The fertile island effect collapses under extreme overgrazing: evidence from a shrub-encroached grassland

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Abstract

Background and aims Woody plant encroachment is a phenomenon of global concern in drylands due to demonstrated reductions in livestock carrying capacity. However, shrubs are known to contribute to the development of patches of enhanced fertility that might offset any negative effects of increasing grazing. We measured soil physical and chemical characteristics within shrub and open patches across a gradient in livestock grazing to explore how the relative effect of shrubs might change with increasing grazing-induced disturbance.

Methods Soil carbon, nitrogen phosphorus and bulk density were measured within 92 shrub patches and their paired interspaces at five sites ranging from long-grazed to long-ungrazed in a semiarid grassland encroached by the N-fixing shrub *Caragana microphylla*. We used a combination of linear and structural equation modelling to test whether shrubs might buffer any negative effects of overgrazing on soils.

Results Shrub soils were more porous, and had more organic carbon, nitrogen and phosphorus than interspace soils. Within both microsites, however, soil bulk density increased, and soil organic carbon and nutrients declined, with increasing grazing intensity. Grazing reduced interspace plant cover and height and exacerbated the negative effects of bulk density on soil carbon, whereas shrubs had the opposite effect. The relative importance of shrubs for soil carbon and nutrients increased with increasing grazing intensity but collapsed under extreme overgrazing.

Conclusions These findings highlight the effect of grazing in promoting shrub dominance, which can also prevent grassland degradation. However, any positive effects of grazing collapsed when sites were severely overgrazed.

Keywords Fertile patch · Overgrazing · Shrub · Soil nutrients · Temperate grassland

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Introduction

A distinctive feature of dryland ecosystems is the concentration of resources (nutrients, organic matter, seeds,

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