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Targeted Grazing in Southern Arizona: Using Cattle to Reduce Fine Fuel Loads☆,☆☆,★

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ABSTRACT

Managing the risk of wildfires is a growing concern in the western United States. Targeted grazing, or managing livestock grazing to achieve specific vegetation goals, is one possible tool to treat fuels, but few studies have evaluated its efficacy. The goal of this study was to test the effect of targeted grazing on herbaceous fuel loads and fire behavior by 1) implementing targeted grazing in a field experiment and 2) using a fire model (BehavePlus) to evaluate changes in fire behavior resulting from treatments. We applied targeted cattle grazing using low-stress herding and strategic placement of low-moisture block supplement on rugged rangelands in southwestern Arizona using a herd of 58 Red Angus cows and two bulls. Six of the cows were initially fitted with global positioning system collars. We tested two grazing treatments: 1) herding and supplement versus 2) no herding and no supplement on two pairs of study sites and replicated this for 2 years. Herding and supplement affected both the distribution of cattle and herbaceous fuel loads. Despite light utilization (26%) in treated sites, the BehavePlus fire model predicted that herding and supplement reduced fire rate of spread by more than 60% in grass communities and by more than 50% in grass/shrub communities. Fuel treatments dropped flame lengths below a 1.2-m critical threshold under the moderate fuel moisture scenario in grass communities and below a 2.4-m critical threshold in grass/shrub communities under both moderate and extreme fuel moisture scenarios. These results suggest that targeted grazing could reduce the potential cost of fighting fires in conditions similar to this study site. However, implementing this type of treatment on other sites will require careful calibration of animal numbers, supplement amounts, and length of herding periods relative to the specific context and goals.

Introduction

Effectively managing the risk of wildfire is a serious concern of state and federal land management agencies, local governments, and residents throughout the western United States. Urban growth into wildlands, decades of fire suppression, and invasion of exotic species have altered fire cycles in the western United States (D'Antonio and Vitousek, 1992; Agee and Skinner, 2005) and increased the risks to human life and property posed by wildfire. From 1987 to 2003, burned area of forested lands increased sixfold compared with area burned in the previous 16 yr (Schoennagel et al., 2009). Simultaneously, the wildland–urban interface (WUI) has expanded by 52% since 1970 and is expected to grow by another 10% by 2030 (Theobald and Romme, 2007). Arizona is among the top six states in which the WUI is expected to grow (Theobald and Romme, 2007). The combination of growth of human populations into the WUI and increased fire frequency in ecosystems throughout the western United States necessitates the development of tools to manage wildfire risk in ecologically, economically, and socially appropriate ways.

Since the Healthy Forests Restoration Act of 2003, fuel management has been the chosen method of managing fires (Stephens and Ruth, 2005; Keeley, 2006). Fuel management allows land managers to reach several firefighting objectives including reduced fire risk, reduced firefighting costs, reduced ecological impacts, and protection of WUI communities (Mell et al., 2010). Although there are many tools available to mitigate the risk of unwanted wildfires through fuel treatments (prescribed fire, herbicides, etc.), each carries trade-offs among cost, impacts, risks, feasibility, and public perception, all of which play a role in the acceptance of a risk-mitigation strategy (Cortner et al.,

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1990; Nader et al., 2007). For example, prescribed fire to manage fuel loads can escape and may affect air quality in nearby communities (Diamond et al., 2009), can be expensive to implement, or may not be desirable because of its impact on native plant species (Germano et al., 2001). Herbicides and mechanical control may negatively impact desirable vegetation, can be prohibitively expensive, and may be difficult to implement in rough terrain (Launchbaugh et al., 2006). Targeted livestock grazing may be one option for reducing fine fuels on extensive rangelands without the negative impacts and limitations from other options (Launchbaugh et al., 2008).

Targeted grazing is "the application of a specific kind of livestock at a determined season, duration, and intensity" to achieve objectives for wildlife habitat or ecosystem services (Launchbaugh et al., 2006). Critical components of a targeted grazing "prescription" are selecting the correct kind and number of livestock and combining this with the correct timing of grazing to address defined vegetation or landscape management objectives. As with every vegetation management tool, targeted grazing has unique costs and benefits (Frost and Launchbaugh, 2003). Under certain circumstances targeted grazing may be the most appropriate tool for vegetation management because it can be used in rough terrain, generally has greater public support, and may be more affordable compared with other methods (Nader et al., 2007). In one successful example, municipal governments successfully balanced multiple stakeholder and ecological values while using goats and sheep to reduce fuel loads near the WUI in Nevada and California (Davison, 1996; Taylor, 2006).

Although many studies examine fuel management in forested ecosystems (Covington, 2000; Agee and Skinner, 2005), few studies have considered alternative fuel management techniques on grasslands (Davies et al., 2010). Exotic grasses can invade ecosystems that have not evolved with fire, thus changing the habitat conditions required for native wildlife species (D'Antonio and Vitousek, 1992). In addition, fine fuels on lower-elevation grasslands and shrublands are easily ignited and serve as a conduit for igniting serious fires, which can spread to higher elevations and different vegetation types. For example, in 2005, exotic grasses and forbs served as an initial ignition source in lower elevations, which facilitated the expansion of Arizona's 100 362-ha Cave Creek Complex fire into higher elevations (CLIMAS, 2006).

In response to concerns over wildfire and the need for management tools, Bailey et al. (2008) called for the need to examine the practicality of using targeted grazing methods to address fuel-loading problems in various ecosystems with livestock distribution management techniques. Specifically, in our study area, the Coronado National Forest was concerned about fine-fuel loading due to Lehmann lovegrass (*Eragrostis lehmannniana* Nees), a warm-season, nonnative, perennial bunchgrass from South Africa. This experiment used 1) a field experiment with targeted grazing and 2) a fire model (BehavePlus; Andrews, 2009) to evaluate changes in fire behavior resulting from targeted grazing.

In the field experiment, we implemented targeted grazing by combining low stress herding (LSH) of cattle with strategic placement of low-moisture blocks (LMBs). We combined LSH and LMB because past research indicates that these two livestock distribution manipulation methods are more effective at increasing utilization than using either of these methods alone (Bailey, 2004; Bailey et al., 2008). Cattle were better suited to the objectives of this study compared with sheep and goats because they typically prefer grasses in greater proportions than other livestock species (Stuth, 1991), they are abundant in Arizona, and they are less likely to be affected by predation (Launchbaugh et al., 2006).

We used BehavePlus to evaluate changes in fire behavior resulting from the field experiment. Early work to translate the effects of cattle grazing into changes in fire behavior because of these impacts used McArthur's Fire Danger Meter, an early index predicting fire danger and suppression difficulty based on forage height and fire observations (Burrows, 1981). Van Wagtendonk (1996) used the fire growth simulation modeling system FARSITE to evaluate the effects of different fuel treatments. More recently, Diamond et al. (2009) determined that observed fire behavior was similar to estimated fire behavior using the fire simulation program BehavePlus on fuel treatment sites targeting cheatgrass (*Bromus tectorum* L.) with cattle grazing. Sophisticated fire prediction models like BehavePlus have made using computer models a sufficient and viable alternative to exploring the impacts of fuel treatments on fire behavior without the cost and risk of burning actual sites.

In evaluating the efficacy of using targeted cattle grazing and estimating its effect on fire behavior, we hypothesized that targeted grazing would 1) increase cattle distribution into previous unused areas, thus increasing utilization and, as a result, 2) decrease fire severity in these areas as modeled by BehavePlus.

Methods

The livestock handling and experiment procedures used in this study were approved by the University of Arizona Animal Care and Use Committee (Protocol 10–220).

Targeted Grazing Field Study

Study Area

Our study was conducted within the 3 000-ha Ranger Station pasture located on the Coronado National Forest in the Santa Rita Mountains of southern Arizona (lat 31°46′378″N, long 110°52′811″W). Elevation within the study pasture ranges from 1 200 m to 2 438 m. The terrain is rocky and very steep in some areas of the pasture and flat to gradually sloping in other areas. Annual precipitation varies between 230 mm and 510 mm (ESD MLRA 41). Average summer daily highs are 32—38°C, whereas winter highs (December and January) are 10—15°C.

The Ranger Station pasture is predominately a mesquite savanna. Dominant woody and herbaceous plant species are velvet mesquite (*Prosopis velutina* Woot.) and Lehmann lovegrass, respectively. Less dominant plant species include oak (*Quercus Emoryi* Torr.), catclaw acacia (*Acacia greggii* A.), fairy duster (*Calliandra eriophylla* Benth.), *Agave* spp., and a variety of native warm-season bunchgrasses such as sideoats grama (*Bouteloua curtipendula* [Michx.] Torr.), threeawns (*Aristida* spp.) and plains bristlegrass (*Setaria leucopila* K. Schum).

The primary perennial water sources for cattle are stock tanks at Benson Wells near the northwest region of the pasture (Fig. 1). Several ephemeral dry washes, springs, and one stock tank are also present in the pasture but contained no water during Year 1 (December 2010 to January 2011) of the study. During Year 2 (December 2011 to January 2012), five times the amount of winter rains compared with Year 1 resulted in numerous ephemeral springs and streams running throughout the pasture. In March 2010, before the initiation of the present study, we conducted an ocular use pattern mapping study by horseback, which indicated that most utilization occurred within 1.6 km of Benson Wells in the flatter areas of the pasture in areas with elevations that were less than 1400 m.

Selection of Study Sites

Two pairs of treatment and control study sites were systematically selected for a total of four study sites (see Fig. 1, Table 1). The primary criteria for selecting paired study sites (see Table 1) were that they 1) be approximately 1.6—2 ha in size; 2) contain similar terrain with roughly equivalent elevations, slopes, and aspects; 3) be located at least 1 km from Benson Wells; 4) have similar perennial grass production; and 5) show little or no evidence of previous use by cattle. Each target/control pair was located within 1.6 km of one another but separated by a rocky ridge that likely impeded travel by cows between the paired sites (see Fig. 1). Paired Study Sites 1 and 2 were located on an east-facing slope. Paired Study Sites 3 and 4 were located on west-facing slopes. Paired study sites were randomly assigned during the first year of the study as either a treated site (referred to as "target") or a control