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Wildlife Responses to Brush Management: A Contemporary Evaluation☆

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ABSTRACT

Wildlife-associated recreation and biodiversity are important management considerations on public and private rangelands, making it imperative that rangeland professionals explicitly take wildlife conservation into account in vegetation management planning and implementation. Here, we synthesize the literature reporting effects of brush management on wildlife and make recommendations for applying brush management to accomplish wildlife conservation objectives. Key observations arising from our synthesis are that habitat-related terminology is often misused in brush management literature. Recommending brush management as a "wildlife habitat improvement" tool is a non sequitur because habitat is species specific and brush management has different consequences for different species of wildlife and plants. Communication between resource managers and stakeholders can be improved by making it clear that habitat is species specific and then identifying what constitutes a benefit of brush management. Changes in resources resulting from brush management may not benefit targeted wildlife species unless these changes overcome some limiting factor or factors. Wildlife responses to brush management treatments are too complex to make broad generalizations because they are mediated by environmental factors and depend on the plant community, size and configuration of the area manipulated, type of treatment applied, and time since application. Prescriptions aimed at improving habitat for wildlife generalists may have relatively modest positive effects on that group but have potentially detrimental effects on specialists. Given this potential trade-off, an idea to consider is that it may be best to err on the side of using brush management as a tool to manage habitat for specialists. Brush management plans and recommendations should take into account trade-offs such as benefiting grassland wildlife at the expense of woodland species. Taking a broader "systems" perspective that balances needs of wildlife in conjunction with other ecosystem services affected by woody plant encroachment and brush management should be a goal of natural resource managers.

Introduction

One of the most striking land cover changes over the past 150 yr on rangelands worldwide has been the proliferation of trees and shrubs, often in conjunction with the loss of herbaceous vegetation and a fundamental alteration of ecosystem processes (Archer et al., 2017). In some cases, native woody plants are increasing in stature and density within their historic geographic distributions; in others, non-native woody plants are becoming dominant. Brush management, defined as the removal, reduction, or manipulation of nonherbaceous plants (Hamilton et al., 2004), is an integral component of rangeland management. However, this practice has historically been criticized, especially when broad-scale programs have narrowly focused on needs of livestock and have failed to consider impacts on wildlife (e.g., Klebenow, 1969; Belsky, 1996).

Rangelands provide biotic and abiotic resources for diverse assemblages of wildlife. Multiple-use mandates on federal lands and the revenue to landowners generated from hunting and ecotourism underscore the value of rangeland wildlife to society. Regarding the latter, in Texas, the potential of rangeland for wildlife-related recreation adds more to real estate values than agricultural production potential (Baen, 1997). About 33% of the private land in the United States is either leased or owned for wildlife-related recreation (Macaulay, 2016). Accordingly, leasing private land for wildlife recreation is an important source of income for landowners. Nationwide in the United States >$900 million is spent annually to lease private land for hunting with another $279.6 million spent for wildlife watching (Macaulay, 2016). The economic significance of wildlife recreation and the fact that returns from wildlife may exceed returns from livestock underscore the importance of accounting for wildlife needs when implementing brush management.

Decisions pertaining to the mixture of herbaceous and woody plants on managed landscapes are challenging because of variation among wildlife species in the kinds, structure, and amount of vegetation cover they require. Increases in woody plants have had mixed effects

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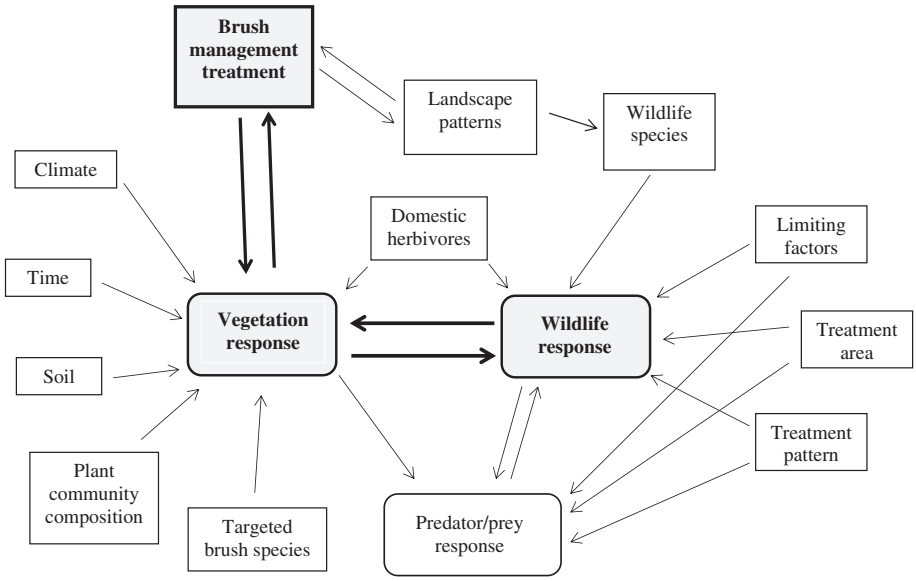

Figure 1. Wildlife response to brush management varies with time since treatment and is determined by a variety of interacting factors. For simplicity, only select feedbacks are shown.

on wildlife. For example, while woody plant proliferation on rangelands is considered among the primary causes of the continent-wide decline in the abundance of North American grassland birds (Brennan and Kuvlesky, 2005; Scholtz et al., 2017), it can benefit wildlife adapted to woody plant communities. Proliferation of non-native saltcedar (*Tamarix* spp.) is widely decried, and the plant has been targeted for reduction via brush management. Saltcedar, however, can perform important ecological roles, including providing habitat for the endangered southwestern willow flycatcher *(Empidonax traillii)* and other avifauna and wildlife taxa (Cohn, 2005; Shafroth et al., 2005). Removal of saltcedar could therefore spawn unintended problems that may need to be addressed in post-treatment restoration activities.

Our primary goal here is to provide a contemporary evaluation of how brush management, when applied as a conservation/restoration tool, affects wildlife and to present recommendations to help natural resource professionals improve planning, communication to stakeholders, and execution of brush management programs to accomplish wildlife conservation objectives. Information transfer from natural resource professionals to the public through scientific publications, technical bulletins, and other forms of communication has been hampered by overgeneralizing the expected benefits of brush management for wildlife. In our evaluation of how brush management affects wildlife, we highlight why such generalizations are often inappropriate. We also emphasize factors that should be accounted for when specifying how brush management may influence wildlife including 1) the effects of biotic factors that influence species- or functional group—specific responses to brush management with respect to gender, season of the year, foraging niche, population status, herbicide toxicity, and trophic level (e.g., predators vs. prey), 2) initial vegetation characteristics and the scale and pattern of brush management, and 3) how local brush management influences on wildlife are mediated by climate (temporal variability) and soils (spatial variability) (Fig. 1). Finally, during our evaluation of the literature we encountered frequent misuse of terminology pertaining to habitat and we make recommendations for improving communication by using appropriate terminology (Text Box 1).

Text Box 1
Definitions of terminology as used in this manuscript.

Cumulative effects—Cumulative effects refer to events, including brush management, that individually may be innocuous but that, over time, accumulate and act collectively to produce substantial and potentially deleterious impacts on wildlife and ecosystems (Odum, 1982; Krausman and Harris, 2011).
Functional group—collection of species that process resources to provide a specific ecosystem service or function (Blondel, 2003).
Edge species—species occurring in greatest abundance where two or more plant communities come together.
Grassland—ecosystems dominated by herbaceous graminoids.
Heterogeneous—temporally and spatially variable structure and composition of physical or biological components.
Homogeneous—little temporal or spatial variation in structure and composition of physical or biological components.
Interior species—species that occupy a certain plant community and avoid areas where plant communities meet and intermingle.
Landscape—a heterogeneous area of land sufficiently large to contain interacting ecosystems.
Landscape level or landscape scale—at a broad scale that encompasses the interacting components of a landscape; > 5 km^2 in size.
Legacy effects—modifications of the environment caused by abiotic or biotic factors that persist for a long time after the factor causing the modification has ceased activity or is no longer present (Cuddington, 2011).
Mosaic—a mixture of patches on the landscape.
Patch—an area with vegetation, soils, or other properties differing from its surroundings
Patch scale—a small scale that includes only an individual patch.
Savanna—shrubs or trees scattered throughout a grassy matrix
Shrubland—ecosystems characterized by short-statured, multistemmed woody plants.
Woodland—open-canopy, arboreal ecosystems.

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