Prescribed Fire Effects and Benefits for Cattle

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Historical perspective of fire and grazing

Human applications of fire to benefit grazing animals is not a new concept. Historical evidence indicates that aboriginal people in North America (Anderson 2006), Australia (Murphy and Bowman 2007), and Africa (Archibald et al. 2005) frequently burned rangelands and forested lands to attract wildlife, remove standing dead plant biomass, to stimulate new plant growth, manage pests, etc. The role of fire also structured the plant community by maintaining open grasslands and shrublands and the dominance of native perennial grasses (Bond and Keeley 2005). While the application and concept of fire to benefit herbivores is not new, research quantifying the benefits and impacts has been developing at a rapid pace, especially over recent decades.

Figure 1. Lighting a prescribed fire in mixed grass prairie

Early U.S. research on fire and grazing benefits

In the United States, research on the benefits of fire for cattle production dates back to the 1960's. Range scientists in Florida, Georgia, and Louisiana applied fire treatments to understand how it influenced animal grazing behavior, animal growth, and the plant community. A study from native longleaf pine – bluestem rangeland in Louisiana demonstrated improved palatability of forage, greater forage nutritive value, greater abundance of herbaceous plants, and greater cow and calf weight gains (Duvall and Whitaker 1964). A similar study in wiregrass (*Aristida* species and *Sporobolus* species) rangelands of Georgia demonstrated this same benefit; increased crude protein of forage, increased utilization of wiregrasses, and increased cattle gains (Hilmon and Hughes 1965). This animal and forage response was also similar in coastal prairies where patchy fires increased forage crude protein, in vitro organic matter digestibility, and maintained to improved steer gains (Angell et al. 1986). Researchers have also concluded that the use of patchy fires in Oklahoma and Nebraska did not decrease cow-calf production and at times improved production for stocker and calves (Limb et al. 2011; Winter et al. 2014).

Attraction to burned areas and animal distribution

An important mechanism that links fire and grazing is the attraction of cattle to recently burned areas. This attraction is largely driven by the positive feedback of high forage quality and palatability in the burned area and the negative feedback of low forage quality and palatability in the unburned areas. A recent study from tallgrass prairie in Oklahoma demonstrated 4-times greater crude protein in burned areas compared to unburned areas (18% and 4%) and that burned areas influenced cattle and bison distribution (Allred et al. 2011). The attraction to burned areas can be an important animal distribution management tool, as cattle have been reported to spend 75% of grazing time in the areas most recently burned (Fuhlendorf and Engle 2004). The use of patchy fires also leads to greater forage utilization in the burned patches compared to unburned areas, and is a way to manipulate animal distribution without the use of fences or herding (Vermeire et al. 2004).

Figure 2. The attraction to burned patches begins immediately due to the natural curiosity of cattle and the rapid regeneration of native plants.

Fire and livestock parasites

Fire may also be a tool that could be integrated into a livestock parasite management plan. Studies on the use of patchy fires have demonstrated a reduction in ticks (*Amblyomma americanum*) on both cows and calves in Oklahoma (Polito et al. 2013), horn flies (*Haematobia irritans*) in Iowa and Oklahoma (Scasta et al. 2012), and face flies (*Musca autumanlis*) in Iowa. The effect on flies could be limited during and after drought years (Scasta et al. 2015). There is also some evidence that fire could reduce internal parasites by disrupting the fecal habitat and free-living terrestrial stages (Barger et al. 1978; Seip and Bunnell 1985; Scasta et al. 2014). Numerous other studies have reported the reductions on ticks but research on flies is relatively new, and research on internal parasites is an area lacking in knowledge. A recent review compiled 24 studies on the effects of fire on these parasites and others such as mosquitoes and fleas (Scasta et al. 2015). Because animal health related costs account for 7 to 13% of total operating costs for beef cattle enterprises, any reduction in parasites should have positive

benefits for livestock and the economic bottom line due to the reduction in blood loss, annoyance, and disease exposure associated with parasites.

Diet diversity and physical dermatitis

It has been suggested that a diverse diet could be beneficial for grazing animals, but how humans can manipulate rangeland cattle and the diet mixture is not well understood (Provenza et al. 2007). Because fire alters the plant phenology for all plants in the burned area, cattle are suspected to graze plants that they might otherwise avoid in more mature stages due to secondary compounds (Helzer et al. 2005; Cummings et al. 2007). The disturbance of fire may also reduce physical dermatitis that can either deter cattle grazing (i.e., hard and abrasive stems of mature warm-season perennial grasses) or the consumption of spines (i.e., such as on prickly pear cactus; Migaki et al. 1969). Fire has been suggested to be a practical and economical strategy to remove spines and reduce contact dermatitis (McMillan et al. 2002). A study on patch-burn grazing in the shortgrass steppe of Colorado resulted in a 5-fold increase of bitten or uprooted cactus pads by pronghorn antelope and a reduction of up to 71% of cactus (Augustine et al. 2015).

Plant community composition and forage production

Fire is also a practical and economical tool for managing shrub and tree invasion as well as invasive weed invasion, and may optimize the growth of perennial grasses. Scientists have reported that fire and grazing could increase the productivity for little bluestem (*Schizachrium scoparium*) and western wheatgrass (*Pascopyrum smithii*) (Limb et al. 2011; Vermeire et al. 2014). These two grasses are different because little bluestem is a warm-season grass and western wheatgrass is a cool-season grass; however, both are important native forage species in different areas of the Great Plains. Fire is also an effective tool for managing sericea lespedeza (*Lespedeza cuneata*), broom snakeweed (*Gutierrezia sarothrae*), prickly pear cactus (*Opuntia polyacantha*), purple threeawn (*Aristida purpurea*), cedars (*Juniperus* species), pines (*Pinus* species), and resprouting shrubs – all plant species that compete with native grasses very effectively. Fire is another tool in the toolbox for ranchers for weed and brush control, but is an option that differs in cost, preparation and planning, risk, and effects. Arguably, no other tool (chemical or mechanical) is also an ecological disturbance like fire, and none can serve as a proxy for fire.

Figure 3 (on previous page). Cows and calves grazing in a recently burned patch (center) due to an increase in quality and palatability compared to unburned areas (foreground and background) that have vegetation that is rank, of low-quality and not as palatable.

Challenges to incorporating fire into the grazing management plan

A common question I have been asked is: "How do you graze and burn?" The difficulty with incorporating fire and grazing is that the fuel for fires is also the forage for grazing, i.e., the fuel-forage paradox. A practical approach has been the application of fire in a small patch within a larger pasture, or "patch-burn grazing." This approach could be contrasted with burning the entire pasture and either deferring grazing for an extended period of time, or burning an entire pasture annually as is common in the Flint Hills of Kansas. The first approach is often impractical for a rancher, and the second approach may be risky when dry years occur. A recent study from tallgrass prairie in the southern extent of the Flint Hills that reaches into Oklahoma demonstrated that burning annually maximized cattle gains when rainfall was plentiful, but during drought, cattle gains were drastically lower. In contrast, patch-burn grazing reduced the risk during drought by maintaining a forage reserve in unburned areas and did not exhibit a statistically significant relationship with rainfall fluctuations (Allred et al. 2014). A researcher studying patch-burn grazing in Tennessee recently suggested that this relationship creates a "grass-bank" (McGranahan et al. 2014).

Figure 4. Developing a burning program requires additional resources and planning.

Key considerations for developing a grazing plan that includes fire should include: how often would fire have historically burned in my area; what size of areas should I burn; are there sensitive species that are critical for wildlife habitat that are fire sensitive (i.e., some sagebrush species); what infrastructure or equipment do I need to safely and effectively apply fire. A good reference that discusses how to apply patch-burn grazing can be found at: http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1439&context=usfwspubs.

Conclusions

While this paper is primarily focused on the benefits of fire for livestock, a large body of research has also documented benefits for wildlife including insects, birds, small mammals, and large mammals. Understanding the historical role of fire in a particular area, including the frequency, seasonality and scale, will be important for incorporating fire into a ranch management plan. Finally, no other tool can replicate the effects of fire on rangeland ecosystems, and developing strategies to integrate fire can have short-term and long-term benefits for ranches in fire-dependent ecosystems.

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