Fire Management today

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Rangeland Fire: The Other Kind of Fire

United States Department of Agriculture
Forest Service

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On the Cover:

A Bureau of Land Management engine assists with holding operations on the Two and a Half Mile Fire in Idaho in 2011. Heavy engines are indispensable tools in rangeland fire suppression. Photo credit: Austin Catlin, Bureau of Land Management

The USDA Forest Service's Fire and Aviation Management Staff has adopted a logo reflecting three central principles of wildland fire management:

- *Innovation:* We will respect and value thinking minds, voices, and thoughts of those that challenge the status quo while focusing on the greater good.
- *Execution:* We will do what we say we will do. Achieving program objectives, improving diversity, and accomplishing targets are essential to our credibility.
- *Discipline:* What we do, we will do well. Fiscal, managerial, and operational discipline are at the core of our ability to fulfill our mission.

Firefighter and public safety is our first priority.

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Anchor Point

by Tom Harbour
Director, Fire and Aviation Management
Forest Service

Understanding Fire Doctrine: The Doctrinal Pyramid

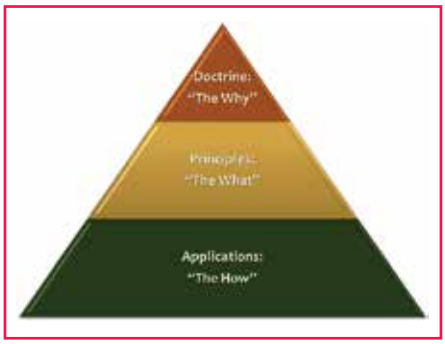
What is doctrine? Eight years after the Forest Service adopted this thing we call "doctrine," I still hear people say that they don't understand it.

Definition: Doctrine is the body of principles that sets the moral or ethical standard and forms the foundation of judgment, mode of action, decision, and behavior. It is authoritative but flexible, definitive enough to guide specific operations, yet adaptable enough to address diverse and varied situations.

The Doctrinal Pyramid

So what does all that mean, and how do we apply it? Perhaps it would be helpful to imagine a pyramid divided horizontally into three sections. The top of the pyramid is "Doctrine"—the why. The middle part is "Principles"—the what. And the bottom, the largest portion of the pyramid, is "Applications"—the how.

Good examples of basic applications of doctrine include guidance such as Lookouts, Communication, Escape Routes, and Safety Zones (LCES); the 10 Standard Firefighting Orders; and 18 Watchout Situations ("10s" and "18s"). These practices are easy to understand and guide preparation and response behaviors. They are the foundation of our operations, just as "Applications" is the foundation of our pyramid. Based on this foundation, we need to learn from



The Doctrinal Pyramid.

and build on our understanding based on the foundation.

When we started in our first jobs as wildland firefighters, we were taught that preparing a good foundation (rules and applications) would assist us in mitigating the risks associated with our roles in wildfire incident response. As we grew professionally, although we started to gain an innate sense of things, too often we devoted more time and attention to the applications (the *how),* and less to the doctrine (the grand "why") and the principles (the "what").

True doctrine, properly understood, changes behaviors. We need to change our behaviors to align with our understanding of *why* things are. Therefore, we need to teach all three parts of the pyramid: doctrine, principles, and applications.

Doctrine and Objectives

Now is the time to focus on better objectives. Objectives should guide our actions and must be shaped by the "whys" and the "whats," while our actions must be carried out through applications. We cannot focus only on topographic or mundane objectives that we repeat by rote.

Yes, our actions are based on operational objectives. But, I want recognition of the complexity in objectives (strategic vs. tactical; largescale vs. smallscale; broad vs. focused, etc.). We need to think much more about the "whys" and the "whats," rather than always the "how."

This starts with a clear understanding. Leaders and firefighters should understand wildland fire or prescribed fire incidents and what the assigned agency administrator wants them to accomplish. The incident commander or the burn boss needs to clearly translate those agency administrator objectives into specific objectives needed to accomplish the "whys" and "whats" of the job to be done.

The key to our success is based on a clear understanding of our fire doctrine. Doctrine is (to repeat) authoritative, yet flexible; definitive, yet adaptable. It creates an organization guided by well-stated principles that represent the scope of the work, the work environment, and the mission. It must be understood and be meaningful to every employee and be at the heart of safe and effective mission accomplishment. ■

Note From This Issue's Coordinator

Ken Frederick

Welcome to a special issue of *Fire Management Today* (FMT). This issue focuses on rangeland fire—how it is different from forest fire, how it is managed and suppressed, and why it is an important aspect of numerous Federal, State, tribal and local fire programs. We have assembled a set of articles intended to create a well-rounded picture of rangeland fire.

The U.S. Department of the Interior, Bureau of Land Management's (BLM) deputy assistant director for Fire and Aviation, Howard Hedrick, sets the tone for this edition of FMT by explaining why rangeland fire is a relevant topic for wildland fire professionals. With 2 out of every 5 acres of land in the United States considered rangeland and factors like climate change and invasive grasses complicating the fire problem, the next generation of wildland fire professionals needs to understand the complexities of rangeland fire.

Randy Eardley contributed an article that explores the predicament fire managers face in numerous places across the arid West: the "vicious cycle" created by flammable invasive species in rangelands. The presence of these flammable invasive species, particularly cheatgrass, sets the table for frequent occurrences of wildfire, and the disturbance created by the unnaturally frequent fires invites more invasive species. Eardley's article examines some of the current strategies available to managers to help break this pattern.

This edition of FMT also includes an article reviewing the basic, but critical, elements of rangeland fire behavior. Although grass and brush fires usually have a low resistance to control, they are often very challenging because they can spread incredibly fast and grow to monstrous sizes in a single burning period. The article presents five common-sense tactical strategies for firefighters engaging these kinds of wildfires. For seasoned wildland firefighters and fire managers, these strategies are good reminders; for people newer to the profession, they are lessons to be learned.

We have also included an article outlining the BLM's strategic use of a highly capable fleet of wildland engines as the backbone of its suppression operation. A great deal of BLM landscapes are sprawling and arid expanses with predominantly lighter fuels. When fires start, the tactical situation usually demands a cost-effective, mobile water delivery platform. Many BLM hotshot crew members and smokejumpers start their careers on engine crews, gaining critical experience in fighting hot, fast-moving fires.

This issue also touches on the rangeland-urban interface. You might not be familiar with this term. When firefighters think of the wildland-urban interface, most of us have an image of nice homes nestled on the edges of forested meadows. But, in the Great Basin and many other parts of the Western United States, the interface includes interstate highways, mining infrastructure, ranches, oil wells, and homes. The article examines some of the special aspects of the rangeland-urban interface. Suppressing fire in these settings means grappling with unique factors and challenges.

Finally, Don Smurthwaite contributed an article about the future of rangeland fire. Much of the 770 million acres of rangelands in the United States are under siege by invasive species, climate change, and shifting land-use patterns. Smurthwaite spoke with scientists, ecologists, and fire managers to get a sense of what the next three to five decades hold for rangelands. Their conclusions are both sobering and eye-opening.

The bleak outlook for rangelands underscores the plight these landscapes are facing today. Invasive species are perhaps the greatest agent of change threatening grass and brush ecosystems; fire is merely the natural force that distills these threats into something we can see and grasp. The perception that brush and grass fires deserve less attention than fires burning in heavier fuels is no longer valid—if it ever was. For the BLM and its partners managing fire across the rangelands of the Western United States, fire management is a massive job, and it must be accomplished safely and correctly, now, more than ever. ■

Ken Frederick is a public affairs specialist with the U.S. Department of the Interior, Bureau of Land Management, External Affairs, National Interagency Fire Center.

The Other Kind of Wildfire

Howard Hedrick

Range Fires: The Perception Problem

Let's be candid: when it comes to wildfire, forests get the lion's share of the attention. There are a number of reasons for this. Start with Smokey Bear, one of the most successful and widely known Ad Council campaigns ever conducted. Generations of Americans have grown up with the friendly reminder, "Only You Can Prevent Forest Fires." Recently, Smokey's famous line was changed to "only you can prevent wildfires." Still, it is difficult for many people, old and young, to overcome the notion that *not* all fires in natural landscapes are *forest* fires.

Although range fires can and do burn ferociously, they are generally much shorter in duration than large forest fires. While a major forest fire may burn for weeks or even months, large range fires typically burn for only a few days. They don't have the staying power to capture the public's attention.

Also, undeservedly, range fires are perceived as being "easier" to suppress. The truth is that range fires, because of their propensity to spread across thousands of acres an hour, are among the quickest to spread and the trickiest of all to manage, especially during initial attack. They're also dangerous: a disproportionately high percentage of fire fatalities and serious injuries occur in light, flashy rangeland fuels.

It's difficult for many people, old and young, to overcome the notion that not all fires in natural landscapes are *forest* fires.

Then there's the dramatic aspect of wildfire: smoke and flames in a forest have a greater visual impact on the public than smoke and flames burning in range vegetation. Crown fires in a forest make for dramatic television footage and photography. Not convinced? When is the last time you saw CNN broadcast footage of a sagebrush fire?

The cruelest truth of all may be that rangelands simply aren't as aesthetically appealing to most of the public as forests. Rangelands do not carry the same associations in the public mind. "It's only sagebrush" or "it's just scrubland" are all-too-common reactions to wildfires burning in rangelands.

Rangelands Under Siege

Across the Western United States, rangelands are simply too vast to ignore, and the impacts of rangeland fire are too great to escape. Two of every 5 acres in the United States are considered rangeland, and these sprawling landscapes aren't as tough, resilient, and static as the casual observer might expect. They are complicated and

The 2013 McCan Fire on the Twin Falls District exhibits explosive fire behavior, especially in brush fuels.

Howard Hedrick is the deputy assistant director with the U.S. Department of the Interior, Bureau of Land Management, Fire and Aviation.

diverse ecosystems that support a surprising variety of wildlife and vegetation and are under constant pressure to change. Species in an ecosystem are interdependent; like dominoes, when one falls, others may be pushed over too.

Rangeland relationships are more fragile than many might suppose. Perhaps the primary rangeland conservation concern currently involves the greater sage-grouse, a species directly linked to the health of rangelands in much of the West. Sage-grouse numbers are shrinking, as are populations of large and small mammals and birds, such as raptors. This is occurring as rangelands across the country are under attack by nonnative vegetation. Invasive cheatgrass, for example, is now the dominant vegetation on as many as 50 million acres (20 million hectares [ha]) in the Great Basin alone. Although this was once thought to be only a lower elevation problem, cheatgrass has now spread to rangelands up to 8,000 feet (2,400 meter) above sea level.

The truth is that range fires, because of their propensity to spread across thousands of acres an hour, are among the quickest to spread and the trickiest of all to manage, especially during initial attack.

As species gain or lose dominance, the ecosystem itself changes. Most of the invasive plant species spreading throughout the rangelands are highly flammable in comparison to native plants, and it's easy to see how an increasing supply of flammable vegetation, coupled with higher regional temperatures and reduced rainfall, adds up to a recipe for ecological disaster. As a result, we've lost much of the long-lived perennial vegetation on our rangelands to fire. Native shrubs rarely come back after a fire, but grasses do, and in many areas, the previous shrub-based ecosystem has changed to a grass-based ecosystem.

Rangeland Fire Protection Associations Are Helping With Rangeland Fire Suppression

Rangeland Fire Protection Associations (RFPAs) are State-chartered, nonprofit organizations established to prevent and suppress range fires. RFPAs are operated by their members (who are typically ranchers, farmers, and rangeland permittees) and are funded by fees (set by local boards) and grants. RFPAs give trained members the legal authority to fight fires—primarily fires occurring on public lands leased or allotted to rangeland users or public lands adjacent to private rangelands.

RFPAs are brought into existence by a State charter and a Memorandum of Understanding, but their activities on incidents are defined and governed by an annual operating plan. The annual operating plan addresses topics like chain of command, organizational structure, dispatch procedures, safety, etc. The annual operating plan also includes direction addressing policies, such as suppression-related ground disturbance (i.e., bulldozer and disk work).

Wes Wootan is a county commissioner, farmer, and one of the early members of the Mountain Home RFPA. "Before we started getting RFPAs set up, the BLM [Bureau of Land Management] fire guys were put in a bad spot," Wootan said in a 2013 interview. "They had to tell ranchers who showed up to help fight fires, "You can't be on this fire." The ranchers wanted to help because these fires were destroying their livelihoods. Now ranchers and farmers have a way to work with the BLM for the good of both parties."

RFPAs do not provide structural fire protection; they are created to protect improvements private landowners have made on rangelands, assist adjoining cooperators if asked, and keep wildfires small through safe, aggressive initial attack.

RFPAs are successfully operating in Oregon and Idaho. The State of Nevada envisions RFPAs in the near future. The RFPA model is proving to be an effective way of fighting fire—and resolving fire management conflicts.

Range Fires: The Other Wildfires

Range fires, "the other kind of wildfire," deserve our attention and respect for a variety of reasons. One is professional: the intervals between rangeland fires are shrinking at an alarming rate, as areas that used to burn every 100 years or so now often burn every 5 to 10 years. Another reason is social: wildland-urban interface issues are not only associated with forests. To illustrate this, spread out a map of the West and look closely at the locations of cities and towns in the Great Basin: the majority of those at risk are hemmed in by rangeland.

Ecological impacts tie these concerns together. As one Bureau of Land Management fire ecologist put it: "People don't think about rangeland resources, but they're important on a local scale and even on a global scale." Noting the loss of native vegetation and its consequences, she somberly adds: "Things—species—are simply disappearing."

Western rangelands are more fragile than many realize, especially when threatened by frequent wildfires.

Addressing a Growing Concern

We thank the editor for inviting us to use this issue to point out the importance of rangelands and the role wildfire plays on them. The information in this issue may not be new to you, but it should serve, at least, as a reminder that rangelands count and that we need to be as vitally aware of the risks and rewards, challenges and opportunities, and consequences and benefits of rangeland fire as we are of any other kind of wildfire in any other kind of fuel type. Too much is at stake for us to do otherwise. ■

Success Stories Wanted!

We'd like to know how your work has been going! Provide us with your success stories within the state fire program or from your individual fire department. Let us know how the State Fire Assistance (SFA), Volunteer Fire Assistance (VFA), the Federal Excess Personal Property (FEPP) program, or the Firefighter Property (FFP) program has benefited your community. Feature articles should be between 1,000 to 2,000 words in length; short items of up to 200 words.

Submit your feedback, articles, stories, and photographs by email or traditional mail to:

Fire Management Today
USDA Forest Service
Fire and Aviation Management
1400 Independence Ave., SW
Mailstop 1107
Washington, DC 20250

Email: firemanagementtoday@fs.fed.us

If you have any questions about your submission, you can contact one of the FMT staff at the email address above.

Rangeland and Wildfire 50-Year Forecast: Mostly Cloudy and Dry

Don Smurthwaite

Rangelands Under Siege

Rangelands—those areas in which vegetation consists predominately of grasses, shrubs, forbs, and similar plants—cover 770 million acres (312 million hectares [ha]) in the United States, or roughly 40 percent of the Nation's entire land mass. These areas occupy sprawling landscapes, besieged by invasive weeds, often unappreciated, and occasionally dismissed by the public as unimportant. Yet, they're surprisingly vital, valuable, and—unexpectedly—vulnerable.

Rangelands are also highly susceptible to wildfire. Given certain conditions, wildfires can race across rangelands, sometimes burning 20,000 acres (8,000 ha) in an hour. "I've seen range fires move 8 miles (13 kilometers) in 90 minutes," says Andy Delmas, the Bureau of Land Management's (BLM) Boise District fire management officer, whose suppression jurisdiction covers 4.4 million acres (1.8 million ha) in what may be the most fire-prone landscape in the country. "On the Pony Fire last summer, we were at 100,000 acres (40,500 ha) in the first 36 hours—and it was still growing."

Don Smurthwaite recently retired as chief of External Affairs with the National Interagency Fire Center, U.S. Department of the Interior, Bureau of Land Management.

New Fire Dynamics

All too often, after a wildfire has ripped across rangeland, fire sets the stage for annual, nonnative species (primarily cheatgrass) to muscle in. Cheatgrass thrives in disturbed areas, is a prolific seeder, dries out quickly, and is highly flammable. That sets up an unhealthy dynamic for rangelands: the more wildfire, the more nonnative annual species; and the more nonnative annual species, the more wildfire. The light fuels and fast-moving nature of range fires can make fighting them especially hazardous.

> What does the future of rangelands and wildfire look like? The easy answer to the question is that rangelands will look different in the future and so will wildfire occurrence and behavior.

According to experts, range fires are growing larger and more frequent. In 2012, an exceptionally challenging fire season in the Great Basin, about 3.2 million acres (1.3 million ha) of rangeland burned. "The overall fire situation on rangelands is in an upward trend," says Mike Pellant, BLM's Great Basin Restoration Initiative coordinator. "[Because of] the increase in wildfire size, fire frequency, and acreage burned, we're on a track that seems to grow exponentially."

"The intermountain rangelands are in pretty tough shape," says Louisa Evers, the science liaison and climate change coordinator for BLM. "We have major problems with invasive species. Everything winds up getting tied to that." Jeanne Chambers, a research ecologist with the Forest Service's Rocky Mountain Research Station, adds, "We could already be seeing novel communities on the landscape because of climate change and the infiltration of invasive species."

Assessment and Response

What's the current state of rangeland and wildfires? What does the future of rangeland and wildfire look like? Are there any steps that we can take to reverse the trend of more rangeland fires? What will future firefighters need to know about rangeland wildfires to fight them? Pellant, Evers, and Chambers, who together have more than 90 years of rangeland management and wildfire experience, have similar questions about what's taking place on western rangelands and the future consequences for wildfire and firefighters.

These three experts answered four key questions regarding the often volatile mix of wildfire and rangeland:

1. What's the current state of rangelands and wildfire?

The short answer from the rangeland experts: "It depends." It depends on the location of the rangelands, their elevation, the occurrence of wildfire, and other factors.

"Outside of the areas where wildfires have burned, we've seen a gradual improvement in rangelands," says Pellant. "Our grazing management has improved over the last 100 years. We don't have the erosion problems we once had, and we're seeing better plant composition in many areas where invasive plants are not a problem."

Chambers agrees: "It's very much context dependent. It depends on where you are on the landscape. The lower elevations are probably not as healthy, but many of our upper elevation systems are in as good or even better condition than they were 50 years ago. It's not an all-or-nothing situation," she says.

The exception—and it's an exception that covers about 30 million acres (12 million ha) of rangeland in the Great Basin alone—is where invasive species have taken over, generally after a disturbance, and most often resulting from wildfire.

"We're considered to have a fire problem on rangelands, but the fire problem is connected to the invasive species, especially the annual grasses," says Evers. Chambers adds, "The problems we're facing are increasingly connected to invasive annuals and nonnative perennials, especially in our lower to middle elevations."

Cattle and other livestock may be important tools in the future of rangeland management. Targeted grazing can be used to combat invasive species (like the dried cheat grass pictured here beneath a sage brush overstory) and maintain greenstrips.

Because of the extent of the invasive species component, wildfires have grown in frequency and size in recent years. That's not a good trend for rangelands in the West. Thirty years ago, 100,000-acre (40,500-ha) range fires were rare. Now, range fires of that size hardly make the headlines. "In 2012, we had a 1-million-acre (405,000-ha) fire footprint in southeastern Oregon alone," states Pellant. "That's a very telling statistic."

So, what is the current state of rangelands and wildfire activity? "We're not on a very good track," says Evers.

2. What does the future of rangelands and wildfire look like?

The easy answer to the question is that rangelands will look different in the future and so will wildfire occurrence and behavior. It is unclear, however, exactly what western rangelands will look like in the future. "I don't think we'll have much of an idea of what our rangelands will look like 50 years from now. It's therefore difficult to figure out just what fire will be like on them," says Evers. But she does have a few suspicions that follow a "domino" line of reasoning. "I strongly suspect rangelands will be different. You change the vegetation, you change the fuels, you change the climate, and you should see a change in the fire regime," she says.

Pellant has similar thoughts, starting with the changing climate. "A warmer climate means that our fire season will be longer because our growing season may be longer. Fuels loads may increase," says Pellant. "It means more rain, less snow, and more carbon dioxide—which acts as a fertilizer to plant growth. It means more consecutive

days of extremely high temperatures and low humidity. It means 1 drought year followed by another drought year."

"Increases in carbon dioxide favor some invasive species, especially in areas where we don't have strong competition from native perennials," states Chambers. For example, in some cases, cheatgrass will be favored by such an increase more than some of the important native species, resulting in more production and, thus, an increase in fine fuels.

All of this paints a troubling picture for tomorrow's firefighters: more fuels, more wildfires, more volatile fire behavior, and longer fire seasons. And, tomorrow may already be here.

…fire sets the stage for annual, nonnative species (primarily cheatgrass) to muscle in.

"We're seeing shifts in spatial patterns, in terms of our plant communities and fire activity, resulting in an increase in invasive species and fine fuel loads, but also an increase in annual forbs, the effects of which are sometimes unknown," Chambers says. That leads to the aforementioned "novel communities:" compositions of vegetation that previously didn't exist in a given area.

"We'll have different community types," she adds. That could mean opening a Pandora's box of problems: more fine fuels and more woody fuels capable of sustaining rangeland canopy fires in pinyon-juniper communities.

Climate change is not just a simple case of dealing with more drought and warmer temperatures. According to Evers, climate change is more nuanced. "Climate change is a real wildcard in all of this, particularly in the Intermountain West. Most of our moisture comes outside of the growing season. We don't get lots of late spring or late summer moisture."

What happens if a more bimodal wet season—precipitation in winter and summer, as happens in the

BLM rangelands in the foothills of Idaho's Owyhee Mountains.

The Next Steppe: Sage-Grouse and Rangeland Wildfire in the Great Basin Conference

In late 2014, Bureau of Land Management (BLM) Fire and Aviation sponsored a ground-breaking conference entitled *The Next Steppe: Sage-Grouse and Rangeland Wildfire in the Great Basin*.

This conference brought leading scientists, land managers, and fire policy and operations leaders together to consider and develop ways to enhance the BLM's fire management in the sage-steppe ecosystem, particularly fire's threats to the 63 million acres (25.5 million ha) of sage-grouse habitat under the BLM's stewardship. More than 300 people attended the conference.

The conference began with 2 days of presentations outlining the current threats, especially fire and invasive grasses and associated impacts to sage-grouse habitat. In addition to Federal agency specialists and leaders, speakers included university scientists and researchers, State government leaders, nongovernmental organization specialists, and land users.

U.S. Department of the Interior Assistant Secretary for Lands and Minerals Janice Schneider (center) was instrumental in creating the *Next Steppe* conference and attended throughout.

During the final half-day of *The Next Steppe* conference, participants met directly with Policy and Fire Management Operations groups. These sessions created structured opportunities for participants to review the multitude of ideas, insights, and concepts that arose during the conference, and to provide input to policy and operations leaders.

Hundreds of other constituents, stakeholders, and professionals participated in the conference remotely using virtual technologies to contribute suggestions and ideas.

Policymakers and leaders in fire management are continuing to analyze results of *The Next Steppe* conference. The ultimate goal of the conference was to develop a comprehensive strategy, using new tools and approaches, to better manage fire for the protection and conservation of critical sage-grouse habitat.

Organizers quickly sorted and tabulated feedback from participants.

Southwest—occurs? Pellant says that cheatgrass could be favored by this change in precipitation timing as it germinates in the fall and would benefit from a warmer winter with more precipitation occurring as rainfall rather than snow. But Evers adds that the change to a bimodal wet season may also result in "a shift in precipitation that might help the native plants compete better against cheatgrass."

In short, even the experts are unsure of just what to expect. However, all three experts interviewed for this article agree that climate change will affect western rangelands.

3. Are there any steps that we can take to change the trend of more rangeland fire?

Few options exist to address the concerns listed above, but none of the scientists hold out hope that western rangelands have any chance of returning to presettlement conditions. Current thinking is now focused on holding on to the relatively intact landscapes that remain. Much of the fire-prone western rangelands are "probably damaged beyond our economic ability to restore them," as Pellant describes the situation. This thinking is a point-protection strategy.

Further complicating any response is the public perception of rangelands; rangelands have a public-relations problem. "Red hillsides—forests invaded by insects—are much more noticeable than a slight graying of rangelands," states Evers. "There is a lot about the natural processes in rangeland systems that we just don't know because they aren't well studied. The general perception is that they're not worth a lot of money, so we haven't made the investment."

As to what can be done to address the situation: first, deal with the cheatgrass. There are hopeful signs in some places that cheatgrass may not provide fuel for so many future fires. Cheatgrass is dying off in some areas, although the cause is uncertain. "Cheatgrass is blinking in and out," Pellant observes. Evers thinks a fungus may be responsible, and it is known that some strains of bacteria attack cheatgrass. "Both the fungus and bacteria that are being studied are native to the West," she observes.

Pellant is encouraged, too. "We're making progress on dealing with cheatgrass. We have promising biological control efforts going on. They aren't the answer, but they do hold hope for the future."

Chambers likes the practice of progressive management. She suggests creating refugia systems, where relic samples of rangeland vegeta-

tion can be conserved, and she's a believer in transformative restoration; places where "We can plant species that are well adapted to the changing climate and droughtier conditions." She's also a proponent of aggressive management: "We need to be prepared for repeated interventions for reseeding and stabilization. We have to be prepared to be very proactive to maintain stability."

Evers adds, "Our real struggle is to keep the healthy areas healthy. When we do, they can resist the invasion of annuals."

None of the actions will be easy. Aside from being at least somewhat overlooked, rangelands are slow healers. Pellant observes that vegetation recovery is painfully slow on rangelands, taking 15 to 20 years. "It's not that these systems are completely trashed when they burn, it's just that recovery time is slow in arid environments."

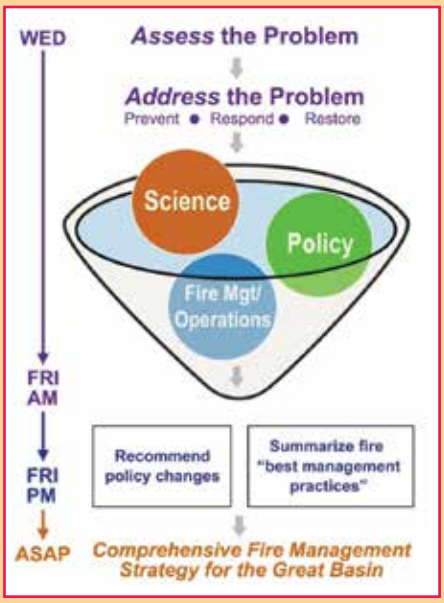
Yet, as much of an ecological nightmare as invasive species are, the current crop may not represent the worst. "We may not be at the bottom of the barrel, ecologically speaking, with cheatgrass," Pellant says. Cheatgrass is showing up at higher elevations as the climate warms, threatening to enter conifer forests. Other invasive grasses and forbs may be even nastier: yellow starthistle, knapweed, rush skeletonweed, and one high on Evers' list of ecological villains: *Ventenata dubia*, a wiry grass from North Africa that is becoming troublesome in the Pacific Northwest. "*Ventenata* has the potential to be insidious," Evers says.

Although they get little attention compared with forests, rangelands also have insect problems. "The outbreak of aroga moths helped drive the giant fires we got in 2012," Evers notes.

The Next Steppe: Sage-Grouse and Rangeland Wildfire in the Great Basin

In November 2014, the U.S. Department of the Interior, Bureau of Land Management (BLM) sponsored a groundbreaking conference entitled *The Next Steppe: Sage-Grouse and Rangeland Wildfire in the Great Basin*. This conference brought leading scientists, land managers, and fire policy and operations leaders together to develop ways to enhance and improve BLM's fire management in the sage-steppe ecosystem, particularly fire's threats to the 63 million acres (25.5 million hectares) of sage-grouse habitat under BLM's stewardship. More than 300 people attended the conference.

The conference began with 2 days of presentations outlining the current threats and focusing on fire and invasive grasses, as well as the associated impacts to sage-grouse habitat. In addition to Federal agency specialists and leaders, speakers included university scientists, researchers, State government leaders, nongovernmental organization specialists, and land users.



During the final half-day of *The Next Steppe* conference, participants met directly with Policy and Fire Management Operations groups. These sessions created structured opportunities for participants to review the multitude of ideas, insights, and concepts that arose during the conference, as well as provide input to policy and operations leaders.

At press time, policymakers and leaders in fire management continued to analyze the results of *The Next Steppe* conference. The ultimate goal of the conference was to develop a comprehensive strategy, using new tools and approaches, to better manage fire for the protection and conservation of critical sage-grouse habitat.

Further tempering the scientists' optimism is the sheer scale of the invasive species problem. "The analogy is that we take one step forward with areas that are recovering, but then, when we lose 3.2 million acres (1.3 million ha) in the Great Basin alone in 2012, that's two steps backwards," Pellant laments.

The work is daunting, and even the scope of it is intimidating. "When you stop to think about it all," says Evers, "it's very depressing." The kind of work Chambers, Evers, and Pellant do is not for those who fold easily. But much is at stake, and they all feel an urgency to push on, even though the task can be discouraging.

4. What will firefighters of the future need to know about rangeland wildfires?

Pellant is quick with an answer to this question: "Cows may be their best friend!" Land managers need a new model to better cope with landscape-scale wildfires, and Pellant believes that one approach worth trying is strategically placed grazing strips or bands to establish landscape-scale fuel breaks that can be maintained primarily through grazing. Ranchers participating in the program on public land would be, in effect, fuels managers and would be compensated accordingly. What he is *not* suggesting is wholesale grazing, with forage nibbled to the nubbins as a means to decrease wildfire. "That's not the answer," Pellant says.

But new approaches need to be tried for at least a couple of reasons. First, suppression is not the ultimate solution. "We're behind on that already," Pellant says. Second, fuels management, on the scale that is currently being done, "isn't able to match the scale of the fires that we're seeing. Managing fuels, which I think is our only hope, must be done on a scale commensurate with the increasing size of wildfires on the landscape," he says.

As for firefighters, he sees a much riskier future: more fire in highly volatile conditions require a close look at tactics and a willingness in firefighting teams to back off or just walk away when the conditions are stacked against them—tomorrow even more so than today.

> All of this paints a troubling picture for tomorrow's firefighters: more fuels, more wildfires, more volatile fire behavior, and longer fire seasons.

Chambers also believes that landscape approaches to fire management hold promise. She pointed out two related threats: the changes in climate and rapid population growth, especially in western rangelands. Combine those two factors, and "It's going to result in more fire starts, and we'll need to determine where we put our resources in terms of fire suppression and prevention. What fire managers will need to know is how to prioritize firefighting efforts to protect both human communities and native ecosystems and species. Planning should be carried out on landscape scales as well as on local ones."

Then there is the "X factor." Sure, things will change and, most likely, the problems will become harder to address, but just *how* everything changes is something that can't be determined with precision. "I believe rangelands will undergo an environmental shift. Many of the changes are predictable; many are not," Chambers says.

So what factors can we consider certain? Maybe the list goes something like this:

- Rangelands are under siege by invasive species.
- The growth of these species is most likely exacerbated by climate change and their expansion is facilitated by fire.
- Rangelands will be altered in the future, although it's difficult to pinpoint in exactly what ways.
- Wildfires are likely going to become more frequent and intense.
- Fire managers and firefighters will need to be more aware than ever about the volatility of wildfires and how quickly they can change.
- Vast chunks of rangeland are in peril, even if the public gives little heed to the problem.

"We are converting to annual grasses at the rate of .01 percent per year," says Evers. "It doesn't seem that big of a problem, but, whenever you turn around, another big chunk of ground has been changed."

"Not that you can't be optimistic," says Chambers, "because we have opportunities for proactive management. We maintain what we can, but there are a lot of good things that we just don't have the resources to do."

For future land and fire managers, it's a sobering thought. ■

BLM Engines: Critical Resources for Rangeland Fire

Ken Frederick

Introduction

Wildland fire engines have been around for decades. Bolting a water tank and pump on the back of a truck and outfitting the rig with a complement of hose and fittings goes back to at least the 1920s. Such engines are important tools of many Federal, State, and tribal fire organizations, but they are critical assets to the Bureau of Land Management (BLM).

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In the expanse of lands managed by the agency, existing fuels, topography, and the scarcity of water sources in arid landscapes require that the BLM have a highly mobile, water-capable firefighting platform to address fire concerns. The BLM in many States depends on versatile engines, water tenders, and well-trained personnel to meet its fire suppression goals.

Fuels

Firefighting engines are critical to the BLM because of the predominant kinds of fuels common to managed lands. Vegetation in the Great Basin includes pinyon pine, western juniper, sagebrush, mountain mahogany, and a variety of other hardy grasses and forbs prone to fire. Because of their mobility and speed, rangeland engines are especially effective tools for fighting fires in these lighter fuels.

For over a century, native fuels have been augmented by nonnative fuels. Some estimates ominously indicate that as much as 60 million acres (24 million hectares [ha]) of the Great Basin have been invaded

A BLM heavy engine from Nevada is positioned for action on the West Cinder prescribed fire on the Twin Falls District in 2010.

by cheatgrass (*bromus tectorum*), an aggressive annual invasive weed that readily moves into disturbed sites (Davidson and Smith 2005). Cheatgrass, a prolific seed producer, grows, ripens, and drops its seeds earlier than native grasses, giving it a competitive edge in germination on open sites. Once cured, the dense beds of dried cheatgrass are highly flammable, ignite easily, and burn incredibly fast. Because it creates a continuous fuel bed, cheatgrass carries wildfire significantly faster than native brush and grass species, and fires fueled by cheatgrass tend to be more intense than historical fires.

Topography and Precipitation

Fuels typical of BLM lands are not the only reason that the BLM favors rangeland engines. The flatter, windier, and more open topography common to BLM-managed land serves as another reason why a highly mobile firefighting platform is critical to firefighting efforts.

Although the BLM does manage mountainous areas (for example, Idaho's Owyhee Mountains) and old-growth forests (particularly in southwestern Oregon), the majority of BLM-managed lands outside of Alaska are typically brushland or grassland. These landscapes tend to be windier than mountainous regions, and because they are more arid, they have less biomass than forested areas.

The largest mass of nonagricultural, arid brush and grasslands lies within the Great Basin. As described by the U.S. Geological Survey, the Great Basin is a connected set of endorheic (closed) basins in the Central-Western United States. The Great Basin lies mostly within the States of Nevada, Utah, and southern Idaho, but it also encompasses parts of California and Oregon. All told, the Great Basin spans about 184,427 square miles (477,644 square kilometers). Much of this land is managed by the BLM.

> The advanced off-road capability of BLM engines means that mobile crews can access parts of the fire otherwise only accessible by aircraft or hand crews.

Values at Risk

Engines are an important part of a fire manager's arsenal for protecting values at risk. Homes and businesses are two important values. The expansion of the wildland-urban interface (WUI) has significantly changed the Great Basin and other grass and brush landscapes in the Western United States (NASF 2009). Increasingly, fire managers must be cognizant of WUI concerns, even when responding to small, seemingly benign grass and brush fires.

BLM firefighters are also concerned with another value at risk: the greater sage-grouse (*Centrocercus urophasianus*). The habitat of the greater sage-grouse once covered nearly 260 million acres (105 million ha) in the Western States, especially in sagebrush ecosystems. By 2006, the sage-grouse's habitat had shrunk to just 56 percent of what was available prior to Euro-American settlement in western North America (Stiver 2006).

As one of the leading stewards of sage-grouse habitat, the BLM is committed to protecting and enhancing these landscapes. That means that the BLM must effectively manage fire in sagebrush landscapes, maintaining the tools and expertise necessary to accomplish that goal.

Designed for the Job

The design and construction of BLM engines reflects their role in BLM operations. Perhaps the biggest difference between the BLM fleet and that of other fire-response agencies is the predominant use of super-heavy engines: those with water tank capacities up to 2,400 gallons (see table 1).

Many BLM units prefer larger capacity engines because crews often fight fires far from water sources. Carrying 850 gallons (3,218 liters [l]) of water instead of a more common 300 gallons (1,136 l) can mean the difference between containing a fire during initial attack and seeing it spread to become a large conflagration.

Table 1—*BLM fire engine fleet characteristics.*

Type	Capacity in gallons (liters)	Number in BLM
Super-heavy	2,000–2,400 (7,571–9,085)	19
Type 4	850 (3,218)	152
Type 3	500 (1,893)	29
Type 6	300 (1,136)	125

"The BLM is proactively seeking advanced-capability, off-road fire-engine platforms to quickly and easily access remote fires in extreme terrain," observed Elden Alexander, supervisory equipment specialist with the BLM's Fire Operations Division at the National Interagency Fire Center (NIFC). "We utilize converted military vehicles and wildland expertise to produce fire-engines capable of delivering firefighters and water safely to remote areas."

The ability to refill an engine from remote water sources quickly is another key feature of BLM engines. Engines have high-pressure pumps capable of quickly filling their tanks by drafting from ponds, streams, or other water sources. The newer pumps and plumbing are so efficiently designed that a skilled operator can refill a 2,000-gallon (7,600 l) engine from draft in 7.5 minutes.

Fire managers try to maintain a variety of engines to maximize

Losing Greater Sage-Grouse Habitat to Fire

Don Smurthwaite

The greater sage-grouse is an icon of western rangelands and provides one of nature's best shows. The males fluff themselves up, inflate air sacs that protrude from their breasts and, by inhaling and exhaling, make a loud rhythmic huffing sound that can be heard up to a mile away. They also do some elaborate dancing.

The greater sage-grouse depends on sagebrush for both food and cover. In the winter, 100 percent of the bird's diet is sagebrush, making sagebrush critical to its existence. The formula is simple: when sagebrush habitat declines, so do the populations of greater sage-grouse. This decline has been happening across western landscapes for the past 40 years. At one point, the greater sage-grouse population numbered in the millions; today, that number has decreased to somewhere between 200,000 and 500,000.

Don Smurthwaite recently retired as chief of External Affairs with the National Interagency Fire Center, U.S. Department of the Interior, Bureau of Land Management.

Wildfire hasn't been a friend to the greater sage-grouse. In fact, in the Great Basin, fire and flammable invasive species have been the worst threats to sagebrush habitat —and, in turn, to the bird itself. The Bureau of Land Management (BLM) has approximately 57 million acres (25.6 million ha) of greater sage-grouse habitat under its care. Much of this area is prone to a repeating cycle of fire and the further spread of invasive species.

Unfortunately, lightning is a frequent visitor to the Great Basin and other sage-grouse habitats, setting the stage for major conflagrations in sagebrush country. In 2007, the Murphy Complex burned 652,000 acres (264,460 hectares [ha]), mostly in Idaho and Nevada. In 2012, the Long Butte Fire in southern Idaho burned 306,000 acres (123,930 ha). In 2014, the Buzzard Complex fires burned over 395,000 acres (159,851 ha). These mega-fires often burn off the birds' cover and deplete their food supply. Once gone, it is difficult to replace.

Wildfire in the Great Basin is even more of a problem due to the spread of cheatgrass (*bromus tectorum*). This species is an opportunistic plant that thrives in disturbed soil. Worse, it is a prolific seeder that is highly flammable when it cures. The more fire, the more cheatgrass; the more cheatgrass, the more fire. Sagebrush often falls victim to this cycle—and so does the greater sage-grouse.

The BLM is working on a number of tactics to break the fire-invasives cycle. First, the agency uses rapid initial attack to keep new fires as small as possible and limit their damage. The BLM also relies on partners like rural fire departments to help limit the occurrence of destructive fires in sagebrush. Efforts are also underway to create or widen firebreaks along roads to help stem the spread of fire, as well as to establish "green strips," or areas of more fire-resistant vegetation, to help slow or stop a fire's spread.

Additionally, ongoing research is looking for ways to create healthier landscapes that will break the fire cycle in rangeland environments. This research will help ensure that habitats are maintained so that the colorful sage-grouse are able to strut their stuff for decades to come.

water delivery and mobility. Smaller engines can quickly adjust to the changing fire scene and find safe access to the fire for larger engines. The advanced off-road capability of BLM engines means that mobile crews can access parts of the fire otherwise only accessible by aircraft or hand crews. The inherent limitations in maintaining this range of advanced capability vehicles are cost, availability, and the need for specialized maintenance.

Finally, BLM engines operate in a remote environment where support isn't always nearby. "BLM engines are self-sufficient," said Charlie Leonard, the Intelligence Operations Coordinator at NIFC and a former BLM engine captain. "Once on-scene, they have everything they need to begin suppression operations without immediate logistical support." Engines carry a full complement of handtools, portable pumps, hoses, and hardware so that an engine crew can equip a hand crew and support it with water as necessary during fire suppression operations. In addition, a BLM engine typically carries enough provisions to sustain its crew for several days in the field.

Many BLM units prefer larger capacity engines because crews often fight fires far from water sources.

Foam Capability

Wildland engines spray more than water on fires. Engines may also carry liquid fire-retardant chemicals and special nozzles to spray foam fire retardant. Foam is often used as a pretreatment for structures that may be threatened by fire, and it can also be used directly to suppress fire. Foam does not evaporate as quickly as water and can provide protection to structures long after it is applied. Foam tends to coat surfaces with a physical layer that blocks fire from reaching the flammable surfaces beneath. It also quenches and cools the flammable material when structures are exposed to fire. Foam has the added benefit of helping to maximize water efficiency because it reduces the surface tension of water molecules, enhancing water penetration and retention into organic fuels.

Facing the Future

The need for effective firefighting capability on BLM lands will increase with time. With their wide-ranging capabilities and up-to-date equipment, wildland engines comprise the backbone of the BLM arsenal of firefighting resources. They have proven effective in the fuels and topography of the landscapes managed by the agency and will continue to do so into the foreseeable future.

A BLM engine monitors the flank of a large prescribed burn in 2010.

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Rangeland Fire and Invasive Species: A Vicious Cycle

Randy Eardley

Fire and Cheatgrass

There is a place on the Snake River plain in southern Idaho where a desert breeze ripples through an expanse of brown cheatgrass like wind across fields of wheat. There is little else on the flat landscape stretching toward the horizon.

That's the scene today, but as recently as the 1970s and early 1980s that same area was dominated by sagebrush and a mixture of native bunchgrasses and invasive cheatgrass. Although the vegetation wasn't in pristine condition, it met many of the needs of wildlife in the nearby Snake River Birds of Prey National Conservation Area. As the frequency of fire increased, beginning in the 1980s, cheatgrass—the most opportunistic and flammable of the plant species in this area—carried fire farther into sagebrush-dominated habitat. Over a number of years, that repeated cycle of fire and re-vegetation converted the landscape into a community largely dominated by cheatgrass.

The Conversion of Rangeland

Despite the best efforts of land managers to reestablish sagebrush and a more diverse vegetation community in post-fire rehabilitation projects, the flammability, invasiveness, and dominance of cheatgrass prevailed. It's a process that has occurred in many areas across the West, not only with cheatgrass, but also with medusahead wildrye, buffelgrass, red brome, and other invasive species. Research has estimated as much as 10 to 12 million acres (approximately 4 to 5 million hectares [ha]) have been converted to a near-monoculture of these species.

As the frequency of fire increased beginning in the 1980s, cheatgrass carried fire farther into sagebrush-dominated habitat.

Fire managers conducting a prescribed burn near Moab, UT, to combat the invasive species, Tamarisk.

"But figures can be deceiving when trying to truly measure the problem," says Mike Pellant, coordinator of the Great Basin Restoration Initiative and a leading authority on rangeland health. "Most acreage figures are obtained from satellite imagery and tend to only show cheatgrass dominance in open

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areas, which underestimates the magnitude of the problem. You have to consider the larger scale and all the areas where cheatgrass is encroaching or already is a dominant plant in shrubland communities."

Some estimates put the number of acres dominated by cheatgrass as high as 20 million acres (8 million ha) and the presence of cheatgrass on as much as 60 million acres (24 million ha) across 11 Western States, with millions more acres being susceptible to encroachment. Whatever the numbers, evidence of invasive species and altered fire frequency is not hard to find.

The Effects of Invasives on Fire

In 2005, in the Sonoran Desert of Arizona, an invasive grass called foxtail chess—another name for red brome, which is closely related to its more northern cousin, cheatgrass—had spread into saguaro cactus habitat. Saguaro and other native desert species of the area had evolved for hundreds—if not thousands—of years without fire. Prior to 2005, when the flammable grass carried fire into saguaro cacti, there had been no recorded history of fire in that region.

> Research has shown that in the first 45 days after germination, cheatgrass can produce twice the root system as bluebunch wheatgrass.

In the 1990s, researchers looked at the fire history in 12 sites in southern Idaho and estimated a 60- to 100-year fire return interval in native sagebrush, but a fire return interval of only 3 to 5 years in cheatgrass-dominated rangelands. This shortened interval is exacerbated by human-caused fires in areas associated with recreation on wildlands containing cheatgrass. The amount of area burned increases as firefighting efforts are redirected to protecting homes and other property in areas bordering the rangelands.

Breaking the cycle of encroachment, subsequent fire, and further encroachment is a daunting and formidable challenge—but one that fire and land managers continue to undertake. "Not all is lost," Pellant says, adding that biological and other control tools continue to be

Cheat grass—its reddish seed heads already drying out in this photo—has invaded millions of acres in brush lands in the Western United States.

studied and developed. "There is hope we can find something to use on a landscape scale to deal with the problem."

Control Tools for Cheatgrass

Cheatgrass was probably introduced into North America in grain and hay transported from Europe in the late 1890s. By the 1930s, cheatgrass had established a foothold, particularly in the Great Basin, where climate and soils were especially conducive to its spread. One reason that cheatgrass is so dominant is that it is a prolific seed producer. Cheatgrass seeds can germinate in either fall or spring. Research has shown that in the first 45 days after germination, cheatgrass can produce twice the root system as bluebunch wheatgrass.

A more natural approach to cheatgrass control may be found in biological tools. One such tool is a fungus dubbed "the black fingers of death," which looks and works much like its science fiction horror name implies. Once introduced, the fungus attacks cheatgrass seed and produces fine, black, fingerlike structures that emanate from the slain seed to enter and attack other cheatgrass seeds. Scientists at the Forest Service's Rocky Mountain Research Station in Provo, UT, are studying and field-testing the fungus to further understand how and why it works so effectively on cheatgrass in order to expand its application.

Looking for Alternatives

Yet another path of research in the battle against cheatgrass stems from the recent discovery of natural large-scale die-offs of the invasive plant. Three years ago, in the Bureau of Land Management's Winnemucca, NV, district, an estimated half-million acres (202,000 ha) of cheatgrass died off for unknown reasons. Although the cheatgrass is now starting to recover, the event holds some intrigue for ecologists like Pellant. "It was inexplicable," Pellant said. "We have worked with several scientists, and so far, it seems there was just a right combination of triggers in climatic and environmental conditions to stimulate several pathogens that ultimately led to the die-off across large areas."

Yet another path of research in the battle against cheatgrass stems from the recent discovery of natural large-scale die-offs of the invasive plant.

Pellant described the die-off situation as a glass half full or half empty, depending on how one looks at it. "It's a glass half full because we know there is a combination of factors that can trigger it," he said. "But it's a glass half empty because we can't predict when and where it will happen again. It's sort of like a wildfire in the sense that we don't know if, when, or where the die-off will occur and the magnitude of the area that will be affected."

Pellant added that, if research can identify what the triggers and pathogens are, then it could be used as part of a control strategy. "For one, figuring out the what, where, and why would allow us to utilize the pathogens under the appropriate climatic and environmental conditions to reduce cheatgrass and restore desirable plants. Also, knowing where the cheatgrass die-off could occur prior to the fire season would assist fire managers in planning strategies to manage wildfires using die-off areas as fire breaks."

Current Strategy

Until cost-effective measures are found to battle cheatgrass and other invasive species on a landscape scale, control efforts will continue when, where, and at whatever scale is possible. Fire and hazardous fuels managers will continue to try new ways to limit the spread of cheatgrass in advance of fire incidents and to create fire breaks by mowing or other means to slow or stop the spread of rangeland fires and aid firefighters in quick containment. In the meantime, firefighters will find themselves returning to areas and aggressively attacking new ignitions to minimize the spread of fires and the subsequent further encroachment of cheatgrass and other invasive species. ■

Herbicides are one option to control cheatgrass and restore desirable vegetation, either as part of a post-fire rehabilitation program or before a fire to reduce cheatgrass and to seed fire-resistant vegetation. One available herbicide is effective in controlling cheatgrass and reducing seed production if applied early in the spring. Another herbicide can be applied in advance of the spring growing season and is absorbed by the cheatgrass roots when growth in the spring occurs. The latter does not kill perennial plants, which is an advantage in areas where perennial native plants are present. While these are good control tools, Pellant said, their effectiveness varies with soil, rain, and other environmental conditions.

Rangeland Fire Behavior and Tactics: What To Know if You Don't Already

Ken Frederick

Imagine yourself in this situation: you are a fire operations specialist in Nevada, and it has been an active and severe fire season across the country—so severe that firefighting assistance has been requested from international partners. You have been tasked with providing a briefing on rangeland fire behavior and tactics to a dozen mid-level Canadian fire managers who are more accustomed to fire in forest ecosystems, but who will be assigned to fires in the Great Basin. The Canadian group includes experienced firefighters and fire leaders, but none are experienced in managing the fast-moving and explosive brush and grass fires they are going to see.

In briefing this group, you should consider a number of basic but critical elements to battle wildfires safely and effectively in typical rangeland landscapes across the Western United States. The following sections summarize these elements.

Fire Behavior

Volatile fire behavior in grass and brush ecosystems is a function of weather conditions and highly available fuels. The Great Basin is technically a desert, and typical summertime weather conditions are hot, dry, and breezy. What surprises many people is how fast grass and brush fires can move in these conditions.

The Great Basin is technically a desert, and typical summertime weather conditions are hot, dry, and breezy.

Sage brush burns rapidly on the Castle Rock Fire near Ketchum in 2007.

Ken Frederick is a public affairs specialist with the U.S. Department of the Interior, Bureau of Land Management, External Affairs, National Interagency Fire Center.

These fires move rapidly because their fuels are, in fire-behavior terminology, highly available. Often, brush-dominated sites are stocked with a grass understory. The dry grasses readily carry fire from one fuel concentration to another and act to lift the flames up into a brush plant's upper structure.

Because species such as cheatgrass tend to create continuous fuel beds, fires often move rapidly and uniformly through them. Even a fire burning downslope in cheatgrass will spread with surprising speed, especially if it has a wind behind it.

Where grasses and volatile brush species dominate the landscape, fires respond almost immediately to weather changes. If a cloud moves across the sun, grass and brush fires typically moderate. When the sun goes down, firefighters often see a significant reduction in fire behavior. Conversly, when the wind changes direction, these fires can turn quickly.

Several brush species are flammable and contribute to hot, rapidly spreading fires. Sagebrush, manzanita, greasewood (also called bitterbrush), and other species burn with impressive flame lengths and bursts of heat. Trees such as pinyon pine and various juniper species also burn, though these trees do not typically produce the thick, continuous fuel beds produced by grasses and brush. Tamarisk, an invasive, low-growing tree in the Southwest and Southern Plains States, burns with an impressive display of heat and flame.

Topography plays a significant role in rangeland fire behavior. Grass and brush fires, of course, will run upslope with ferocity. These fires will hurtle through hillside saddles and blow out the ends of box canyons. Firefighters need to be highly cognizant of any topographic feature that channels, compresses, or otherwise alters wind.

Unless fire managers and firefighters are aware of how shrub species can burn, their explosive fire behavior can be surprising. Arizona brush lands burn ferociously in the Gladiator Fire, near Crown King, AZ, in 2012.

Where grasses and volatile brush species dominate the landscape, fires respond almost immediately to changes in the weather.

Finally, grass and brush fires tend to have a low resistance to control, which means that these fires respond readily to water, fire retardant, or fuel breaks. These fires do not generate the amount of heat and embers produced by the heavier fuels typical of forest fires, and they tend toward short-range spotting rather than long-range spotting. But grass and brush fires across the Western United States are still quite challenging, primarily because of their rapid rates of spread.

Strategies and Tactics

Because of their rapid spread and ready response to weather and topographical changes, grass and brush fires can be tricky in their vagaries. Firefighters experienced in working these fires have learned to be careful in applying tactics associated with direct attack. They have also learned the following lessons: ***Have a good anchor point.***

In direct attack, firefighters have to be sure that they are truly flanking the fire so that the fire cannot hook behind or beneath them. Firefighters should avoid unsecured frontal attacks on a volatile grass or brush fire without a secure anchor point; any wind shifts might threaten the firefighters' position.

This principle is illustrated by the Point Fire tragedy. In June 1995, two firefighters operating a wildland fire engine on the Point Fire

near Kuna, ID, were killed when the fire switched direction and overran them. They were fighting a brush fire with a significant light fuel component; the fire behavior changed dramatically when a passing thunder cell caused winds to change direction and increase in velocity.

When doing direct attack, keep one foot "in the black." "The black" (an already burned area) is the best safety zone in grass and brush fires. Firefighters can remain close to this zone as they suppress the fire. As they progress, they can either burn out their line or ensure that their suppression actions (for example, spraying water, throwing dirt, or swatting out the fire) have completely extinguished the fire. The result is the same: they are bringing the burn perimeter along with them as they progress in suppressing the fire.

Do not outdistance your safety zone. If firefighters have followed the previous suggestions, they have already accomplished this objective. But when employing an alternative method of attack, firefighters must constantly be aware of the location of their nearest safety zone and the route they would take to get there if necessary. The further firefighters progress from their safety zone, the lower its operational value.

Because of their rapid spread and ready response to weather and topographical changes, grass and brush fires can be tricky in their vagaries.

Most injuries and fatalities in the grass and brush fuel type occur when fire personnel are caught unprepared by the speed at which these fuels burn and how quickly the tactical situation on the fireline can change.

Keep track of the engine's water consumption. Wildland engines give firefighters a mobile means of attacking a fire's edge with water, but firefighters must monitor water usage and factor tank refill logistics into their attack. Using an engine in a running attack enables firefighters to cover a lot of ground, but an engine without water could become a liability by increasing firefighter exposure. When fighting grass and brush fires, engine crews must exercise caution to avoid outdistancing safety zones as the tank's water level drops.

Base actions on an accurate observation of the fire's rate and direction of spread. To fight a fast-moving grass or brush fire, firefighters must anticipate how far and how fast a fire will spread over time and how large it is likely to be by the time resources are arrayed against it. Those estimates are important because they influence how many and what kind of resources to order and where to place incoming resources. If firefighters are not "reading" the fire properly, they may assign the wrong type or the wrong number of resources to the fire, allowing the fire to escape containment.

Fighting grass and brush fires can be highly nuanced and complex, especially for those who are not accustomed to the kinds of fire behavior and rapid spread these fires can display. As in any potentially dangerous situation, firefighters fighting grass and brush fires must pay careful attention to all of the factors influencing the fire's behavior. ■

Keep one foot in the black—a time-honored adage for wildland firefighters.

Rural Volunteer Fire Departments Receive New Equipment

Brian Haugen and Jacob Beauregard

The equipment needs of many rural fire departments far exceed the funding available to them. However, the Minnesota Department of Natural Resources (MNDNR) is doing what it can to remedy this problem. In collaboration with the U.S. Department of Defense and the Forest Service and through the Federal Excess Property Program (FEPP), the MNDNR has been able to acquire a wide range of equipment and allocate it to rural fire departments throughout Minnesota.

This program, approaching its 30th year of operation, has supplied volunteer fire departments with a wide range of products, including screwdrivers, stop blocks, safety equipment, trucks, and trailers. The FEPP has helped expand the capabilities of rural fire departments.

The program allocates equipment acquired from the Federal Government by the MNDNR to Minnesota rural fire departments via written requests. Requests for equipment originate with individual fire and/or emergency management system stations and can be very specific or fairly broad. The department receiving the equipment pays the State for the cost of shipping the equipment, any replacement parts needed, and minor repairs. The money that the MNDNR receives is then placed into a special account used solely for the purpose of future equipment transfers.

Brian Haugen and Jacob Beauregard are rural fire program specialists for the Minnesota Department of Natural Resources.

Hitterdal's Crash Rescue Truck before and after modification.

> The more flexible a fire department is with its request or desired outcome, the better its chances that the equipment will sooner become available.

For example, a fire department might need a truck that can be used for wildfire suppression efforts and actively seeks a 4-by-4 truck that it can modify to meet its current needs. Placing the request, the fire department puts its name on a list requesting any type of vehicle that meets that description. The more flexible a fire department is with its request or desired outcome, the better its chances that the equipment will soon become available.

The recent acquisitions of the Hitterdal and Mahtowa Volunteer Fire Departments illustrate acquisition under the FEPP process. The Hitterdal Fire Department was looking for a heavy-duty truck that could be modified to accommodate a long bed. The plan was to outfit the bed with an equipment box, hose reel, generator, and pump, which could be used in a variety of emergency situations. When a truck meeting Hitterdal's specifications became available, the fire department went to work to receive and modify the truck and then install necessary equipment. That truck is now the newest equipment "member" of the volunteer firefighting force.

The Mahtowa Fire Department, a small but often busy fire department, has a protection area that consists of 72 square miles, with wildland and urban protection responsibilities and a major freeway that cuts through the heart of the coverage area. In 2010, the department started looking at options to upgrade equipment, replacing a 1,500-gallon (5,700 liter [l]) tender that was becoming antiquated. In 2011, the Mahtowa Fire Department was able to acquire through the FEPP a 1993 Navistar International 4900, a 6-by-6 truck that came equipped with a 2,000-gallon (7,600 l) tank. The unit now serves as the primary tender for the area, as it fits many mission requirements.

More information and details on equipment currently available to rural Minnesota fire departments can be viewed at: <http://www.dnr.state.mn.us/grants/ruralfire>. Follow Minnesota's rural fire program on Facebook at <https://www.facebook.com/ruralfire>. ■

Mahtowa's 2,000-gallon (7,600-liter) water tender before and after modification.

Encountering Dirt, Fire, and Road: My First Season as a Wildland Firefighter

Michaela Hall

For the second time, I spilled burn mix on my clothing as I reached to replace a drip torch, a wildland firefighting tool used to ignite fires for controlled burns. After 3 days of working with the Davidson River Initial Attack Crew, I was getting used to how things worked—except for the drip torch.

I'd spent the first 7 years of my career buried behind papers and computers in the Forest Service headquarters office in Washington, DC. When I heard of a job to improve firefighting training skills for Job Corps students, I jumped at the chance. As a Job Corps alumna and someone who's still passionate about the program, I felt that I was the perfect candidate, except that I had no fire experience.

Eager to bolster my qualifications, I completed fire training at Harpers Ferry Job Corps. A year later, I started a temporary job with Davidson River to gain firefighting credibility. It was an amazing 4 months of dirt, fire, and road (in the order of what I experienced the most). By the end of my training, I'd learned three lessons for surviving in the fire world. I soon realized they could be applied to regular life.

Pack Light

My personal gear bag was a monster. Justifying its size, I swore that it only held essentials. After weeks of teasing, a fellow crewmember predicted that I'd tire of carrying it. Sure enough, I downgraded after 2 months. I hadn't needed many of those items, and I ditched the "body bag" for a much smaller pack.

Knowing what to take depends on personal preference and, for me, trial and error was the best way to personalize my gear for fire season. Getting rid of the extras from my gear bag was such a relief that I cleaned and downgraded other parts of my life, like my massive purse and my shoe collection. It continues to feel liberating!

Michaela Hall was part of the Davidson River Initial Attack Crew on the Pisgah National Forest. She is a graduate of the Job Corps program, which is taking steps to help protect our environment and connect students with businesses and their surrounding communities through green training.

Say Yes

Aside from bathing in burn mix, my third day held successes like driving a bulldozer and riding in a fire engine. I think I created many great memories because I didn't say "no." And, there were times I

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wanted to say no. Times when I had no idea what to do and didn't want to risk failing.

I learned at the Action Review held after each burn that failure is a lesson. And when you share your lessons, others grow. So, the fear of failure dissipated into confidence that no matter what happened I would learn something.

Now, as I participate in meetings and projects, I present ideas or volunteer for lead roles. I'm not afraid of messing up or asking for help or failing. I'm more afraid of the experiences that I will miss if I never try.

Don't Sweat (the small stuff)

The stains, tears, and burns on personal gear tell a story about the person using it. A clean, flame-resistent Nomex shirt screams your status as a rookie or overhead. One glance at my eager smile and sparkling eyes revealed which group I belonged to.

I learned at the Action Review held after each burn that failure is a lesson. And when you share your lessons, others grow.

I was lucky to keep my smile and sparkle for most of the season, although the early mornings and late nights took their toll towards the end of the fire season. What kept me sane was remembering to not sweat the small stuff. It still works. I ask myself, "Will this matter next year?" If the answer is no, and it usually is, I move on.

My first fire season was an introduction to embracing nature in its creation and destruction. I pushed myself, made friends, and traveled to amazing places. I saw beautiful mountains, prairie land, and a lakeside home that I instantly fell in love with.

"How many fire seasons would it take to buy this property," I asked after a day of preparing the property for a nearby burn. "A lifetime," someone yelled.

I saw that as a good thing because while I don't have millions, I do have a lifetime. ■

Contributors Wanted!

Fire Management Today is a source of information on all aspects of fire behavior and management at Federal, State, tribal, county, and local levels. Has there been a change in the way you work? New equipment or tools? New partnerships or programs? To keep up the communication, we need your fire-related articles and photographs! Feature articles should be between 1,000 to 2,000 words in length. We also need short items of up to 200 words. Subjects of articles published in *Fire Management Today* may include:

- Aviation
- Communication
- Cooperation
- Climate Change
- Ecosystem management
- Equipment/Technology
- Fire behavior
- Fire ecology
- Fire effects
- Fire history
- Fire science
- Fire use (including prescribed fire)
- Fuels management
- Firefighting experiences
- Incident management
- Information management (including systems)
- Personnel
- Planning (including budgeting)
- Preparedness
- Prevention/Education
- Safety
- Suppression
- Training
- Weather
- Wildland-urban interface

Rangeland Interface Fires: Where They Are and How They Are Different

Ken Frederick

The Charlotte Fire started south of Pocatello, ID, on a bad day for a wildfire. High temperatures and dry fuels created dangerous and explosive conditions, and strong winds rapidly pushed the fire into a neighborhood on the outskirts of the city. This June 2012 wildfire shocked observers with its speed and ferocity. Before it was contained, the Charlotte Fire burned just over 1,000 acres (405 hectares [ha]), but destroyed 66 homes and 29 outbuildings. Nearly 5,700 people had to be evacuated from the fire's path.

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> Not every wildland-urban interface is in a forested area; some are in the deserts and brushlands of the Western United States.

The Charlotte Fire was noteworthy because it burned in lighter fuels yet wreaked the kind of destruction in the wildland-urban interface (WUI) normally associated with fires burning in forest fuels. This fire burned in sagebrush, dried grass, and scattered juniper trees. Across many areas of the Western United States, brush and grass fires are throwing light on the rangeland-human interface—those areas where people live and businesses operate in a grassland and shrubland environment.

The Rangeland Interface

A common perception of the WUI is a picture of housing subdivisions on the fringes of the forest. Images of beautiful homes built among lush green woodlands offering nice views and idyllic settings come to mind. But not every WUI is in a forested area; some are in the deserts and brushlands of the Western United States. Many of these interface areas are more rural than urban or suburban. The fuels

Rural rangeland interface areas in less populated areas of the Western United States tend to be isolated.

that surround communities in the rangeland interface tend to be brush and grass species.

Major population centers in the Western United States situated near large rangeland areas include:

- Las Vegas, Carson City, and Reno, NV;
- Salt Lake City and Provo, UT;
- Phoenix and Tucson, AZ;
- Boise, ID;
- Billings, MT; and
- Cheyenne, WY.

People live in the rangeland interface for a variety of reasons. Some like the weather, while others prefer open space, the solitude of desert vistas, and out-of-the-spotlight brushland areas. Lower real estate prices found in arid zones also may compel people to buy or build a home in these areas. Although urban growth has slowed since the economic recession of 2008, many of these interface areas continue to expand. Rangeland interface issues will likely continue.

Rural rangeland interface areas in less populated areas of the Western United States tend to be geographically isolated. Often, little fire protection equipment is situated near these areas, meaning response times for emergency services are longer. Rangeland interface areas also tend to lack the infrastructure and resources more common in areas with a higher population.

For those new to the rangeland interface, the fire behavior exhibited in its fuel types can be surprising.... Grass and brush fires can move unbelievably fast.

"The lack of water surprises people who move here," said Randy Willden, Chief of the North Tooele County Fire District in north-central Utah. "People are surprised when they realize there are no fire hydrants on their street. Well, not every community in the rural parts of Tooele County has that amenity. That's just our reality." Only a single community in the North Tooele County Fire District's 1,700 square-mile (4,403 square-kilometers) protection area has fire hydrants. Rangeland interface areas may also lack features like paved roads, multiple access points, and wireless communication capabilities.

For those new to the rangeland interface, the fire behavior exhibited in its fuel types can be surprising. "Probably the biggest differences between a rangeland WUI and a forested WUI are a fire's speed and intensity," said Rex McKnight, fire management officer for the Nevada Bureau of Land Management (BLM). "Grass and brush fires can move unbelievably fast. Consequently, firefighters dealing with these kinds of fires have to plan effectively, react quickly, and work efficiently."

According to Rex McKnight, ranchers in the rangeland interface typically don't wait to be told how to react to a threatening fire. "Most of the time, ranchers are going to protect their infrastructure and livelihood," he said. "Where the traditional WUI homeowner will often be advised to leave their neighborhood, they usually do that. But ranchers will stay and try to save their houses and ranch buildings."

Other Aspects of the Rangeland Interface

Farms and Ranches. Perhaps the most recognizable symbol of the rangeland interface is the working ranch. Ranches and farms in rangeland country are spread far apart and tend to comprise clusters of buildings. They often store motor fuel in above-ground tanks. They may have millions of dollars of equipment parked under open-air sheds surrounded by brush. And when it comes to fires, farmers and ranchers understand they are probably going to be on their own for a while when a fire breaks out.

Transportation Corridors. Interstate highways and State highways cross arid lands in many Western States, and, occasionally, these corridors are impacted by wildfires. Disruption to interstate highway transportation has significant economic consequences. According to a Federal Highway Administration (FHA) report, over 2,100 freight "bottlenecks" throughout the United States caused more than 243 million hours of delay to truckers during fire events, resulting in a cost of approximately $6.5 billion (FHA 2005).

While fire managers occasionally must close an interstate highway to protect the public from smoke or other fire impacts, the decision can have enormous economic consequences for individuals and businesses. Willden recalls getting urgent phone calls from a trucker

during a closure of Interstate 80 west of Salt Lake City, UT, during a brush fire. "The caller was a driver out on the interstate hauling produce," Willden said. "He stood to lose his cargo to spoilage if he ran out of fuel for his reefer during the freeway closure. He really wanted to know what was going on."

Mines. Throughout much of Nevada and some other regions of the Great Basin, active mines are a part of the rangeland interface. Fire managers occasionally have to deal with fires that threaten mines. "Rangeland fires don't really affect open-pit mines," said McKnight, "but they can definitely affect an underground mine." Smoke entering a ventilation system will bring the work in an underground mine to an immediate halt. Working mines operate around the clock and can extract millions of dollars worth of ore every day. Shutting these operations down due to smoke can have a major impact on a mining company.

Electrical Transmission Lines. De-energizing a major electrical transmission line in response to an advancing fire creates a significant impact on power suppliers, power distributors, and electricity consumers. Fortunately, with some advance warning, electrical transmission grid managers can reroute the flow of electricity with few complications. However, for both safety and economic reasons, fire managers must be cognizant of wildfire threats to major power lines.

Range Improvements. The BLM often experiences massive range fires during the summer months. According to National Interagency Fire Center (NIFC) statistics, over the past decade, nearly every Western State has experienced a rangeland fire that has exceeded 100,000 acres (40,500 ha) (NIFC 2014). Some of these fires—for example, the 2012 Long Draw Fire near Burns Junction, OR—have surpassed 500,000 acres (225,000 ha).

Two ranchers watch fire operations on the 2013 Pony Complex, which burned northeast of Mountain Home, ID.

Due to the size of its large fires, BLM post-fire rehabilitation projects tend to be large as well. The BLM makes substantial investments in rehabilitation projects designed to combat erosion, impede invasive species, and restore habitat. For example, the BLM invested $33.4 million to perform emergency stabilization and rehabilitation on lands burned in the 2012 Holloway Fire (461,000 acres; 186,500 ha) straddling the Nevada/Oregon border. Even so, land managers cringe when they see a fire burning an area that had been reseeded just 1 or 2 years earlier because beneficial plants may not have had adequate time to become established.

Conclusion

Rangeland fire has always been a concern for fire managers. Grass and brush fires burning in hot summer conditions can exhibit incredible rates of spread and burn with surprisingly high, albeit short-lived, intensity. The rangeland interface has some unique factors to challenge fire managers, and as populations continue to expand into that interface in the Western United States, rangeland fires will increasingly threaten lives and resources there.

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Guidelines for Contributors

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Fire Management Today (FMT) is an international quarterly magazine for the wildland fire community. *FMT* welcomes unsolicited manuscripts from readers on any subject related to fire management. Because space is limited, long manuscripts might be abridged (with approval by the author) by the editor; *FMT* also prints short pieces on topics of interest to readers.

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Electronic Files. *Electronic files are preferred and may be submitted via email or traditional mail.* Electronic files must be submitted in PC format. Manuscripts should be submitted in Word (.doc or .docx) and should be between 200 to 2,000 words, depending upon the type of article. Illustrations and photographs must be submitted as separate files: ***please do not include visual materials*** (such as photos, maps, charts, and graphs) ***as embedded illustrations*** in the electronic manuscript file. Digital photos may be submitted in JPEG, TIFF, or EPS format, and must be at high resolution: at least 300 ppi at a minimum size of 5x7 (additional requirements are listed in the Photo section below). Information for photo captions (subject and photographer's name and affiliation) should be included at the end of the manuscript. Charts and graphs should be submitted along with the electronic source files or data needed to reconstruct them, any special instructions for layout, and with a description of each illustration at the end of the manuscript for use in the caption.

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