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Effects of fall burning: Workshop follow-up resources

Compiled by Sherry A. Leis, Fire Science Program Leader

INTRODUCTION

October 13, 2015 a diverse group of people interested in grassland fire convened to learn about effects of season of fire and see the results of a fall burn (1-year post-burn) at the Tallgrass Prairie National Preserve, Strong City, Kansas. This document is intended as a resource of information related to that event and seasonal fire effects in grasslands.

ACKNOWLDEGEMENTS

This workshop was sponsored by Kansas Prescribed Fire Council, Kansas Grazing Lands Coalition, Kansas Section of the Society for Range Management, Kansas Native Plant Society, and Great Plains Fire Science Exchange. Much gratitude is offered to The Nature Conservancy Kansas and The National Park Service for allowing this workshop to take place on the preserve, including use of the facilities and touring their fall burn site. This workshop was created by Shelly Wiggam and Jason Hartman through the Kansas Prescribed Fire Council, and implemented by Shelly Wiggam, Brian Obermeyer, Kristen Hase, Sherry Leis, and Jason Hartman.

FEATURED SPEAKERS-SUMMARIES

David Engle: What We Know and Don't Know About Burning in Flint Hills Prairie

Thorstein Veblen, the author of The Theory of the Leisure Class that explained the concept of conspicuous consumption, said "The outcome of any serious research can only be to make two questions grow where only one grew before."

At the risk of being accused of the prototypical research scientist, I am going to suggest that what we don't know about burning prairie far outweighs what we do know. To explore this statement, the workshop participants listed elements of the fire regime (Table 1) that apply to prairie. As this was not how we were accustomed to thinking about prairie, we were a bit perplexed at first, but we soon got the hang of it.

Practitioners (ranchers and technical specialists/advisors) and research scientists rated how much was known for each specified element of the fire regime, and in the case of ranchers, rated how comfortable they are with the state of their knowledge and experience (Table 1).

Summary of the discussion- We discovered that research scientists and ranchers alike perceive that there is a lot about the fire regime including the effect of season of burning that we don't know. This suggests season of burn (timing) might be a fruitful area for additional research. Ranchers and researchers are not uniform in how much they think we know (or need to know) about elements of the fire regime. Researchers considered knowledge gaps about spatial pattern, extent of burning, and other elements as important, but ranchers did not. Perhaps ranchers perceive these elements to be irrelevant to their operations and to meeting burn objectives.

Table 1. Current Knowledge of Specific Fire Elements as Ranked by Researchers and Fire Practitioners. Rating was from 1 (inadequate knowledge) to 5 (adequate knowledge).

Element	Researchers	Practitioners
Fire return interval (fire frequency)	3 or 4	5
Season of burn (timing of burn, calendar date)	3	3
Spatial pattern and extent of the burn	1	4
Fire behavior	2	5
Interaction of fire and other factors, especially grazing and climate	1	4
Willingness for off-season burning (speaking for the ranching community)	--	1

Rancher knowledge of their land and how to burn it may include elements not included in the scientific literature. Ranchers need to balance production and social elements along with biological elements when deciding to burn, and the case for burning outside the traditional late-spring burn period has not be adequately demonstrated.

John Briggs: Effects of Season of Fire: Konza Prairie Biological Station.

Dr. Briggs discussed Konza research on fire effects through different seasons of burning. A summary of this work can be found at: http://www.gpfirescience.org/research-publications-1/2015/6/21/research-brief-towne-and-craine-2014?rq=Craine. In particular, (from the brief authored by Dufek, 2015) "this study shows that fall and winter burning in ungrazed watersheds of the Kansas Flint Hills can be conducted with little adverse effect on desirable forage species. The authors emphasize three key results from the experiment as evidence to support this case. First, end-of-season grass biomass in ungrazed prairie was not significantly different between autumn, winter or spring burns. Second, autumn and winter burns increased the window of opportunity for grasses to take advantage of spring precipitation for productivity compared to spring burns. Lastly, changes in plant composition from autumn and winter burns favor cool season grasses without negative impacts on warm season grasses, improving overall forage quality and potentially allowing for a longer grazing season. Further studies are needed to assess whether these responses to different season of fire are modified by the activities of grazers."

ADDITIONAL RESOURCES

Fire Effects Monitoring Report and brief

Leis, S. A. and S. E. Hinman. 2015. Prescribed fire monitoring report: Tallgrass Prairie National Preserve 2014 (IQCS fire number 285382, 285383, 266782, 285677). Natural Resource Report NPS/HTLN/NRR—2015/1025. National Park Service, Fort Collins, Colorado. https://irma.nps.gov/App/Reference/Profile/2224113

Fire History via fire rings:

The Missouri Tree Ring Laboratory has several publications describing fire history as a result of reading tree ring scars in localities as well as modeling approaches to estimating fire return intervals nationally. Many research papers are available in pdf from their website: http://web.missouri.edu/~guyetter/pubs.html

Extension publications on season of burn:

Watch a video of John Weir (Oklahoma State University, OSU) describing the vegetation changes in their research plots. https://www.youtube.com/watch?v=PDjHpitD4MI&index=5&list=FLBSiAArzi0O6T_1tGqKApXw

Extension publications on fire effects and choosing season for fire objectives from OSU:
http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-2703/NREM-2877web.pdf

http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-2704/NREM-2878web.pdf

Kansas State University (KSU) extension publication on Rangeland Brush Management. In a section on controlling problem plants they recommend:
"The best time to control most species with fire is when the plant reaches its low point in food reserves. That normally occurs in mid- to late-April when dominant warm-season perennial grasses (e.g., big bluestem and Indiangrass) are one to two inches tall. Smooth sumac and leadplant, however, have root reserve cycles similar to warm-season perennial grasses and are unharmed by late-spring burning." http://www.bookstore.ksre.ksu.edu/pubs/mf1021.pdf

Patch burn grazing (patch burning) resources:

Both OSU and Great Plains Fire Science Exchange have some helpful publications related to the practice of using the fire grazing interaction in livestock production.

OSU: Patch Burning publication (E-998; Sept. 2007) http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-4677/E-998.pdf

GP Fire Science: Application of patch burn grazing for landowners http://www.gpfirescience.org/research-publications-1/2015/6/18/application-of-patch-burn-grazing-for-landowners?rq=patch%20burn%20landowner

GP Fire Science: Patch burn-grazing: an annotated bibliography http://www.gpfirescience.org/research-publications-1/2015/6/18/patch-burngrazing-an-annotated-bibliography?rq=annotated%20bibliography

Operational considerations:

A study of available days for burning throughout the year in Oklahoma demonstrated that there are a substantial number of burn days in the fall as compared to the spring.
http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-7504/NREM-2885web.pdf

Summer burning extension publication http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-7629/E-1025%20Burning%20in%20the%20Growing%20Season.pdf

BLOG POSTS THAT ORIGINALLY APPEARED ON THE GREAT PLAINS FIRE SCIENCE EXCHANGE WEBSITE, RE-PRINTED HERE.

Got Woodies? By Sherry A. Leis

Blog post http://www.gpfirescience.org/research-publications-1/2015/6/21/got-woodies?rq=Got%20Woodies

Across the GP, grassland managers are diligently working to maintain acceptable levels of shrub cover. Restorations are especially prone to explosions of sumac, dogwood, and a variety of other shrubs. A new study from researchers at Kansas State University synthesized the mechanisms for woody encroachment as they are currently understood.

Download the paper here:Fire dynamics distinguish grasslands, shrublands and woodlands as alternative attractors.

This paper discussed grassland, shrubland, and woodland transitions in the central grasslands of the U.S. Authors noted that shrubs are highly successful at acquiring and using deep water sources in deep soils. In shallower soils, shrubs must compete directly with the fine root systems of grassland plants and may not be as successful. These differences in how plants acquire water can help us understand shrub transitions and fire effects.

The authors noted the importance of fire return intervals for maintaining grassland and the difficulty of returning to the grassland state once shrubland and woodland thresholds have been crossed. They found that 2 year fire return intervals are likely to maintain grasslands successfully, while 3 year intervals are less predictable. Precipitation, fire intensity, and a number of factors can also influence the rate of transition to shrubland or woodland. Previous work has described a transition from grassland to juniper woodland in about 40 years without fire, but the authors suggest a much quicker transition to the woodland state is possible. Grazing may moderate longer fire return intervals, but much more needs to be learned about the mechanisms and relationships of grazing to fire and grassland stability.

Reference: Ratajczak, Z., J. B. Nippert, J. M.Briggs and J. M. Blair. 2014. Fire dynamics distinguish grasslands, shrublands and woodlands as alternative attractors in the Central Great Plains of North America. Journal of Ecology 2014, 102, 1374–1385 doi: 10.1111/1365-2745.12311

What's the big deal about fall burning? By Sherry A. Leis

Blog post: http://www.gpfirescience.org/research-publications-1/2015/6/19/whats-the-big-deal-about-fall-burning?rq=fall%20burning)

We have heard a lot of buzz in the tallgrass prairie fire community recently surrounding the practice of fall burning. The recent release of a research paper by Towne and Craine (2014) describes a 20-year dataset, where the authors looked at effects of burning at different times during the

Tallgrass Prairie National Preserve burn conducted October 16, 2014. This burn was conducted for administrative reasons.

year on the plant community. They conducted the study on ungrazed sites at the Konza Prairie in Kansas, where they burned in late-November, mid-February, and mid-April. They found similar grass productivity across burn season and upland/lowland sites. However, culm production was greater with spring burns. However, forb productivity decreased for spring burns in upland sites. Woody species, often a target for prescribed burners, increased across all treatments in the upland and lowland sites. Grass productivity, an important consideration for livestock producers, seemed to be more sensitive to precipitation in the fall and winter than spring. Subtle shifts in species composition encouraged the authors to contend that "autumn and winter burns promote a broader phenological diversity of species than spring burns."

Pre– and post-burn photos at monitoring sites at the Tallgrass Prairie National Preserve. Darin McCullough and Chyna Pei pictured (October 2014 burn).

Land managers in the Great Plains have conducted prescribed fires most often in the spring. The spring window of opportunity was thought to last longer than other times of year, providing more opportunities to complete burns, however Roberts et al. (1999) found that fewer burn days were actually available in April than in other months (see also Weir 2011). Spring moisture can also make fire more manageable than during droughty periods in summer. The Towne and Craine findings are important to the Flint Hills range community, where the Intensive Early Stocking (IES) system, most commonly used there, has recommended early April burning (Launchbaugh and Owensby 1978, Towne and Owensby 1984). Because of the wide adoption of IES grazing system, many ranchers burn simultaneously, resulting in regional smoke management challenges (see http://ksfire.org/ for smoke management plans and background). A flexible burn period, if adopted, has potential to reduce

smoke management concerns in the spring.

Unfortunately, Towne and Craine's research was not conducted in grazed pastures, so the direct implications for grazed lands are unclear. However, a meta-analysis on burn-season research in grazed grassland by Engle and Bidwell (2001) demonstrated the resilience of tallgrass prairie. Consistent with Towne and Craine, they found that productivity varied little across sites burned at different times, including grazed prairie, but other compositional shifts varied by topography, precipitation, soil, fire history, and other factors. Other grazing-fire research found that sedges and other cool season grasses increase with fall or summer burning consistent with the Towne and Craine results. Sedges are a key winter and spring forage for bison in particular (Coppedge and Shaw 1998, Coppedge, et al. 1998).

In spite of variable results from burn-season studies, some very good reasons encourage us to consider vary time of burning in fire management plans. (See Leis 2008, chapter 1.1 for a thorough discussion of fire history in the Heartland, including frequency and season). We know that fires occurred year-round historically, but anthropogenic burning occurred most frequently in spring and fall periods, while lightening ignitions dominated in summer (Howe 1994, Bragg 1995). Burning in fall protected winter settlements and created grazing incentives. Research clearly tells us that most grassland grazers, especially those of the tallgrass prairie, prefer recently burned patches. (See annotated bibliography for a sampling of relevant citations) Therefore, having fresh plant growth that would persist for most of the winter season attracting game would encourage hunters to burn nearby grasslands. So, varying burn season would be consistent with historical fire occurrence.

Wilson's Creek National Battlefield in Missouri conducted a prescribed fire for glade and grassland restoration in October 2014.

Diversity in plant phenology is another reason to vary burn season (and probably one of the best reasons). Plants reach different lifecycle stages at different times through the year. Altering burn season provides opportunities for organisms to thrive in various years as burn timing changes. For example, spring burns typically reduce the spring forb guild and native cool season plants, while fall or late summer burns may give these species a temporary boost (Engle et al. 1998, Towne and Crain 2014). Similarly, wildlife species that are vulnerable in one period may benefit from varying burn season in some years. For example, herpetofauna come out of hibernation sluggishly in the spring, making them susceptible to mortality from fire, but a dormant season burn might find them sheltered from harm (see Gaetani et al. 2010 for more discussion of fire effects on wildlife).

Fire intensity affects plant responses to fire. Unfortunately, little research has effectively controlled fire severity to help us sort out how to reach our goals (See GPE 2013-23 for a discussion of this). Recent work has quantified fuel moisture levels needed to effectively burn eastern redcedar (Weir and Scasta 2014). Choosing timing when live fuel moistures would aid in attaining target fire intensities might more successfully achieve objectives than would locking into a single burn season when ideal conditions might not exist (Weir 2011). Varying burn season would allow managers to select for the right combination of fuel load, winds, fuel moistures, and phenological stage to best achieve objectives.

Lastly, varying burn season might provide logistical benefits. If you burn at a time when there is little demand for fire crews and when funding is available, you might have greater success in conducting the burn, than at times when there is high demand for crews and funding cycles are restrictive. The best place to start in determining the ideal time to burn should always begin with evaluating objectives for each fire you plan.

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More on Season of Fire by Sherry Leis

Blog post: http://www.gpfirescience.org/research-publications-1/2015/6/21/more-on-season-of-fire?rq=fall%20burning

After writing a recent post about fire effects for fall burning, a couple of interesting papers that speak to season of fire have crossed my desk. Both studies hailed from Texas and evaluated summer and winter burning in savanna. Although they measured different variables, both studies saw more pronounced effects of summer fire than winter fire.

Taylor et al. (2012) found that summer burning maintained live oaks while reducing other undesirable plants. Winter fires maintained the woody plants in the overstory but increased them in the understory, except for Ashe juniper. Winter burns also altered the frequency of grasses, in particular by increasing little bluestem.

Ansley et al. (2006) looked at the effects of burning in winter or summer on the soil nutrient pools. Interestingly, whole plant mortality was <5% for both seasons, but summer fire seemed to be more effective for top-killing plants. Mesquite resprouted more frequently in the summer fire treatments. C3 grasses (cool season) increased over controls in both fire seasons. Black carbon did not differ meaningfully between treatments or controls. Soil organic carbon and nitrogen increased as a result of summer fire, likely because of increased fire root production (indicated by greater primary production). Winter fire had no effect on soil organic carbon or nitrogen.

Together these projects, as well as the ones described in the fall burning post, indicate that the timing of prescribed fire can help managers work toward achieving specific objectives. Despite the differences between burning in different seasons, the biggest differences in many target variables may occur when comparing areas treated with prescribed fire to those with no fire treatment.

Literature cited

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