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Information and tools to conserve and restore Great Basin ecosystems

Fuel Breaks that Work

The Northern Great Basin (NGB) sagebrush steppe has undergone significant transformations in the last few decades. Formerly a shrub-bunchgrass community that was only periodically affected by wildfire, the NGB sagebrush steppe is now one of the most threatened ecosystems in the United States (Noss et al. 1995). Invasive grasses like cheatgrass (*Bromus tectorum*) and medusahead (*Taeniatherum caput-medusae*) are continually increasing, converting native sagebrush steppe plant communities into nonnative annual-dominated grasslands. In lower elevations of the NGB sagebrush steppe (below 4000 ft), the fire return interval has been reduced from 50 to100 years to less than 10 years in some places. These changes are having highly negative effects on sagebrush obligate species, including greater sage-grouse (*Centrocercus urophasianus*), which is being considered for listing under the Endangered Species Act.

Wildfires in the sagebrush steppe expand quickly and can affect hundreds of thousands of acres of sage-grouse habitat in a matter of days. For example the Long Draw (2012) and Buzzard Complex (2014) fires in southeastern Oregon both had multiple hundred-thousand-acre runs in a single burning period with a rate of spread between 10 and 15 miles per hour. To compound the problem, annual grasses that typically invade lower elevation sagebrush communities (below 4000 ft) are now expanding into mid elevations following wildfire. In cases where the perennial grasses and forbs have been depleted, these previously more resistant sagebrush communities have become susceptible to conversion to invasive annual plant dominance (Davies et al. 2011). Scientists and managers struggle with how to protect sagebrush habitat from wildfires that perpetuate the invasive annual/wildfire cycle.

In January 2015, Department of Interior Secretary Sally Jewell implemented Secretarial Order 3336 that builds on the National Cohesive Wildland Fire Management Strategy, and provides for policies and strategies for preventing and suppressing rangeland fire and restoring sagebrush landscapes impacted by fire. One method fire managers are using in the NGB to combat wildfires is the establishment of strategically placed fuel breaks. Fuel breaks are blocks or strips where fuels have been modified or reduced and are placed adjacent to discontinuous or altered fuel beds that are intended to reduce flame lengths and the rate of spread of oncoming wildfires. Fuel breaks can facilitate fire suppression efforts and reduce the loss of key sagebrush habitat.

Purpose: To provide a framework for the placement, use, and effectiveness of established fuel breaks for protecting sagebrush ecosystems.

In Brief:

- Established fuel breaks are a useful tool for managing the size and severity of wildfires.
- Managers recommend a holistic approach that includes education, monitoring, and maintenance to maximize the benefits of fuel breaks.
- Fuel breaks are useful for slowing and sometimes stopping fires, but can’t alone be depended on to stop a wind-driven head fire.

Four main criteria for fuel breaks

- Landscape level considerations. Locate breaks in low to mid-elevation ecosystems that have low resistance to invasive annual grasses.
- Strategic level considerations. Locate breaks where necessary for firefighter access and safety.
- Timetable considerations. Plan construction so that breaks are there when you need them.
- Economic considerations. Use breaks as a long-term strategy to reduce the size and severity of wildfires.

BLM Fire Manager Interviews from Idaho, Nevada, and Oregon

Peer-reviewed literature on the effectiveness of fuel breaks in the sagebrush steppe is hard to find. Available research primarily addresses the protection of property, not the protection of habitat. Fire behavior models can't capture the combined effects of fire suppression and fuel breaks. Despite the lack of scientific information, firefighters routinely use (and require) fuel breaks in wildfire operations. Firefighters are able to observe the effectiveness of fuel breaks first hand. Using qualitative interviews, information from the fire line can be captured.

To glean that first-hand experience, fifteen interviews were conducted with fire managers – fuels and fire specialists and fire ecologists – who have worked in the NGB. They were interviewed from district offices across the network of BLM districts in the NGB – Boise and Twin Falls in Idaho, Elko and Winnemucca in Nevada, and Vale and Burns in Oregon. Managers were asked about the function, strategic placement, and effectiveness of different types of fuel breaks that had been used on their districts. Managers who were interviewed averaged 23 years of experience and each contributed substantial operational knowledge that normally goes unrecorded. Themes from the interviews are summarized below.

Function of an Established Fuel Break

Fire managers resoundingly agreed that the purpose of fuel breaks is to allow firefighters to actively engage in fire suppression in a safe, strategic manner without committing exhaustive resources to control or contain the spread of wildfire. The basis for constructing fuel breaks should be the expected fire behavior for a given fuel or vegetation type and the resource objectives that the fuel breaks are designed to protect. Fuel breaks in one form or another are constructed "on the fly" for every fire; these include basic hand lines, dozer lines, and retardant lines. Established fuel breaks apply the same concept as suppression fuel breaks, but are put in place before the fire so that firefighters can use them when wildfires occur.

Proactive fuel breaks (the enhancement of existing roads and vegetation manipulation adjacent to these roads) can constrain fire spread and augment suppression efforts by providing firefighters better access to the fire and safe locations to establish anchor points and engage in suppression.

By reducing the flame intensity (Figure 1) and the rate of spread, a fuel break can work as a fire suppression resource and allow firefighters to focus on areas of greater concern (e.g., key sagebrush habitat). Strategically placed fuel breaks help contain flanking and backing fires using fewer resources and provide safe anchor points to conduct burnout operations for combating head fires.

"*The main function of any fuel break is to break the fuel side of the fire behavior triangle (fuels, weather, and topography). The only leg of that triangle that we can manipulate or control is the fuels*."

–Lance Okeson, Boise District BLM Fuels AFMO

"*Changing fire behavior from 12 to 15 foot flame lengths down to a 0 to 4 range gives them a fighting chance.*"

–Jason Simmons, Vale District BLM AFMO

Backing Fire: Fire spreading, or ignited to spread, against the wind or downslope. A fire spreading on level ground in the absence of wind is a backing fire.

Burnout Operations: Setting fire inside a control line to consume fuel between the edge of the fire and the control line.

Head Fire: Fire spreading or set to spread with the wind.

BEHAVE+: A system of interactive computer programs for modeling fuel and fire behavior, comprised of two systems: BURN and FUEL.

Flame Length Comparison between Mowed and Unmowed Sagebrush

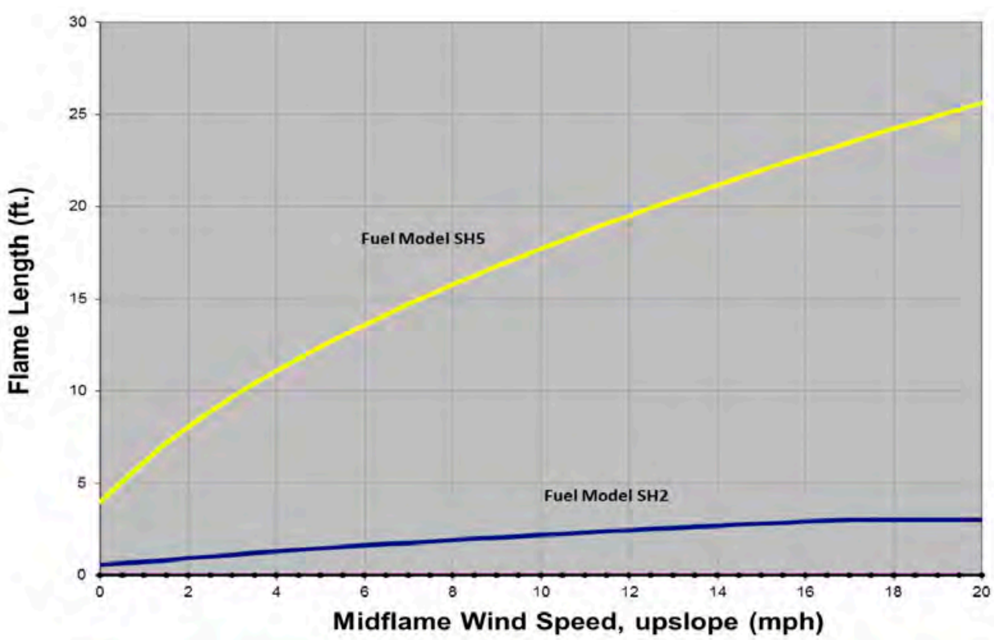

Figure 1. Flame length comparison between the typical sagebrush fuel model (SH5) and a representative model (SH2) for mowed fuel. The graph shows the results of the BEHAVE+ fire behavior model in typical summer conditions with a 20 percent slope.

Fuel Break Treatments and Parameters

Fire managers have used a wide variety of established fuel break types to help suppress wildfires in the NGB. Fuel break treatments and parameters are considered based on location, elevation, climate, values at risk and species of concern. In some cases, several treatments are used in combination to establish and maintain fuel breaks.

Road Maintenance: Roads have been the primary form of control lines and in some cases provide the only source for a fuel break. Clearing roads and adjacent roadbeds can be very effective for preventing and/or controlling rangeland wildfires, and is what firefighters use most of the time to help suppress wildfires. Road improvements alone, however, are not enough to suppress wildfires in heavy brush or during high wind events. All managers recommend combining fuel breaks with roads for better access to the fire and to limit the disturbance footprint.

> *"But we've had others, I was part of one…right here off the interstate…and we just had one little fuel break that went off I-84 … it tied into an existing road. It wasn't that long of a fuel break but it started in a place where we've had prior fire starts. Right on an interchange used as an exit pull off … All it was is just road improvements where we cleaned and widened the road… We turned a jeep trail into an actual fuel break and the fire was just 30 acres as opposed to the potential for something over 100. So I think they definitely had an advantage."*

–Jason Simmons, Vale District BLM AFMO

Brown Strips Devoid of Vegetation: Disk lines are the preferred treatment for preventing wildfire starts along interstates and highways. Disk lines may range from 10 to 20 feet and are taken down to mineral soil. Boise, Winnemucca, and Vale districts all use disk lines adjacent to interstates to prevent human caused starts. Tumbleweed burning along fence lines is another method of creating brown strips. Brown strips were proven to be effective in preventing wildfires, though lack of continual annual maintenance was stated as a significant downfall to their use. But erosion potential is a concern on erodible soils or steeper slopes.

> *"For example, in 2012 just one of those fuel breaks along Highway 95 aided in the suppression of … I think it's six or eight fires that particular year."*

–Mark Williams, Winnemucca District BLM Fire Ecologist

Mowed Fuel Breaks: Mowed Fuel breaks immediately adjacent to roads are the preferred treatment to limit wildfire size in or near intact sagebrush patches. Fire managers recommend mowing strips of at least 100 to 300 feet adjacent to roads on both sides, depending on live fuel loading and resource objectives. Mowed strips must be wide enough to break large-scale, wind-driven fires that can produce 30-foot flame lengths. Managers agreed that "the wider the fuel break, the better." Vegetation should be mowed down to 6 to 12 inches to be effective. Follow-up chemical treatments and drill seeding may be needed to prevent the spread of invasive plants. Selection of species to seed is a local decision based on soils, community potential, invasive species present, and management objectives. The advantages of mowing include maintaining native vegetation and the ability to set back fires if needed.

Winnemucca and Elko Districts use mow lines to protect key sagebrush habitat. Vale District uses a combination of mowing, disking, and chemical treatments.

Back fire: Intentionally setting fire inside the control line to slow or contain a rapidly spreading fire. Provides a wide defense perimeter and makes possible locating control lines where the fire can be fought on the firefighter's terms.

Figure 2. Example of fire behavior in a Wyoming big sagebrush vegetation type (SH5 fuel model).

Mowed fuel breaks adjacent to roads were an integral part in corralling the western flank of the Long Draw Fire in 2014. Mowing treatments require maintenance. Maximizing the control of sagebrush in initial treatments will maintain the integrity of the fuel break for a longer period.

"That same fuel break system stopped another two fires. Jackie's Butte fires, which ended up being about 15,000 acres. When we design those that were just outside that boundary, we were looking at compartmentalization."

–Jason Simmons, Assistant Fire Management Officer Vale District BLM.

Greenstrips: Greenstripping is the concept of strategically establishing fire-resistant vegetation to reduce the rate of spread and the intensity of wildfires. Greenstripping is a preferred method in areas that have undergone conversion to invasive annual grassland or areas highly susceptible to annual grass invasion. Strips 100 to 300 feet wide are recommended. The primary advantage of greenstripping is that once they are established they are long term fuel breaks that require limited maintenance. Another advantage is that properly timed livestock use can reduce cheatgrass thereby decreasing fuel continuity and lowering competition with seeded species, which can lengthen the period that the greenstrip plants remain green (Figure 3). Species selected for greenstripping should be fire and drought tolerant, palatable, and able to compete with annual species (Pellant 1994). Species selection for greenstripping is contingent on local conditions and management objectives. Introduced or native species can be effective depending on site conditions (Monsen 1994). Some introduced species have the potential to escape into native communities (Gray and Muir 2013), and species should be chosen carefully.

"I know the Murphy Complex fire … they actually mowed an existing green strip the year before and the crews used that area to burn out from and catch the north head of that fire. And talking to the IC (Incident Commander) that was out there, it did make a big difference because it had been mowed the year before. They can move a lot faster on their burnout operation."

–Brandon Brown, Fire Management Specialist, Twin Fall District BLM

Strategic placement

Fire managers agreed that access was the number one priority for strategic fuel break placement. By using existing road systems such as known fuel breaks, disturbance can be minimized and the initial response time to wildfires can be reduced. Managers recommended that placement of fuel breaks be tied to weather patterns and wind direction, fire frequency and land protection priority. Fuel breaks can be placed directly next to resources at risk in order to provide point protection. They can also be used to compartmentalize large intact sagebrush communities to minimize losses of landscape-scale vegetation. Fuel breaks should be continuous, well known, and most importantly, accessible.

"*The better bang for your buck is to put fuel breaks on a road system so your ground suppression resources can get there, especially in the sagebrush fuel type. If you have air resources, you could put one in and rely on maybe hand crews and aircraft. But to me that's not as effective."*

–Tom Reid, Elko District BLM Fuels Program Manager

Figure 3. A greenstrip in south-central Idaho grazed by livestock in early spring resulting in reduced cheatgrass and a longer effective period to reduce potential wildfire impacts.

Effectiveness

The main theme fire managers expressed regarding fuel breaks is that they are not show stoppers. "*You still have to show up to the fire,*" said Lance Okeson, Boise District BLM Fuels AFMO. Fuel breaks are designed to work in conjunction with fire resources (e.g., engines, water tankers, etc.) to stop fires. In most situations fuel breaks alone will only reduce the rate of spread and intensity of a wildfire. It won't put it out, but it can greatly increase the chances of containing a fire and can dramatically reduce the size and severity of wildfires. Managers agreed that fuel breaks will not slow down head fires under extreme conditions, but will dramatically reduce the spread rate of a flaming front under normal conditions. They also reported that fuel breaks are extremely effective in controlling backing and flanking fires. Managers from all six districts gave several accounts of how established fuel breaks on their districts have been effective in reducing the size and severity of wildfires.

> *"It just takes your success rate from 40 percent to 80 percent and you don't see the bubble paint job and melted lights on the engine. When you don't have those fuel breaks, you're still trying to hold the same roads but it's going to take a dozer, eight engines and a crew to pull this project off and in the end they may or may not be successful, but I can tell you it puts firefighters in a greater exposure of risk."*

–Dave Toney, Zone Fire Management Officer, Burns Interagency District.

Issues to consider when constructing fuel breaks

The main issues to consider when constructing fuel breaks include: wildlife concerns, invasive weeds, use of non-native plants, wilderness characteristics, jurisdictional boundaries and resource objectives. The fire managers we interviewed resolved most of these issues by effective scoping during the NEPA process, working with subject matter specialists, and using a science-based approach to maintain key habitat in sagebrush ecosystems. Although managers agreed that it is difficult to completely address all of the social and environmental issues related to fuel break construction, for them the benefits of reducing wildfire size and severity always outweighed the cost of disturbance.

Management implications

Established fuel breaks are a useful tool for managing the size and severity of wildfires. Fuel breaks need to be integrated with other natural resource management practices to maintain and restore sagebrush rangelands in the Northern Great Basin. *"It's not just fuel breaks, this is just one tool,"* said Brandon Brown, Fire Management Specialist, Twin Falls District BLM. Limiting large-scale wildfires helps break the invasive annual/wildfire cycle, and provides opportunities for improving the long-term viability of sagebrush steppe restoration. Managers recommend a holistic approach of education, monitoring, and maintenance to maximize the benefits of established fuel breaks.

Table 1. The BLM is currently using the Fuel Treatment Effectiveness database (FTEM) to track the effectiveness of fuel treatments. The list below is a compilation of fuel treatment effectiveness, including fuel breaks, in Oregon, Idaho, and Nevada and shows the percent of treatments (based on acres) that have been effective in changing fire behavior and controlling wildfires. Fires reported are BLM only.

	Did treatment Change Fire Behavior				Did Treatment Control wildfire?				
Year	No		Yes		No		Yes		Total
	Acres	%	Acres	%	Acres	%	Acres	%	
2006	0	0.0%	70	100.0%	0	0.0%	70	100.0%	70
2007	0	0.0%	8,442	100.0%	0	0.0%	8,442	100.0%	8,442
2008	0	0.0%	17,229	100.0%	150	0.9%	17,079	99.1%	17,229
2009	40	1.7%	2,250	98.3%	40	1.7%	2,250	98.3%	2,290
2010	142	7.1%	1,868	92.9%	142	7.1%	1,868	92.9%	2,010
2011	0	0.0%	10,933	100.0%	0	0.0%	10,933	100.0%	10,933
2012	259	0.3%	78,432	99.7%	3,776	4.8%	74,601	94.8%	78,691
2013	1,077	39.3%	1,666	60.7%	977	35.6%	1,766	64.4%	2,743
2014	2,600	12.7%	17,802	87.3%	1,681	8.2%	18,721	91.8%	20,402
Total acres and average percentage	**4,118**	**2.9%**	**138,692**	**97.1%**	**6,766**	**4.7%**	**135,730**	**95.0%**	**142,810**

Detailed Methods

Interviews were coded in agreement with qualitative grounded theory analysis (Struass and Corbin 2008) using NVIVO qualitative software version 10. Individual interview texts were read sequentially and text segments were inductively assigned open codes (simple words or phrases that summarize the theme of the segment). Texts coded with similarity in the previously mentioned categories (i.e. function, parameters, effectiveness etc.) were assigned themes. Themes common among fire managers are described in text.

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References

Crawford, J. A., R. A. Olson, N. E. West, J. C. Mosley, M. A. Schroeder, T. D. Whitson, R. F. Miller, M. A. Gregg, and C. S. Boyd. 2004. Ecology and management of sage-grouse and sage-grouse habitat. *Journal of Range Management* 57: 2-19.

Davies, K. W., C. S. Boyd, J. F. Beck, J. D. Bates, T. J. Svejcar, and M. A. Gregg. 2011. Saving the sagebrush sea: an ecosystem conversion plan for big sagebrush plant communities. *Biological Conservation* 144: 2573-2584.

Gray, E.C., and P. S. Muir. 2013. Does *Kochia prostrata* spread from seeded sites? An evaluation from southwestern Idaho, USA. *Rangeland Ecology and Management* 66:191-203.

Monsen, S. B. 1994. Selection of plants for fire suppression on semiarid sites. p. 363–373. In: S.B. Monsen and S.G. Kitchen (comps.). Proceedings-symposium on ecology and management of annual rangelands. 18–21 May 1992. Boise, ID. Gen. Tech. Rep. INTGTR- 313. USDA Forest Service, Intermountain Research Station, Ogden, UT. 416 p.

Noss, R. F, E. T. LaRae III, and J. M. Scott. 1995. Endangered ecosystems of the United States; A preliminary assessment of loss and degradation. National Biological Service Report 28, Washington DC

Pellant, M. 1994. History and applications of the intermountain greenstripping program. p. 63–68. In: S.B. Monsen and S.G. Kitchen (comps.). Proceedings-symposium on ecology and management of annual rangelands. 18–21 May 1992. Boise, ID. Gen. Tech. Rep. INT-GTR-313. USDA Forest Service, Intermountain Research Station, Ogden, UT. 416 p.

Strauss, A., and J. Corbin. 2008. Basics of Qualitative Research: Grounded Theory Procedures and Techniques, 3rd Edition Sage Publications: Thousand Oaks, CA.