Tallgrass Prairie and Oak Savanna
Fire Science Consortium

JOINT FIRE SCIENCE PROGRAM

Research Brief for Resource Managers

Release: August 2015
Contact: Tracy L. Hmielowski
Phone: (608) 890-4713
Email: thmielowski.tpos.firescience@gmail.com

Measuring prescribed fire temperatures in South Dakota

Michelle K. Ohrtman, Sharon A. Clay, and Alexander J. Smart. 2015. Surface temperatures and durations associated with spring prescribed fires in eastern South Dakota tallgrass prairies. The American Midland Naturalist 173(1):88-98.

Prescribed fire is used in the Northern Great Plains region to enhance native vegetation and control invasive plants. Fire characteristics, including fire temperatures and duration of lethal heating, are dependent upon fuel loads, fuel moisture, and environmental conditions (e.g. ambient temperature). Measurement of fire characteristics is important because these characteristics are related to plant tissue damage and other measures of fire severity.

For example, in annually burned grasslands there is typically less fuel accumulation (i.e., lower fuel loads) and prescribed fires have lower temperatures and a shorter heating duration when compared to sites burned less frequently. There are also potential interactions between fire and grazing. This relationship between fuel loads, fire characteristics, and subsequent heating of plant tissues is complicated by seasonal timing, weather the day of the burn, and annual climate variation. Prescribed fires with greater temperatures or heating duration may favor native warm season grasses, but these relationships are not well documented in the upper Midwest and Great Plains.

The authors hypothesized that conditions which typically reduce fuel loads (annual burning and grazing) would decrease fire temperatures and duration of lethal heating in spring prescribed fires. To test this, experimental plots were established in eastern South Dakota in 2009. One set of plot was established in **cool season pasture** seeded with big bluestem, and the other plots in a native **prairie**. These different plot locations enabled the authors to test for differences in fire behavior between these community types in addition to the burning and grazing treatments.

Management Implications

- Lower fuel loads are associated with lower temperatures, and these conditions may be less effective at controlling cool season grasses
- Quantifying fire behavior and linking to fire effects can improve chances of meeting prescribed burn objectives

Prescribed fire treatment plots (no fire, annual spring fire, biennial spring fire) were split such that half of each plot was clipped to simulate grazing. Specifically, simulated grazing consisted of clipping vegetation to a height of 2 cm and the removal of clipped biomass once each week for four weeks following fire treatments. The authors acknowledge clipping is not the perfect analog for cattle grazing, as all vegetation was removed from the clipped plots. Grazing results in incomplete and selective vegetation removal and may subsequently result in different effects on fire performance. Prescribed fire treatments were initiated in 2009 and temperature and duration

were measured in 2011 and 2013. In addition to measuring surface temperatures, probes were also placed below the soil surface to test for heating at depths of 1, 2, and 3cm.

Maximum temperature and heating duration differed by year, site, and treatment in complex ways. These differences were mainly attributed to the effects that annual variation, site variation, and time since previous fire can have on fuel loading. In general, maximum recorded temperatures were greater in biennial fire plots and plots with no clipping. Maximum temperatures were also greater in 2011 compared to 2013, but interestingly the average heating duration was shorter in 2013 than 2011. Heating duration was also generally greater at the pasture site and in biennial fire plots.

There was no evidence of heating below the soil surface, suggesting that seeds are unlikely to be damaged by surface fires. Additionally, perennial plants with apical tissues belowground or capable of resprouting are unlikely to be killed by low intensity prescribed fires.

The variability observed in maximum temperatures and heating duration between the two sites and years demonstrates the importance of site specific evaluations over time. This study points out the difficulties in linking quantitative measures of fire behavior to fuel conditions and subsequent fire effects. However, by continuing to obtaining these data fire practitioners can improve their ability to predict fire behavior and improve the chances of meeting burn objectives.