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White-tailed deer distribution in response to patch burning on rangeland

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ABSTRACT

Management of rangelands has changed substantially over the past few decades; today there is greater emphasis on wildlife management and increased interest in using natural disturbances such as fire to manage rangeland plant and animal communities. To determine the effect of prescribed fires on the distribution of white-tailed deer (*Odocoileus virginianus*), we used Global Positioning System (GPS) collars to monitor the movements of bucks and does during four, month-long, trials before and during the year after implementation of three late summer burns. Deer were expected to increase their use of burned areas to take advantage of fresh plant growth after the disturbance. However, the only increased use of burns occurred 1–2 months after treatment. The presence of cattle did not limit deer use of burns. Low use of burned areas was attributed to drought conditions, which limited vegetation regrowth. Other than a brief flush of fresh grass in autumn, no changes in plant cover could be ascribed to the burns. Thus, in semi-arid areas, use of prescribed burns to reduce brush cover and increase forb production for deer may not be successful, at least in the short-term, if lack of rainfall limits regrowth of vegetation.

1. Introduction

Many semi-arid rangelands have evolved under a regime of natural fires, but a combination of cattle grazing, fire suppression, and climatic change has reduced the frequency of fire and resulted in encroachment of shrubs on former savanna grasslands (Archer, 1989; Archer et al., 1988; Frost and Robertson, 1987; Mayeux et al., 1991; Scifres and Hamilton, 1993; Trollope, 1978; Wright and Bailey, 1982). Increased woody cover often results in lowered productivity of the herbaceous layer, with concomitant decreases in animal productivity (Hamilton et al., 2004). Rangeland improvement practices, such as mechanical brush removal and use of prescribed fire, reduce the over-storey of shrubs to allow more sunlight and precipitation to reach the ground and stimulate production of herbaceous vegetation. The regrowth of herbaceous vegetation and palatable shrubs is often high in protein and low in fiber, providing improved nutrition for herbivores (Everitt, 1983).

Over the last two decades, rangeland management in South Texas has moved towards greater use of the land for recreational purposes (Kjelland et al., 2007). The annual economic impact of hunting white-tailed deer (*Odocoileus virginianus*) in Texas was assessed at more than US $2 billion (International Association of Fish and Wildlife Agencies, 2002). Deer hunting leases have therefore become a substantial form of additive ranch income, and in some instances,

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the primary revenue source for ranchers (Adams et al., 2000). Interest in producing trophy deer bearing large antlers is intense, and because maximum expression of antler growth is influenced by year-round nutrition of the animal (Harmel et al., 1989), there has been a surge of interest in improving the quality and quantity of deer forages on rangeland. Historically, white-tailed deer did not inhabit open grassy rangeland, but were restricted to creeks and drainages with greater shrub cover (Inglis et al., 1979). While shrub invasion initially increased useable habitat for deer, current shrub cover is often too dense for optimal production of protein-rich forbs which are an essential component of the deer's diet for maximum growth and antler production (Fulbright and Ortega-S, 2006; Wright et al., 2002).

Traditionally, mechanical methods have been the most commonly used techniques for shrub reduction. These are largely effective, but are often expensive (Scifres and Hamilton, 1993). Prescribed fire may be more cost effective and is often used as a maintenance treatment following shrub reduction by mechanical methods (Rogers et al., 2004). Because the rangeland ecosystem evolved under a regime of natural fires, the vegetation is expected to respond favorably to burning (Ruthven et al., 2000), and the use of patch burns is predicted to emulate the way natural forces, such as lightning, would disturb the area to produce a heterogeneous landscape with an interspersion of shrubs for cover and browse with open areas suitable for forb production.

Use of prescribed burns as an initial treatment to improve habitat and forage quality for wildlife has met with mixed results in southern Texas and other shrub-dominated rangelands. Use of fire, wild and prescribed, was reportedly successful in increasing herbaceous production and vegetative diversity at the Kerr Wildlife Management Area on the Edwards Plateau in Central Texas, although this has not been rigorously tested (Armstrong, 2005). In the South Texas Plains, prescribed fire was effective in increasing forb coverage, but not density (Ruthven et al., 2000). However, in the transitional zone between these two ecoregions, the effect on vegetation composition was found to be minimal (Owens et al., 2002).

Rapid increases in the value of white-tailed deer on rangeland has also lead to new management practices such as supplemental feeding programs and containment of deer within high fences. These practices may permit deer densities to exceed the natural carrying capacity of the land. Even with high rates of supplemental feeding, deer will continue to browse on natural vegetation (Cooper et al., 2006; Doenier et al., 1997) and may over-utilize available browse and damage the habitat (Anderson and Katz, 1993; deCalesta, 1994; Pellerin et al., 2006; Rossell et al., 2005; Russell et al., 2001). In any rangeland improvement project, it is important to consider the impact that resident herbivores will have on regrowth of the vegetation (Hobbs, 1996). Animals are frequently attracted to feed on the new regrowth vegetation emerging after shrub removal or fire (Hobbs and Spowart, 1984; Wallace and Crosthwaite, 2005; Wisley, 1996). The success of rangeland restoration could be limited by an overabundance of deer if they concentrate their feeding activities on treated areas enough to influence vegetative recovery and the restoration process.

This study investigates the distribution of white-tailed deer before and after implementation of patch-scale disturbance by prescribed burns. We hypothesized that the post-burn distribution of deer would change if deer were attracted to feed on the new regrowth vegetation following the prescribed burns. Distribution was estimated using deer fitted with Global Positioning System (GPS) collars to limit human disturbances to the deer and provide a greater amount of more accurate data than traditional radio-telemetry.

2. Materials and methods

2.1. Study area

This study was conducted on the Harris Ranch, located 35 km west of Uvalde, Texas (Uvalde County). The 6764 ha ranch (29°15′0.02″N, 100°5′54.01″W) was situated at the interface of two ecoregions, the Edwards Plateau to the north and the South Texas Plains to the south. Much of the ranch consisted of gently undulating caliche ridges covered by shallow calcareous soils, with areas of deeper clay loam soils in the flatter areas and drainages. Within the ranch, the study was conducted in a 1214 ha pasture north of the river, cattle were limited to this area but deer could cross the cattle fence into a further 877 ha. Thus, deer had access to a 2091 ha area from which their dispersal was limited by high fencing on three sides and a natural bluff formation along the southern border. The West Nueces River runs through the study area but never flowed during the study so was not a barrier to animal movements (Fig. 1). The major ecological sites in the study area are loamy bottomland (27.5%), clay loam (22.2%), stony ridge (18.8%), and shallow ridge (17.5%) (Stevens and Richmond, 1970). The loamy bottomland and clay loam sites are the most productive sites. Loamy bottomland sites supported trees such as live oak (*Quercus virginiana*) and sugar hackberry (*Celtis laevigata*), and thickets of pink mimosa (*Mimosa borealis*). Clay loam rangeland is identified by scattered trees of honey mesquite (*Prosopis glandulosa*) and mixed shrubs including whitebrush (*Aloysia gratissima*). The most abundant grasses on these sites are common curly-mesquite (*Hilaria belangeri*), buffalo grass (*Buchloe dactyloides*), lovegrass tridens (*Tridens eragrostoides*) and Texas wintergrass (*Stipa leucotricha*). Forb cover was diverse and varied with rainfall pattern and abundance, but western ragweed (*Ambrosia psilostachya*), violet ruellia (*Ruellia nudiflora*) and false ragweed (*Parthenium hysterophorus*) were common.

The upland areas have thin soils and lower herbaceous production, and are either shallow ridge or stony ridge ecological sites. The shallow ridge ecological sites are characterized by mixed-shrub communities, consisting primarily of guajillo (*Acacia berlandieri*) and cenízo (*Leucophyllum frutescens*). Stony ridge sites are dominated by spiny shrubs such as blackbrush (*Acacia rigidula*), guajillo, and pricklypear cactus (*Opuntia lindheimeri*). Grass cover is sparse but included