Destroying Forests to Save Them:
Rational Responses to the Summer 2000 Wildfires

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1. The Reason for Concern

For at least 30 years citizens, academics, and environmental groups have struggled to see that the full range of values associated with our National Forests be reflected in forest management decisions. The perception of many was that since the 1950s commercial timber values had come to dominate forest management priorities and decisions. Wildlife, watersheds, fisheries, recreation, and scenic beauty were being seriously damaged by commercial timber harvests that often lost money when all of the costs associated with them were taken into account.

To an economist this appeared to be a classic case of the misallocation of scarce resources to uses with relatively low net value at the expense of uses with much higher net value. In short, it was pure economic waste: Many, if not most, commercial timber sales could not be justified even in commercial terms because their costs exceeded the value of the raw materials harvested. In addition to that out-of-pocket net loss there were also the costs associated with the massive environmental damage that accompanied timber harvests.

As the economies of the communities adjacent to National Forests shifted away from dependence on timber harvests towards dependence on the natural amenities associated with those forested landscapes and the recreation they supported, the political pressure on the US Forest Service to change its priorities increased. A coalition of fiscal conservatives and environmentally concerned citizens increased the pressure on Congress to end below cost timber sales that were damaging the environment. As a result of these economic and political changes, timber harvests on National Forest in the Western states declined dramatically in the 1990s after reaching peak levels in the 1988-89 period.

Critics of the reduced timber harvests in our National Forests have used the extensive wildfires of the summer of 2000 to basically argue that commercial timber harvests are necessary to control fuels in our public forests and prevent catastrophic wildfires. They argue that the "environmental" policies now dominating forest management are naïve since they are built around the concept of a "natural forest" that will take care of itself if only humans would leave it alone. Those who support very active timber management of our public forests insist that active human intervention in forests is now necessary both because of past policies such as fire suppression and because of the values our citizens expect forests to

produce including residential home sites, recreation, big game hunting, as well as wood fiber production. They assert that passive management that seeks to allow "natural forests" to slowly emerge will lead to catastrophic wildfires that will do permanent damage to almost all forest values and render large parts of the West unsafe for human habitation.

The Governor of Montana and other Western political and timber industry leaders made exactly these claims during the Summer 2000 fire season, blaming the fires on the reduction in federal timber harvests during the 1990s and the failure of the federal government to road and log the remaining roadless areas.

This represents a powerful counter-attack on the direction that public land management has been taking throughout the last decade and on many of the primary themes of modern environmentalism of the last half-century. It requires a coherent, detailed, and emphatic response. This paper outlines one set of general, non-technical, responses that seeks to speak to the general issues of forest management, fire policy, and human and community safety.

2. The Popular Caricature of the Forest Policy Dilemma We Face

The case for active timber management of our National Forests is built around a characterization the pieces bits of forest and fire science together to tell a particular story. That story goes something like this. North American forests have been influenced by human activity, especially burning, for as long as ten thousand years. The historic forests some now label as "natural" were the result of ongoing human habitation and use. With European settlement in permanent locations, fire control because necessary to protect homes and towns. With our increased reliance on wood fiber for building and packaging, protecting the commercial values of our forests also became important.

That fire suppression, however, has changed the natural history of our forests. What had been productive forest parks of large trees has become a congested, unproductive forest that is also a severe fire danger. Where light, non-destructive fires once helped protect forest productivity, now hot, intense, forest-destroying fires threaten. In this setting, fire cannot be reintroduced because the fuel load has moved far beyond normal levels. Instead, we need to use the normal tools of timber management to fill the role that fire once played. Timber management can be used to thin the forests. This will both reduce the fire danger by removing dangerous fuels and boost forest productivity by removing the mass of competing vegetation that fire used to eliminate. It will also produce a forest that is more amenable

to recreation and wildlife. We would once again be able to enjoy the vast forested parks that Native Americans and early European settlers enjoyed.

The timber management tools that will allow us to regain safe, productive forests have been described in a variety of different ways. Those tools do not primarily involve the removal of brush and dense stands of small trees. Instead they focus on thinning out the larger trees by removing many of them. This is sometimes labeled "thinning from above" since it aims at opening the forest canopy by spacing large trees far enough apart to discourage crown fires. In contrast, "thinning from below" would remove the highly flammable brush and small trees that also serve as ladder fuels that carry wildfires into the forest canopy. These smaller fuels could be removed at the time the larger trees are harvested, using the value of the commercially valuable trees to finance the removal of these non-commercial materials. Alternatively, after the larger trees had been dramatically thinned, controlled burns could be used to remove the lighter fuels. Experiments in the Flagstaff, NM, area have been seeking to demonstrate this approach. Similar experiments are underway in the Northern Rockies.[1]

If this approach were to applied systematically to our forested lands, we are told by its advocates that forest fires would cease to be threats to either our forests or our communities since the fires would be of so much lower intensity that either they could be allowed to burn with beneficial effects or, where appropriate, they could be more easily controlled.

3. The Problems with This Romantic Stroll in the Forested Park

The rest of this paper will discuss in some detail why this approach to fire control and forest health would, in general, be ineffective, inappropriate, and dangerous. Here I simply list the points that will be elaborated on in later sections.

a. Mischaracterization of Western Forests: This approach is built around the assumption that most of the West's forested lands were open, park-like, forests before Europeans arrived on the scene. This is not true. Only a small percentage of the total Western landscape, namely **parts** of the dry, lower-elevation, forests, can be characterized in this way. Seeking to move almost all forests to this condition would carry them far beyond the range of their historical conditions. Such forest treatment would also do nothing to control the wildfires that burn in the West's extensive **non-**

[1] New equipment is becoming available that effectively mows down the small trees, shrubs, forbs, and grasses and spreads the chopped material across the forest floor. The acceptability of this as a way of controlling flammable forest fuels is not clear yet. The impact on soils, wildlife, and visual quality also has yet to be analyzed.

forested landscapes. For instance, about 77 percent of the area of the Northern Rockies is not forested and 36 percent of the acreage burned in the year 2000 wildfires in that region was non-forest land.

b. Mischaracterizing the Role of Timber Harvest in Reducing Fire Danger: This approach assumes that because commercial timber harvest removes large quantities of wood fiber, it reduces the fuels that energize forest fires. But this is not the case. As any picture of a burned forest will show and as the timber industry's interest in "salvage logging" after forest fires confirms, the trunks of the large trees rarely become fuels in a forest fire. Commercial timber harvest primarily removes the wood fiber that is fire resistant, the larger trees. In the process, it leaves behind the volatile fuels and lays the basis for the growth of more volatile fuels (brush and young trees). Even areas stripped of all trees become extremely dangerous wildfire sites. Removing commercially valuable trees does not, by itself, reduce fire danger.[2]

c. Ignoring the Cost of Fuels Management and the Conflict between Fuels Management and Commercial Timber Harvest: The most flammable forest fuels have little or no commercial value.[3] The most commercially valuable trees contribute little to forest fuels. Those two facts create a conflict between managing the forest to reduce fire danger and managing the forest for commercially valuable products. Fuel reduction efforts by themselves are very costly. If those costs are incorporated into the full harvest cycle costs and benefits, even fewer of the Western forests can be managed economically for commercial timber. Large, repeated costs have to be incurred for a good part of a century before there is a payoff in the form of commercial harvest. If the harvest of commercially valuable trees is used to "sweeten" or fund the thinning, brush removal, and controlled burning, fuel control and forest health objectives are likely to be compromised.

d. Managing Forest Fuels, by Itself, Will Not Stop Homes and Communities from Being Threatened by Wildfire: It is rarely the intense heat from wildfires that ignite homes and other structures. Instead, the threat to homes comes from much lighter ground fire and firebrands carried by the wind. If home sites and homes are not maintained in a way that reduces the

[2] The removal of dead or down noncommercial trees (windthrow, disease kill, past fire kill, dense thickets of small diameter lodge pole,etc.) may well reduce the danger of an unusually hot wildfire.

[3] What is commercially valuable or not is, of course, not fixed. Many of the small trees now being run thorough our mills had no commercial value 20 years ago. Various forest science labs, both private and public, have been working on developing markets for very small diameter trees, the mulched brush and small trees, and the chipped waste from timber harvests. Markets for these materials may develop in the future.

opportunity for ground fire to approach the home and to reduce the likelihood that firebrands will ignite flammable materials on or in the home, even light wildfires at some distance from the home site can lead to the loss of structures. Thinning all of the forests will not save structures if home sites are not prepared to resist wildfire. On the other hand, if home sites are so prepared, they will not be threatened by wildfire even if almost no forest thinning takes place except in the immediate vicinity of home sites. The location and character of homes and home access also play an important role in determining the risk of structure loss. It may be far less costly to control this than to control wildfire.

4. Over-Simplifying Our Forests

Previous to European settlement of the West, most of the region's forests were **not** open and park-like. One only has to read Lewis's and Clark's descriptions of the forests they encountered as they searched for a way through the mountains to the Columbia River, back and forth across the Bitterroot Mountains in Montana and Idaho. Andrew Garcia's ***Tough Trip through Paradise***[4] provides a similar description of the tangled, tight forests of Montana 75 years later as he struggled to cross from the Big Hole to the Bitterroot Valleys of Montana.

The reports of early European travelers focused on what they saw as they moved through the Western landscape. Trails, in general, followed the easiest route available. Open forests along the lower elevation valleys and benches often provided that. Those travel routes, however, do not provide an accurate sampling of the historical Western forested landscape.

Dry, lower-elevation, forests in the West often **were** dominated by mature Ponderosa Pine forests that had the park-like characteristics that now provide some with a model of what a "healthy" forest should look like. But even these forests were more complex than the suggested image of endless open forests periodically cleansed by light ground fires. For instance, in the Black Hills ponderosa pine forests of South Dakota and Wyoming, there were extensive tracts of relatively dense, closed-canopy forests including some very large patches of dense old growth. These areas experienced large, stand-replacing fires in the 18th and 19th centuries.[5] Similarly, in the Blue Mountains of Oregon, of the 22 habitats now dominated by grand fir and subalpine fir, only three were historically seral ponderosa pine that were

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[4] ***Tough Trip through Paradise, 1878-1879***. Edited by Bennett H. Stein. Boston: Houghton Mifflin. 1967.

[5] Douglas J. Shinneman and William L. Baker. 1997 "Nonequilibrium Dynamics between Catastrophic Disturbances and Old-Growth Forests in Ponderosa Pine Landscapes of the Black Hills. ***Conservation Biology*** 11(6): 1276-88, December.

burned by periodic surface fire.[6] Analyses of historic forest conditions and fire history in single lower elevation drainages also show very diverse forest settings, from the open, park-like forests to dense, fire-prone stands similar to what one now finds on most of that landscape. In general, even the lower elevation forests consisted of relatively complex mosaics of patches. As one moves out of those lower elevations, the relevance of the open, ponderosa pine forest declines.

The higher one moves up the West's forested landscapes and the cooler and wetter the climate becomes, the more one moves away from open forest conditions. At the extreme, the subalpine forests tend to be dense stands that experience stand-replacing fires every 50-300 years (Arno, 1980, Fisher and Smith 1995, Agee 1993, Agee 1997). This contrasts dramatically with the open ponderosa pine forests that experience frequent (5-20 year) ground fires that do not threaten the stand (Arno 1980, Smith and Fisher 1997). Since widespread fire suppression began in the early 20th century, many subalpine forests have not yet missed a fire cycle.[7] In that sense the condition of these subalpine forests are **not** drastically different from historic conditions.

In between the low-elevation dry forests and the subalpine forests is a mid-elevation, montane zone of forests composed of Douglas-fir, grand fir, subalpine fir, lodgepole pine, red cedar, western hemlock, western larch and other species.[8] The character, the fire regimes, and the historic fire-return intervals for the montane forests of the northern Rockies vary considerably with location and forest type (Arno1980, Bradley, et al. 1992, Smith and Fischer 1997). Historic mean fire-return intervals range from 25 to over 250 years in these stands (Arno 1980, Smith and Fisher 1997). The effects of fire exclusion and past logging have varied within the diverse montane forests of the northern Rockies. In some areas, the effects have been subtle and slow to develop, while in other areas fire exclusion has lead to the development of dense understory vegetation and changes in forest composition (Smith and Fisher 1997). Potential wildfire severity has been substantially altered in some montane forest stands and only subtly altered in other montane forest stands (Smith and Fisher 1997). In any case, the lower elevation ponderosa pine park model is not generally appropriate.

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[6] Arthur R. Tiedemann et al, 2000, "Solution of forest health problems with prescribed fire: are forest productivity and wildlife at risk?" ***Forest Ecology and Management,*** 127(2000):1-18, p. 3.

[7] Those subalpine forests that have been roaded and logged, of course, are no longer in their historical conditions and may have been subject to effective fire control.

[8] This paragraph follows ***Assessment of Summer 2000 Wildfires: Landscape History, Current Condition and Ownership***, Peter H. Morrison et al., Pacific Biodiversity Institute, www.pacificbio.org, September 15, 2000.

Northern Rockies Forest and Wildfire Distribution
[Idaho, Montana, Wyoming]

Forest Type	Acreage	Percent of Total Land Area	Percent of Total Forest Land	July 4-Aug. 22, 2000 Acres Burned	July 4-Aug. 22, 2000 Percent of Acres Burned
Forests	50.3 million	23.3%	100.0%	1,568,000	64.3%
Dry, low-elevation	9.0 million	4.1%	17.9%	1,900,000	7.8%
Montane	18.6 million	8.6%	37.0%	680,000	27.9%
Subalpine	22.7 million	10.5%	45.1%	698,000	28.6%
Non-Forests	166 million	76.7%	0.0%	870,000	35.7%

Source: Assessment of Summer 2000 Wildfires: Landscape History, Current Condition and Ownership, Peter H. Morrison et al., Pacific Biodiversity Institute, www.pacificbio.org, September 15, 2000.

The limited applicability of the model of an open park-like forest to the Northern Rockies is indicated by the data in the table above. Only about one-sixth of the forested landscape and only four percent of the total land base consists of the type of forest that could support the forest conversion measures being proposed. In addition, only about 8 percent of the acres burned by wildfire this summer in the Northern Rockies were in this type of forest.[9] Put differently, if, unrealistically, we could "fire proof" all of the dry, lower-elevation forests, 80 percent of the forests and 96 percent of the land base would still be vulnerable to fire and 92 percent of the acres burned this last summer would still have burned.

The primary point is that open canopy forests with very widely based trees and a nearly fuel-free forest floor is not the natural condition for the vast majority of the forests of the Northern Rockies. Trying to create such forests where such a biological system lies far beyond historical conditions is highly likely to cause significant environmental problems. Most of the higher elevation forests in the Northern Rockies are still close to their historical, natural conditions. Even some of the dense lower elevation ponderosa pine forests are close to their natural conditions. They never were all open canopy forests. Fire and ecologically sound forest management measures must begin with an accurate model of the forest site under consideration for treatment. Using a romantic 19th century picture of park-like forests to drive ***landscape-wide*** forest treatment is bound to fail, creating more serious problems than it sought to cure. As will be discussed later, in lower

[9] Of course, fires continued to burn in the last week of August on which the above statistics do not report. Since fires tend to burn up in terms of elevation, fires that started in the dry, lower-elevation forests were burning up through the montane and into the subalpine. So the percentage of burned acreage accounted for by the dry, lower-elevation forests is likely to have fallen, not increased.

elevation forests adjacent to human habitation, human activity may so permanently dominate the natural forest systems that manipulation of the vegetation to both reduce the danger of hot, tree-destroying fires and create an attractive forest landscape may be acceptable and appropriate.

5. Timber Harvest, Roads, and the Control of Wildfire

About 77 percent of the land area of the Northern Rockies is **not** forested. Yet, as this fire season dramatically demonstrated, these non-forested areas support dangerous wildfires. Wildfires swept through farmers' fields, burned grasslands, and charred scrublands. 36 percent of the acres burned by wildfires in the Northern Rockies were **non-**forest lands. One of the fire complexes that destroyed 12 homes in Montana, the Canyon Ferry fires, started in grasslands that represented 35 percent of the acreage burned and moved from there into forested areas. Clearly logging will do nothing to help control wildfire dangers outside of forested landscapes.

Logging is assumed to assist in the control of wildfires in forested areas for two reasons. First, because it removes substantial volumes of wood fiber, it is assumed to reduce the amount of fuel available to support wildfires. There is less to burn. Second, because logging usually requires a network of roads to be constructed, it provides easier access to equipment and firefighting crews in the event of a fire. Such easier access is assumed to increase the speed with which a fire can be controlled. Both of these assumptions and the conclusions that follow from them are flawed.

The deadliest wildfire in American history, one that took more than 1,200 lives, broke out in northern Wisconsin in 1871 on private land that had been heavily logged. The mix of logging slash, brush, farmers fields, and forests exploded in flames during a very dry period and swept across the town of Peshtigo, burning it to the ground, and damaging 16 other towns, burning a total of 1.2 million acres. The winds carried the firebrands across Green Bay, igniting forests on the Green Bay peninsula too.[10]

One can jump forward in time to the 2000 fire season. The largest fire of that season, the Valley Complex of fires in Montana's Bitterroot Valley, began in densely roaded, heavily logged areas as a result of multiple lighting strikes and gained its strength burning rapidly through similar timber management areas, both public and private. The private owners of a

[10] Managing the Impact of Wildfires on Communities and the Environment A Report to the presidential Response to the Wildfires of 2000 , Secretaries of Interior and Agriculture, US Departments of Interior and Agriculture, Washington, DC, September 8, 2000, p. 6.; and Green Bay Press-Gazette, from Peshtigo, Wisconsin Web Page also http://members.nbci.com/jbiehl/peshtigo/peshtigo.html

significant part of the burned area had recently logged their lands. The map below shows the high density of lumber roads areas in the burned area; the roads are so dense that they look like a plate of spaghetti on the map. The extensive logging activity in the past and present and the extensive road system did not help bring the fire under control. It continued to burn and expand until wet, cool weather in early September slowed its progress and slowly extinguished it. There are two important lessons here. First, intensely managing an area for timber does not prevent huge, naturally caused, wildfires. Second, we do not have the ability to put such fires out or, in some circumstances, to even control them.

When that cool weather ended the threat from wildfires in Montana in early September, many of the firefighters flew to Texas to battle wildfires. Importantly, about 40 percent of the Texas wildfires and burned acreage were found in pine *plantations.* That is, the Texas forest fires were concentrated on private lands that were being intensively managed for timber.

Of the eight wildfires in Montana that destroyed private homes and buildings, all eight began in roaded areas. Six were human caused; five of the six in forested areas were ignited in recently logged areas; two took place outside of forest areas (prairie fires). Again, roads, logging, and the absence of trees did not protect people from wildfire.

The basic flaw in the assumption that logging reduces the fuels that feed fires because it removes large volumes of wood fiber is that it removes the wrong wood fiber, that which is unlikely to burn. In the aftermath of the Valley Complex of fires in Montana's Bitterroot Valley, the State of Montana is preparing salvage logging sales covering 5,000 acres and 37 million board feet of timber killed by the fires on state forest lands. Such salvage logging would not be possible if forest fires, in general, burned the timber that loggers would otherwise extract. Wildfires do not. Logging removes the fire resistant materials, often leaving behind as slash the more flammable branches and needles. In addition, following the logging, small trees and brush grow back rapidly, reestablishing highly flammable fuels.

Besides claiming that timber harvest reduces wildfire danger, timber industry representatives also argue that the road network that facilitates entry into and fiber removal from forested lands provides quicker access to firefighters to control fires. As a result, it is asserted, roading forested landscapes is an important part of wildfire control. The available evidence also does not support this set of claims.

Statistical analysis of the relationship between lumber roads and logging and the outbreak and extent of wildfires does not support the assumption that roads and logging help with fire control. Wildfires are *seven times* more likely to start outside the inventoried roadless areas of our National Forests. On the basis of fire starts per 10,000 acres of land, fires are twice as likely to start outside of roadless areas. 92 percent of human-caused fires on National Forest lands are set outside of the roadless areas. Per ten thousand acres of land, a human-caused fire is almost four times more likely outside of the inventoried roadless areas than within them. That is, 11 out of every 12 human-caused National Forest fires already had the "benefits" of roads. Fires outside of the roadless areas not only are more likely but also tend to be larger than those within roadless areas. For instance, in the Mountain West, fires outside the roadless areas are almost 60 percent larger than fires within them.[11]

There is no mystery here. Building roads into wildlands brings human activity that tends to increase the risk of fire. Timber harvest opens up the forest canopy and allows fuels on the forest floor to dry more quickly and stay dry longer. Harvest also allows wind to penetrate more easily allowing the fire to spread faster and become larger. The harvest of the large shade-intolerant trees like the ponderosa pine, western larch, and western white pine and their replacement with homogeneous, small, dense stands of Douglas fir and various true firs enhanced the fire danger. Similarly with heavily grazed lands, grasslands and forbs give way to increasingly woody vegetation such as sagebrush, juniper, as well as Douglas fir forests, adding considerably to the fire danger. In general the areas with the most forest health problems are areas that have been roaded and harvested. This interacts with the negative impacts of past fire suppression activities allowing fuel loads to build in areas previously roaded and logged.

Normal commercial timber harvests do not reduce the threat of wildfire. If anything, the evidence suggests they may increase the threat of wildfire. This, however, does not mean that logging activity and other mechanical treatments of forestlands could not be designed to reduce the intensity of wildfires. If most of the trees on forested lands are removed, the leave trees are spaced widely apart so that crown fires are almost impossible, and the logging residue is also removed along with young trees and thick brush, only light ground fires would be possible. This mechanical removal of almost all fuel would have to be repeated at regular intervals either mechanically or through controlled burns. The extent to which this is economically feasible

[11] Interior Columbia Basin Ecosystem Management Program, Supplemental Draft Environmental Impact Statement, Chapter 2, pp. 222-236, "Factors Influencing Health of Ecosystems," and Roadless Areas Initiative Draft Environmental Impact Statement, Chapter 3, pp. 3-152 to 3-158.

and its cost in terms of pursuing forest values other than fire control is the subject of a later section.

6. Homes and Communities Cannot Be Protected by Treating Forests

When a home is lost as wildfire moves through forests and grasslands, it is not surprising that we blame the loss on the wildfire. After all, those wildfires usually originated at sites far removed from our homes and it was the forests and grasslands that brought the fire to them.

But home loss to wildfire is not some random act of god or simply the result of inappropriate forest management policy. Not all homes confronted by wildfire burn; only some do. It is important to understand what it is about homes and home sites that lead to these disparate results. In addition, forest fires cannot burn homes that are not built in the middle of fire-prone forests.

The issues here are similar to those associated with homes built on a river's flood plain or homes and other structures built in earthquake prone areas. Since it is the homeowner who decides where to build the home, how to construct the home, and how to maintain it in a way that minimizes the damage from such expected and natural events, those private decisions have to be considered in setting public policy. Public policy that ignores the importance of the private decisions that often determine the outcomes from natural disasters risks reinforcing irrational private decisions and creating perverse incentive systems. The expected outcome from such arrangements are much higher total costs associated with preparing for, coping with, and recovering from natural disasters.

Fire scientists have been studying how wildfires lead to homes burning for quite some time. They experiment with the flammability of home structural components immediately adjacent to burning forests. They also analyze why some homes burn while other adjacent structures do not when wildfire approaches. Finally, they study in detail just how wildfire leads homes to ignite in flames. The results of this fire science research are very important in designing policies to minimize the damage done by wildfire.

Stated bluntly, forest fires by themselves rarely burn homes and other structures. The intense radiant heat from a wildfire's flames is not usually the source home ignition. Instead, wildfire reaches the home by traveling along the ground, using fuels that the homeowner has either planted or allowed to accumulate there. Alternatively the fire is carried by firebrands to flammable roofs, pine needles in rain gutters, or, even, into homes through

open windows.[12] If homes are constructed with appropriate materials, if dense tree stands are not immediately adjacent to the home, if the grounds and home are maintained to reduce ground and ladder fuels, and if there is water available to keep the home and surroundings moist, the wildfire will pass the house by, relatively undamaged. There were many examples of this during this last fire season.

At Los Alamos, for instance, the tragic home loss was not due to flaming trees adjacent to homes torching those homes. In fact, the trees in many of the residential neighborhoods where dozens of homes burned to the ground never ignited at all, expect where the burning homes themselves ignited the closest trees. That is, homes were burning trees rather than trees burning homes. Although forests surrounding Los Alamos did burn, as the fire hit the residential areas, in general, it became a ground fire, following surface fuels, when available, to the homes and then igniting them when there were flammable materials immediately adjacent to the home.[13] For residential neighborhoods that forest fires are supposed to have destroyed, it is startling to see the burned out homes surrounded by healthy green conifer trees.

There is a very important forest policy implication that follows from these fire science results. Efforts to protect homes and communities from wildfire by mechanically removing fuels from surrounding forests are likely to be ineffective. If the forests are thinned but homeowners do not manage their home sites and homes to reduce ignition, the homes will still be at risk. This is so because winds can carry firebrands even from relatively light wildfires for very long distances, a half-mile or more. When they fall in fuel loaded home sites, homes will ignite even though the wildfires in the surrounding forest are not threatening the forest's trees. On the other hand, if homeowners do build and maintain their homes and home sites to reduce the threat from ground fires and fire brands to their homes, the surrounding forest does not have to have been thinned except in the immediate vicinity of the home (e.g. 30 to 120 feet). There may be other reasons besides home safety to be extensively thinning forests, but that extensive thinning is not necessary for home safety.[14]

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[12] "Reducing the Wildland Fire Threat to Homes: Where and How Much?" Jack D. Cohen, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, , Missoula, MT, 2000.

[13] "Examination of the Home Destruction in Los Alamos Associated with the Cerro Grande Fire," Jack D. Cohen, Research Physical Scientist, USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, Montana, July 10, 2000.

[14] "What is the Wildland Fire Threat to Homes?" Presented as the Thompson Memorial Lecture, April 10, 2000 School of Forestry, Northern Arizona University, Flagstaff, AZ Jack D. Cohen U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, MT; "Reducing the Wildland Fire Threat to Homes:

Clearly there is a vital role to be played by homeowners in minimizing the costs associated with wildfire. There is also a role for local public policy. Although some Westerners reacted in shock to all of the close calls with wildfires this last summer, some communities have confronted the problem of homes in highly flammable landscapes for many years because of those communities' regular confrontations with wildfire. Think about all of those California brush and forest fires that regularly consume entire neighborhoods in the fashionable canyon areas. These are not just natural disasters; they are the result private decisions that have been made to live in harm's way without taking even the most basic precautions.

This summer Montana's governor raised exactly this question of homeowner responsibility for choosing to live in harm's way. He was partially frustrated by all of the resources dedicated to saving homes that otherwise could have been deployed to reduce damage to natural resources. He admitted, of course, that trying to regulate home location and character raised difficult property rights questions, especially for a Republican like himself. But these are not new questions. Almost all of us build our homes subject to local and state building codes that enforce certain fire and safety standards. People may or may not be able to build on a floodplain; if they can, the house and sewage system have to meet certain standards. All buildings in earthquake-prone areas have to meet earthquake codes. Coastal states have hurricane construction standards.

Counties in wildfire-prone areas have begun adopting similar codes to increase the survivability of homes. In Summit County, Colorado, those who wish to build in forested areas have to use fire resistant materials, install sprinklers, cut back trees, and keep enough water on hand in large cisterns to douse an out-of-control blaze. In Orange County in Southern California and the Sun Valley area of Idaho similar codes to protect against wildfire damage to homes have been adopted. In subdivisions, wider streets are required as both firebreaks and to allow easier escape and access by fire equipment. On some locations, for instance steep slopes where fire can spread very rapidly, building is simply banned.

The general idea is to get those who choose to live in areas where wildfire is a regular part of the natural environment to take on a major share of the costs of effectively coping with that danger rather than shifting that cost to others at the time of an emergency. Insurance companies and local firefighting units have a role to play in improving the rationality of those

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Where and How Much?" Jack D. Cohen, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, MT, 2000.

private decisions that have significant social consequences. They can contribute significantly in terms of education and enforcement. Regular inspections of homes in fire-prone areas can alert both homeowners and firefighters about growing fuel problems at the home site or home maintenance problems that increase the likelihood of a home igniting when a wildfire is near. Insurance companies could insist on regular certification by the local fire-fighting agency before they will renew fire insurance policies. Homeowners, of course, would be responsible for paying for such inspections and certification.

None of this will sit right with many Westerners. We are used to doing things as we please and being left alone. But when the fires rage, we are not left alone. Fire fighting personnel and equipment camp out at our doorstep waiting to risk their lives to protect our homes. In addition, huge expenditures are made to try to guide the fire away from areas of human habitation. The federal and state government picks up the tab. Some of us even demand that the entire forested landscape be fire proofed, as plausible a concept as stopping a hurricane or earthquake, at a cost of billions of taxpayers' dollars and untold environmental cost. Because of the public costs incurred partially because of private decisions, those decisions cannot be treated as entirely a private matter.

Taxing our neighbors and millions of unknown fellow citizens to help subsidize our decision to live in areas where wildfire is one of many natural processes is not a noble expression of freedom and liberty. Homeowners in forested landscapes have to be willing to do their share to reduce the danger and cost to their neighbors when they choose to live in harm's way. Nothing else is fair. Nothing else is a legitimate expression of independence.

7. The Economic Costs and Benefits of Forest Fuel Management

It may be physically possible to manage our forestlands to minimize the possibility of large, hot, stand replacing wildfires. A key question, however, is what this would cost in terms of both money and other forest values that might have to be sacrificed and how those costs compare to the benefits of that wildfire control effort.

The Forest Service has estimated that there are 40 million acres of National Forest land in danger of catastrophic wildfire because of accumulated fuels and declining forest health. It has proposed a $12 billion, 15-year effort to reduce those fuels. Congress has approved the President's request for $400 million for this coming year for fuel reduction and fire recovery efforts. The part of this going solely to fuel reduction is well below the $825 million per year the Forest Service has estimated it would need to spend each year for

the next 15 years to get on top of the problem. Even after a peak fire season, Congress and the Administration obviously have doubts about the costs and benefits of a massive, landscape-wide mechanical treatment of our public forests to reduce fuels.

In evaluating the economic rationality of proposals to mechanically manage forest fuels, it is again important to distinguish between the lower elevation forests that are already roaded and that have been managed for timber in the past from less accessible mountainous backcountry much of which is not currently roaded and is not scheduled for timber management. Significant timber harvests to drastically thin the forests and repeated entry to remove slash, brush, and young trees would be extremely costly in rough, steep, unroaded terrain. The costs would almost certainly exceed the value of the commercial products extracted and the discounted future harvest values on these high, slow growing, isolated sites, would certainly not justify these intensive management costs. It was the low net commercial timber values that led these areas not to be roaded and logged in the past and managed instead for other forest values.

Given that many of these higher elevation forests have not been so changed by human logging, grazing, or fire suppression activity that their fuel loads and forest conditions lie outside of historical norms, it is not clear that costly mechanical manipulation of these forests is appropriate in ecological terms. Given these forests' remote locations, far from human habitation, it is also not clear that fuel management efforts there do much to promote human safety. Given that the value of the standing inventory of trees is below the cost of extracting them, fire control cannot be justified in terms of saving a commercial resource. If these naturally dense forests were to be mechanically thinned to very wide spacing, other forest values would be lost: watershed, fishery, wildlife, recreation, scenic, etc. values would be sacrificed. Finally, given that most of these areas have not skipped a natural fire cycle because of fire suppression and given that natural fires in these habitat types are typically stand-replacing fires, it is not clear that such fires, in any sense, threaten ecological stability. In these forest types, it is not clear that there is any justification for fuels management by mechanical means: There are few or no benefits and the costs are quite high. Fuel management policy should focus elsewhere.

If the focus of fuel management efforts is on lower elevation forests the likely benefits increase and the costs decrease. First, most of these forests have already been roaded and logged. Access costs are a lot lower. Second, these are the forests that are adjacent to human habitation, both individual homes and communities. Fire control efforts here can directly improve human safety. Third, some of these forests were originally open and

park-like. Logging, grazing, and fire control have led some of these forests far from historical conditions. Mechanical treatment could move these areas back to a more stable and less threatening regime of light, ground fires. Finally, many of these areas are already human-dominated landscapes and are likely to become increasingly so as logging continues, population grows and sprawls, and recreational use expands. Since human activity is going to be a significant modifying force in any case, careful and adaptive human manipulation of the vegetation to achieve a broad range of human objectives is probably appropriate since human impacts are inevitable.

In evaluating the benefits of forest fuel management in the dry, lower elevation forests, it is important not to exaggerate the reduction in damage to human structures. As pointed out above, the extent of that damage is primarily determined by the character and maintenance of the home and home site. Forest treatment beyond 30 to 120 feet of the structure will not contribute to the reduction of structure losses.

There is still the issue of the costs of the proposed fuel management. Simply planning timber harvests will not work as many of the wildfires this past fire season in recently logged areas clearly demonstrated. Fuel management requires that the mechanical treatment be guided by the fire control objectives, not by commercial timber objectives. From a commercial timber point of view, the largest and most fire resistant trees would be taken. In the process of extracting those large trees efforts would be made to minimize the associated costs including those associated with the disposal of the non-commercial wood fiber waste, the slash. If the area is replanted or allowed to regenerate, the commercially optimal spacing of the new trees is likely to be much closer than fire control advocates who want an open canopy would recommend.

Forest management governed by fire control considerations is likely to be much more costly and result in a forest with lower commercial timber productivity. Not only do the existing stands of mature trees have to be drastically thinned and the non-commercial waste removed, but this process have to be regularly repeated to control brush and young trees. Whether this is done mechanically or with controlled burns, it will be costly. Fuel management is not a matter of acting now and walking away and allowing the forest to take care of itself. The various fuel management strategies all involve repeated entry into the forest every 5 to 20 years to maintain low fuel loads.[15] This is very intensive forest management that has not been

[15] Natural fire that is allowed to burn or prescribed burns could provide this maintenance treatment. Given that advocates are talking about treating millions of acres in this manner, this would involve accepting the burning of hundreds of thousands or millions of acres each spring or fall. Finding an appropriate window of opportunity to carry out this level of

used across the entire forest base in the past simply because it was not economic. Where it has been practiced, it has been on the more productive commercial timberlands.

The impact of very widely spaced trees on the production of fiber is also an issue. Although widely spaced trees grow faster, total volume of fiber produced per acre is likely to be reduced. Park-like stands of large, slow-growing ponderosa pine produce less fiber per acre than do more closely spaced mixed species forests on similar sites. Even when ponderosa pine stands are compared, timber productivity can be reduced as much as 40 percent.[16] This means that there is less commercial timber value to justify the investment in more intensive management.

Besides the out-of-pocket costs associated with managing forest fuel loads, there are the costs associated with other forest values that may have to be compromised. Whatever its benefits for fire control, a continuous park-like setting of widely spaced trees with minimal ground cover is not, in general, a natural forest. Natural forests are patchworks of different tree densities, tree species, ground cover, non-forested grass or shrub lands, etc. Each patch serves a different ecological function in the larger forest "quilt." To take one obvious example, big game require the cover provided by dense thickets of trees. If, in the pursuit of fire control, such thickets are systematically eliminated, substantial big game habitat would be lost as would the dense Doug fir stand habitat for snowshoe hare and the Canadian Lynx that preys on them. It would not be much of an ecological improvement to jump from primarily managing our forests for commercial timber to primarily managing them for fire control under the guise of "forest health." Single focus management is likely to always be environmentally damaging.

Finally, wildfire control is being pursued because of its perceived benefits. Implicit is the assumption that wildfire causes damage. Although that clearly can be the case in some important and prevalent settings, in general, wildfire is a productive part of Western ecosystems. Just as periodic floods are important in renewing rivers and riparian areas, fires play an important role in keeping our forests productive and healthy. In that context, wildfire provides important benefits rather than imposing costs. The Yellowstone National Park fires of 1988, as catastrophic as they seemed at the time, have

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burning and the acceptability of the smoke associated with it is uncertain. Allowing natural wildfires to burn in lower elevation forests during dry, hot, windy weather is also of doubtful feasibility. These problems with the use of fire at lower elevations suggest that more costly periodic mechanical treatment may be needed instead.

[16] Arthur R. Tiedemann et al, 2000, "Solution of forest health problems with prescribed fire: are forest productivity and wildlife at risk?" ***Forest Ecology and Management,*** 127(2000):1-18, p. 4

provided a case study of how resilient forest systems can be to even very hot fires that appear to be so destructive that they literally sterilize local natural systems. Given our increasing knowledge of the importance, even necessity, of retaining fire as an active part of our Western forests, the first judgment that has to be made is whether any fire control is appropriate in each particular forest setting.

Timber harvests on National Forests have declined during the 1990s for two reasons. First, there were increasing demands that public forests be managed for a broader range of forest values than just commercial timber. Changes in the economies and demographics of communities adjacent to National Forests encouraged this shift. Second, as fiscal responsibility became a bipartisan issue, commercially oriented government activities that lost money and, as a result, placed demands on the US Treasury, fell into disfavor. The timber programs of many National Forests ran a deficit. Many timber sales generated revenues that did not cover the costs associated with the timber harvest. Such "below cost" timber sales ceased to be acceptable.[17]

If timber management is going to become even more intensive, if some of the most valuable trees are going to be left rather than harvested, and tree spacing is likely to reduce timber productivity, even more timber sales are going to generate revenues that fail to cover costs. If that timber management is going to proceed, it will require increased infusions of public money. That will require reversing the trend towards limiting public subsidies to the National Forest timber programs.

Of course, it can be argued that these higher costs and lower fiber production are due to the pursuit of non-timber objectives, namely forest health and fire control. Given the ongoing role of timber harvests in that forest management strategy, however, and the other forest values that are likely to be sacrificed, it is uncertain that broad public support for such subsidies will be forthcoming.

If that is the case, then "fuel management" efforts will have to find ways of funding themselves. The way to do that, which the timber industry already supports, is to modify the fuel reduction strategy by allowing more commercially valuable trees to be harvested than the fuel reduction strategy would have recommended. Instead of leaving all of the older, more fire

[17] There is little or no agreement on the appropriate accounting treatment of various US Forest Service timber program costs. As a result, there is no consensus on how to determine "below cost" status. The handling of overhead, administrative, road and regeneration costs as well as payments to local governments in lieu of taxes are often in dispute. There is little dispute, however, that many timber sales are, in fact, below cost.

resistant trees, the idea would be to "sweeten" the deal by allowing the harvest of some of those trees. The revenues associated with that harvest can then be used to fund the other fuel reduction measures. At one extreme, this would lead to straightforward commercial timber harvest, largely unaffected by fuel management measures. Even if the compromise between fuel management and commercial timber harvest is not carried to this limit, the effectiveness of fuel management efforts will have been at least partially offset by the wildfire enhancing aspects of commercial timber harvest. The extent to which wildfire control will have been enhanced and forest health improved will be debatable. Again, given the other forest values that may be threatened or damaged, it may not be possible to build a consensus around this approach either.

8. A Rational Response to the Dangers of Wildfire in a Forested Environment

What then is an appropriate public policy response to the dangers posed by wildfire in a forested environment? Based on the above discussion and analysis, I would suggest the following:

i. Because concerns over community and human health and safety will remain a top priority of wildfire management, mechanical treatments to reduce fuels should be focused in the immediate vicinity of human habitation. Because of their proximity to human settlement, these areas already tend to be human dominated landscapes. Roads, past logging, grazing, home construction, pets, fencing, clearing, irrigation structures, fire suppression, etc. have already significantly modified natural systems. It may be possible to manipulate the character of those forests to reduce the threat of wildfires originating there to human life and property while protecting the other values associated with the forest. Heavy-handed mauling of the landscape that disregards the damage being done to natural systems, however, would be stupid, and ultimately, destructive. Cautious, adaptive management is what is called for.

ii. No attempt should be made to "fire proof" the forested landscape. Wildfires must continue to be allowed to burn in our forests. The focus should be on reducing the damage caused by those fires, when there is any. It is homeowners who should be making their homes and home sites "fire wise." The forests should not be damaged because homeowners have not taken the necessary steps to allow them to live in a setting where fire is a common and natural occurrence. Education, incentives from insurance companies, and local building codes and land

use regulations should be used to shift the cost of protecting homes from the public and the surrounding natural forests.

iii. No attempt should be made to impose a single model of a "healthy" or "fire safe" forest on all forested landscapes. In different forested settings, infrequent, stand replacing, fires are as natural as frequent, light, ground fires that threaten no mature trees at other sites. All forests should not be open and park-like. Complex patchworks or mosaics of diverse forest conditions are what make up a natural forested landscape.

iv. Commercial timber harvest is obviously a legitimate activity in a forested landscape. Commercial timber harvest, however, is ***not*** a form of forest fuel management. The two should not be confused. One should not be a cover or excuse for the other. The pursuit of commercial timber values usually comes at the expense of wildfire control and forest health. It is important to recognize the tradeoffs inherent in that.

v. Forest fuel management has significant costs associated with it, both out-of-pocket and opportunity costs associated with the loss of other forest values. Forest fuel management should not be looked upon as a relatively costless undertaking. It has to be subjected to the same economic scrutiny in terms of both its costs and its benefits as any other natural resource use. In our eagerness to reduce the threat of wildfire, we should not ignore the long-term maintenance costs that may be associated with particular mechanical treatments of the forest.

vi. Ultimately humility is called for in the face of powerful natural forces that we only partially understand and often will not be able to control. We should learn from our experiences with river systems and the painful reevaluation we have had to go through with respect to flood control. We have learned that we cannot and should not try to eliminate all floods and ultimately cannot manage large floods. The same is true of wildfire. We need wildfire. Even if we did not need it, we often would not be able to contain or control it. At those times all we can do is what other animal who inhabit forests do, get out of the way until the fire passes and then take advantage of the changes that the fire brings in its wake.