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Wildland Fire Management: Are actively managed forests more resilient than passively managed forests?

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SUMMARY ABSTRACT

Large areas of federal lands in the western states are currently at high risk of severe wildfire and have many insect and disease problems, indicating a significant decline in forest health and resilience. Although research studies have not been done that would measure whether actively managed forests are more resilient to wildfires than passively managed forests, results from studies of hazardous fuels treatment effectiveness and the economic benefits from avoided costs of future wildfire suppression due to fuels treatment can be used to support an affirmative reply to the question. If a forest management project includes hazardous fuels treatments at a sufficiently large scale, placed strategically so that there is a high likelihood that future fire behavior would be modified under all but the most severe weather conditions, then economic benefits from avoided costs of future fire suppression can be sufficient to justify investments needed to implement the fuels treatments. This positive benefit-to-cost relationship would be improved by including avoided costs of site rehabilitation and, in some cases, monetary returns from the sale of timber products. Passive management (benign neglect) is appropriate for wilderness areas designated by statute, and perhaps other areas administratively withdrawn from timber production. Passive management promises surprises instead of active management's deliberate choice of objectives and means to attain them in support of the ecological, economic, and social goals inherent in sustainable forest management. Active management can provide a triple win by improving forest conditions, especially wildfire resilience; providing useful consumer products with renewable energy feedstocks as a by-product; and revitalizing rural communities by putting people to work. Improved long-term carbon storage is a bonus.

1. Introduction

The Office of Idaho Governor C.L. "Butch" Otter has requested "data showing the benefit of managed lands vs. unmanaged lands in mitigating fire risk"; more specifically, does the University of Idaho know of information supporting the idea that "managed forests are more resistant/resilient from fire than are unmanaged forests?" [1] Some mild rephrasing is needed before a reply can be attempted. To some degree all forests are managed, even in wilderness areas where "wilderness management basically involves the applications of guidelines and principles to achieve established goals and objectives." [2] In addition, the modern concept of resilience includes the idea of resistance. A more appropriately worded question would be, are actively managed forests more resilient than passively managed forests?

That question in the wildfire context warrants discussion provided in Section **2. Active and Passive Forest Management** as well as Section **3. Defining and Measuring Resilience**. Furthermore, fire behavior is affected by topography, weather, and fuels. Humans cannot manage the first two factors, leaving fuels treatment as the one thing humans can do to modify fire behavior. Reducing fuel loads can improve efforts to control or suppress fire after it has started to burn, thus mitigating some of the adverse impacts from fire's aftermath on things people value, including property, structures, and a variety of ecosystem services. Section **4. Fuels Treatment as Wildfire Risk Mitigation** supports these statements.

Wildfires have been a focal point of U.S. forest policy since the Big Burn or Great Fires of 1910 in Idaho and Montana affected more than 3 million acres and killed 87 people. [3, 4] Idaho's reputation as a place where large destructive wildfires occur has not diminished, but thankfully due to effective suppression efforts the 1910 fires remain as Idaho's largest wildfire event. However, the average size of wildfires has been increasing throughout the western states since 2000, spawning a wildfire policy called the National Cohesive Strategy for Wildland Fire Management. It addresses forest and rangeland wildfire risk issues in part through the goal of maintaining and restoring *resilient landscapes*; its other two goals are creating fire-adapted communities and improving response to wildfires, which are not addressed herein. Reports by the Western Region Strategy Committee as they address the landscape resiliency goal are summarized in Section **5. Cohesive Strategy for Wildland Fire Management**. [5, 6, 7]

Section **6. Conclusions** briefly describes efforts of forest scientists over the past 40 years to highlight the importance of removing fuels from forests in order to modify fire behavior and lessen the adverse

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[1] Personal communication, Bonnie Butler, Senior Special Assistant for Natural Resources, Office of Idaho Governor C.L. "Butch" Otter, received September 30, 2013.

[2] Hendee, J.C., G.H. Stankey, and R.L. Lucas (2000). *Wilderness Management*, 2nd ed., revised. Fulcrum Publ., Golden, CO. 546 pp.

[3] Egan, T. (2009). *The Big Burn: Teddy Roosevelt & the Fire That Saved America*. Houghton, Mifflin, Harcourt. 336 pp.

[4] Pyne, S.J. (2001). *Year of the Fires: The Story of the Great Fires of 1910*. Viking Penguin. 322 pp.

[5] WRSC (Western Regional Strategy Committee, 2012). *The National Cohesive Wildland Fire Management Strategy: Phase III Western Regional Science-Based Risk Analysis Report*. November 2012. 99 pp. Available at http://www.forestsandrangelands.gov.

[6] WRSC (Western Regional Strategy Committee, 2013). *The National Cohesive Wildland Fire Management Strategy: Phase III Western Regional Action Plan Report*. April 2013. 99 pp. Available at http://www.forestsandrangelands.gov.

[7] Jay O'Laughlin was a member of the Western Governors' Association Forest Health Advisory Committee from 2004-2013, and as such, a member of the Western Region Technical Work Group that helped write the Western Region Cohesive Strategy reports (WRSC (2012), *supra* note 5; WRSC (2013), *supra* note 6).

effects severe wildfires can produce. U.S. Forest Service Chief Tom Tidwell is trying to accelerate restoration of resilient conditions on National Forest System lands using prescribed fire and thinning. Restoration-based fuels treatment projects are an active management approach that can be a triple win for society: improved forest conditions, useful wood-based products plus renewable energy feedstocks, and jobs that can revitalize rural communities. As a bonus, long-term carbon storage can be improved.

2. Active and Passive Forest Management

Active and passive forest management approaches are analogous to, and largely have replaced, the terms intensive and extensive forestry used in early studies of forest ecosystem health management. Intensive forestry refers to a high level of investment in the best techniques of silviculture and management to obtain high levels of goods and services per unit area. Extensive forestry, by contrast, is based on low operating and investment costs per acre. [8]

Active forest management is the tending of forest trees, including steps planned by professional foresters and resource specialists to affect their growth, density, health, harvest, regeneration, and access for a variety of objectives. [9] Although active management can improve forest conditions, public policies thwart managers from maintaining and restoring resilient forests on timberlands (i.e., forest lands not withdrawn administratively or statutorily from timber production) by implementing long-term hazardous fuels reduction projects designed to protect wood, water, wildlife, and other values. [10]

Passive forest management is essentially benign neglect, in which a landowner prefers some objective over others and provides it by neglecting or reserving opportunities to provide other things. [11] Passive management is appropriate for wilderness areas designated by statute, and perhaps other areas administratively withdrawn from timber production. Implicit in passive management is that whatever "natural" conditions result from forest disturbance is acceptable. Because of previous management, fuel loads in many forests have exceeded what might have been considered "natural." [12]

Passive management promises surprises instead of active management's deliberate choice of objectives and the means to attain them. Indeed, writes U.S. Forest Service research biologist Andrew Carey, passive management is less likely to support sustainable forests than is intentional active management: "Passive management does not necessarily remedy whatever degradation might have occurred under past management or neglect, including loss of biodiversity and presence of diseases, or increased vulnerability to wildfire and other disturbances. Purposefully managing processes of forest development and landscape dynamics is more likely to be successful in maintaining ecosystem and landscape function, as well as and adaptiveness, than just providing select structural elements in stands and select structural stages in landscapes, as is often suggested for conservation. Research supports the

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[8] O'Laughlin, J., J.G. MacCracken, D.L. Adams, S.J. Bunting, K.A. Blatner, and C.E. Keegan III (1993). *Forest Health Conditions in Idaho*. Report No. 11, Idaho Forest, Wildlife and Range Policy Analysis Group. University of Idaho, Moscow, ID. 244 pp.

[9] Oregon Society of American Foresters (2013). Active management to achieve and maintain healthy forests. A Position of the Oregon Society of American Foresters. http://www.forestry.org/media/docs/or/Policy/2013_Active_Mgmt_Healthy_Forests.pdf.

[10] O'Laughlin, J. (2009). Active forest conservation beats passive preservation: Addressing accumulated forest fuels can yield a triple win. *California Forests* 13(1):10-11. http://www.uidaho.edu/~/media/Files/orgs/CNR/PAG/other%20pubs/New/2009_active-conservation.

[11] Carey, A.B. (2006). Active and passive forest management for multiple values. *Northwestern Naturalist* 87:18-30.

[12] O'Laughlin (2009), Active forest conservation beats passive preservation, *supra* note 10.

importance of bio-complexity and suggests that various techniques used purposefully over time are more likely to be successful than any one-time intervention, passive management, or traditional timber management involving deliberate simplification of ecosystems for maximizing wood production via even-aged single-species plantations. At the landscape scale, passive management in reserves and riparian corridors that does not take into account restoration needs may be self-fulfilling prophecies of forest fragmentation and landscape dysfunction. Intentional active management that is integrated, holistic, and collaborative seems to offer the best hope for meeting diverse objectives for forests, including conservation of biodiversity, a sustained yield of forest products, and economic, social, and environmental sustainability." [13]

3. Defining and Measuring Resilience

Resilient landscapes or ecosystems are forests or rangelands that resist damage and recover quickly from disturbances such as wildfires. [14] Because this definition of resilience folds the resistance concept into it, the latter term is dropped from the question posed by the Governor's Office. [15]

To say that one forest area is more resilient than another depends on criteria to make such judgments. A team of ecologists have defined resilience as the magnitude of disturbance that a system can tolerate before it changes to the extent that it becomes controlled by a different set of processes, and they add that resilience has multiple levels of meaning: as a metaphor related to sustainability, as a property of dynamic models, and as a measurable quantity that can be assessed in field studies of socio-ecological systems. [16] To our knowledge field studies have not been done to determine whether actively managed forests are more resilient than passively managed forests.

4. Fuels Treatment as Wildfire Risk Mitigation

Although we are not aware of research studies that directly address whether actively managed forests are more resilient than passively managed forests, there are some studies focused on fuels treatment as risk mitigation that address a) the effectiveness of fuels treatment projects in modifying wildfire behavior in forests, and b) the economic value of benefits from forest fuels treatment projects. These studies are pertinent only to the degree that management activities include restoration-based fuels treatment strategically placed at a large scale. If so, fuels treatment study results could be sufficient to support an affirmative response to the question, with appropriate qualifications, including space and time considerations with respect to the vegetation type in the fuels complex, topography, and weather conditions, all of which interact to affect fuels and fire behavior, and thus the ability of a landscape or ecosystem to resist damage and recover quickly from wildfire impacts. Summaries of these studies are provided in the next two sub-sections and provide a proximate affirmative reply to the question this study is addressing.

In forestry, managing for multiple objectives is normal, so fuels treatment is but one of several possible forest management objectives. Although certain management strategies are sometimes described as single-use management, wilderness areas provide many values for society, and so do tree farm

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[13] Carey (2006), Active and passive forest management for multiple values, *supra* note 11.

[14] WRSC (2012), *Science-Based Risk Analysis Report*, *supra* note 5.

[15] See O'Laughlin et al. (1993), *Forest Health Conditions in Idaho*, *supra* note 8, pp. 46-50, for additional information and discussion of resistance, resilience, stability, and sustainability as ecosystem health goals.

[16] Carpenter, S., B. Walker, J.M. Anderies, and N. Abel (2001). From metaphor to measurement: Resilience of what to what? *Ecosystems* 4(8):765-781.

plantations. For example, almost all forest landowners and interest group stakeholders likely recognize water quality and wildlife habitat as high-priority forest management objectives, and public policies ensure that. [17] For some landowners monetary returns from timber harvesting is an important objective. This would include the State of Idaho and private corporations. Other landowners are less interested in monetary returns, including the U.S. Forest Service and some family forest landowners.

The specific objective for fuels treatment projects is to modify future wildfire behavior using various vegetation management techniques to reduce wildfire risks. Risk is a combined statement of the probability that something of value will be damaged and some measure of the damage's adverse effect. Wildfires burning in the uncharacteristic fuel conditions now typical throughout the western states can damage ecosystems and adversely affect environmental conditions. [18]

Reducing future wildfire risks generally involves maintaining or restoring forest conditions that are resilient. Fuels treatment is a different objective than slash management after timber harvest, as required by the Idaho Forest Practices Act: [19] "To provide for management of slashing and fire hazard resulting from harvesting, forest management, or improvement … in that manner necessary to protect reproduction and residual stands, reduce risk from fire, insects and disease or optimize the conditions for future regeneration of forest tree species and to maintain air and water quality, fish and wildlife habitat." [20]

The importance of managing lands with fuels treatment projects to mitigate fire risk is captured in this quotation: "Analysis shows us where fires are occurring, where future fires are likely to occur, and where we might be able to *intervene with mitigation efforts to reduce fuels to reduce the severity of future fires*. The landscape needs active management to reduce fuels in order to reduce losses of homes, lives, and resources to wildfire. Experience with fuels treatment projects has demonstrated the value of fuels reduction to reduce wildfire suppression costs and protect land and resources." [21]

Effectiveness of Fuels Treatment Projects in Modifying Wildfire Behavior in Forests. Scientists and forest managers generally agree that fuel treatments can be effective, but effectiveness varies according to type of vegetation, type and extent of treatment, weather, topography, intensity of fire when it encounters a treated area, and time since treatment. [22] Fuel treatments have been shown to be effective at reducing wildfire severity at the stand level, and research is beginning to show their effectiveness at the landscape scale. Less clear is how much of the landscape needs to be treated to reduce wildfire severity overall. [23] Strategic placement of treatments can be approached by evaluating tradeoffs among multiple treatment options by gaming fire scenarios with fire behavior and spread modeling software. [24]

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[17] All landowners must adhere to the regulations promulgated to implement the federal Clean Water Act and Endangered Species Act.

[18] O'Laughlin, J. (2010). Ecological risk assessment to support fuel treatment project decisions. In, *Advances in Threat Assessment and Their Application to Forest and Rangeland Management*, PNW-GTR-802, U.S. Dept. of Agriculture, Forest Service, Portland, Oregon, Vol. 2, pp. 249-270. http://www.treesearch.fs.fed.us/pubs/36995.

[19] Forest Practices Act. Idaho Code § 38-13 http://legislature.idaho.gov/idstat/Title38/T38CH13.htm.

[20] Idaho Administrative Procedures Act (IDAPA) 20.02.01 § 070.01.

[21] WRSC (2012), *Science-Based Risk Analysis Report*, *supra* note 5, p. 4. (Emphasis added.)

[22] Cook, P.S., and J. O'Laughlin (forthcoming). *Fuel Treatment Effectiveness in Idaho's Forests*. Report No. 34, Policy Analysis Group, College of Natural Resources, University of Idaho, Moscow.

[23] *Ibid.*

[24] See O'Laughlin (2010), Ecological risk assessment, *supra* note 18, for additional discussion and references.

A group of scientists at Northern Arizona University recently sought to determine whether the ramping up of hazardous fuel reduction treatments over the past 10 years made a difference. They used an evidence-based approach to objectively evaluate the relevant literature. For the forest ecosystems they examined, the evidence suggests that restoration-based fuels treatment can reduce fire severity and tree mortality in the face of wildfire, and also increase carbon storage over the long-term. [25]

Economic Value of Benefits from Fuels Treatment Projects. Another group of scientists at Northern Arizona University researched the wildfire situation in Arizona and New Mexico, and wrote that "Without large-scale implementation of fire hazard reduction treatments, the costs of uncharacteristic crown fires in southwest forests will continue to increase. Federal policy continues to allocate vastly more funds to suppression than to pre-fire hazard reduction. We examined the economic rationality of continuing this policy of emphasizing fire suppression activities over restoration-based fire hazard reduction treatments. We compared treatment plus fire suppression costs to the cost of fire suppression without treatments over 40 years for southwestern forests. This avoided-cost analysis estimates the amount one could invest in treatments to avoid the future cost of fire suppression. Using conservative economic values, we found that avoided future costs justify spending $238 to $601 per acre for hazard reduction treatments in the southwest. We conclude that the policy of underfunding hazard reduction treatments does not represent rational economic behavior, because funding hazard reduction would pay for itself by lowering future fire suppression costs." [26]

Fire suppression costs, while often considered synonymous with the full costs of a wildfire, are only a fraction of the true costs associated with a wildfire event. [27] Synthesis of case studies published by the Western Forestry Leadership Coalition reveals a range of total wildfire costs anywhere from 2 to 30 times greater than the reported suppression costs. A more robust accounting of these costs would help improve budgeting and planning processes at all levels of government and would lead to better understanding of the value of investing in hazardous fuels reduction and other forest management activities before a fire occurs. Strategic and targeted active management can improve the health and resiliency of the land, while reducing fire hazard and associated costs of large fires. [28] The case studies show that site rehabilitation after a severe wildfire can be expensive, especially if watershed values and infrastructure are damaged. Reducing wildfire severity creates benefits from the avoided costs of rehabilitation.

Scientists at the University of Washington who studied the economics of the wildfire situation on two national forests in the Pacific Northwest wrote that "Forest fuel reduction treatments are needed, as shown by the increased number and cost of devastating crown fires in overly dense forests. Although large trees can be removed for valuable products, the market value for the smaller logs may be less than the harvest and hauling charges, resulting in a net cost for thinning operations. However, failure to remove these small logs results in the retention of ladder fuels that support crown fires with destructive impacts to the forest landscape. A cost/benefit analysis broadened to include market and non-market considerations

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[25] ERI (Ecological Research Institute, 2013). *Efficacy of Hazardous Fuel Treatments: A rapid assessment of the economic and ecological consequences of alternative hazardous fuel treatments: A summary document for policy makers.* Northern Arizona University, Flagstaff, 28 pp.; and Fact Sheet with the same title, 2 pp. http://library.eri.nau.edu/gsdl/collect/erilibra/index/assoc/D2013004.dir/doc.pdf.

[26] Snider, G., P.J. Daugherty, and D. Wood (2006). The irrationality of continued fire suppression: An avoided cost analysis of fire hazard reduction treatments versus no treatment. *Journal of Forestry* 104(8):431-437.

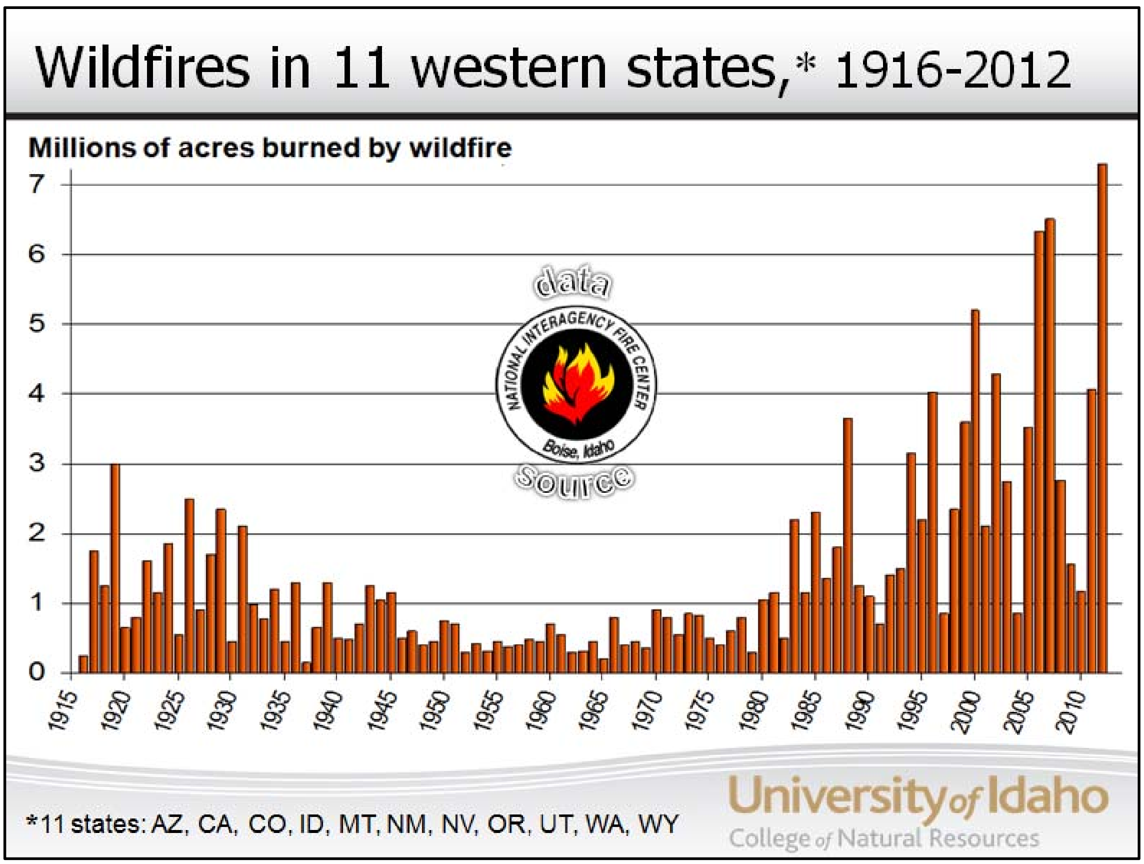
[27] WFLC (Western Forestry Leadership Coalition, 2010). *The True Cost of Wildfire in the Western United States*. Western Forestry Leadership Coalition, Lakewood, CO. 15 pp. http://www.wflccenter.org/news_pdf/324_pdf.pdf.

[28] *Ibid.*

indicates that the negative impacts of crown fires are underestimated and that the benefits of government investments in fuel reductions are substantial." [29] They concluded that estimated values from fuels reduction projects "have been shown to be of sufficient magnitude to warrant aggressive public investment in fire risk reduction. The approximated net benefits from fuel removals are greater than $1,400 per acre for high-risk forests and $600 per acre for forests with moderate risk. Furthermore, it appears that substantial portions of fuel treatment costs are recoverable to the U.S. Treasury from tax collections. Conversely, failure to treat at-risk forests has resulted in a major national liability exposure." [30]

4. Cohesive Strategy for Wildland Fire Management

Following the record wildfire season of 2000 during which more than 6.8 million acres of land in the U.S. burned, including more than 5 million acres in 11 western states, President Bill Clinton asked the Secretaries of the Departments of Agriculture and the Interior to prepare a report recommending how to respond to severe fires, reduce the impacts of fires on rural communities, and ensure sufficient firefighting resources in the future as a cohesive wildfire strategy. [31] Although some wildfires in 2002 were very large, total acreage burned did not exceed 2000 (see chart).



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[29] Mason, C.L., B.R. Lippke, K.W. Zobrist, T.D. Bloxton Jr., K.R. Ceder, J.M. Comnick, J.B. McCarter, and H.K. Rogers (2006). Investments in fuel removals to avoid forest fires result in substantial benefits. *Journal of Forestry* 104(1):27-31.

[30] *Ibid.*

[31] U.S. Forest Service (2000). *Protecting People and Sustaining Resources in Fire-Adapted Ecosystems: A Cohesive Strategy.* The Forest Service Management Response to the General Accounting Office Report GAO/RCED-99-65. http://www.fs.fed.us/publications/2000/cohesive_strategy10132000.pdf.

The record acreage burned in 2000 was exceeded in 2006 and 2007 (see chart on page 7). Idaho led the nation in 2007 with almost two million acres burned, double the Idaho acres burned in 2006. Because the cohesive strategy was not effective enough, in 2009 the U.S. Congress called for a new cohesive strategy when it passed the FLAME Act. [32] In 2012, a new record wildfire year, more than 9.3 million acres burned in the U.S., including 7.2 million acres in 11 western states (see chart on page 7). Idaho led the nation with 1.7 million acres burned. In 2013, by late September more than 4 million acres had burned in the U.S., and Idaho, with 742,500 acres burned, was second to Alaska's 1.3 million acres burned.

Problem Statement. The following statement of the western wildfire problem situation is from the Western Regional Science-Based Risk Assessment Report: "Managing wildfires in the western states is becoming increasingly complex and consumes the majority of suppression dollars spent nationally. A century of widespread fire exclusion and the more recent steep decline in active management in the western states" [33]—e.g., since 1990 there has been an 80 percent reduction of timber harvesting on federal lands [34]—"have resulted in a build-up of surface fuels (downed wood, litter and duff) and the overstocking of forests with trees and ladder fuels. Those conditions—exacerbated by other stressors such as drought; insects and disease; invasive species; and changing climate conditions—have led to uncharacteristically large, severe, and costly wildfires that threaten homes, communities, and cultural and resource values, and can cause widespread property and environmental damage. More than half of the lands in the western states are administered by federal agencies. This creates opportunities and offers challenges. Currently, large areas of federal lands are at risk for catastrophic wildfire and have many insect and disease issues, with a significant decline in forest health and resilience." [35]

Mega-fire Reality. In 2000, a year of unprecedented severe wildfires that has since been eclipsed three times, Regents Professor Wallace Covington of Northern Arizona University, one of the nation's most prominent forest ecologists, wrote in the prestigious journal *Nature* that "We must change our approach to fuel and forest management. The shocking fire season of 2000 and the environmental and economic damage left in its wake are tragic consequences of management and interest groups that have failed to understand natural ecosystem structure and function. [The wildfires in 2000 were] so extreme in their behavior and effects that they are in many ways worse than clearcutting. Critical habitat for threatened and endangered species is destroyed, watershed function is disrupted and human habitat value reduced for centuries to come. And such wildfires are a threat to human lives and property." [36]

The term "mega-fire" became popular in 2002 after five western states experienced their worst wildfires on record (Arizona, California, Colorado, New Mexico, and Oregon); in 2011, mega-fires in Arizona and New Mexico eclipsed the records set only nine years before. [37] Mega-fires cause severe damages in terms of human casualties, economic losses, or both, and have deep, long-lasting social, economic and environmental consequences. Calling these events mega-fire conveys the astounding

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[32] Federal Land Assistance, Management and Enhancement Act of 2009 (FLAME Act).

[33] WRSC (2012), *Science-Based Risk Analysis Report*, *supra* note 5.

[34] U.S. Forest Service (2013). Forest Management: Cut and Sold Reports. http://www.fs.fed.us/forestmanagement/products/sold-harvest/cut-sold.shtml.

[35] WRSC (2012), *Science-Based Risk Analysis Report*, *supra* note 5.

[36] Covington, W.W. (2000). Commentary: Helping western forests heal: The prognosis is poor for US forest ecosystems. *Nature* 408:135-136. http://library.eri.nau.edu/gsdl/collect/erilibra/index/assoc/HASHdbf4.dir/doc.pdf.

[37] Williams, J. (2013). Exploring the onset of high-impact mega-fires through a forest land management prism. *Forest Ecology and Management* 294:4-10.

magnitude and impacts relative to people's historical expectations. [38] In quantitative terms, approximately one fire out of a thousand is a mega-fire, but these account for roughly 95% of the total area burnt and 85% or more of the total costs of wildfire suppression. [39]

Although the mega-fires receiving the most media attention destroy property and cost firefighters their lives, others result in losses of wildlife habitat and ecological services that are more difficult to quantify. For example, when mega-fires burn old-growth forests, it can take centuries for ecosystem functions to recover. People have been directly affected by mega-fires causing adverse effects on hydrology and water yield from forested catchments. Carbon emissions from wildfires can exceed decades or centuries of the slow accumulation of carbon from tree growth. [40]

Changes in human activities that relate to fire activity are many, but the most critical in terms of fire intensity are those that have a direct effect on fuel load. [41] Jerry Williams, retired Director of Fire & Aviation for the U.S. Forest Service, described the problem this way: In many forests "the rate of biomass accumulation has become far greater than the rate at which it is used, treated, or otherwise decomposes. In the presence of drought, more of these fuel accumulations become available to burn at ever-higher intensities, compounding wildfire risks." [42]

The Western Governors' Association is concerned that "the health of the national forests and rangelands has deteriorated due to a reduction in management and changing climate conditions which contribute to the vast expansion of catastrophic wildfire, damaging insects, diseases and invasive species. The wildfire season is longer, more extreme, and wildfires are larger." [43] Although some forest restoration work is ongoing, planning and implementation should occur at a scale commensurate with the scale at which dominant disturbances (i.e., uncharacteristically severe fires) are occurring. [44] At landscape scales, "restoration can and should provide predictable supplies of forest products, including small diameter timber and woody biomass. These predictable supplies are necessary to build or maintain the infrastructure and industry needed to implement forest restoration treatments in a cost-effective manner. Restoration at these scales should also facilitate cross-ownership planning and implementation, which would provide needed balance among local, state and federal cooperators in management decisions." [45] Active management, such as thinning, prescribed fire, and road maintenance, has been used successfully to improve the health of forest and rangeland ecosystems. This type of active management can provide significant benefits to ecosystem function, while protecting and promoting development of healthy, resilient landscapes. [46]

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[38] Attiwill, P., and D. Binkley (2013). Editorial: Exploring the mega-fire reality. *Forest Ecology and Management* 294:1-3 (additional references cited in original are deleted).

[39] Williams (2013), Exploring the onset of high-impact mega-fires, *supra* note 37.

[40] Attiwill & Binkley (2013), Exploring the mega-fire reality, *supra* note 38.

[41] *Ibid.*

[42] Williams (2013), Exploring the onset of high-impact mega-fires, *supra* note 37.

[43] WGA (Western Governors' Association, 2012). Wildland fire management and resilient landscapes. Policy Resolution 12-01. WGA, Denver, CO. http://www.westgov.org/policies/cat_view/42-resolutions/150-forest-health/272-2012.

[44] WGA (Western Governors' Association, 2011). Large scale forest restoration. Policy Resolution 11-01, WGA, Denver, CO. http://www.westgov.org/component/docman/doc_download/1390-11-01?Itemid= .

[45] *Ibid.*

[46] WGA (2012), Wildland fire management and resilient landscapes, *supra* note 43.

Cohesive Strategy and the FLAME Act of 2009. The Federal Land Assistance, Management and Enhancement Act of 2009 (FLAME Act) called for a cohesive wildland fire management strategy in response to growing concern over mounting annual costs of fighting wildfires, devastating wildland fire losses to communities, and concern about overall landscape health. [47] The Cohesive Strategy has three goals:

- Restore and maintain resilient landscapes,
- Create fire-adapted communities, and
- Improve wildfire response.

While all three goals are important and work together to mitigate the risk of wildfire, over time the maintenance and restoration of resilient landscapes will significantly reduce or modify the impacts of wildfire, the level of required response, and help to protect fire-adapted communities. [48] Restoring landscapes to a healthy, resilient state would generate important environmental and social benefits, create much-needed jobs and revenue for rural economies, and lead to tremendous cost savings in wildfire suppression efforts. [49] These costs include impacts to watersheds, ecosystems, infrastructure and the local economy; specifically, property loss, post-fire impacts such as flooding and erosion, air and water quality damage, increased healthcare costs, and lost revenues due to infrastructure shutdown. [50]

Active management to reduce fuels would reduce losses of homes, lives, and resources to wildfire. Experience with fuels treatment projects has demonstrated the value of fuels reduction to reduce suppression costs and protect land and resources, and the importance of collaborative groups, which bring a variety of stakeholders to the table to forge agreements on how to restore resilient landscapes and reduce wildfire risk. [51]

Cohesive Strategy Goal 1. Resilient Landscapes. Resilient landscapes or ecosystems are forests or rangelands that resist damage and recover quickly from disturbances. Such resilience is related to the natural and historical fire regime in which the disturbance occurs, and the potential need to assist the ecosystem in restoring it to a resilient state. Landscape resilience can be defined as the ability of a landscape to absorb the effects of fire by regaining or maintaining its characteristic structural, compositional and functional attributes. The amount of resilience a landscape possesses is proportional to the magnitude of fire effects required to fundamentally change the system. [52]

Eleven principles and core values were used to guide the development of the Cohesive Strategy. [53] Two of them fit hand-in-glove to describe where science may help improve wildland fire management problems by focusing attention on resilient landscapes:

- Actively manage the land to make it more resilient to disturbance, in accordance with management objectives.

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[47] WRSC (2012), *Science-Based Risk Analysis Report*, *supra* note 5.

[48] *Ibid.*

[49] WGA (2011), Large scale forest restoration, *supra* note 44; WRSC (2012), *Science-Based Risk Analysis Report*, *supra* note 5.

[50] WGA (2011), Large scale forest restoration, *supra* note 44.

[51] WRSC (2012), *Science-Based Risk Analysis Report*, *supra* note 5.

[52] *Ibid.*

[53] *Ibid.*

- Fire management decisions are based on the best available science, knowledge, and experience, and used to evaluate risk versus gain.

Actively managing western landscapes will have positive benefits for all three goals of the Cohesive Strategy. Active management can accomplish landscape resiliency through a variety of different management tools including mechanical, prescribed fire, and other treatments. Primarily due to the lack of an integrated active management approach, the federal lands need increased active forest and rangeland management in the form of fuels management. [54]

Much of the work to impact landscape resiliency will occur within the "middle lands"—lands between the wildland-urban interface (WUI) and wilderness or other special-use areas—through active forest, rangeland, and fuels management. Treatments in wilderness will occur through wildfires and prescribed fires, while other special land-use designations may use a suite of appropriate options.[55] The middle lands are especially important, when considering the spatial extent of many large wildfires and rapid rates of spread that directly impact fire-adapted communities, as well as the adverse impacts on private timber and grazing lands, natural resources, cultural and watershed resources that support these communities. A cohesive strategy would ensure that commitments to collaborative efforts and partnerships that have developed in treating areas outside of the WUI are maintained. [56]

Landscape Resiliency Recommendations. The Western Regional Science-Based Risk Analysis Report component of the Cohesive Strategy [57] carefully examined the existing situation in the western states, including biophysical and social factors, and set forth recommendations for attaining the Cohesive Strategy's goals. Recommendations for attaining the landscape resiliency goal are as follows:

1. Encourage U.S. Forest Service and Department of the Interior/Bureau of Land Management to use existing authorities under Healthy Forest Restoration Act, Healthy Forest Initiative, and other contracting authorities to expedite fuels treatments. Assess what is currently being spent on these tools and increase that amount. Develop project criteria for reducing risk to landscapes and/or communities and work them out during action planning using collaborative processes. These criteria might include the following:
    - design projects to be 5,000 acres or larger,
    - focus on areas that have a high burn probability or departure, and
    - initiate projects within 2 years.
2. Explore data to identify and prioritize landscapes for treatment. This information would be provided to sub-geographical stakeholders, decision makers, as well as state and federal officials for their consideration and use.
3. Expedite coordinated identification, prioritization, and restoration of damaged landscapes as a result of natural disturbances including, insect/disease, hurricanes, wildfire, invasives, changing climatic conditions. Identify where investments are not likely to restore areas to assist in prioritization of resources.

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[54] WRSC (2012), *Science-Based Risk Analysis Report*, *supra* note 5.

[55] *Ibid.*

[56] *Ibid.*

[57] *Ibid.*

4. Work with the Council on Environmental Quality (CEQ) in developing categorical exclusions for landscape restoration. Use CEQ alternative arrangements where appropriate when restoring damaged landscapes as a result of natural disturbances.
5. Examine legislative-related barriers that are impeding implementation of collaboratively developed landscape health related projects and pursue reform of the existing process to increase effectiveness in active forest and rangeland management (e.g., Endangered Species Act, Equal Access to Justice Act, National Environmental Policy Act (NEPA)).
6. Encourage and enlist local, state, tribal, and federal environmental regulatory agency representatives to participate actively in collaborative efforts to restore resilient landscapes. [58]

Landscape Resiliency Action Plan. Through active management of forests and rangelands, reducing fuels by either prescribed fire or mechanical means, the severity of future fires can be reduced. Active management of the landscape reduces the fuel for a wildfire, which reduces flame lengths and fire behavior, which in turn can reduce the potential impact of wildland fire on communities. [59] Continued investment in active management across the landscape contributes to a reduction in the broader costs associated with wildfire; such an approach to forest management also increases public benefits from healthy forest ecosystems. The timeline is critical because high-level, long-term fire recovery costs underscore the importance of fostering resilient ecosystems before fires occur. Continued investment in risk assessment will help communicate the magnitude of the wildfire problem in the western states and to prioritize management actions across the landscape to mitigate the risk and costs of catastrophic wildfire. [60]

The Western Regional Action Plan component of the Cohesive Strategy [61] is a science-based roadmap for approaching wildland fire issues. It builds on the Science-Based Risk Analysis Report [62] and identifies actions, tasks, suggested lead and collaborating agencies, and the timeframes in which those actions and tasks should take place. A high priority action is to identify and prioritize landscapes for treatment via active management. Many of the tasks associated with this action involve science:

1. Recognize and support collaborative solutions for the local prioritization of landscapes for treatment (i.e. WUI, middle ground, and backcountry or wilderness) to reduce potential large fire costs and mitigate negative consequences while considering the benefits of wildland fire.
2. Use completed risk and hazard assessments such as Westwide Risk Assessment (state and private), Regional Ecosystem Assessments (BLM), State Forest Resource Assessments, Community Wildfire Protection Plan risk assessments (state, private, federal), and/or local risk and hazard assessments to prioritize landscapes for treatment and for building capacity for collaboration.
3. Consider local and regional priorities such as protection and enhancement of sensitive species habitat, air quality, and economic opportunities when utilizing data to prioritize treatments.
4. Enable local collaborative(s) to use national, regional, tribal, and local data to inform scale and interconnectivity of priority focal landscapes.

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[58] WRSC (2012), *Science-Based Risk Analysis Report*, *supra* note 5.

[59] *Ibid.*

[60] WFLC (2010), *The True Cost of Wildfire in the Western United* States, *supra* note 27.

[61] WRSC (2013), *Action Plan Report, supra* note 6.

[62] WRSC (2012), *Science-Based Risk Analysis Report*, *supra* note 5.

5. Recognize the value of previous investments and prioritize ongoing maintenance, enhancement of past treatment areas, or areas of post fire restoration in allocation of funds.
6. Provide opportunities to ground-truth existing data, which feeds into the various risk and hazard assessments.
7. Use local and traditional ecological knowledge of fire history and vegetative conditions in prioritizing projects and informing the decision-making process.
8. Define treatment effectiveness and collect data to use in identification and prioritization of projects and in promoting the positive effects of hazardous fuel treatments. [63]

National Cohesive Strategy. The Cohesive Strategy takes an "all lands" view of wildland fire management. [64] Because fire and its effects extend beyond political or social boundaries, a landscape-level approach that works across boundary lines is needed to implement effective management techniques. And, it is important to include all the stakeholders to reach decisions that are supported by the community at large. The three Cohesive Strategy regions—Northeast, Southeast, and West—have all analyzed the unique needs within their regions and the national issues of concern. These emerging national issues will be addressed in a separate National Action Plan currently under development. [65]

6. Conclusion

More than 40 years ago, U.S. Forest Service scientists wrote about the futility of expecting wildfire suppression alone to reduce wildfire risks without actively reducing fuels: "More than a billion acres of forest and rangeland in the United States are managed under some form of organized fire protection. On much of this land, there is a buildup of flammable fuels that under critical burning conditions can feed disastrous forest fires. *The continuing trend toward intensive forestry will, in the long run, contribute to the reduction of this wildfire potential*. ... But many foresters have convinced the public, and even themselves, that mechanization and armies of trained forest firefighters are sufficient to handle any threat from fire in our forests. Unfortunately, it is not. ... Examples [from across the western states and including the 1967 Sundance Fire in northern Idaho] only emphasize the futility of setting mechanized man against the destructive forces of wildfire where fuels have accumulated." [66]

On the federal lands that dominate western landscapes, the "continuing trend toward intensive forestry" called for in the above quotation ended in 1990 as timber harvest began a steep decline. [67] Fuels accumulated as timber harvests declined, and as the fuel buildup continues, most people continue to ignore what many scientists have to say. [68] The folly of counting on wildfire suppression to handle the wildfire job without pre-fire fuels treatment continues. [69] Through the Cohesive Strategy perhaps that will begin to change.

Twenty years ago, a team of scientists based at the University of Idaho concluded that "If forest health is a statement about trees at risk of mortality from insects, diseases, and wildfire, then much of

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[63] WRSC (2013), *Action Plan Report, supra* note 6.
[64] *Ibid.*
[65] *Ibid.*
[66] Wilson, C.C., and J.D. Dell (1971). The fuels buildup in American forests: A plan of action and research. *Journal of Forestry* 69(8):471-475. (Emphasis added.)
[67] See U.S. Forest Service (2013), Forest Management: Cut and Sold Reports, *supra* note 34.
[68] See Covington (2000), Helping western forests heal, *supra* note 36.
[69] See Snider et al. (2006), The irrationality of continued fire suppression, *supra* note 26.

Idaho's forest land is either unhealthy or on the verge of poor health, especially in the national forests. ... In forests throughout the state, environmental, ecological, economic, and social values are at risk. The situation can be changed by using forest management practices favoring pines instead of firs and reducing competition between trees by thinning, while protecting other forest values. Two obstacles to this are public policy and public trust." [70]

Furthermore, "Idaho forests are in decline, and will continue to decline unless management action is taken. Intensively managed private forests do not exhibit similarly high levels of mortality as nearby public forests. Idaho's federal forests are at risk of insect epidemics in southern Idaho and root disease problems in northern Idaho. Both situations set the stage for catastrophic wildfires that can adversely affect wildlife habitat, water quality, and public budgets for fire control to protect private property adjacent to public forests. … Intensive care can help remedy unhealthy forest stand conditions. That is, intensive forestry practices can be used to favor resistant and resilient tree species – pines and western larch. Among other things, intensive forestry practices including thinning dense stands, the use of prescribed fire, and regeneration of more resistant and resilient tree species. The alternative to intensive forestry is reduced productivity, many dead trees, and fuel conditions favorable to large and potentially destructive wildfires." [71]

Regents Professor Wallace Covington of Northern Arizona University for decades has been encouraging scientists to conduct forest health studies and engage in efforts to restore forest ecosystems. During the record-setting wildfire season of 2000 he urged action: "To act now is to save the patient. To act now means a healthy, biologically diverse forest that is an asset, not a threat, to future generations. Is there really an alternative?" [72]

Approximately three-fourths of Idaho's forests are in the National Forest System administered by the U.S. Forest Service. According to U.S. Forest Service Chief Tom Tidwell, whose roots are in Idaho, "One thing Congress and the public can expect is results from active management. ... Using prescribed fire and other vegetation treatments, we can restore overgrown forests and other degraded ecosystems. By restoration, we mean restoring the functions and processes characteristic of healthier, more resistant, more resilient ecosystems. We are striving to sustain and restore ecosystems that can deliver all the services that Americans want and need, including resistance to catastrophic fire. ... In Idaho, about 15 million acres are in need of restoration work, including 2 million acres of mechanical treatments." [73]

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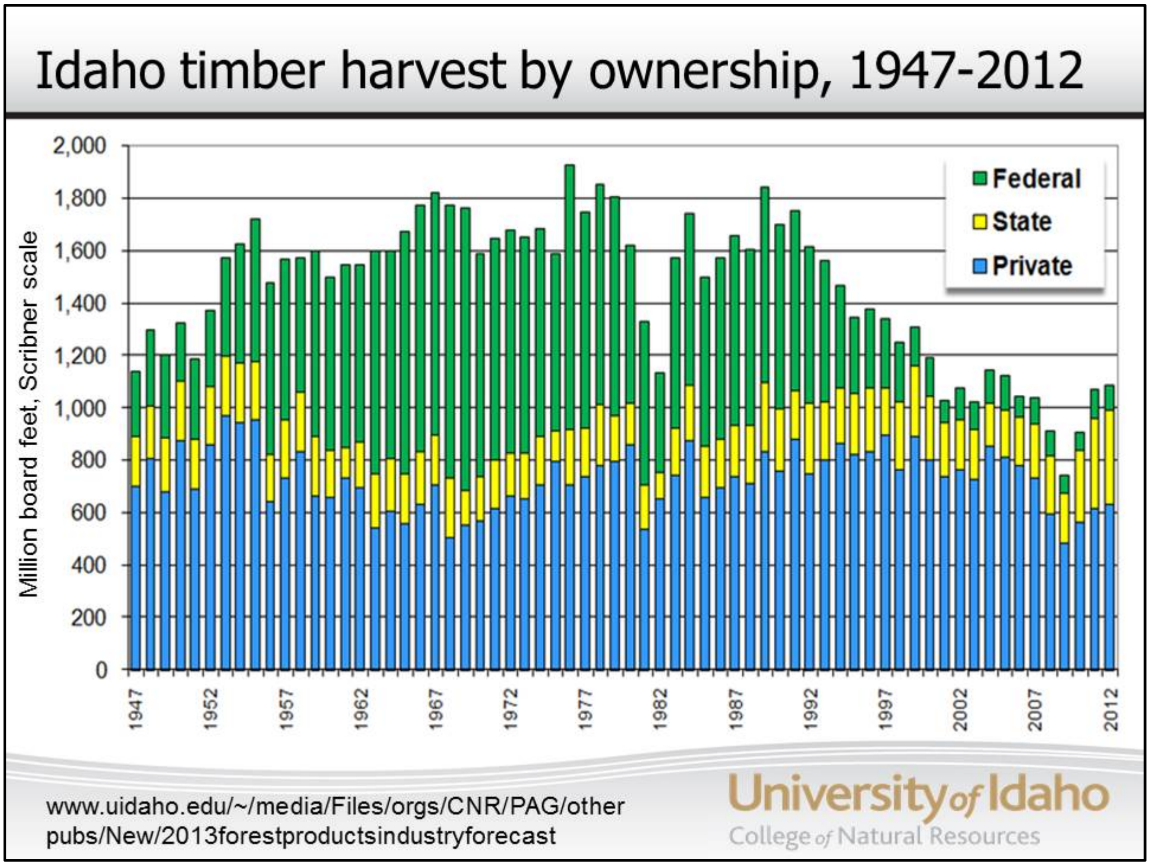
[70] O'Laughlin et al. (1993), *Forest Health Conditions in Idaho*, *supra* note 8.

[71] *Ibid.*

[72] Covington (2000), Helping western forests heal, *supra* note 36.

[73] Tidwell, T. (2012). Restoration through community-based collaboration. Speech to Boise City Club, Nov. 30, 2012, Boise, Idaho. http://www.fs.fed.us/news/2012/speeches/11/restoration.shtml.

The U.S. Forest Service wants to increase timber harvests, with the specific objective of restoring landscape resiliency.[74] Today there is less active management in the form of timber harvesting on Idaho's national forests than at any time in the past 66 years (see chart).



The purpose of hazardous fuel treatment is to reduce wildfire risks by modifying future wildfire behavior. Even if the objective is restoring landscape resiliency, reducing forest fuels via thinning can be called logging, or timber harvesting, which can be unpopular. Professor Covington addressed this issue: "The current crisis in western forests demands action now; there is sufficient information to design and implement scientifically valid approaches that will help determine how best to proceed. … Stopping ecologically-based forest restoration because of an ideological opposition to tree cutting is not saving forest ecosystems, as some would like to believe, but only contributing to their demise and causing severe losses to the wealth of species that depend on them. It also places ecosystem health practitioners in a situation similar to eliminating surgery from the options for treating human diseases." [75]

Active management that includes increased timber harvests and large-scale hazardous fuels treatment can be a triple win for society that 1) improves forest conditions, especially wildfire resiliency; 2) provides useful wood-based consumer products, including lumber, panels, and paper products, and as a by-product, renewable energy feedstocks; and 3) revitalizes rural communities by providing family-wage jobs in the forests, on the roads, and in the mills. Improving long-term carbon storage is a bonus.

[74] U.S. Forest Service (2012). *Increasing the Pace of Restoration and Job Creation on Our National Forests*. 8 pp. http://www.fs.fed.us/publications/restoration/restoration.pdf.

[75] Covington (2000), Helping western forests heal, *supra* note 36.