Wildland Fire Use and Cost Containment: A Colorado Case Study

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In the last decade, policymakers and forestry experts have decried the "crisis" in forest health, placing much of the blame on a century of fire suppression that has starved fire-dependent ecosystems of regular fire cycles, created unhealthy fuel loads, and led to conditions ripe for uncharacteristically large wildfires. During that same time period, the practice of fire suppression on public lands has grown to become a multimillion dollar endeavor annually. Land management agencies are under political pressure both to reduce fire costs and to mitigate fire risk. One new tool, the development of Fire Management Plans (FMP), is considered so central to both of these objectives that it is now required by law for each administrative unit. A growing recognition that fire has substantial benefits for the land is leading many to incorporate Wildland Fire Use (WFU), the preplanned use of wildland fire for resource benefit, into their emerging FMP analyses.

Current fire management assumptions place federal agencies in a position of being primarily responsible for reducing fire risk to communities and protecting people and property from fire. Providing this protection amounts to three sets of activities: preparedness in the form of equipment and training for firefighters, prevention in the form of aggressive fuels reduction projects conducted by the land management agencies, and suppression of fires with inexhaustible federal funds when they do burn. As a whole, national policy continues to support and build infrastructure for fire suppression. But there is a fourth trajectory: the creation of conditions where we might be able to allow fire to play its natural role. Recent policy changes such as the passage of the Healthy Forests Restoration Act in 2003 and the steady increase in subsequent appropriations for hazardous fuel reduction are intended, at least in part, to support the reintroduction of natural fire where it might be considered safe. However, in the vast majority of landscapes, long-term planning documents do not reflect a commitment to the reinstatement of natural fire conditions. Instead, a project that treats fuels buildup more often than not is merely the first step in an iterative and indefinite sequence of similar and costly treatments, backed by the implicit promise of ongoing costly fire suppression.

If the reintroduction of fire is desirable for ecosystems, and this is certainly supported by exhaustive scientific evidence, then it behooves fire managers to consider not suppressing fires that burn in remote areas and do not threaten lives or property. Many compliant FMPs already allow fire managers to consider WFU under appropriate weather conditions in designated Wilderness areas; the use of fire for resource benefit is slowly expanding to include areas near Wilderness and other remote terrain where lives and property are not immediately at risk from fire. Land management units are expressly forbidden to allow fire to be used for resource benefit anywhere without a compliant FMP in place. Barriers that continue to impede WFU application include both planning and economic dimensions, which are explored here. The example of Colorado is offered to provide a quantification of cost differences between current suppression practices and potentially increased WFU on public lands.

National Fire Plan: Policy Framework

A brief review of the key policy documents that form the basis for federal approaches to fire reveals several patterns. Within the last decade, there has clearly been an evolving acceptance of fire, growing concern over costs associated with suppression, and a rising call for fire management planning that creates opportunities for WFU on public lands. Recognition that WFU represents not only sound ecology but also an opportunity to reduce costs is increasingly evident.

Federal Wildland Fire Policy 2001. National obsession with wildfire began in 1995, following the exceptionally costly fire season of 1994. The 1995 Federal Wildland Fire Management Policy (US Department of Agriculture and US Department of Interior 1995) marked a significant departure from any prior public stance on wildfire: it was the first time the government clearly and unequivocally described wildfire as a natural process with a critical role to play in forested ecosystems. The policy asserted the need to "adopt land management practices that integrate fire as an essential ecosystem process." Following another unusually dramatic fire season in 2000, agencies reviewed and updated existing policy and issued the 2001 Federal Wildland Fire Management Policy, formally replacing its 1995 predecessor, and forming the current basis for fire planning and management in the United States.

The importance of FMP preparation is prominent in the 2001 policy, and agencies are reminded that "FMPs that implement Federal Fire Policy must be completed *as soon as possible*" (emphasis added). These FMPs should be based on the "best available science," tiered to local Land and Resource Management Plans (LRMP), and strive for cost containment. Furthermore, WFU is clearly endorsed throughout the policy: "Wildland fire will be used to protect, maintain, and enhance resources and, as nearly as possible, be allowed to function in its natural ecological role." Regardless of ignition source or location, fires should be approached with the benefits of preplanning to help determine the Appropriate Management Response (AMR). Despite this strong encouragement, the policy also makes clear that fires that occur in areas that lack compliant and approved FMPs "must be suppressed."

10-Year Comprehensive Strategy. When Congress appropriated funds for FY2001 to cover the National Fire Plan, it also mandated the creation of a collaboratively developed 10-Year Comprehensive Strategy (Western Governors Association et al. 2001, 2002) and, under separate cover, an Implementation Plan for the Strategy. Both urge a "shift in fire management emphasis from a reactive to a proactive approach" and recognize the importance of FMP preparation. For example, one measure of success is identified as the "percent of burnable acres covered in federal fire management plans in compliance with Federal Wildland Fire Policy."

Forest Service Manual & Handbook. The Forest Service Manual & Handbook (USDA Forest Service 1999, 2003d) provide implementation direction to foresters as they work to implement national policy. Recent manual language encourages fire managers to use both prescribed and wildland fire for resource benefit when appropriate and backed by FMP direction. Recall that the 2001 Fire Policy specifically authorizes the use of fire *regardless of ignition source*; the manual, on the other hand, effectively codifies liability concerns when it cautions "human-caused wildland fires may not be managed to meet resource objectives. Natural ignitions may be managed for resource benefits."

Current Fire Management Costs: Suppression

Economic Theory and Fire Funding. Economists have long assessed the cost of fire using the Cost + Net Value Change model. A subset of the more general Benefit-Cost Analysis approach, C+NVC has been most commonly applied as the basis for NFMAS and FIREPRO, the two most common software programs used by federal agencies as a planning tool to assess the financial impacts of presuppression and suppression alternatives. While *net value change* is neutrally expressed and therefore might function to assess both costs and benefits, in fact "in most studies net value change usually refers only to timber losses" (Butry 2001). Benefits associated with fire remain invisible to the decisionmaking process. In a time when we see strong public support for "noneconomic over economic values in forestry" (Tarrant 2003), the C+NVC model falls short as an accurate planning tool for fire funding, a fact that has been clearly recognized by agency planners.

Fire Planning Analysis (FPA) is a new system designed to better assess efficient fire funding levels. The rationale for the fresh approach speaks directly to some of the concerns raised here, including the observation that "fire managers spend increasingly more time addressing the effects of fire on social and noncommodity values than on commodity values" (Hubbard 2001). FPA is undoubtedly a step in the right direction, as managers begin to grapple with including nonmarket values into their evaluation of the most cost-effective fire response. Still, the model as described in preliminary documents fails to include a matrix for adequately assessing the *benefits* of fire. That is, while the model expands the definition of fire impacts to better capture noncommodity values such as watershed protection and preservation of "the quality of life in the wildland-urban interface" (Hubbard 2001), the underlying assumption remains intact: fire is a negative force from which the agencies must provide protection.

Cost Containment: Current Strategies. As policy makers and fire managers become increasingly aware of the exceedingly high cost of fire and suppression, they have sought to better understand how the costs of suppression might be contained. Since more than 99% of all fires are extinguished in the initial attack, and 80% of all fire costs are generated on a mere 2% of total fires (USDA Forest Service 2003a), cost containment strategies tend to be focused on the management of the most prominent large fires. Many fire analysts have simply concluded that the costs of these large fires remain mostly out of the control of fire managers, and that factors such as extreme weather and heavy fuel loads create erratic fire conditions that necessarily require expensive attacks (USDA Forest Service 2000). Most recommendations are issued within the context of suppression; that is, rarely is it suggested that perhaps we need to reconsider when and where we even agree to fight fires in the first place. Once we change the suppression assumption, new tools for containing costs become vivid.

Shifting the Paradigm: Rethinking the Economic and Financial Dimensions of Fire

Costs: A New Calculus? Where current decisionmaking models rest largely on timber values and suppression costs, a new paradigm will also incorporate shifting values for public lands and the proven benefits of fire. Difficulty in adequately capturing nonmarket values and long-term ecological services continues to challenge scholars, but there are some economic benefits associated with fire that are measurable. In many parts of the West, for example, rural towns that used to be rooted in timber or mining are now converting to a service economy; the recreation industry contributed over six times the number of jobs as the timber industry did in 1999 and was responsible for five times as much value added to the Gross Domestic Product (USDA Forest Service 2003b). Capturing the impact of fire on recreation is notoriously difficult, but a few researchers have attempted to quantify it and results are inconclusive. In one prominent case, evidence from Yellowstone National Park after the 1988 fires suggests that fire has little effect on recreation demand: while visitation to the park was indeed down 15% the summer of the fires, by 1989 it had rebounded to record highs (Franke 2000). Some studies even suggest that "curiosity and the desire to see the effects of fire, particularly crown fires" create *increased* demand for recreation following a fire event (Hesseln and Alexander 2001).

$$\text{Cost} = \left[\left(\begin{array}{l}\text{\% acres WFU} \times \\ \text{cost/acre WFU}\end{array} \right) + \left(\begin{array}{l}\text{\% acres Suppression} \times \\ \text{cost/acre Suppression}\end{array} \right) \right] \times \begin{array}{l}\text{Ave. \#} \\ \text{acres} \\ \text{burned} \\ \text{annually}\end{array}$$

Figure 1. Formula used to calculate cost of managing fire.

If the heart of environmental economic calculus lies in an assessment of *net value change*, then strident efforts must be made to account for benefits of fire in addition to damage. Likewise, on the other side of the equation, suppression itself is far from neutral; ecological damage from suppression practices (Gardner 2001) and firefighter risk both represent high costs. Not fighting fire, then, can have both immediate and long-term benefits, measurable in terms of ecological health and taxpayer savings. As a tool for reintroducing natural fire to the landscape, WFU functions as both a means and an end.

Cost Containment Strategies. Two changes, supported by national policy but constrained in practice, will dramatically bring down fire costs. First, the preparation of a FMP is, in itself, a vehicle for containing fire costs. The process of gathering data and organizing options for the AMR on different tracts of the landscape in a pre-crisis decision space leads to more efficient fire management, and therefore less costly errors.

Permitting WFU in an approved FMP allows for even more dramatic outcomes. Even if WFU is limited to natural ignition sources, as described in the 10-year Comprehensive Strategy and Forest Service Manual & Handbook, the money saved by *not* fighting fire is profound. For example, over a 20-year period, the Forest Service recorded an average of $582/ac for suppression compared with just $51/ac for WFU (USDA Forest Service 2003a). Another way of measuring costs is in the aggregate. By approving WFU on just 41 fires, the Nez Perce/Clearwater National Forest in Idaho reported a savings of over $11 million in 2003 (Oppenheimer 2003). The same forest reports that a variety of creative fire strategies, all amounting to "less than full control suppression" (Oppenheimer 2003), saved the unit at least $25 million in that same year.

Colorado Case Study

Purpose and Need. That WFU is ecologically beneficial now receives widespread agreement; likewise, many argue that it is a less expensive approach to managing fires and therefore deserves greater attention by managers. The literature does not offer any cost estimates beyond the cost/acre numbers and anecdotal evidence discussed above to quantify potential savings associated with increased WFU. This case study was conducted in an effort to provide some broad-strokes estimates to foster discussion. The analysis that follows is intended neither to suggest specific places on the landscape where WFU ought to be implemented, nor is it designed to reflect precise costs. Instead, the case study is meant to tackle a difficult question: what are the potential cost savings if we expand our use of wildland fire for resource benefit?

Methods. The first step of our process was to estimate the average annual area burned on federal land in Colorado. Unfortunately, because these numbers were not directly available, we had to determine the average number of acres burned on all lands within Colorado and then allocate those acres proportionally to the 36.4% of the state that is federal. According to data obtained from the Rocky Mountain Area and Coordination Center (Marco Perea, Nov. 14, 2003, personal communication) the average annual area burned in the state over the years 1997-2003 was 151,108 acres, so we estimate the annual federal area burned to be 55,103 acres.

Next, we estimated the number of areas currently allocated to WFU status, relying on data from the Aldo Leopold Wilderness Research Institute documenting acreage within the state designated for WFU according to current Fire Management Plans (Carol Miller, unpublished data). The resulting 1,951,936 acres represents 8% of federal land in Colorado and provides a rough estimate of the current area in the state that might be managed with something other than a full suppression effort should fire occur. The other 92% of federal land was assumed to be managed using full suppression. Using USDA Forest Service 20-year averages of $582/ac for suppression costs and $51/ac for WFU costs and assuming the annual area burned to be proportionally distributed between WFU and suppression acres, we then calculated the current cost of fire in the state in an average fire year according to Figure 1.

Finally, as a way to estimate potential WFU in the state we employed the Wildness Index, developed by The Wilderness Society (Aplet et al. 2000). The Wildness Index accounts for variables such as population density, the existence of permanent structures, and the degree to which an area has been left in its natural state, to estimate the relative wildness of areas within any geographic extent. To estimate the potential cost savings from expanded WFU, we mapped the Wildness Index across the state, extracting the three wildest classes (out of 30) to represent the acreage of the state potentially available for expanded WFU, and recalculated cost according to Figure 1.

It should be noted here that separating WFU acres from suppression acres to determine cost estimates is impossible to do with total accuracy. In many cases, one fire event will be managed using several different approaches in different areas. For example, one more remote flank might be managed for containment and resource benefit, while the other edge of the same fire, perhaps closer to a community, will be suppressed. Costs in these mixed-response fires are not clearly reported, and identifying individual acre costs becomes nigh impossible. For these reasons, we opted to use cost averages.

Current WFU in Colorado. As is true in the rest of the United States, Colorado currently has only a small proportion of its burnable acreage designated for WFU. Looking only at federal lands, a mere 8% is managed for WFU, while 92% is managed for full suppression (Figure 2). Applying these numbers to the methodology described above we calculate that the current average annual cost for managing fire on federal lands in Colorado is $29,729,171.

Potential WFU: The Wildness Index. The Wildness Index was not developed for WFU. However, the data layers employed in its creation approximate the criteria fire planners used to determine fire risk to communities. To assign a degree of "wildness" to a given 1 km^2 cell, Aplet et al. (2000) gauged population density, road networks, watershed integrity, natural disturbance regimes,

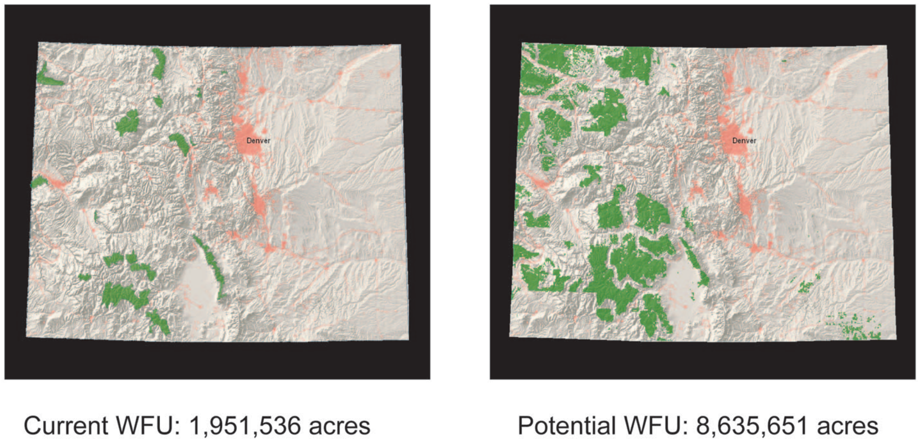

Figure 2. Current and potential WFU in Colorado.

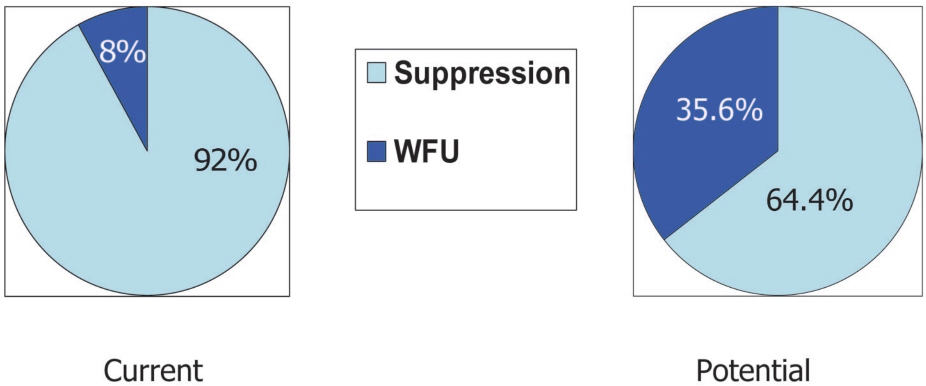

Figure 3. Comparison of suppression and WFU acres on public land in Colorado.

the proportion of native species present in vegetative cover, the relative lack of built structures, and levels of pollution. Of note in their national assessment was the unexpected amount of "non-Wilderness land in the wildest land classes" Aplet et al. (2000), suggesting that designated Wilderness areas represent but a small portion of lands that might be ultimately be considered for WFU.

Applying the Wildness Index to the WFU question yields a very different cost picture for Colorado. The most remote parcels of land in the state, places where WFU might safely be considered pending careful on-site review and integration into FMPs, total 8,635,651 ac. These new numbers represent 35.6% of total federal land in the state, meaning that under this simulated management scenario, only 64.6% of the land would be managed with complete suppression (Figure 3). Inserting these percentages into the same formula, based on the average number of acres burned annually in Colorado, reveals that with this kind of expanded WFU the total cost of managing fire in Colorado would shrink to $21,653,495 a savings of 27.2%, or $8,075,676. When every land management unit succeeds in completing its FMP as required by law, integrating WFU where appropriate, and then allows fire to burn for resource benefit in preapproved locations under appropriate weather conditions, we can expect to see suppression costs decline dramatically in the state.

Discussion and Implications

The findings of this case study suggest that substantial cost savings will result from expanded use of wildland fire. While cost savings alone cannot justify WFU, they also cannot be ignored; the Colorado case study serves to estimate the potential scope of financial benefits in one state. Other states in the west, such as Montana and Idaho, have substantially more remote forestland where WFU might eventually become standard management practice. Cost savings in those states are likely even more profound, and research is needed to assess these potential outcomes.

Revising and updating the economic models that drive decisionmaking and fire funding will aid policymakers in capturing the many benefits associated with fire, along with some of the hidden costs of suppression. Combined with the ecological benefits associated with allowing fire to play its natural role in fire-dependent ecosystems, these cost savings make a strong case for further study. Fire managers, if given incentives to do so, will complete FMP documentation and likely find that the inclusion of WFU enriches their toolbox and strengthens their ability to deal effectively with the myriad of fire challenges they face on the landscape.

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