Plenary Paper

Between a Rock and a Hard Place: Toward a More Effective Protection Strategy as Wildfire Threats Intensify

Jerry T. Williams, Former National Director of Fire & Aviation Management, United States Forest Service, Retired

IN REMEMBRANCE

This paper is dedicated to the memory of Dr. Robert Edward Martin (1931-2013). Fire Science Professor, Mentor and Friend.

Context and Terminology

Before I get started, let me suggest that context and terminology are fundamentally important in the large fire discussion. Many will see large fires as bad; others not so. Whatever our leanings, judgments surrounding wildland fire are based on a number of perspectives: social, political, economic and ecological, as the theme of this conference reflects. It goes without saying that these effects will take on different meanings as we move across wildland-urban interface values, the general forest zone, large natural areas, and wilderness. Effects also often change over time.

Some forests are adapted to high-intensity, stand replacement fires; others are not. The fire regime concept offers a useful contextual gauge that helps in determining fire's short- and long-term ecological effects by framing the characteristic frequency, intensity, scale and seasonality of historic fire rhythms with respect to forest type. Departures from characteristic fire behavior to uncharacteristic fire behavior offers a basis for determining the ecological implications involved (Hardy, 2005).

Value laden terms such as "disastrous" or "catastrophic" are more suited to describe social, political and economic impacts. These words are defined by Federal Emergency Management Agency (FEMA) with reference to the Stafford Act (FEMA Definitions, 10/27/2008). Wildfire disasters cause "substantial damage or injury to civilian property or people." A catastrophe is a "disaster so overwhelming that a large segment of society is affected and extraordinary resources and skills are required to cope, some from other areas of the country or from other nations." Let me note that this may be a good place to thank our friends from Canada, Mexico, Australia, New Zealand, and the other countries that have helped us deal with wildfire disasters over the years.

This paper draws attention to the unplanned, unwanted wildfires occurring in the densified dry forest types of the Interior West (e.g., ponderosa pine and associated species)[1]. Their impacts are measured against the sum of suppression costs, private property losses and environmental damages. Sometimes, human fatalities are included. These altered forests are often where the social, political, economic and ecological measures of significant adverse impact all converge. Although this paper draws conclusions that may have similarities or parallels in other forests, we would be mistaken to apply them universally. Each fire regime has its own ecologies, its own measures of impact and presents its own management challenges.

Introduction

In an era when preparedness budgets have never been higher, when cooperation between partners has never been better, when predictive models have never been more sophisticated, and when technological support has never been more available…we are suffering from the worst wildfires since America organized to eliminate the large fire problem at the turn of the last century (Figure 1).

High-cost, high-loss wildfires—at unprecedented scales—are becoming the new normal, particularly in the West. The emergence of these recurring, record-setting incidents signals a new reality that challenges us to re-think protection strategies.

Federal, state and local governments are struggling to meet their mandates for protection, ensure the safety of their firefighters, and control fire suppression costs. Within the U.S. Forest Service, in the early 1990s, Fire & Aviation

[1] Although a 2009 Federal Fire Policy change allows managers to use wildfires to achieve resource objectives, as of this writing, the term "wildfire" is defined by the National Wildfire Coordinating Group (NWCG) as "an unplanned, unwanted wildland fire where the objective is to put it out (NWCG, 7/2012"). In this paper, where the word "wildfire" is used, the meaning reflects the NWCG definition.

In: Keane, Robert E.; Jolly, Matt; Parsons, Russell; Riley, Karin. 2015. Proceedings of the large wildland fires conference; May 19-23, 2014; Missoula, MT. Proc. RMRS-P-73. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 345 p.

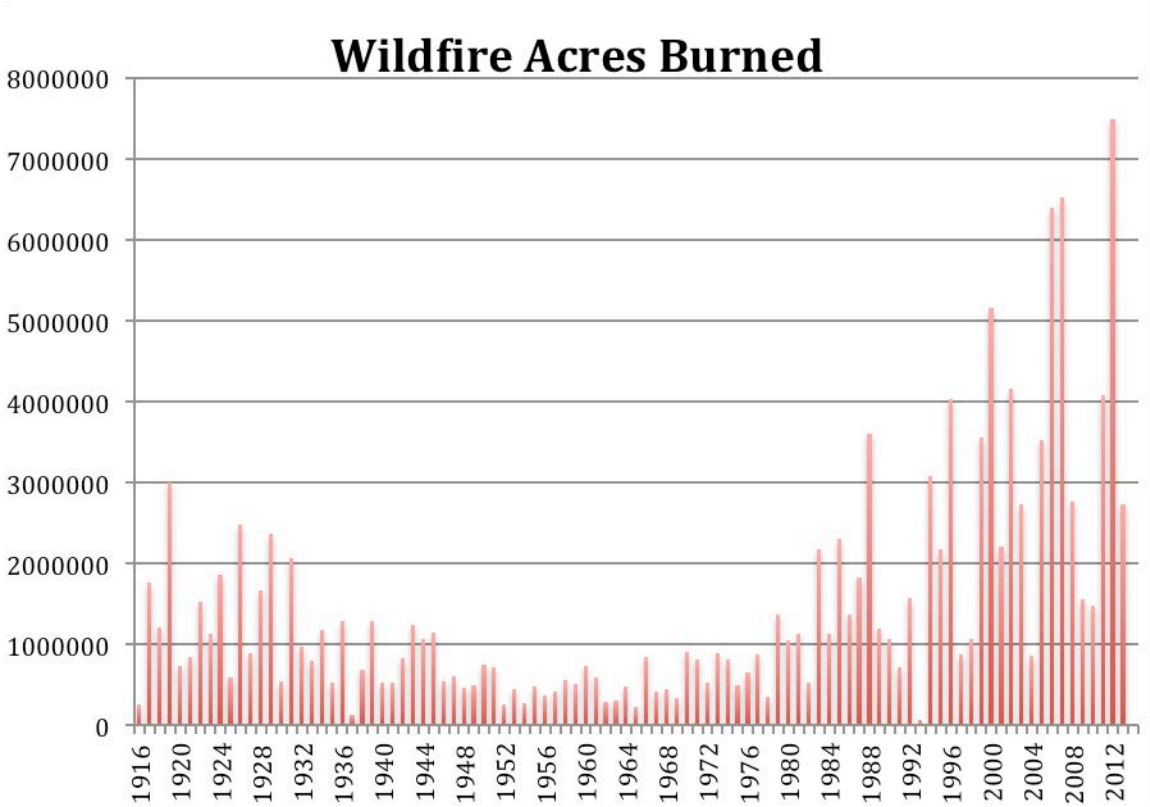

Figure 1—Reported wildfire acres burned on state and federally protected lands in the eleven states in the western United States (1916-2013)

Management activities represented about 8% of the total agency budget. Today, it is nearing 50% and still growing. In this same period, there has been a four-fold increase in fire-fighting preparedness budgets in the Forest Service. Recent projections indicate that the federal government will spend upwards of $1.8 billion in firefighting this year. In a zero-sum budget environment, fire-fighting costs have been eating into other programs, including those that might further reduce the fuels that might mitigate these large fires.

Catastrophic wildfires fall under the emergency exemptions in policy. In regulation, they are accepted as an accident of nature or excused as an act of God. However, more lately, the public seems in a less forgiving mood when it comes to the management of wildfires. There has been a growing tendency to find fault, point out an operational failure, and assign blame. In the aftermath of a wildfire disaster, there is a predictable wave of investigations, Town Hall meetings, Blue Ribbon Panels, Governor's Commissions, and Congressional hearings. Most call for a faster, more determined initial attack response, larger firefighting capacity or a better fire policy. However, the problem persists.

Perhaps because our after-action assessments are confined to firefighting response or the incident's management between time of detection and time of containment, we tend to focus too narrowly on operational performance and overlook that these extraordinary wildfires usually trace to a long-developing, but unrecognized land management problem. The large fire phenomenon is often less about how we fight fire than how we attend to fire-dependent forests.

Although some might dismiss this as "eco-babble," we cannot bemoan the costs, losses and damages that follow in the aftermath of catastrophic wildfire, and at the same time, remain unknowing or indifferent to fundamental disturbance processes and successional dynamics that define fire-dependent ecosystems. We cannot overlook how fuel accumulations and the densification of these forests predispose them to disaster.

In the West, we use the term "between a rock and a hard place" to describe a vexing, most difficult dilemma. These problems are not ones where a political solution reaches for an altogether good outcome; there is none. Lacking public and political will to act, these problems remain under the domain of the managers and on-the-ground responders to, somehow, deal with in the absence of a realistic plan. Fire managers and firefighters are between a rock and a hard place because they are unable to control the worst wildfires, but neither can they work at large-enough scales to mitigate the hazards that predispose them.

- The consequences of the few wildfires that escape initial and extended initial attack have become enormous. A remarkable success rate may be masking a deeper problem that strikes to the heart of protection aims. Fair or not, firefighting forces are not judged by how many wildfires they put out; they are judged by how they perform at the highest level of threat[2], when the protection of lives, property and natural resources matters the most.
- Expectations for protecting houses at the wildland-urban interface is growing, while the willingness to

accept thinning, prescribed burning and government-recommended fire-safe building codes on private lands is often unwelcome. Fire danger warnings are often ignored until there is smoke in the air.

- Despite knowing the value of fuel reduction treatments in mitigating wildfire risks, active management is often met with a series of discouraging and near-insurmountable obstacles. High costs, long planning horizons, and a number of regulatory requirements impede hazard reduction work at effective scales. "No-action" has become the default alternative, compounding the problem over time.
- Finally, although we maintain that firefighter safety comes first in policy, in practice pressures to get the job done and take risks are intensifying, especially at the wildland-urban interface. Lacking clear limits in an increasingly unforgiving environment, we are left wondering where the boundaries are, in terms of acceptable loss. Whether measured in lives lost, homes lost, public values lost, or money expended, we wonder what threshold must be crossed before we pause and insist on change.

So, at an impasse between a suppression strategy that comes up short under extreme burning conditions and a mitigation strategy that is largely hamstrung, firefighters soldier on, getting more deeply invested in pushing an untenable position.

How do we break this impasse? How do we get out from between this "rock and a hard place"? Why do we need to re-think wildfire protection strategies and consider changing course?

Objectives

Increasing drought, deteriorated forest conditions, and expanding development at the wildland-urban interface have combined to change the calculus of wildland fire protection. An over-reliance on suppression-centric protection strategies, where increasing wildfire threats are met with greater firefighting force, are failing to work under extreme burning conditions. The onset of mega-fires and forecasts for deeper, more prolonged droughts are clear indication for a new, more comprehensive wildfire protection strategy.

This paper maintains that safer, more cost-efficient, and more sustainable fire protection strategies will need to look beyond operational and fire policy "fixes" and address the causal and contributory factors involved. The paper calls for a more comprehensive wildfire protection strategy; one where the idea of protection is expanded to include the land management policies, land-use behaviors and regulatory requirements that influence and govern the condition and vulnerability of the Interior West's fire disturbance regimes.

In the spirit of this conference's call for exploring solutions, this paper will propose some thoughts on a set of management actions going forward.

Background

Large wildfires are relatively rare (only about 1 or 2% of all starts), but they account for about 95% of the total burned acres and roughly 85% of all suppression costs (Hyde and Williams 2007; Figure 2). Over the past several years, there has been a growing number of nationally significant wildfires in this country. At least 7 of the 11 Western states have suffered their worst wildfires on record; some more than once. So-called "mega-fires" (Omi 2005; Williams 2007; Williams and Hyde 2009) may be extraordinary for their size, the magnitude of response, and their cost, but they are better defined by the deep and long-lasting social, economic, and environmental consequences involved. They commonly evoke a governor's disaster declaration to support the emergency. Politically, their repercussions reach the highest levels of government. Lives are often lost. Hundreds, sometimes thousands of houses are destroyed, local economies are disrupted and community infrastructure is often left in shambles. People don't easily "move on" from these catastrophic fires.

Throughout the 1950s, 1960s and 1970s, however, large wildfires were unusual. In fact, under the old reporting system, the "G" size class was the largest, describing those incidents of 5,000 acres or greater. Throughout the West in this three-decade period, relatively few "G" fires were reported. Today, a 5,000 acre fire may not make the Daily Situation Report because it is not big enough. In Arizona—up until the beginning of the 21st century—the largest forest fire reported in state history was the tragic Dude Fire in 1990, at 28,000 acres. In 2002, the Rodeo-Chediski Fire burned a shocking 468,000 acres. A short nine years later, it was eclipsed by the Bear-Wallow Fire (469,000 acres in Arizona and 538,000 acres in Arizona and New Mexico combined). In the past twenty years, one expert estimates that nearly 20 percent of Arizona's forests have burned over, resulting in near-complete mortality (Swetnam, 2012). Alarmingly, these enormous wildfires are often occurring in altered forests that have higher fuel loads and are more dense and more vulnerable than they were before the turn of the last century. In these forests, changed conditions have resulted in changed fire behavior. Historic low-severity, stand-maintenance burning has given way to severe stand replacement burning. These changes have occurred throughout much of the Interior West's ponderosa pine forests.

[2] The highest level of threat describes those conditions where the exposure to risk and likelihood of loss is high or near-certain. It is where extreme fire behavior challenges all efforts at control. Fireline intensities preclude direct attack by any means. Long-range spotting often inhibits indirect attack. The combined effects of drought, hot, dry and windy weather, along with dried-out, desiccated fuels ranging, uninterrupted, across whole landscapes result in rates of spread that far out-pace ground and aerial fireline production rates. The level of threat is often exacerbated by a serious draw-down of firefighting assets, due to demand from other, simultaneously occurring wildfires and the emergence of new starts.

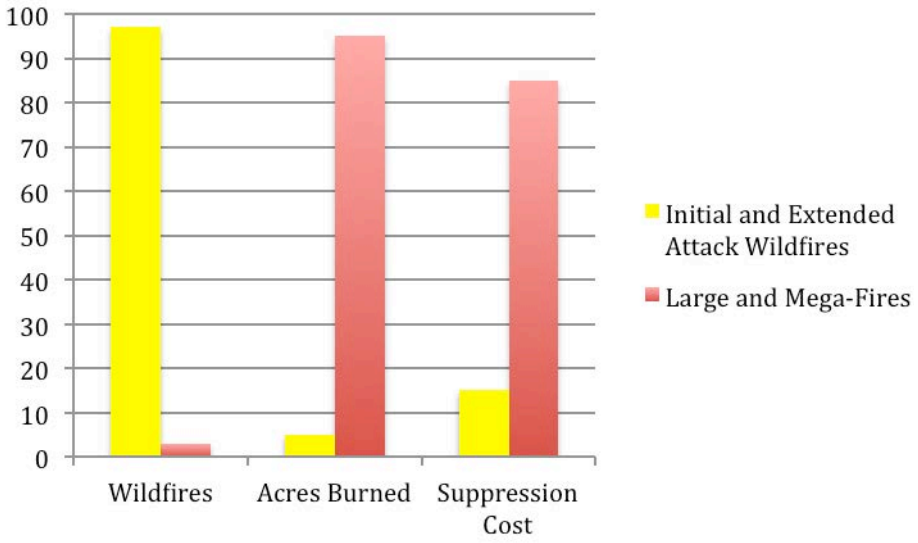

Figure 2—Approximate distribution of acres burned and suppression costs between initial and extended attack wildfires and large or mega-fires, by percentage.

Some years ago, we examined recent worst-on record wildfires to see if we could identify any common characteristics (Williams and Hyde 2009). Here are a few:

- Most large fires were in the Interior West. Nearly half were person-caused. Of these, most were the result of carelessness, but some were intentional.
- Although many mega-fires burned through a variety of forest types, much of the total burned acreage was in forests once dominated by ponderosa pine and associated dry-site species (Figure 3)

Most forests had undergone significant changes in species composition, stand structure, stand density, and fuel accumulation. These once-open forests, with about 50 large trees per acre are now commonly choked with 500 to 1,000 or more smaller trees per acre. Over-accumulated biomass, dried out in the presence of drought, has resulted in severe fire behavior in these altered forests. These wildfires did not "just happen," as an accident might; they have been incubating for over a century. The effects of fire exclusion, over-grazing, high-grade logging, and, more recently, preservation or "hands-off" forest management approaches have manifest themselves in forest conditions that fuel severe wildfires(Figures 4 and 5). Ironically, many of today's worst wildfires are occurring in forests that were among the most benign in terms of potential fire behavior 100-years ago.

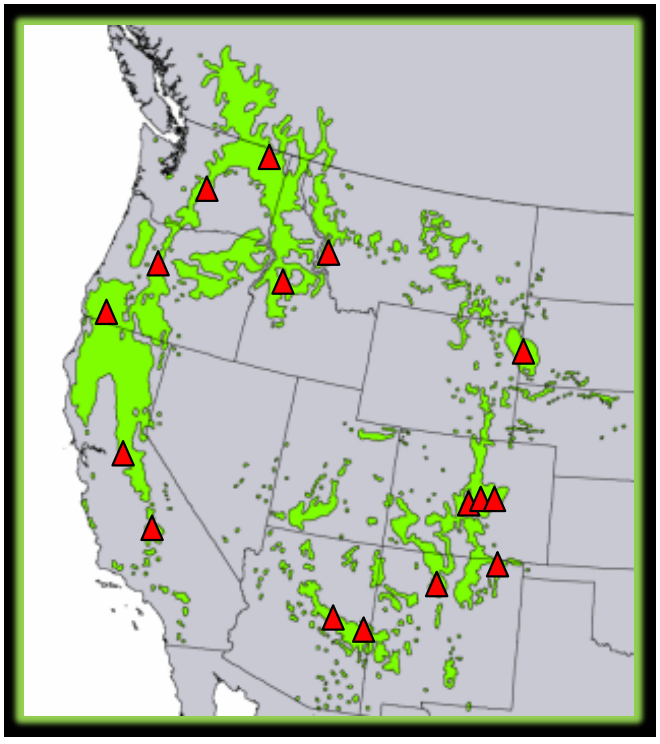

Figure 3. Recent highest cost, loss and/or damage forest fires in relation to native ponderosa pine distribution (2000-2013).

- The once-open forests, commonly at valley-bottoms, historically afforded something of a "buffer" between the stand-replacement fire regimes in forests higher in elevation and removed from the settlements below. That "buffer," now, is all but gone. At the wildland-urban interface, this shift from open, low fuel- load conditions to dense, high fuel-load conditions has important implications for protection. Much of the West's wildland-urban interface is concentrated in these forests.
- All incidents occurred under extreme burning conditions. Energy Release Components (ERC: a measure of drought) were above the 100th percentile during the life of most of these fires.
- These record-setting wildfires exceeded all efforts at control until they burned to a break in fuel or there was relief in weather. Perimeter growth remained far greater than fireline production rates (both ground and air) until severe fire behavior abated.
- Wildland urban interface values were common on these incidents and almost always given the highest priority for protection. "Point protection" strategies usually resulted in greater perimeter growth elsewhere, often onto public lands *perceived* to be of lower value. It was not clear that the cumulative impacts to watersheds, wildlife habitat, old growth, endangered species, viewsheds, air quality

Figure 4—Representative stand conditions, burning characteristics and aftermath of a historic fire-maintained ponderosa pine forest.

Figure 5—Representative stand conditions, burning characteristics and aftermath of a modern undisturbed ponderosa pine forest.

and other public values were being adequately weighted in making tactical decisions or establishing protection priorities.

- The land and resource management plans where these fires occurred called for maintaining undisturbed conditions for a variety of resource needs (e.g., watershed, wildlife habitat, roadless, recreation, etc.). These undisturbed conditions, on these dry sites, were characterized by dense stands with high volumes of biomass and heavy fuel loadings. Under extreme fire weather conditions, these conditions contributed to severe fire behavior.
- Notably, within the perimeter of many of these incidents, there were relatively small areas that were treated and prior understory thinning and/or prescribed underburning had been accomplished. In these treated areas, fire-intensity was much lower. Consequently, mortality and damage was also much lower (Figure 6).

Figure 6—Comparison in post-fire mortality between treated areas (in green) and un-treated areas (in black). From: Tyee Fire, Wenatchee National Forest (1994).

Discussion

Policy objectives are important benchmarks that are used to evaluate performance. When objectives are no longer attainable, there is strong indication that our approach needs to change.

The wildfire protection objective has long been to:

> *"Protect people and property and—without compromise to firefighter safety—minimize natural resource losses and environmental damage at the least suppression cost,"*

As the number of disaster wildfires has increased, most observers would have to acknowledge that our current protection strategy has run up against clear limits under extreme burning conditions. The worst wildfires defeat virtually every component of the protection objective (lives, property, natural resources and cost). When it gets hot, dry, and windy, and there is too much fuel and too much biomass, accumulated over too many years, recent disaster wildfires have become too much to control.

It was many years ago that pioneer fire ecologist Dr. Harold Biswell described the move from fire control to fire management as more balanced. If memory serves, he described fire management as one-third suppression, one-third fuels reduction and one-third prevention. We've been slow to achieve that balance. In fact, most post-disaster recommendations and actions have us "retreating" to more suppression (Zimmerman 2014).

In the aftermath of a disaster, there are often public and political calls for a faster response and a more determined effort...next time. Many argue that we need to "double down" on suppression, invest more in preparedness and fight fire more aggressively. Some argue that we need to return to the "10 a.m. Policy," whereby all new starts are to be controlled by 10 a.m. the following day at less than 10 acres. A few suggest that we need to go "all-in" with suppression and move away from a natural resource orientation to a Federal Fire Service.

Other themes are sometimes surfaced, as potential solutions to the large wildfire problem:

Protect Houses and Let More Fires Burn Into the Wildlands. Some say we should fireproff homesites, emphasize FIREWISE planning and take other precautions around high values, letting fires run their course and burn more freely in the general forest zone where values-at-risk are *perceived* as lower.

Large Wildfires Are Going to Happen…Some argue that large wildfires are going to happen and that not all is bad about it. Given that we cannot prevent them all and that restoration work is too expensive or too contentious, they say, "why not let nature take its course and let fire play its role, in order to clean out over-accumulated fuels?"

Accelerate Fuel Reduction Work...No one promises that reducing fuels will prevent wildfires, but the severity of those wildfires should be lessened, particularly in the short-interval fire-dependent ecosystems. Many experts contend that fuel reduction works at reducing wildfire impacts, but most also agree that we don't do enough of it.

Among the Western forests, perhaps none has the science supporting fuel reduction and fire-use more than the ponderosa pine type. Long before we began managing these forests, Native Americans routinely underburned them for food, forage and access (Barrett and Arno 1982; Barrett and others 2005). Early in the twentieth century, Aldo Leopold observed the importance of frequent, low-intensity burning in maintaining these forests (Leopold 1924). Other scientists, over the decades, have supported the benefits of fuel reduction and low-intensity fire-use in ponderosa pine (Weaver 1943; Sweeney and Biswell 1961; Biswell and others 1973; Hall 1976; Gruell and others 1982; Agee 1993; Arno and Allison-Bunnell 2002; Keeley and others 2009).

Our own firefighters emphasize the importance of fuel reduction. In 1996, following the disastrous Storm King Mountain Fire, a landmark national survey found that an astounding 83% of firefighters ranked fuel build-ups as among the most important factors affecting their safety (Tri-Data, 1996).

In 1999, at the behest of Congress, the Government Accounting Office (GAO) issued a report in response to a series of disaster fires (GAO 1999). The report found,

> *"The most extensive and serious problem related to the health of national forests in the Interior West is the over-accumulation of vegetation, which has caused an increasing number of large, intense, uncontrollable and catastrophically destructive wildfires."*

The report estimated that some 39 million acres were at highest risk. It identified much of the highest risk in altered ponderosa pine forests. It cannot be overlooked that these forests are often at the interface and typically closest to people and communities.

The Forest Service answered the report the next year and described what it would take to address the Interior West's wildfire problem (USDA Forest Service 2000). "Protecting People and Sustaining Resources in Fire-Adapted Ecosystems:

A Cohesive Strategy" called for a ten-fold increase in fuel reduction treatments in the Interior West, eventually reaching 3 million acres per year. It prioritized ponderosa pine and associated dry forest types in the highest hazard condition for treatment. The strategy anticipated a 15-year treatment time frame to begin realizing a reduction in wildfire costs, losses and damages. It estimated that fuel treatment costs would eventually reach $600 million per year.

In the early 1990s, the Forest Service fuels budget increased from $12 million to $50 million, nationwide. At the time when the Cohesive Strategy was submitted, the Forest Service was treating about 300,000 acres per year in all fire regimes throughout the West.

Perhaps the most important features of the 2000 Cohesive Strategy was that it was the first agency report scaled to the size of the problem and that it established a priority for treatment. But, its ambitions were thought too costly. Its goals were not fully implemented. However, it did establish the need for far greater levels of fuel reduction work. It became the basis for a significant jump in fuels funding through the National Fire Plan (2002) and the Healthy Forest Restoration Act (2004)—from $50 million per year to $350 million per year. Yet, there has not been a corresponding increase in treated acres on high-priority sites. The agency treats little more today than it did before the budget took a seven-fold increase (Peterson 2011). Higher treatment costs near the wildland-urban interface, restrictive regulatory constraints, a general lack of consensus among stakeholders, and higher pool and overhead costs seem to be implicated in this inability to increase treatments commensurate with increased funding levels.

There are isolated areas where progress is being made, but they remain the exception rather than the rule. Demonstration areas near Sisters in Oregon, Flagstaff in Arizona, the White River-Apache Indian Reservation in the Mogollon Rim country of New Mexico, the east slope of the Sierras and, here, near Missoula—among others—are places where people are supporting more mitigation work. Other long-standing fire-use programs in Yosemite National Park and several large wilderness areas (Gila, Selway-Bitterroot, Frank Church, and Bob Marshall Wilderness Areas) also offer examples where fire risks have declined as new starts are limited in growth potential by the size, distribution and arrangement of earlier fires (Teske and others 2012). Today, many of these places may be among the safest, most resilient and least costly-to-protect landscapes in the Interior West. Despite the historical Native American use of fire in these forests, the early observations of Leopold, a 50-year history of supporting research from fire ecologists and fire scientists, testimony from our own firefighters, GAO reports and agency responses, evidence from demonstration areas and observations from treated areas within mega-fire perimeters, we continue to favor suppression and remain unable to make much progress with fuel reduction, prescribed burning and restoration.

Formidable obstacles preclude getting more done, but these barriers, left unchallenged, will perpetuate the large fire problem.

Thoughts on a Way Forward

This paper argues that the Interior West's wildfire problem is rooted in the vulnerable condition of its dry forests. In the ponderosa pine type, especially, high fuel loadings, over-accumulated biomass, and dense, multi-storied canopies have developed over a period of many decades. More recently, a "hands-off" approach to forest management continues to exacerbate the densification of these forests. The condition of these forests is enabled by a regulatory framework that punishes mitigation treatments, while giving a "pass" to the consequences associated with "no-action." The problem is further abetted by an incomplete and inconsistent accounting of total wildfire-related costs, losses and damages that mask the true impacts, making hazard mitigation appear un-economical. In some cases, more fuels "pile-on" as a result of incompatible forest plan objectives and ill-fitting land-use expectations.

There are five areas that I believe need attention if we are to get out from between this "rock and this hard place." They might be the elements of a next generation wildfire protection strategy.

Analysis at the program level

Program level analysis evaluates long-term trends against policy objectives. It aims to establish a basis for direction. It can reflect the need to change direction. It is used to develop budgets, staffing, priorities, and overarching strategies. Its usefulness depends on reliable data and a willingness to dispassionately assess the facts surrounding a program's implementation.

Last August, the GAO issued a fire-related report that expressed concern over:

> *"...a firefighting culture that values experience and history over data and scientific analysis (GAO, 2013)."*

Federal wildland firefighters can be proud of their "can-do" attitude and their traditions, but GAO has a point. In many areas, we have done a good job with project-level or implementation analysis, but many of the larger program-level or strategic questions are left unanswered. Many of us are familiar with the National Fire Management Analysis System (NFMAS), Aerial Delivered Firefighter Studies, Aerial Platform Studies, engine studies, firefighter qualification studies, mobilization reports, and a host of other analyses to determine the mix, positioning, and numbers of "the most efficient level" of firefighting assets.

We do very well at achieving protection objectives almost all of the time, but—given the enormity of consequences involved when severe wildfires occur—we have to ask if we might be fine-tuning the tactical applications of a fundamentally flawed strategy; a strategy that relies almost entirely on the ability to put fires out and carries with it the implicit assumption that we ***can*** put all fires out. If a suppression-centric strategy has clear limits of effectiveness at the highest level of threat, and these fires account for almost all of the total costs, losses, and damages, we have to ask if this strategy can continue to achieve protection objectives.

We also have to ask if a suppression-centric strategy can be sustained, as forest and climate conditions worsen.

What other wildfire protection strategies might be more effective under these conditions? What would a rigorous analysis show, if we evaluated the short- ***and*** long-term social, economic, and ecological costs, risks, and benefits among alternative protection strategies? How does suppression compare with other alternatives if we continue to emphasize it in the future? What are the eventual risks to public values like water, wildlife, air quality and other values if we choose to protect private property and houses over public lands? What does it mean if we accept that large fires are inevitable and "let nature take its course?" What are the pros and cons if we accelerate fuels reduction work to more meaningful scales? And, of the alternatives we might decide upon, which one (or combinations of several) best meets our wildfire protection objective? Over the long-term, which is economically feasible and ecologically appropriate?

This need for program-level or strategic analysis is not confined to firefighting. In land management policies and plans managers are required to evaluate proposed actions at the project-level, but, at the program-level, wildfire risks are seldom identified, much less accurately assessed among broad forest plan alternatives.

If the need arises to reduce wildfire threats somewhere, we will enlist a number of interdisciplinary specialists and pull together an Environmental Assessment (EA) to navigate the selective logging, thinning and prescribed burning impacts that are likely to affect the project area. Before it is completed, we will have probably spent most of the project's allocation. The project plan will probably take a couple of years to complete and gain internal approval. Chances are better than even that the project will get appealed or scaled-down. It may stall altogether for the weight of its costs and constraints.

On the other hand, in the absence of action, a much larger wildfire threat may continue to incubate. When the eventual serious wildfire happens, many will be surprised or, even, outraged. This wildfire may grow to many times the size of our proposed project, cost many times more than our project, and result in many times greater impacts than our project. Before the smoke clears, intense scrutiny will be brought to bear in how the incident was managed. Operational performance will be reviewed and, maybe, investigated. It may be litigated. An Incident Commander may get sued.

For all of the scrutiny that will be brought to bear after a high-consequence wildfire, little attention will be directed to the causal and contributory factors that predisposed the disaster in the first place. There are no regulatory requirements to evaluate the factors that predispose wildfires. In fact, wildfires are exempt from the kind of analysis that is required for the proposed actions that would prevent them.

When it comes to the best way to protect against high-consequence wildfires, whether it's Biswell's balanced 1/3-1/3-1/3 formula or one or more of the protection options we outline above, evidence- and science-based analysis helps us find, or at least document, the optimal, most sustainable alternative and avoid settling on the most expedient, but socially, economically and ecologically ***wrong*** solution over the long-term. Credible analysis helps us understand what problems our "solutions" may bring over time. Analysis done right helps us avoid un-intended consequences.

The regulatory exemption for wildfires

In the past few years, some have urged re-visiting the environmental laws that govern the management of federal lands (Bosworth 2006; Thomas 2011; and Engel 2013). They argue that, altogether, these laws have become a hodgepodge of single-focus requirements that work at cross-purposes with one another and overlook larger ecosystem needs.

Many of these laws were enacted in a cooler, wetter climate cycle of the 1930s to 1970s, before the onset of extended drought conditions that we experience today. Prior to the 1970s, we did not see the kind of fire behavior at the scales that we see today. The science of fire ecology was in its infancy and not many plans addressed the disturbance dynamics of fire. With the exception of the 1964 Wilderness Act, most legislation was silent on fire's ecological role. Although the current regulatory framework, such as that employed by the Environmental Protection Agency, tends to accept wildfire impacts as unavoidable, it holds prescribed fire, hazard mitigation and fire-use proposals to a different, more stringent standard. Smoke from a prescribed fire is subject to EPA's air quality standards, while smoke from a wildfire is considered "natural" and, in regulation, exempt from the standards. In the laws' interpretation, active management decisions are subject to regulatory controls that wildfires are not. In the laws' application, using fire must "compete" against possible short-term impacts to a wide range of values. This disparity or bias begs attention in fire-dependent ecosystems.

In practice, environmental regulations typically subject proposed actions to series of requirements and a long, costly planning process, but the wildfire outcome, in the absence of treatment, gets a "pass" in the language of the law. Wildfire impacts are considered an act of God or an accident of nature. Their impacts fall under emergency exemptions; they don't count against air quality, greenhouse gas emissions, endangered species habitat, watershed integrity or other objectives. In practice, there is no consequence for "no action." The West's large fire problem in dry forests is being abetted by a regulatory framework that makes the high-severity wildfire outcome all but certain. This bias in the law is almost certainly perpetuating the large fire problem in the West's dry, fire-dependent ecosystems.

Are safer, more cost-effective wildfire protection strategies unattainable in fire-prone ecosystems because the selective logging, under story thinning and prescribed burning projects might be perceived as too contentious, too costly or too risky? What are the tradeoffs? Are healthy, resilient and diverse fire-adapted ecosystems realistic if the treatments that get them there are constrained by a regulatory bent for stasis?

Dismissing wildfires as acts of God or accidents of nature does not hold when we consider the effects of 100 years of human-induced changes, especially in the West's interior

dry forests. These changes have predisposed these forests to severe burning and large fire potential. Removing the wildfire exemption in altered dry forests strikes the perception that "no action" equates to no consequence. In fire-prone ecosystems, it forces the realization that significant social, economic and ecological effects can and do result from "no action."

Full accounting for total wildfire impacts

Over the years, Agency Administrators, Comptrollers and Budget Examiners have been critical of federal spending on wildfires. Some believe that there is a lot of waste in firefighting: the Fire Services spend money recklessly and Incident Management Teams spend so much money simply because they can.

We are between a rock and a hard place because many of the highest cost wildfires involve threats to high values (e.g., houses and private property). Any opportunity to rein in spending on these kinds of wildfires is invariably met with public and political demands to do and spend more, regardless of effectiveness. It doesn't matter that fuel accumulations went un-addressed for years before the incident. It is never a good time to broker savings in the middle of an emergency.

A full accounting of wildfire costs includes much more than the suppression component. Private property and infrastructure losses, natural resource damages, burned area emergency re-habilitation costs, human health impacts, post-fire impacts (e.g., mudslides and flooding), and costs related to settling lawsuits are all a part of large fires' true costs. Some high-consequence wildfires have control costs that represent less than 15% of the true, total costs. For example, the Rodeo-Chediski Fire cost $46 million to suppress, but another $308 million to cover losses and damages. It is not unusual for property losses and natural resource damages to exceed three-quarters of total wildfire costs (Western Forestry Leadership Coalition, 2010).

The costs of reacting to an emergency, rather than proactively preventing a disaster are where the real savings lay. The costs of "no action" are enormous and getting bigger.

When Administration Budget Examiners and Congressional Appropriators realize the full costs of these wildfires, they might better support fuel reduction strategies that, before, were dismissed as too costly.

Linking land management direction to wildfire risks

Modern large wildfires are often blamed on yesterday's land management practices (e.g., a century of fire exclusion, high-grade logging and over-grazing). But, the mega-fire assessment revealed a number of examples where many of today's land management plans call for maintaining dense, late-successional conditions un-interrupted over broad landscapes for a number of resource aims (watershed protection, endangered species habitat, roadless natural areas, and others).

An effective wildfire protection strategy must look beyond the management of fire; it must more broadly focus, also, on the management of fire-dependent ecosystems. This paper calls for a more comprehensive wildfire protection strategy that takes into account how land management policies, plans, and practices influence wildfire outcomes. Specifically, it calls for better aligning land management approaches with the ecological dynamics of fire-dependent forests as an important means of reducing wildfire impacts and protecting key values.

Perhaps after decades of over-exploitation, our notions of protection became aligned with an emphasis on preservation, "hands-off," and maintaining undisturbed conditions. In fire-dependent forests, this is proving a costly and unsustainable approach. In fact, we may actually be imperiling the very values we hope to sustain by insisting that altered fire-dependent forests can be held in stasis by relying on suppression (Figure 7).

A policy requirement that connects the long-term risks of land management decisions to likely wildfire outcomes needs to be put in place in the post-fire review process. This linkage is seen as critical so there will be a more defensible basis to revise land management plan objectives as the means to reduce wildfire impacts. Until we better align land management plans with the dynamics of dry, fire-dependent ecosystems, we run the risk of "piling on" more fuel and adding more complexity onto an already-dangerous situation (Williams 2012).

Address agency firefighting's limitations

There is another issue that waits on wildland fire managers and firefighters: the need to acknowledge the limits of suppression. Safety concerns, funding issues, and the ability of local, state, tribal, and federal agencies to continue building ever-bigger firefighting capacity have reached critical limits with the onset of the large fire problem. There remains an important place for firefighting, but it is time to make clear the

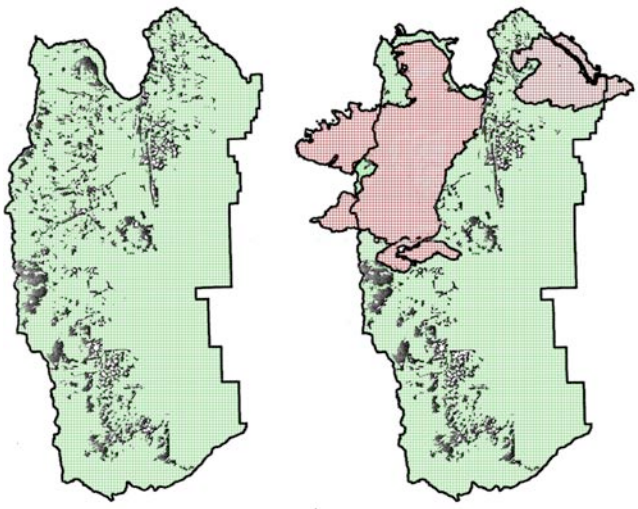

Figure 7—Wildfire perimeters from 2002 and 2003 overlayed onto Northern Spotted Owl habitat areas, Sisters Ranger District, Deschutes National Forest.

need to confront the high-hazard forest conditions that predispose or set the stage for many of these disastrous wildfires. The structural fire services did something similar nearly a century ago, when they turned to managing for safer, more fire-resistant conditions in our cities instead of only building bigger fire departments.

As long as public and political perceptions hold that bigger and better firefighting assets can solve the large wildfire problem, real solutions will remain elusive. We are sometimes seduced into thinking that more and larger assets will solve the large wildfire problem. However, when bigger budgets, bigger aircraft, bigger engines and bigger organizations don't live up to our promises (real or implied) public and political scrutiny will turn to focus on failures in operational performance. As you are perhaps already seeing, fire managers and, even, firefighters will increasingly find themselves being blamed or sued for wildfire outcomes.

Conclusions

We are between a rock and a hard place because, in the West's interior ponderosa pine forests, the idea that we can somehow keep these forests as they are, suspended in stasis, is incompatible with the disturbance dynamics that define these ecosystems. Unless we reconcile this belief, we will not only see more costly, more dangerous wildfires, we will also run the risk of imperiling the very values that we hope to preserve.

Caught between a suppression-centric strategy that does not work at the highest level of threat and a regulatory process for fuel reduction that too often defaults to inaction, wildfire protection for people and natural resource has arrived at a dangerous and costly impasse. We do not want to linger here long.

Experienced firefighters know that to ignore troubling indicators and "push" an untenable position invites disaster. The costs, losses and damages that are trending upwards with a growing number of large, uncontrollable wildfires are a powerful indicator that we need to adapt. This paper argues that we need to *comprehensively* deal with the barriers that enable and abet these severe, high-cost wildfires. The onset of these fires challenges us to expand our focus from tactical, technical and operational to more long-term social, economic and ecological.

Of all the natural disasters that Americans deal with, high-consequence wildfires that burn in altered dry forests of the Interior West may be among the least natural. Contrary to widespread belief and the prevailing language of the law, this "natural disaster" is rooted in the way we use, manage, attend to, and protect fire-dependent ecosystems. Unlike most other natural disasters, this one has solutions.

At this conference, the International Association of Wildland Fire and the Association for Fire Ecology are confronting this important problem at a pivotal time. Your standing gives you an opportunity to bring land managers, policy-makers, and law-makers to confront the large wildfire problem. In large measure, it is a problem that only they can solve.

'We have been the architects of our own danger."
-Mayor Jorge Castro, following Valparaiso,
Chile, fire disaster
13 April, 2014

References

Agee, James K., 1993. Fire ecology of Pacific Northwest forests. Island Press, Washington, DC.

Arno, Stephen F. and S. Allison-Bunnell, 2002. Flames in our forest: Disaster or renewal? Island Press, Washington, DC.

Arno, Stephen F. and C. E. Fiedler, 2005. Mimicking nature's fire: Restoring fire-prone forests in the West. Island Press, Washington, DC.

Barrett, Stephen W. and S.F. Arno 1982. Indian fires as an ecological influence in the Northern Rockies. Journal of Forestry. 80: 647-651.

Biswell, Harold H., H. Kallendar, R. Komarek, R.J. Vogel and H. Weaver 1973. Ponderosa pine fire management: A task force evaluation of controlled burning in ponderosa pine forests of Central Arizona. Tall Timbers Research Station, Miscellaneous Publication 2, Tallahassee, Florida.

Bosworth, Dale, 2006. Fire and fuels: We need a public lands policy debate. Forest Service Chief's speech delivered at the Cal Poly seminar: Changing fire management and policy. San Luis Obispo, California (March 6).

Engel, Kirsten H., 2013. Perverse incentives: The case of wildfire smoke regulation. Ecology Law Quarterly Vol.40: 623-672. Regents of the University of California, Los Angeles, California.

Gruell, George E., W. Schmidt and others 1982. Seventy years of vegetal change in a managed ponderosa pine forest in Western Montana—implications for resource management. USDA Forest Service, Intermountain Research Station, General Technical Report 130, Ogden, Utah.

Hall, Frederick C., 1976. Fire and vegetation in the Blue Mountains: Implications for land managers. pp. 155-170 in Proceedings – Tall Timbers Fire Ecology Conference 15. Tall Timbers Research Station, Tallahassee, Florida.

Hardy, Colin C., 2005. Wildland fire hazard and risk: Problems, definitions, and context. Forest Ecology and Management 211 (2005) 73-82. Elsevier Publishing.

Hyde, Albert C. and J.T. Williams 2007 (June). The mega-fire phenomenon: Implications for leadership. Phase II (operations): Developing a mega-fire management model. Summary report on file USDA Forest Service headquarters, Washington, DC.

Keeley, Jon E., G.H. Aplet, N.L. Christensen, S.G. Conrad, E.A. Johnson, P.N. Omi, D.L. Peterson and T.W. Swetnam 2009. Ecological foundations for fire management in North American forest and shrubland ecosystems. USDA Forest Service General Technical Report PNW-GTR-779.

Leopold, Aldo, 1924. Grass, brush, timber, and fire in Southern Arizona. Journal of Forestry 22(6): 1-10.

Omi, Phillip N., 2005. Forest fires: A reference handbook. Contemporary World Issues, ABC-CLIO, Inc. Santa Barbara, CA.

Peterson, Jodi, 2011. A burning problem: Why good Policy and good intentions won't stop big, destructive fires. High Country News, Volume 43, No. 17.

Sweeney, James R. and H. H. Biswell 1961. Quantitative studies of the removal of litter and duff by fire under controlled conditions. Ecology 42 (3): 572-575.

Swetnam, Tom (Director, Laboratory of Tree-Ring Research, University of Arizona. Tucson, Arizona. In personal e-mail exchange with the author (5/12/2012).

Teske, Casey C., C. Seielstad, L. Queen, 2012. Characterizing fire-on-fire interactions in three large wilderness areas. Fire Ecology 8(2).

Thomas, Jack Ward, 2011. The future of the national forests: Who will answer an uncertain trumpet? Fair Chase. Boone and Crockett Foundation, Missoula, Montana.

Tri-Data Corporation, 1996. Wildland firefighter safety awareness study. Phase I: Identifying the organizational culture, leadership, human factors, and other issues impacting firefighter safety. Tri-Data Corporation, Arlington, VA. Study on-file National Interagency Fire Center, Boise, ID.

United States Forest Service, (April 13) 2000. Protecting people and sustaining resources in fire-adapted ecosystems: A cohesive strategy (USDA Forest Service response to GAO Report RCED-99-65). On file, U.S. Forest Service Headquarters, Washington, DC.

United States General Accountability Office, (April) 1999. Western national forests: A cohesive strategy is needed to address catastrophic wildfire threats. GAO/RCED-99-65.

United States Government Accountability Office, (20 August) 2013. Improvements needed in information, collaboration and planning to enhance federal fire and aviation program success. GAO-13-684.

Weaver, Harold, 1943. Fire as an ecological and silvicultural factor in the ponderosa pine region of the Pacific Slope. Journal of Forestry 41(1):7-14.

Western Forestry Leadership Coalition, 2010. The true cost of wildfire in the Western United States. Available through www.wflc-web.org.

Williams, Jerry T., 2007. The mega-fire reality. Keynote address: National bushfire forum: Are big fires inevitable? Canberra, Australia 27 February 2007. Published by the Bushfire Cooperative Research Centre.

Williams, Jerry T. and A.C. Hyde, 2009. The mega-fire phenomenon: Observations from a coarse-scale assessment with implications for foresters, land managers and policy-makers. Presented at the 89th Society of American Foresters National Convention, Orlando, Florida (2 October 2009).

Williams, Jerry T., 2012. Exploring the onset of high-impact mega-fires through a forest land management prism. Forest Ecology and Management 294 (2013) 4-10. Elsevier Publishing.

Zimmerman, Thomas, 2014. Wildland fire management: Are we doing enough? The Mike and Mabelle Hardy Fire Management Lecture Series (20 February, 2014). College of Forestry and Conservation, University of Montana. Missoula, Montana.

Background Material

Eccleston, Charles H., 1999. The NEPA planning process: A comprehensive guide with emphasis on efficiency. John Wiley and Sons. New York, New York.

Friederici, Peter (ed.), 2003. Ecological restoration of Southwestern ponderosa pine forests. Island Press, Washington, DC.

Howitt, Arnold M. and Herman B. Leonard, 2009. Managing crisis: Responding to large-scale emergencies. CQ Press, Alexandria, VA.

Intergovernmental Panel on Climate Change, 2012. Summary for policy-makers, in: Managing the risks of extreme events and disasters to advance climate change adaptation, C.B.Field and others. Cambridge University Press. Cambridge U.K. and New York, NY.

Mutch, Robert W., 2013. Framing our fire story to promote sustainable policies and practices. Wildfire Magazine (May 13 2013). International Association of Wildland Fire.

Pyne, Stephen J., 2008. Passing the torch: Why the eons-old truce between humans and fire has burst into an age of megafires, and what can be done about It. American Scholar 77 (2): 22-32.

Schmidt, Kirsten M., J.P. Menakis, C.C. Hardy, W.J. Hann, D.L. Bunnell, 2002. Development of coarse-scale spatial data for wildland fire and fuel management. General Technical Report RMRS-87, Rocky Mountain Research Station. USDA, Forest Service, Ft. Collins, CO.

Stephens, Scott L., N. Burrows et al, 2013. Temperate and boreal forest mega-fires: characteristics and challenges. Frontiers in Ecology and the Environment. The Ecological Society of America. Available through http://www.frontiersinecology.org

The content of this paper reflects the views of the authors, who are responsible for the facts and accuracy of the information presented herein.