

Wildlife Use of Habitat in Response to Prescribed Fire

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Abstract

Grasslands are among the most threatened ecosystems in the world, and many of the wildlife species that inhabit these landscapes have experienced dramatic declines over the last century. One of the greatest threats to grassland wildlife in addition to habitat loss is changes in fire patterns in many grasslands that have resulted in gradual but important shifts in vegetation structure and composition. Alteration of historic fire patterns has resulted in two primary threats. First many grasslands where disturbance patterns are greatly simplified are likely missing important seral stages or patch types that provide critical habitat for some species during certain parts of the year. Alternatively, the complete suppression of fire in many landscapes has resulted in a widespread shift in plant communities towards a tree or shrub-dominated communities. Avoidance of trees by many grassland species can result in both direct and indirect loss of habitat as individuals may avoid otherwise suitable grasslands due to the presence of nearby trees. Restoration of fire into grassland systems is likely an important conservation strategy for many wildlife species. Further use of fire to limit the spread of trees and shrubs into grasslands will be critical for maintaining grasslands as grasslands and ensuring adequate habitat for wildlife species.

Introduction

Grasslands were historically highly dynamic ecosystems, where the interaction of grazing and frequent fires were key determinants of ecosystems structure and function (Anderson 2006, Fuhlendorf and Engle 2001). Further, frequent disturbance from fire and grazing likely maintained grassland communities through the exclusion of fire-sensitive tree and shrub species (Bond and Keeley 2005). However, many grasslands are managed today under practices that emphasize the simplification of disturbance processes (Holecheck et al. 2011). With a few notable exceptions, such as the Flint Hills of Kansas and Oklahoma, fire has largely been excluded or is actively suppressed in many grassland landscapes (Fuhlendorf et al. 2012). The reasons for these shifts in management practices are numerous and can include social and historical factors, limitations due to climate, or more recent concerns about landowner or manager liability (Sayre 2017, Twidwell et al. 2013). The loss of historic disturbance regimes can have significant implications for the native fauna that inhabit grasslands. The simplification of fire and grazing have been linked to widespread losses in biodiversity in grasslands (Fuhlendorf et al. 2002, Robbins et al. 2002, With et al. 2008), and as a result, the restoration of historic disturbance patterns have been put forward as an important conservation strategy for grassland wildlife (Fuhlendorf et al 2006, Twidwell et al. 2013).

For most wildlife species, vegetation structure and composition are the foundation of their habitat, as different plants and their arrangement in time and space influence the availability of a variety of different critical resources they may need. Fire and grazing are among the most important factors determining vegetation structure in many grasslands (Anderson 2006). Many wildlife species, evolved in under variable disturbance patterns they are often adapted to different seral stages in the time since fire mosaic (Engle et al. 2008b, Hovick et al 2014,

Hovick et al 2015c, Ricketts and Sandercock 2016). Further some species may even require the use of multiple grassland patches differing in their time since fire, grazing pressure, and vegetation structure and composition to complete their life-cycles (Londe et al. 2019, Sandercock et al. 2015). As a result, many species may not be able to persist in grasslands where disturbance from fire and grazing has been suppressed or simplified as they are likely missing key seral stages.

A Case Study: Habitat use of grassland birds in the Southern Great Plains

Grassland birds have experienced some of the largest population declines of any North American taxa, with as many as 60% of species having experienced substantial declines over the last century (Sauer et al. 2014). While these declines have been attributed to several causes including habitat loss and degradation, the suppression of fire and the ensuing changes in vegetation communities and habitat structure in grasslands is considered among the leading threats to this group of species (Brennan and Kuvlesky 2005, Samson and Knopf 1994). For this reason, considerable research effort has been placed on understanding the role of fire and grazing on the habitat selection and distribution of grassland birds.

Several research programs have been conducted in the Flint Hills Ecoregion of Kansas and Oklahoma in the Southern Great Plains on not just the role of fire and grazing in creating grassland bird habitat, but also the importance of variable disturbance for maintaining the entire suite of grassland bird species. Abundance and diversity of both breeding and nonbreeding passerines (songbirds) have been shown to increase in landscapes with increasing levels of patchiness resulting from heterogeneous fire and grazing (Figure 1; Hovick et al 2014, Hovick et al 2015c). This is in part due to the greater variety in vegetation structure, which allow species that require early seral habitat associated (reduced grass cover, exposed bare ground) such as the Upland Sandpipers (*Batramia longicauda*), as well as species that require patches with greater time since fire (higher litter cover, and taller vegetation), such as the Henslow's sparrow (*Ammodramous henslowii*) to persist.

Additionally, some species require multiple patches in the time since fire mosaic to meet all of their life history needs. For example, the Greater Prairie-Chicken (*Tympanuchus cupido*), requires recently burned areas with short sparse vegetation for communal courtship displays during the early spring (Hovick et al 2015b, Patten et al. 2007) followed by patches that have been unburned for several years with tall dense vegetation for nesting cover (Mcnew et al. 2015). Recent research has further shown that recently burned patches are likely critical for young prairie-chicken broods as these areas provide abundant food resources in the form of invertebrates (Londe et al. *in preparation*). Recent declines in prairie-chicken populations in the Flint Hills have been linked to increased use of prescribed fire and grassland homogenization, emphasizing the importance of fire and vegetation heterogeneity for this species (Robbins et al 2002).

The Green Glacier: an impending threat to grassland wildlife

While the grassland homogenization is a threat to many grassland species, short-term changes to management practices can result in rapid rebounds in the diversity of grassland species as well as their numbers. However, a more widespread and existential threat to many grasslands and the wildlife found in them is the gradual increase and spread of woody plant species into grasslands (Engle et al. 2008). Due to a widespread culture of fire suppression and overgrazing many North

American grasslands have experienced a precipitous increase in tree (*Juniperous* sp.) and shrub species into grasslands (*Propsois* sp.) (Engle et al. 2008). The spread of these species into grasslands can result in losses of forage production, wildlife habitat, changes in water availability.

Many grassland wildlife species, particularly many grassland birds, are highly sensitive to the presence of trees or tall structures in grasslands (Chapman et al. 2004, Coppedge 2001, Grant et al. 2008), resulting in gradual loss of habitat for many species as trees encroach into infrequently burned prairies. Once again, prairie-chickens provide an illustrative example of the potential impacts of tree encroachment into grasslands as a result of fire suppression. Both lesser (*T. pallidicinctus*) and greater prairie-chickens have been shown to avoid treed areas during all parts of their life-cycles (Lautenbach et al. 2016, Londe et al. 2019), with this avoidance potentially extending up to 1000 meters from the wooded area (Figure 2). While information about the impacts of tree encroachment on greater prairie-chickens is limited, recent research in lesser prairie-chickens have shown that prairies that have experienced even low levels of encroachment may become unusable during some life stages such as nesting (Lautenbach et al. 2016).

Conclusions and Manager Implications

The implementation of fire as a management tool can be an important strategy for promoting biodiversity in grasslands (Fuhlendorf et al. 2006). In particular, by using fire to create a variety of patches that vary in their vegetation structure and composition land managers can potentially create habitat for the entire suite of grassland species. However, several factors must be considered before the implementation of heterogeneity-oriented management with fire that will potentially inform if a manager will achieve their conservation goals. These factors include a variety of things including site productivity, precipitation, past management, degree of woody plant encroachment, and the presence of invasive species (McGranahan et al. 2012, McGranahan et al. 2013, Skagen et al. 2017). Further, the number of animals and the duration of grazing a site can have important implications for how plants respond to and recover from a fire (Pillsbury et al. 2011). For these reasons land managers should have a clear understanding of their overall objectives before implementing new management strategies and should rely on local or expert knowledge to guide the implementation of these practices.

However, despite this, current research is clear that the suppression and loss of fire in grasslands worldwide is resulting in a significant shift in these ecosystems towards tree and shrub-dominated states. These changes can have long-lasting effects in terms of productivity, and wildlife habitat. Further, once the conversion of grasslands has taken place, restoration of fire regimes rarely is sufficient to restore these landscapes to their previous states (Briggs et al. 2005), suggesting that prevention is paramount for maintaining grasslands as grasslands. Implementing fire in grasslands before woody plant encroachment has begun or during the early stages of encroachment will ensure effective control of trees and shrubs, and the maintenance of wildlife habitat.

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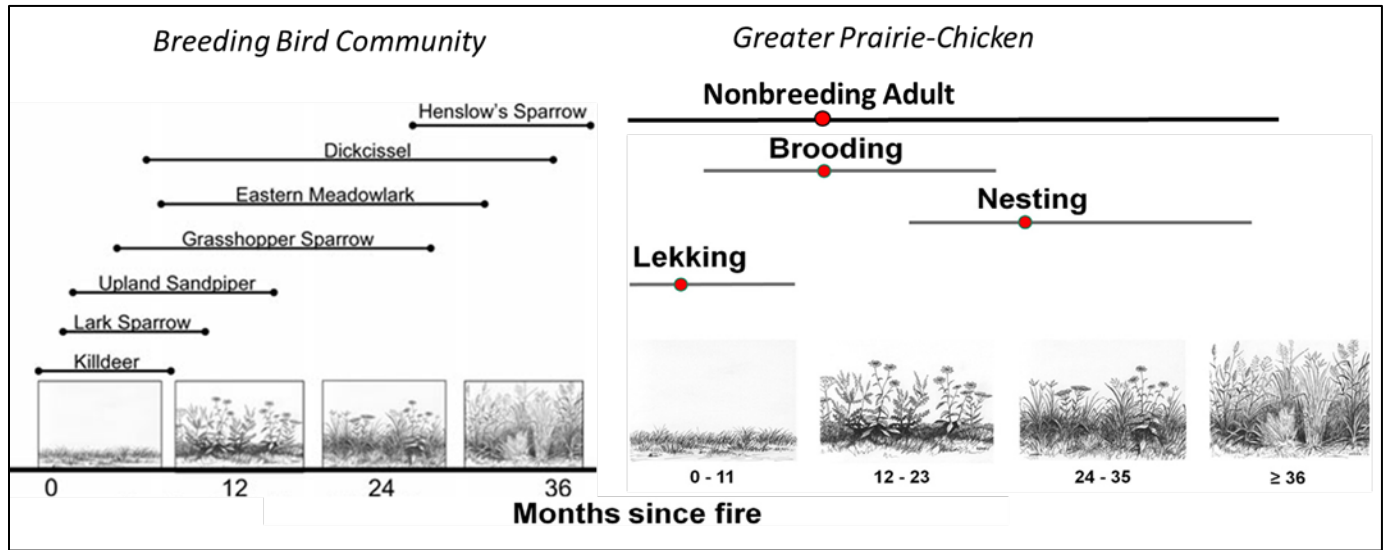


Figure 1. Grassland bird community in relation to time since fire (left panel) and Greater prairie-chicken use of different time since fire patches (right panel) in Osage County Oklahoma.

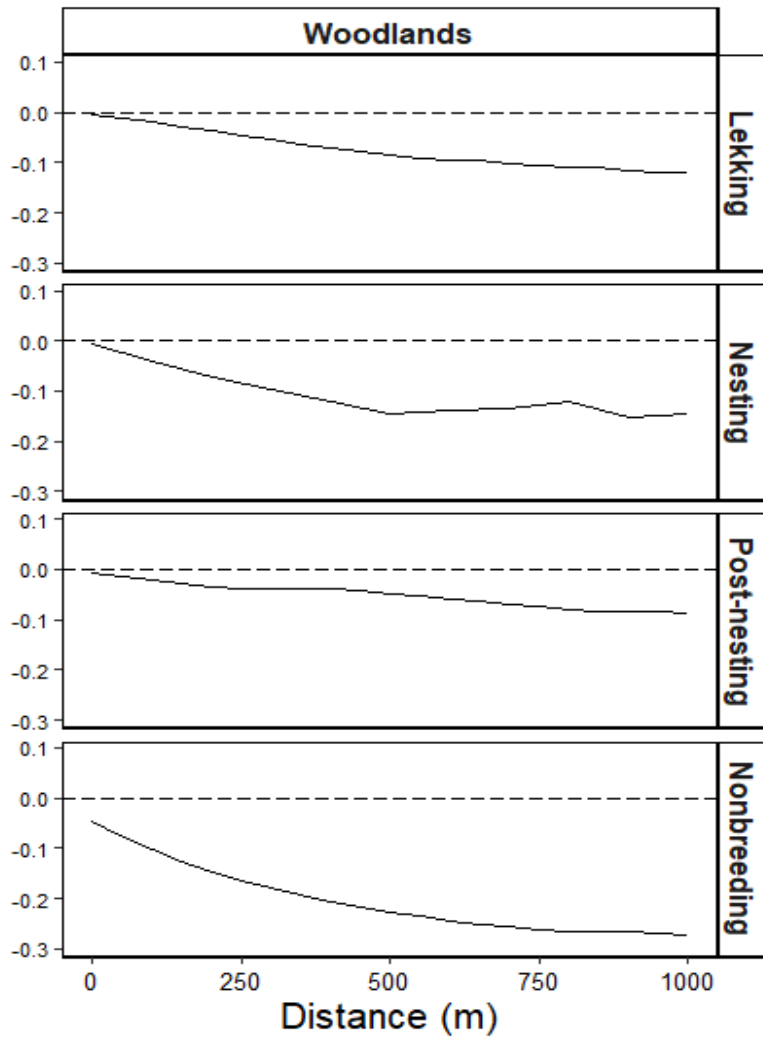


Figure 2. Cumulative Distribution Curves for Greater Prairie-Chicken telemetry locations relative to woodlands during four behaviorally distinct life periods (lekking, nesting post-nesting, and nonbreeding). CDF curves are a graphical representation of selection/avoidance behaviors for continuous variables. Negative slopes indicate and avoidance of a feature over a specified distance, while positive slopes indicate an attraction. In all four seasons, prairie-chickens show avoidance of woodlands (negative CDF slopes) as far as 1000-meters from woodland areas.