Effectiveness and Longevity of Wildland Fire as a Fuel Treatment

NORTHERN ROCKIES FIRE SCIENCE NETWORK

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Wildland fires, especially wildfires, are not commonly thought of as fuel treatments; however, because fires consume fuels and alter vegetation structure, they can serve as fuel treatments similar to more traditional means (e.g., mechanical or prescribed fire). To consider previously burned areas when managing subsequent fires, managers need information pertaining to the effectiveness and longevity of wildland fires as fuel treatments.

This study was designed to quantify how wildfire influences subsequent fire occurrence, fire progression (size), and fire severity.

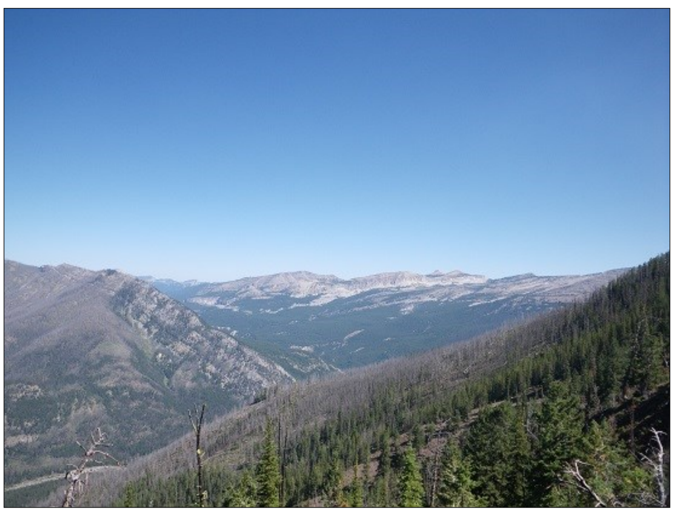

Figure 1. A portion of the Bob Marshall Wilderness, part of the Crown of the Continent Ecosystem, burned in the 2003 Little Salmon Creek fire. Photo courtesy of Sean Parks.

To limit the potential for confounding effects of past land management activities (e.g., timber harvest) and to ensure an adequate number of fires to evaluate, this study was conducted in four large study areas.

- The Frank Church—River of No Return Wilderness (FCRNRW) in central Idaho is characterized by a mixed-severity fire regime. Low-elevation, open ponderosa pine forests typically burn in frequent, low-intensity fires. Generally, fire frequency decreases and severity increases with increasing elevation, moisture, and tree density.
- The Selway-Bitterroot Wilderness (SBW) of western Montana and north-central Idaho is characterized by a mixed-severity fire regime. Many fires are nonlethal surface fires, but under suitable weather and fuel conditions, lethal surface fires and even stand-replacing crown fires occur.
- The Crown of the Continent Ecosystem (CCE) in northwestern Montana is characterized by mixed- to high-severity fire regimes, which are common in all but the alpine ecosystems (Figures 1, 3).
- The Gila and Aldo Leopold Wilderness Areas (GALW) in southwestern New Mexico are characterized by frequent, low-severity surface fires, but fire severity increases with elevation (Figure 2).

The influence of past fires on subsequent *fire occurrence* and *fire size* were evaluated using fire perimeter data in all four study areas. The influence of past fires on subsequent *fire severity* was evaluated using Landsat imagery in two of the study areas (FCRNRW and GALW).

Key Research Findings

Wildland fire acts as a fuel treatment by limiting the occurrence, size, and severity of subsequent fires.

The ability of wildland fire to act as a fuel treatment diminishes with time after fire and this time varied by study area .

Under extreme weather conditions, the ability of wildland fire to act as a fuel treatment is reduced.

Fire Occurrence

Wildfire limited subsequent fire occurrence in all study areas (Table 1). To evaluate the effect of previous burned areas on subsequent fire occurrences, researchers compared random and observed models. The observed model recorded the actual time between an initial wildfire and subsequent fire occurrence that resulted in a fire of at least 50 acres in size. The random model was generated by placing random ignitions on the landscape, which represented no effect of previous fires on subsequent fire occurrences. This process allowed researchers to evaluate the strength of the effect relative to time-since-fire. The limiting effects of past wildfire on subsequent fires lasted longer in the middle and northern Rocky Mountains than in New Mexico.

Table 1. Number of years fire acts as a fuel treatment for three treatment effects.*				
Treatment effect	**FCRNRW**	**SBW**	**CCE**	**GALW**
Fire occurrence	>25	21	24	9
Fire size	16	18	15	6
Fire severity	>20	NA	NA	>20

*Note: There is some uncertainty associated with these estimates (see Parks et al. 2016).

Figure 2. One year after the 2011 Miller Creek fire in the Gila Wilderness, New Mexico. Photo courtesy of Sean Parks.

The longevity of the effect of past fires limiting subsequent fire occurrence varied among study areas (Table 1), persisting for 9 years in the warm/dry GALW study area and over 20 years in the cooler/wetter FCRNRW, SBW, and CCE study areas (Parks et al. 2016). This variability in the longevity of the effect likely reflects differences in productivity and fire regime characteristics among study areas and ecosystems (Rollins et al. 2002). In GALW, fine fuels such as grasses and surface litter (i.e., pine needles) re-establish quickly after fire, re-setting the stage for the occurrence of new fires. In FCRNRW, SBW, and CCE, however, fire conducive conditions are less frequent and, when fire does occur, it is less influenced by herbaceous fuels than it is by ladder and canopy fuels that develop after relatively long fire-free intervals (Schoennagel et al. 2004).

Fire Size

Past wildfires limited the size of subsequent fires (Table 1). To evaluate the effect of previous burned areas on the size of subsequent fires, researchers analyzed fire perimeter data with an objectively and consistently applied rule-set defining whether or not burned areas acted as a barrier to

Table 2. Number of years fire limits subsequent fire size under different weather conditions as evaluated by energy release component (ERC).				
Energy release component (percentile)	**FCRNRW**	**SBW**	**CCE**	**GALW**
ERC 50th	18	24	24	8
ERC 75th	17	20	19	5
ERC 90th	15	17	16	4
ERC 99th	13	13	10	2

subsequent fire as time-since-fire increased (Parks et al. 2015a). Fires no longer limited the size of subsequent fires after 6 years in GALW, 15 years in CCE, 16 years in FCRNRW, and 18 years in the SBW. The ability of past fires to limit the size of subsequent fires weakened under extreme fire weather conditions (Table 2). The length of time that a past fire limited the size of a subsequent fire was shorter under extreme fire weather conditions than under moderate fire weather conditions in all four study areas. The ability of past fires to limit the size of subsequent fires diminished quickly in the dry conifer forests of GALW compared to the cool, moist conifer forests of CCE, FCRNRW, and SBW.

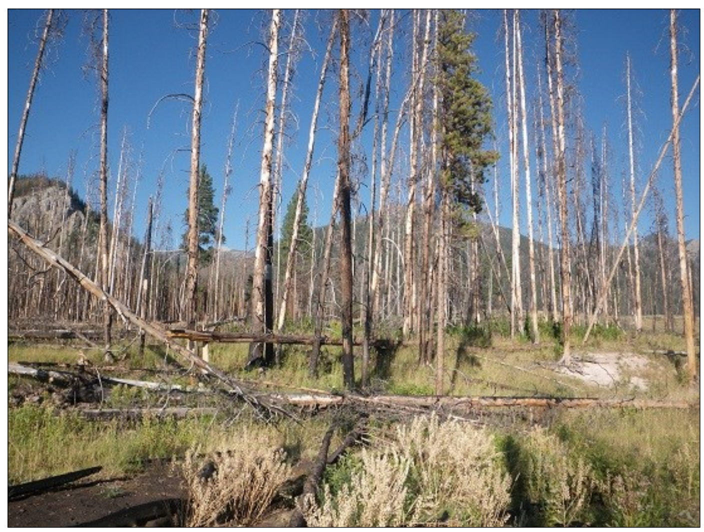

Figure 3. One year after the 2011 Hammer Creek fire in the Bob Marshall Wilderness, part of the Crown of the Continent Ecosystem in Montana. Photo courtesy of Sean Parks.

Fire Severity

Fire severity, as measured by the delta normalized burn ratio (dNBR), was substantially lower in recently reburned areas than in areas that had not burned recently in the FCRNRW and GALW (Parks et al. 2014). In the FCRNRW, the mean dNBR in reburned areas was 158 compared to 339 in non-reburned areas. In the GALW, mean dNBR in reburned areas was 89 and in non-reburned areas was 213. Fire severity in reburned areas increased with time since fire, and the ability of previous wildfires to mediate subsequent fire severity lasted at least 20 years.

Management Implications

In the western US, many landscapes have experienced substantial fire activity in recent decades. This study informs decision making by fire managers. Knowing that fire occurrence, size, and severity are limited by recent wildfires should provide greater flexibility and confidence in managing fire incidents and managing for resource benefit. Specifically, the findings from this study can be used by fire managers to help predict whether a previous fire will act as a fuel treatment based on fire age, forest type, and expected weather.

Additional Reading & Information

Parks, S.A.; Miller, C.; Holsinger, L.M.; Baggett, L.S.; Bird, B.J. 2016. Wildland fire limits subsequent fire occurrence. International Journal of Wildland Fire. Online: dx.doi.org/10.1071/WF15107.

Parks, S.A.; Holsinger, L.M.; Miller, C.; Nelson, C.R. 2015a. Wildland fire as a self-regulating mechanism: the role of previous burns and weather in limiting fire progression. Ecological Applications. 25(6): 1478-1492.

Parks, S.A.; Miller, C.; Nelson, C.R.; and Holden, Z.A. 2014. Previous fires moderate burn severity of subsequent wildland fires in two large western US wilderness areas. Ecosystems. 17: 29-42.

Parks, S.A. 2014. Mapping day-of-burning with coarse-resolution satellite fire-detection data. International Journal of Wildland Fire. 23(2): 215-223

Parks, S.A. 2015b. The ability of wildfire to act as a fuel treatment: Webinar with the Northern Rockies Fire Science Network. http://nrfirescience.org/event/ability-wildfire-act-fuel-treatment

Rollins, M.G.; Swetnam, T.W.; Morgan, P. 2001. Evaluating a century of fire patterns in two Rocky Mountain wilderness areas using digital fire atlases. Canadian Journal of Forest Research. 31(12): 2107-2123.

Schoennagel, T.L.; Veblen, T.T.; Romme, W.H. 2004. The interaction of fire, fuels, and climate across Rocky Mountain forests. BioScience. 54(7): 661-676.

Data generated for this project are available online -

FCRNRW: www.fs.usda.gov/rds/archive/Product/RDS-2015-0021

SBW: www.fs.usda.gov/rds/archive/Product/RDS-2015-0024

CCE: www.fs.usda.gov/rds/archive/Product/RDS-2015-0022

GALW: www.fs.usda.gov/rds/archive/Product/RDS-2015-0023

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The Northern Rockies Fire Science Network (NRFSN) serves as a go-to resource for managers and scientists involved in fire and fuels management in the Northern Rockies. The NRFSN facilitates knowledge exchange by bringing people together to strengthen collaborations, synthesize science, and enhance science application around critical management issues.