**Paper**

Remote sensing in rangeland fire ecology: Comparing imagery to measured fire behavior, and burn severity across prescribed burns and wildfires

Summary/Accomplishment

Rangeland managers often want to know how effectively prescribed fires burned, but collecting fire behavior data requires substantial resources and expertise. Meanwhile, managers are uncertain about how to apply ecological knowledge about fire effects from prescribed fire experiments to rangeland affected by wildfire, because wildfires often burn under more extreme conditions and therefore might burn with greater severity. This study uses fire behavior measurements taken during prescribed fires and burn severity data taken from freely-available satellite imagery to compare 54 prescribed burns and 29 wildfires in and around North Dakota. As a fire’s rate of spread increased and flames burned hotter, burn severity also increased, but there was no significant relationship between burn severity and soil surface temperature. In the semi-arid parts of western North Dakota, eastern Montana, and northwest South Dakota, wildfires and prescribed burns all had low to moderate burn severity and thus were not different. In central North Dakota, wildfires had moderately high severity and prescribed burns were low. This study shows that differences in how fires burn can be described after the fact without needing to measure fire behavior as the fire occurs, which makes assessments of wildfires much easier. Understanding the relationship between burn severity across wildfires and prescribed burns helps apply knowledge gained from research on prescribed fires to grazingland impacted by wildfire. Hesitancy about prescribed burning might be overcome by increasing livestock managers' experience with post-fire forage resources through grazing areas burned in unintentional wildfires.

Abstract

Wildland fire scientists have made substantial advances in measuring fire behavior, but properly collecting data is often beyond the capacity of prescribed fire managers and by definition all but impossible for wildfire events. While a method for the immediate assessment of burn severity has been developed around multispectral imagery from space-based Earth observation systems, there has been little comparison of these post-hoc metrics to actual fire behavior. Meanwhile, the application of research results from experimental prescribed burns to rangeland affected by wildfire can be impeded by a lack of understanding of how immediate burn severity differs between wildfires and prescribed burns, especially in rangelands. Overall, much of what is known about wildland fire behavior, severity, and effects comes from forests, whereas rangelands are characterized by having lower fuel loads comprised of fine vegetation that promotes high rates of spread and brief residence time. This paper provides rangeland-specific information on the relationships between direct field-based fire behavior measurements and a space-based index of burn severity (differenced Normalized Burn Ratio, ΔNBR, from Sentinel-2 imagery), and use those data to compare burn severity across 54 prescribed burns in North Dakota, USA, and 29 nearby wildfires in the US Northern Great Plains. In prescribed burns, remotely-sensed burn severity increased with rate of spread and flame temperature 15 cm above the ground, but had no statistically-significant relationship with soil surface temperature. In the semi-arid western zone of the Northern Great Plains, wildfires and prescribed burns had similar, low-moderate severity; wildfires in the eastern zone tended to be moderately-high severity and thus greater than the low severity of the experimental prescribed burns. By describing meaningful gradients in surface fire behavior in rangelands with ΔNBR, even those without the capacity to measure fire behavior in the field can monitor prescribed fire effectiveness and incorporate burn severity in adaptive management plans. Understanding the relationship between burn severity across wildfires and prescribed burns is a critical step in applying knowledge gained from research on prescribed fires to areas impacted by wildfire. Resistance to prescribed burning might be overcome by increasing livestock managers' experience with post-fire forage resources through grazing areas burned in unintentional wildfires, but current practice and policy dissuades or outright prevents ranchers from doing so. Future research ought to connect burn severity with ecosystem recovery metrics to ensure post-fire grazing does not impair rangeland sustainability.

**SRM**

Remotely-sensed burn severity tracks with measured fire behavior, and is similar across prescribed burns and wildfires in semi-arid rangeland

Talk abstract

Properly collecting fire behavior data is often beyond the capacity of prescribed fire managers and all but impossible for wildfires. There has been little comparison of burn severity from remotely-sensed imagery to actual rangeland fire behavior. Meanwhile, the application of research results from prescribed burns to wildfires is impeded by a lack of knowledge about how burn severity differs. This study compares the relationships between field-based fire behavior measurements and a space-based index of burn severity (differenced Normalized Burn Ratio, ΔNBR, from Sentinel-2 imagery), and use those data to compare burn severity across 54 prescribed burns in North Dakota, USA, and 29 nearby wildfires in the US Northern Great Plains. In prescribed burns, remotely-sensed burn severity increased with rate of spread and flame temperature 15 cm above the ground. In the semi-arid western portion of the Northern Great Plains, wildfires and prescribed burns had similar severity; wildfires in the eastern zone tended to have higher severity than experimental prescribed burns. By describing meaningful gradients in surface fire behavior in rangelands with ΔNBR, even those without the capacity to measure fire behavior in the field can monitor prescribed fire effectiveness and incorporate burn severity in adaptive management plans. Understanding the relationship between burn severity across wildfires and prescribed burns is a critical step in applying knowledge gained from research on prescribed fires to areas impacted by wildfire. Resistance to prescribed burning might be overcome by increasing livestock managers' experience with post-fire forage resources through grazing areas burned in unintentional wildfires, but current practice and policy dissuades or outright prevents ranchers from doing so.