Analysis of the Healthy Forest Restoration Act of 2003: The good the bad and the ugly.

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by

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B.S. University of Montana 2001

presented in partial fulfillment of the requirements

for the degree of

Master of Ecosystem Management

The University of Montana

December 2003

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12 - 16 - 03

Date

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INTRODUCTION

Since the early 1960's, debates over management of the National Forest System have been increasingly contentious. For example, the Forest Health Restoration Act (FHRA) of 2003 has stimulated rhetoric from opposite poles of opinion. Timber groups such as the American Forest and Paper Association have called for the Forest Service (FS) to develop a fire management plan for designated Wilderness areas that includes removal of trees, saying that "Current well-intentioned but misguided regulations require exhaustive environmental documentation delaying harvests indefinitely" (Lazaroff 2000:7).

Environmental groups have countered. The Alliance for the Wild Rockies urged Congress to hold hearings on, "A transparent attempt to gain access to the National Forest for the express purpose of logging" (Alliance for the Wild Rockies 2000:1). Rhetoric has occurred at the highest levels of government as well.

President Bush addressed a group of FS personnel at the site of a recent Arizona fire saying, "Forest-thinning projects make a significant difference about whether or not wildfires will destroy a lot of property. We saw the devastation, we saw the effects of a fire run wild, not only on hillsides, but also in communities, in burned buildings, lives turned upside down because of the destruction of fire" (Associated Press 2003:11).

Senator Joseph Liberman, (D-Conn.) countered: "Unlike our first president, George Bush just can't come clean about his plan to cut down trees...He's using the real need to clear brush and small trees from our forests as an excuse for a timber industry giveaway, and Arizonans should make no mistake: this is logging industry greed masquerading as an environmental need" (Associated Press 2003:12).

However, there seems to be a broad general consensus among natural resource managers, scientists, the timber industry, and environmental organizations. Forests are in need of treatment of fuel accumulations outside the natural range of variability, to reduce the threat of catastrophic wildfire, (i.e., stand-replacing fires) occurring in areas where such is not the norm. This consensus ends here.

Natural resource policy has historically embodied a utilitarian philosophy. This paradigm was fundamental in transforming federal lands from historic ecological condition to current conditions. This frequently resulted in use, removal, and protection of resources at levels that changed ecological functions. Thus, grazing, logging, road-construction, human settlement, and fire suppression took place through the mid 1900's at the expense of ecological integrity. These mechanisms have worked synergistically to leave large portions of national forests outside their natural range of variability, as related to fuel stocking, species composition, and forest age class--thereby altering the frequency, type, and severity of fire disturbance (Graves 1987).

The distribution of forest conditions are dynamic across the landscape and determined by a suite of environmental and anthropogenic factors. Discussion of the role of fire as it relates to forest health is facilitated by a simplified description of western forest fire disturbance regimes.

High Severity Fire Regimes: Alpine, sub-alpine, and coastal forest systems evolved with high-severity fire regimes with fire return intervals of between 200 and 400 years (Agee 1993, Agee and Krusemark 2001). These regimes are "weather-driven" as cool-moist conditions allow greater accumulations of fuels between burns. High fuel loading combined with uncommon, extreme weather events (e.g., long periods of dry weather followed by lightning) results in stand replacing fires that determine forest stand heterogeneity at the landscape level (habitat type and structure are usually changed at the kilometer scale). Even in "stand-replacing" fires, islands of unburned habitat commonly remain, producing diversity in wildlife habitat and forest regenerative structures across the landscape (Agee 1997).

Mixed Severity Fire Regimes: Occur in mid-elevation forests with historic fire return intervals of 40-80 years. Mid-elevation forests embody complex species distribution and relatively highly variable environmental conditions which produce a mosaic of habitat types--each with individually unique response to fire. Fires range from high to low severity depending on habitat type, topography, fuel accumulation, and weather. Fire has been largely responsible for maintaining this ecologically imperative mosaic of habitat types. Due to fire exclusion over the last century many forests are more likely to experience a high-severity or stand-replacing fire (Agee 1993, Taylor and Skinner 1998).

Low Severity Fire Regimes: Historically, low elevation, dry forest types were shaped by low-severity, but more frequent, fires. Fire return intervals of 5-15 years have been determined through cross-dating techniques (Agee 1993, Heyerdahl et al 2001). This regime had less effect on larger trees with insulating bark, but had significant effect on grasses, brush, shrubs and small trees. Mature tree mortality occurred largely from insect infestation and windthrow. Downed trees were consumed by fire which exposed mineral soil which allowing for recruitment of trees of species suited to such opportunities.

These processes produced a mosaic of different aged stands – usually 1-2 acres in size ranging from 0-500 years old with an average age of 225-276 (Munger 1917).

The combination of increased tree recruitment on soils exposed by livestock grazing and fire protection coupled with the removal of large fire resistant trees through logging, replaced an historic low fire regime with occurrence of mixed fire severity disturbance regimes with more infrequent catastrophic fires, at the landscape level. This coincided with the surge of westward settlement by Euro-Americans and conversion and use of forested lands. This transformation of forests from "healthy" to "un-healthy" (using the standard of fuel loading to define "healthy" according to FHRA standards) was rooted in the utilitarian philosophy that drove public land management until the mid-1900's.

Across federally owned lands, there is ongoing discourse over appropriate mechanisms to mitigate fuel loading (accumulated fuels, generally resulting from fire suppression, that could result in a stand-replacing fire). Important and highly variable ecological responses are directly linked to such activities.

The USDA (2002) outlined the need to treat 190 million acres of national forests to mitigate risk from catastrophic wildfires. Subsequent identification of federal lands eligible for treatment covered a spectrum of habitat types, fire-return intervals, roaded and non-roaded areas, endangered species habitats, and lands perceived to face threat from pest outbreak, windthrow, and disease. Each treatment area presented a diverse array of probable ecological and sociological response to treatment.

This generality allowed for opposite poles of opinion related to national forest management to focus on areas proposed for treatment under the FHRA and react with "propaganda."

Statements in the news media by interest groups of varying stripes contributed to polarization, which may result in some modification, postponement, or prevention of implementation of treatments (Shindler 2002). This polarization, coupled with immense differences in ecological costs/ecological benefits of eligible treatment areas, demonstrate need to develop criteria to set priorities for treatment areas. The only form of priority setting spelled out within the FHRA is "...the secretary concerned shall give priority to hazardous fuel reductions projects that provide protection for communities and watersheds" (H.R.1904IH 2003:5). Definitions for communities and watersheds can be found in (Federal Register 2001: 766) as follows:

> Communities at risk can be defined as interface or intermix communities for which there are two categories. Category 1. Interface Community: The Interface Community exists where structures directly abut wildland fuels. There is a clear line of demarcation between residential, business, and public structures and wildland fuels. Wildland fuels do not generally continue into the developed area. The development density for an interface community is usually 3 or more structures per acre, with shared municipal services. Fire protection is generally provided by a local government fire department with the responsibility to protect the structure from both an interior fire and an advancing wildland fire. An alternative definition of the interface community emphasizes a population density of 250 or more people per square mile. Category 2. Intermix Community: The Intermix Community exists where structures are scattered throughout a wildland area. There is no clear line of demarcation; wildland fuels are continuous outside of and within the developed area. The development density in the intermix ranges from structures very close together to one structure per 40 acres. Fire protection districts funded by various taxing authorities normally provide life and property fire protection and may also have wildland fire protection responsibilities. An

alternative definition of intermix communities emphasizes density of at least 28 people per square mile.

The amendment printed in Part A of House Report 108-109 clarifies that perennial streams feeding "at-risk" municipal water supply systems (i.e. watersheds) are eligible for hazardous fuels reduction projects. These definitions allow a breadth of treatment areas with variable ecological and social costs and related benefits. Allowing for opposite poles of opinion to focus rhetoric on whichever treatments or lack of treatments that best meet their desired outcome. This may provide a potential political roadblock to desired treatments.

Most wildland urban interface/intermix (WUI) communities occur at low elevations where increasingly developed private lands border federally owned uplands. These areas are generally comprised of dry forest types with low intensity/high frequency fire return regimes. Proposed FHRA treatments include "thinning from below" (leaving larger trees and, then removing smaller diameter trees, removal of understory brush, low limbs of mature trees, and ladder fuels in hopes of preventing hot, fast-moving, ground fires). The stand structures attained are to be maintained via repeated controlled burns. Additional treatments call for removal of some larger trees in order to prevent touching canopies so as to prevent spread of crown fires. In addition to failing to sufficiently set priorities for treatment areas, several other tenets of the FHRA and/or associated impacts of the FHRA are inadequate. The efficacy of the thinning from below method was challenged by (Fielder 2001). He offered an alternative, the Natural Process Method, which provided for recruitment of large trees, and young non-shade tolerant species, offering a greater resistance to fire and increased wildlife habitat, vegetative structure, and nutrient cycling processes. The Natural Process Method yield greater forest health benefits, however, thinning from below is the on method considered by the FHRA and thus will be the method considered in this analysis. The FHRA attempts to "mix apples and oranges" i.e., the impacts and benefits of FHRA treatments in the WUI are different from areas not in the urban interface/intermix. Mechanisms employed and associated short-term risks of degradation versus the long-term benefits of improved forest health are widely disputed and a likely focus of litigation. These treatments will produce consequences that have not been thoroughly recognized.

For these reasons, I have employed ecological and sociological evaluation criteria in analyzing responses to the FHRA. Though the FHRA applies to all federally owned lands, the scope of this review is limited to forest types west of the Rockies, and east of the Cascades.

BACKGROUND

Opinions, definitions, objectives, etc. result from different ideologies along a continuum. Depending on tradition or ideology of those deriving the definition, the desired output from public forests changes along with definition of what is "healthy." The breadth of possible definitions varies widely as does the associated impact(s) of each definition, if identified or implemented as a goal of the FHRA. In other words, without a vision of a desired future condition, it is difficult to accurately assess potential ecological and sociological responses.

A fundamental principal of a restoration project is description of desired future conditions (Society of Ecological Restoration 2002). Such conditions are delineated by the use of reference site(s) consisting of ecosystems with similar attributes, the historic condition of the target restoration site, or a combination thereof. Embedded in the current ecosystem management paradigm employed by public land management agencies and found within the FHRA, is the concept of historical range of variability (Wimberly et al. 2000). This concept is based on the premise that ecosystems are dynamic and have evolved within parameters of "disturbance–driven" temporal variation throughout their history (Wimberly et al. 2000). Understanding parameters under which a system evolved helps identify management goals and threats to the system.

Current literature regarding forest health uses terms such as: a return to "pre-settlement conditions", "park-like" stand structure, or alteration of forest stands to "an early seral state" (these terms are functionally synonymous and represent ca. 50 trees per ha) (Tiedeman et al. 2000:1). The use of pre-settlement forest structure as a model for a desired future condition raises several significant questions.

How well do we know historic forest structures—and at what moment in history? Tiedeman et al (2000) noted that historic conditions are poorly described and understood. Hoover (1952 personal communication *as cited in* Tiedemann et al. 2000: 2) referring to historic ecological descriptions observed:

> It may be worth noting that travelers seek open stands. Few trails passed through dense stands by choice. Naturally, early wagon passengers and horsemen saw open stands. Also, photographers and artists favored more open forests and avoided dense stands for their illustrations. This could bias our impression of past conditions.

During "pre-settlement" times, there were relatively few people in the West and even fewer trained in natural sciences. Few people wrote descriptions of forest conditions and those stands that were described were likely encountered with travel by wagon.

Descriptions likely served functional purposes such as identifying potential uses, homestead site identification, passage, or resource extraction. By and large, these descriptions were neither biological nor ecological in their nature. Thus, the forest conditions perceived were derived from a different and narrow suite of environmental, social, and functional criteria than ecologists would use today in describing attributes of an ecosystem.

Aside from inadequate understanding of historic forest conditions to facilitate selection of reference sites, current expectations of forest outputs and values vary from those of persons in pre-settlement times (e.g., wood fiber, wildlife, endangered species act requirements, multiple-use and sustained-yield protocols etc.).

This, combined with wide-scale introduction of non-native flora and fauna and alteration of successional processes through management practices that resulted in altered species composition, frequently produced a shift of flora and fauna outside the historic range of variability. Returning today's forests to conditions emulating those of pre-settlement times may not be desirable, feasible, nor possible--except at a very small scale. These commissions will likely center on true Ponderosa pine (*Pinus ponderosa*) or low-elevation dry-forest types most frequently described in historic accounts. Returning any plant community that is now outside its historic range of variability to original condition is unlikely, costly to achieve and maintain, represents only an informed guess at best and, even then, may not meet the diverse needs placed on today's forests.

However, knowledge of pre-settlement conditions should be considered when identifying future management goals. As Hesburg et al (1999), Swanson et al.(1994), and Wimberly et al. (2000) observed, determination of past conditions can help clarify the type and extent of changes that have occurred and can help identify and evaluate future management objectives and priorities.

The FHRA does not identify desired future conditions, other than the ambiguous goal of reduction of the likelihood of catastrophic wildfire and disease and insect infestation threats via mechanical fuel reduction treatments and controlled burns. "Forest health" or a "restored forest health condition" are undefined.

As Filip (2002) pointed out, definitions of forest health vary depending on desired outputs from the system in question. For instance, from a private industry viewpoint, a forest with more than 10% pest damage might be considered "unhealthy." From a federal-agency viewpoint, a forest with 25%-50% pest-caused mortality may be considered "healthy." Kolb et al. (1994) state the utilitarian definition of forest health as using timber production as an indicator of health, with dying and dead trees indicating poor forest health. The FS (1993) defined forest health as a condition where living and non-living influences on forests (i.e., pests, pollution, sivilcultural treatments, harvesting) do not threaten management objectives (which may be highly variable), now or in the future. Monning and Byler (1992) note that a forest in good health is a fully functioning community of plants and animals and their physical environment.

Proper definition of the desired future conditions of public forests must incorporate appropriate ecological indicators and social values. Wimberly et al (2000:177) discuss appropriate use of historic range of variability as it relates to forest management:

> Until we can estimate ranges of historical landscape variability more accurately, it will be difficult to substantiate an argument for their use as forest management goals. Despite these uncertainties, comparisons with historical variability are still useful as general indicators of forest health

> and the potential to sustain populations of native species. Our research supports assumptions within the Northwest Forest Plan (FEMAT 1993) that declines in the amount of old-growth are unprecedented in recent history, and it provides an approximate target for restoring old-growth on federal lands. Simply providing areas of habitat similar to historic levels, however, will not necessarily guarantee the survival of associated native species. Other landscape attributes such as the spatial arrangement of habitat types and rates and pathways of landscape dynamics will need to be considered as well.

Tiedemann et al (1999) demonstrated dynamic growth rates and subsequent relative increases in basal area per/ha dependent on thinning density and frequency of prescribed fire. Based on these described factors those applying the FHRA will need to define the desired future conditions of treated areas, including a "forest health equation" which incorporates the ecologic and social values. Tiedemann et al (1999:2) elucidated, "...if the objective is to restore forest health then forest productivity, wildlife, biodiversity, protection of structure and function of ecosystem components, are as important to the forest health equation as the structure of a stand and its resistance to fire."

The field of landscape ecology continues to evolve with increased understanding of how ecosystems interact, to provide a dynamic equilibrium (i.e., spatial and temporal variation) that includes local and landscape influences. This understanding should be applied to any project of this magnitude i.e., the WUI and watersheds do not exist in isolation. Thus, a forest health restoration project should be a part of a comprehensive ecosystem restoration project or should, at least, consider impacts of local treatments to the landscape. This will mean the inclusion of landscape variables, protection of rare habitats such as old-growth, and rare wildlife and aquatic populations and resources.

Agee (1996, 1998) asserted that efforts to reduce fire are apt to be futile; in the manipulation of stand structures in high fire severity regime habitat as Johnson et al.

(1995) and Weatherspoon (1996) point out, fuel treatments in high severity fire regime habitats will move these systems away from historic conditions, to the detriment of some wildlife and watersheds. Fuel levels in mixed, but predominantly high severity fire regime habitats, may suggest a high fire hazard under conventional assessments. However negative ecological consequences of wildfire are likely to be minimal, as demonstrated by the Yellowstone fires of 1988 (Romme & Despain 1989, Knight &Wallace 1989). The more recent "Biscuit fire" in 2002 in southwestern Oregon is another example. With a plethora of island habitats and an immense amount of regeneration occurring 1 year post-fire, it appears not to have been the touted overall "ecological disaster." To the contrary, it produced heterogeneity, new growth, and remnant stands, providing complex habitat structures required by many organisms. It however it did cause a great loss in timber, damage to the Late Successional Reserve system designated under the NWFP, a number of spotted owl (*Strix occidentalis*) nest sites. Again, differing environmental ideologies will determine what is considered a naturally occurring environmental disturbance or a dramatic loss of timber.

Proposed treatments of watersheds and associated perennial streams, as well as habitats for threatened or endangered species that have evolved with fire, raises ecological and social questions worth addressing before treatments are initiated. First, what terrestrial habitat has not evolved with fire? Does this mean that all habitats for threatened and endangered species are eligible for treatment? Second, thinning in watersheds and associated perennial streams will frequently involve projects in the "backcountry" with associated construction of roads and removal of some large trees. In order to maintain the desired stand structure over time, these roads will have to be maintained to facilitate periodic treatments. Roads increase invasion of exotic plants, increase chances of human ignited fires, and a myriad of negative ecological consequences. The removal of large trees, treatments in threatened and endangered species habitats, and the ecological degradation caused by roads are all factors likely to be challenged and perhaps litigated by disapproving segments of public. The common thread in debate related to these proposed treatments is the evaluation over short-term degradation versus long-term improvement in forest health. As a result treatments will vary in applicability dependent upon the target system's biogeophysical, soil, wildlife, and aquatic characteristics, available resources, desired future conditions, and public opinion. Elucidation of potential consequences and alternatives can be generated through the combination of relative risk assessments, embracing adaptive management principals, and dialogue/debate with stakeholders over inherent trade-offs--all of which are central to the ecosystem management paradigm.

Natural resource specialists should be able to describe desired future conditions in a more precise manner than a "pre-settlement condition" or "increased resistance to catastrophic wildfire," considering the potential extent and aggressive management proposed in FHRA treatments.

Following the dramatic fire seasons of 2000, 2002, and 2003, the George W. Bush administration announced the "Healthy Forests Initiative," and a revised NFP. While providing a vision of collaboration, ecosystem health, and the need for fuel reduction to reduce the threat of catastrophic wildfire, the emphasis was to "streamline the appeals process" (USDA 2002:2). This goal was attained in Sections 104 and 402 of the FHRA and reads:

> Section 104 (b), Discretionary Authority to Eliminate Alternatives. In the case of an authorized hazardous fuels reduction project, the Secretary concerned is not required to study, develop, or describe any alternative to the proposed agency action in the environmental assessment or environmental impact statement prepared for the proposed agency action pursuant to section 102(2) of the National Environmental Policy Act of 1969.
>
> Section 402 (d), Categorical Exclusion. Applied silvicultural assessments carried out under this section are deemed to be categorically excluded from further analysis under the National Environmental Policy Act of 1969. The Secretary concerned need not make any findings as to whether the project, either individually or cumulatively, has a significant effect on the environment.

Shindler (2002: 140) stated, "...citizen support is an essential component of effective forest management...any management program is likely to falter if agency personnel have not adequately incorporated citizen concerns." Shindler (2002: 141) outlined factors crucial to successful fuel reduction treatments. The titles of the presented factors demonstrate the significance of how individuals view the world around them and relate it to fuel reduction projects:

1) "It makes little difference how good a fuel management plan may be; nothing will be supported unless the people involved trust each other.

2) Public acceptance of fuel reduction treatments depends on the process of how and why decisions are made as much as the decision itself.

3) Technical science-based planning does not adequately incorporate public concerns.

4) Achieving natural, healthy forests systems is complicated by a range of perceptions of what "natural forests" might be.

5) It is a misconception that information alone will lead to an increased understanding. People learn and change their behavior based on relevant personal experience."

In the end public understanding, and how people come to accept management programs, is based on a litany of factors interpreted by personnel experience.

Clearly, the elimination of appeals is contentious, and not the salient issue in the forest health crisis. Given the extent of proposed treatment areas (190 million acres), obvious contentiousness of treatments mechanisms and locations, and broad changes proposed to an established forum of public involvement, policy evaluation is warranted. I will analyze potential impacts of FHRA treatments on: Urban/Wildlife conflicts, Colonization by exotics, Smoke externalities, Generalized Ecological and wildlife impacts, Escape of controlled burns, and Public trust.

ANALYSIS

Increased Urban-Wildlife Conflicts

Although rural, suburban, and urban residents generally enjoy wildlife, reports of negative experiences with wildlife are increasing (Messmer et al 1999, Messmer et al. 1997, Warren 1997). Human-wildlife conflicts include disease transmission to humans and domestic animals, injuries and fatalities to humans and domestic animals resulting from wildlife attacks, deer-automobile collisions, as well as impacts to crops, ornamental vegetation (Conover et al. 1995). Conover et al. (1995) estimated the total impacts of wildlife damage to human life and property in the United States to approach 3 billion dollars annually. It seems likely that vegetative treatments carried out as a result of FHRA treatments will increase human/wildlife conflicts.

Alteration of forest understory structure combined with crown thinning followed by repeated controlled burns will significantly alter wildlife habitats with likely reactions by resident and wintering ungulate populations. Increased amounts of sunlight and water will reach the forest floor producing increased volumes of grasses, forbs, and shrubs (the food base for wild ungulates). This increased food base will provide for increased numbers of resident white-tailed deer (*Odocoileus virginianus leucurus*) as well as migratory mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*). In addition to an increase in human ungulate conflicts, in some areas predators such as wolves (*Canis lupus*), coyotes (*Canis latrans*), bears (*Ursus americanis and arctos*), and cougars (*Felis concolor*) will utilize this prey base—wherever it occurs—even in the WUI that includes livestock, pets and danger to people.

Increased numbers of ungulates and predators will increase human/wildlife conflicts. It is likely that State fish and wildlife agencies will bear the brunt of the socially controversial management actions required to address these issues financially, publicly, and politically. Control of wildlife numbers in the WUI is difficult (shooting and poisoning is dangerous, trapping is expensive, etc) and all are socially difficult, labor intensive, and expensive. There are no current sources of revenue to support such activities.

Exotics and the FHRA

Griffs et al. (2001) stated that, with increased site disturbance, there is an increased chance of that area being colonized by non-native plant species. If the disturbance is anthropogenic, the likelihood of non-native vegetative colonization increases. Proximity to human settlement, livestock, and roads are all factors, which amplify probability that colonization by non-native vegetation will be enhanced. Numerous researchers have documented the establishment of exotic species as a threat to biological integrity and ecosystem function (Griffs et al 2001). Thinning, mechanical fuel treatment and repeated controlled burns will likely be conducive to introduction and support of exotic vegetation.

The FHRA identifies 190,000,000 acres of federal lands that are in "need" of FHRA treatments. Many of these lands are located in the WUI or municipal watersheds, and require use of existing roads or construction of "temporary" roads. Initial treatments will be mechanical, employing the use of heavy equipment likely resulting in substantial soil disturbance. The accumulation of these factors make treated areas prone to establishments by exotics, according to the factors identified by Griffs et al (2001). Colonization by exotics is likely to have significant impacts on aesthetic value, species diversity, successionial attributes, and wildlife habitat.

Herbicide use is prohibited by the implementation plan; dramatically reducing effective means of controlling exotic weeds and would likely be socially unacceptable even if allowed. Possible mechanisms to alleviate colonization by exotics, as identified by Sheley et al. (1995), are repeated controlled burns, mechanical treatments, and hand-pulling, with the ensuing planting of native vegetation. However, Sheley et al. (1995)

caution that often non-natives will out-compete native plants, even when sites are augmented with native vegetation. Each of these treatments, or their combinations, has associated impacts requiring consideration and inherent trade-offs.

Repeated burns would have to occur frequently in order to quell subsequent colonization, creating significant impact to soils, intact native vegetation and wildlife habitats. Controlled burns will be executed when chances of escaping control are least—i.e., under relatively moist conditions with lower temperatures. Burns under such conditions will tend to produce more smoke. And, these "cold fires" will not loft smoke effectively. Nearby communities will be routinely subjected to smoke from controlled burns.

The other strategies for mitigating exotic colonization are expensive, and time consuming and not practical over large areas. And, the number of acres that must be routinely treated to maintain the desired future condition will increase steadily over the duration of the program. Ability to maintain such a program in perpetuity will be very high in cost, which will steadily increase for many decades until equilibrium is reached. It seems likely that under current policies, that the WUI itself will continue to increase as the population in the west continues to grow. This will require discipline in funding, evidenced by the most recent GAO report (the fourth such report on this topic) in which the FS identifies weather and lack of funding as the primary reasons fuel reduction projects are not completed (GAO 2001). Degradation caused by exotic invasion is less of a concern in the WUI as these areas have already, in general, existing populations—the ecological threat to watersheds and backcountry treatment areas is much greater, in general, due in large part to the absence of exotics.

Implications to Wildlife

There are multiple attributes of the FHRA that will have inevitable, diverse, and far-reaching impacts to wildlife. The FHRA describes mechanical treatments to remove understory vegetation, small diameter trees, and ladder fuels. The resulting desired structure is to be maintained by the use of repeated controlled burns. The mechanical removal of snags, coupled with the elimination of the majority of down wood habitats via prescribed burns will have impacts to wildlife that use snags and down wood as habitat.

Snag and down wood are vital habitats for wildlife in all forest type (Thomas et al 1979). Over 35% of vertebrates in the intermountain West utilize snags and down wood for nesting, denning, feeding, perching, or shelter (Johnson and O'Neil 2000). Over 80 species of birds, mammals, reptiles, and amphibians use defective, live trees, snags or down wood. Down wood logs and snags engender complex physical and thermal habitats and offer a myriad of ecological benefits including food storage as well as natal and denning habitats (Bull and Parks 1997). Mclleand et al (1979 and Thomas et al. 1979) observed approximately 25% of nesting bird species in Rocky Mountain forests were cavity nesters. Concomitantly, down wood provides habitat for several forest arthropod species. Tiedeman et al. (2000) found populations of forest floor arthropods significantly lower in harvested, and then burned areas than in adjacent non-treated areas three years after treatment; this was attributed to inadequate amounts of down wood. This is of particular importance because several species of forest arthropods are predators of the spruce budworm and other tree predating arthropods. Additionally, forest arthropods play a critical role in forest ecosystem structure and function, simultaneously providing a significant food source for many forest vertebrate species.

Embedded in the issues of down wood and snag habitat loss, is the question: How will the genesis of future snag and down wood habitats occur and be maintained? Rochelle (2002) states that emphasis should be placed on retention of large snags 16-22 inches in diameter. Henjum et al. (1994) and Wickman (1992) assert protection of remnant old-growth, from the stand level to the individual tree (including snag and down wood) habitats should be top priority for any forest health restoration project. They contend a hundred years of logging in western forests has severely depleted these ecologically, genetically, and scientifically important resources. Agee and Huff (1986) and Stephenson (1999) suggest a possible mechanism by which recruitment of large snags and down wood may occur. Rather than taking stands to desired conditions in one treatment, they observe, it may be more ecologically appropriate to use mild/moderate thinning, reducing the threat from severe wildfire, and concomitantly allowing fire, insects, and disease to maintain a trajectory toward old-growth conditions.

Selection of fall versus spring prescribed burns will have divergent impacts to wildlife and forest function. Spring burns have the potential to eliminate or greatly reduce the success of ground nesting/denning small mammals and birds. Fall burns will see increased erosion by wind and water, in response to the elimination of plant bio-mass which holds snow and increases slope stability. Fall burns will also limit winter forage resources for ungulates.

It seems likely that in the WUI where initial treatments are to reduce fire danger and repeated controlled burns are used that these areas will become highly depaupurte of snags and down woody material over time. In such areas there will be little tolerance for snags due to danger to people and enhanced fire threat. Conversely, backcountry treatments resulting in the same aforementioned outcome may be socially controversially and ecologically damaging.

Associated Impacts of Mechanical Treatments

Restoration of some forest types (those located in mid and high elevations and those that have evolved with mixed or high severity fire regimes) may be accomplished through the use of prescribed fire alone (Agee & Huff 1986, Weatherspoon 1996). Specifically Tiedemann et al. (2000) illuminated several concerns about the ecological efficacy of prescribed burning citing nutrient loss, forest productivity (in terms of basal area/ha), and impacts to wildlife as three primary concerns. The impacts to wildlife and possible solutions have been previously discussed; a discussion of the complex interaction between forest nutrient cycling/forest production and forest health restoration projects is outside the scope of this paper. However, these assertions are robustly supported with literature. A coarse description of their conclusions as they impact FHRA treatments is presented below.

Tiedemann et al. (2000) present significant impacts to aforementioned attributes of forested ecosystems, specifically Ponderosa pine/Douglas fir dominated forests, via damage to root systems, tree crowns and significant nutrient loss via frequent prescribed burns. The effects of prescribed burns were run through two separate models. Severe negative impacts to soil, forest production and wildlife at the 10-year prescribed fire interval were reported, with impacts greatly reduced at the 20-year mark, and no impacts at the 50-year mark. They also recommend leaving a portion of thinning materials lopped and scattered or chipping and scattering thinning residues, thus mitigating some nutrient loss; managing for a variety of species and seral stages was suggested as beneficial to wildlife and prevention of infestation by insects and disease. This is a complex issue both ecologically and socially. Identification of an acceptable level of tradeoff between environmental degradation and reduced risk from wildfire needs to be identified through empirical research.

It appears that a burning regime of less than 10 years is not ecologically sustainable for several reasons. Old trees that are inherently more resistant to fire, have been predominantly removed from these forests, degradation of these habitats will have negative impacts to some wildlife, and frequent burns damage soils affecting productivity and nutrient cycling. With longer time frames between burns, social tolerance of smoke events may be increased as well. With longer time frames comes increased risk of fire as well as damage to life and property. Tiedeman et al's. observations seem most applicable to watershed and backcountry treatment areas, as the need to protect lives and property will supercede many ecological concerns.

In other forest types, fuel accumulations are too great too prevent the unacceptable loss of green trees or engender too high a risk of fire escape and therefore, will require the use of mechanical treatments followed by subsequent use of prescribed fire on a repeated basis. Mechanical treatments outlined in the FHRA focus on the removal of small diameter trees and understory shrubs and forbs. The high cost of treatment and low economic value of the trees to be removed will encourage—or even dictate--low cost logging methods.

The use of ground-based heavy equipment is likely to compact soils, thus affecting organisms dependent on proper soil function. Soil compaction, which can require decades to recover, reduces plant vigor and water infiltration as well as increasing erosion and runoff (Harvey et al. 1989). The FHRA treatments allow construction of "temporary roads," in order to access identified eligible treatment areas under certain circumstances. This begs the question of how "temporary" these roads can be in circumstances where continued access is needed to facilitate the use of prescribed fire at prescribed intervals to maintain the desired forest condition. Literature pertaining to the adverse ecological effects of roads is robust (Trombulak & Frissel 2000).

The WUI, watersheds and associated perennial streams have been identified as priorities for initial FHRA treatments. WUI's usually have established road systems, leaving the areas at risk from road construction to watersheds and their associated perennial streams. Thus, successful fuel reduction may help improve watershed resilience to wildfire and associated aquatic habitats with the tradeoffs of producing associated risks of degradation from road construction or other soil disturbance (Lee et al. 1997, Greswell 1999). The high value of water, already existing extensive degradation of watersheds and the potential presence of at-risk fish populations, mandate that such areas receive special evaluation before FHRA associated activities are undertaken to assure the best possible trade-off between enhanced protection from stand-replacing fire and negative ecological impacts. Long-term versus short-term risks and benefits should be included as part of treatment considerations.

Riparian areas provide disproportionate benefits to aquatic and terrestrial wildlife habitat, water quality, and ecosystem function relative to their distribution on the landscape (Marcot et al. 1997 and National Resource Council 1996). Logging in riparian areas can have significant detrimental effects on ecosystem function, incorporating reduced aquatic and terrestrial habitat quality via increased sediment delivery to streams, reduction in thermal regulating capability, reduction of large woody debris, and other associated impacts. Ecologic interactions at the landscape level related to riparian habitats are highly complex, as are the risks of wildfire versus treatment (Agee 1999). While pre-commercial thinning may have some application in riparian areas, restoration should initially focus on uplands (Gregory 1997). Carefully applied prescribed fire, based on site-specific analyses, may be the most appropriate treatment in riparian areas. Thus, a blanket decision to attempt to protect watersheds and associated perennial streams from stand-replacing fire through thinning and fuel reduction, without assessment and innovative mitigation of associated risks or opportunities for adaptive management, may produce ecologically unacceptable consequences.

Social Analysis

Social Tolerance and Impacts of Smoke

There is little empirical evidence pertaining to social tolerance and public health responses to increased levels of smoke. Mott et al. (2000) looked at hospital visits during severe wildfires and found an increase of pulmonary complaints of 52%. In 1969, strict air-quality standards were placed on burning slash and making prescribed burns in Oregon, in response to health concerns caused by smoke accumulations near population centers (Schroder 1977). This bill regulated the number of burn days and the number of acres to be burned, based on predicted weather conditions. This bill, in conjunction with the federal Clean Air Act (United States 1981) and increases in health problems are evidence of a socially important issue.

FHRA proposes prescribed burns to achieve and maintain desired forest conditions. Common practice is to schedule such burns when the chance of "escape" is least, due to cooler temperatures and higher fuel moisture levels. Associated with such burns is increased smoke production. As treatments occur and the years progress and more acreage is brought into desired condition, coexistent burns will be needed to maintain previously treated areas. This pattern will increase year by year. There may well come a time when social tolerance and public health concerns may override public support for forest health.

Inability to use controlled fire will cause default to the employment of mechanical treatments, which are more labor intensive, more expensive, and likely to be more ecologically degrading. Or if forests are not maintained via mechanical treatments, conditions will revert to "pre-healthy" condition. Weatherspoon (1996) points out that thinning alone may be successful in reducing fire hazard. However, thinning is unlikely to meet ecological objectives unless combined with prescribed fire. Tiedeman et al. (2000) described significant nutrient losses in forest ecosystem as a result of mechanical treatment without employing controlled burns. There are distinct costs associated with management choices and divergent ecological and social responses pertaining to each related to FHRA treatments and smoke production.

Escape of Controlled Burns

Anyone who understands dynamics of fire realizes that the term "controlled burn", over time, is something of an oxymoron. Controlled burns do escape control. For example, the infamous Los Alamos fire which destroyed 48,000 acres, 1500 archeological sites, and over 200 homes, with damages of over 1 billion dollars, resulted from an "escaped" controlled burn (Forest Fires 2000). The Los Alamos fire was certainly the most publicly visible and financially costly fire resulting form a controlled burn in recent history. Other such burns that have escaped in the recent past include, 14,000 acres of the Grand Canyon National Park burned forcing the closing of multiple tourist lodges and another forced the evacuation of the entire town of Seven Springs, New Mexico (Forest Fires 2000).

It is inevitable that some controlled burns will escape control and some will result in stand-replacing fire and large economic consequences given the justification for FHRA treatments. There will be inevitable negative ecologic and sociologic consequences given proximity of treatment areas to the WUI and ecologically sensitive watershed and riparian areas. Such incidents may also reduce public confidence in management agencies, their methods, and efficacy in employing this tool. Understanding this, systems need to be in place to financially, socially, and ecologically minimize the damage caused by escape before such activities are undertaken. Stringent protocols for burn applications, accountability, an abundance of available resources to counter consequences of an escape (i.e., aircraft, fire crews, and other fire fighting equipment), and speedy compensation for damage will be essential if such programs are to be sustained. Yet, there has been no clear identification of need to allocate resources and/or develop mitigation and prevention protocols that provide for a level of preparedness adequate to effectively deal with the inevitability of the unfortunate reality of escaped fires. Further evidence of this ambivalent attitude toward preparation and compensation is that, to this day, many victims of the Los Alamos fire have not been compensated (Forest Fires 2000).

Public Trust and Perceptions Affected by the FHRA

Public trust of management agencies has been identified as critical to any "successful" fuel reduction or forest health project (Cortner et al 1998, Cortner et al. 2003, Putnam 2001, Shindler and Neburka 1997, and Winter et al. 2002). There are many clauses within the FHRA that potentially affect public trust and perceptions of management agencies. Two clauses are contentious and potentially damaging to social trustful interaction with public land management agencies. Sections 104 and 402 of the FHRA reads:

> Section 104 (b), Discretionary Authority to Eliminate Alternatives. In the case of an authorized hazardous fuels reduction project, the Secretary concerned is not required to study, develop, or describe any alternative to the proposed agency action in the environmental assessment or environmental impact statement prepared for the proposed agency action pursuant to section 102(2) of the National Environmental Policy Act of 1969.
>
> Section 402 (d), Categorical Exclusion. Applied silvicultural assessments carried out under this section are deemed to be categorically excluded from further analysis under the National Environmental Policy Act of 1969. The Secretary concerned need not make any findings as to whether the project, either individually or cumulatively, has a significant effect on the environment.

In addition to removing NEPA requirements for lands infested by, or perceived to be at risk from insects, section 402 is the only section where timber removal, as opposed to thinning, is mentioned as a "tool." The combination of timber removal versus removal of small diameter trees and the exclusion of NEPA processes are clearly suspect by an already suspicious environmental movement and a large portion of society. Embedded within this reality is the threat of litigation.

As noted in the 1997 GAO report, exemption from NEPA processes did not expedite salvage sales and may have in fact slowed the process due to increased litigation. Categorical exclusions provide a mechanism by which FHRA projects can be conducted without Environmental Impact Statements (EISs) or administrative appeals. Nevertheless, these proposed projects could be challenged in court. Clearly most successful challenges to proposed forest management action have been related to NEPA compliance. However, violations of other laws such as the, Clean Water Act (United States 1977), Clean Air Act (United States 1981), and Endangered Species Act (United States 1973) etc. could be used to challenge proposed actions. Categorical exclusions can be challenged under two categories according to the Council on Environmental Quality (CEQ) (CEQ 2003) and the FS (2003):

1. Extraordinary circumstances i.e. that is the presence of some extraordinary quality inherent to the system to which management action is to be applied.

2. Failing to meet the criteria listed in the required definition of an "eligible" categorical exclusion project.

What is the likely outcome of such policy, other than an increase in litigation? Political backlash similar to that related to the 1993 salvage rider, wherein constituents stifled accelerated actions through political protests seems likely. FHRA's Section 104 eliminates the listing of alternatives, taking away the potential of choice or set of potential choices. Will stepping back into the Progressive Era paradigm, wherein "experts" were trusted to determine what is best for the whole be acceptable today?

Ehrenhaldt (1994:6-7) asserts, "...when given a set of choices, even ones that are limited or imperfect, citizens will often choose the lesser of two evils and accept it."

Public input is critical to understanding dimensions of an issue, regardless of the conflicting environmental traditions from which it originates. That is to say, that both sides of "environmental" issues have values attached to the governance of public lands and both should be considered. For example, in some circumstances timber removal may be both necessary and a good thing while in other circumstances timber removal may have ecological, aesthetic, or social concerns that outweigh the value of the timber. In such situations public involvement is most critical beyond simply saying "yes" or "no" to a project—i.e., the public can identify values and goals and nuances of differences associated with individual forest management projects.

On Monday August 11, 2003, President George W. Bush speaking in Summerhaven, Arizona, addressed several dozen FS employees, members of the press, and the public. He stated, "...legal challenges to harvests on environmental grounds have caused large-scale reductions in logging... Forest-thinning projects make a significant difference whether or not wildfires will destroy a lot of property" (Associated Press 2003:13). He made clear that the FHRA's goal was to protect communities from wildfire. He simultaneously blamed environmental organizations for thwarting management activities and re-sounded the rationale for categorical exclusions and NEPA limitations.

Only days before, officials of the Bush administration settled the last of five lawsuits brought by the timber industry out of court. Some 300 million board feet per year were assured to come from FHRA thinning treatments, to be accompanied by

"...dissolving as much as possible of the 1.6 million acre old-growth, fish, and wildlife reserves on BLM lands"(Willis 2003a:9). While it is unclear what this will ultimately entail, it should be noted that these lands are crucial to the network of habitats created by the Northwest Forest Plan (NWFP). The leader of the team that prepared the option that lead to the NWFP Jack Ward Thomas was quoted as saying, "it would be more honest and cheaper to stop trying to cut old-growth due to the intense opposition from environmental groups" (Willis 2003a:10). The settlement also promised a review of the status of the spotted owl (*Strix occidentalis*) and marbled murlett (*Brachyramphus marmoratus*) as well as a reconsideration of the Survey and Manage protocols and the Aquatic Conservation Strategy of protecting watersheds included as part of the NWFP.

Fulfilling NWFP timber projections and making alterations in conservation reserves and aquatic management strategies while simultaneously pursuing a goal of "forest health," may be very difficult to achieve while maintaining legality of the plan and social support.

The President seeks a system commensurate with the projections in the NWFP (1.1 bbf/year) flowing to market over the life of the plan. Forests are declared to be in need of restoration treatments; and "analysis paralysis" is acknowledged to exist due to an excess amount of process related to compliance with rules and regulations. Trying to increase timber supplies in the Pacific Northwest to levels projected in the NWFP while restoring forest health, and mending years of policy-related controversy with one fell swoop of the legislative pen appears socially and ecologically improbable.

Public trust of management agencies is crucial to successful public forest management. Limiting public involvement, constraining public choice, while proposing socially and ecologically controversial alterations in management approaches is unlikely to build trust and seems likely have the opposite effect. If past is prologue, these actions will increase litigations and civil disobedience--mechanisms cited as reasons for ineffectiveness in public land management.

Circumstances 150 years in the making will likely take decades to fix. There is abundant and building evidence that "no action" is not publically acceptable, though that will be reality over much of the areas involved due to inability to move fast enough to make much difference. Simple math shows how few acres—as a percentage of the whole--can be influenced over the next several decades. Therefore, strategic planning is essential to yield the best result with whatever limited effort is possible. As more people move into WUI areas, and the constantly accumulating treated areas require maintenance, progress on treating new areas will slow. Wildfire will likely be the "majority partner" in reducing future fire danger. Public involvement in identifying areas of primary concern could help build trust and improve efficacy of future projects. However, looking before we leap and progressing at a rate which adaptive knowledge can be applied is advisable. The reactive, all-or-nothing attitude of past legislatively derived policy relating to fire suppression and timber harvest is the genesis of the current forest health crisis. Current policy makers should not be blind to the consequences of such approaches.

Management Recommendations

Alternatives to FHRA Treatments

Beyond forest thinning and prescribed burning, the FHRA does not consider alternative policy options to provide prudent and effective management tools. Cohen

(1999) stated that the crucial area around structures to prevent loss from wildfire is within 40 yards of such structures. However, vegetative treatments alone will not suffice. Structures must incorporate fire safe elements such as metal roofs; stucco siding, metal window frames and absence of wood decks. The suggested rationale for the FHRA is the reduction of risk to human life and property. Without appropriate modifications to structures and land use modifications to enhance the efficacy of FHRA treatments, public investment in forest health restoration treatments to prevent loss of structures in the WUI is likely to be only marginally successful and socially questionable. Some state-based legislation to assigns culpability to landowners unwilling to take appropriate precautions and assume some costs for mitigating fire risk i.e., the cost of choosing to live where they do. An example of such legislation is Oregon's "Urban-Interface Fire Protection Act" (ORS 1997)

As the number of people and development in the WUI increases, it is important to note that if there were no structures in these areas, there would be no WUI along with a hugely reduced threat to property and lives. Perhaps alteration of zoning laws would lessen the future magnitude of "forest health problems." Increased mandatory insurance costs in the WUI could serve as a powerful mechanism to mitigate expansion, cost of prevention and protection, and public costs to assuage the costs of these "acts of God"—which in the long-term are quite predictable.

Ballou (2002) differentiated sources of ignition of the total number of fires in Oregon from 1912 through 2002 into two categories—human-caused versus lightning. Considering only the last fifteen years, it is clear that the overwhelming majority of fires (11,863) were human-caused--about half that amount (5,676) were caused by lightning.

Obviously, a vigorous education and stringent permit system should exist for those citizens wishing to use fire as a tool. Whether it is a multi-million dollar logging operation or a neighbor burning a trash pile, implementation of more severe penalties for companies/individuals responsible for escape of controlled burns may stimulate greater caution in using fire as a tool. This combination of education and deterrent has yielded favorable results in the past (e.g., the "Smokey Bear" campaign).

These alternatives will not replace the need for thinning in combination with prescribed fire--but a combination of these management tools could complement FHRA treatments. The adage "an ounce of prevention is worth a pound of cure" is appropriate in this situation.

Focus on the Wildland Urban Interface

Low elevation WUI forests engender qualities that will initially provide the highest priority and the best opportunity for successful forest health treatments. These forests border or encompass communities where fires threaten life and property. Therefore, these treatments will be prone to broad social support. These areas are often heavily roaded, thus avoiding controversy surrounding road construction and the associated negative ecological impacts. Concomitantly, these forests are comprised of the low elevation, low fire severity, and frequent fire return interval habitat types in general, are the furthest outside their historic range of variability, and are best described by historic accounts—i.e., there is some realistic vision of the range of historic variability or condition

Restoration of forest health being the stated goal, low impact extraction methods should be employed. This means strategies and equipment to mitigate snag habitat loss, soil compaction, run-off, and inclusion of wash stations to reduce noxious weed infestations from equipment, and re-seeding with native flora to prevent colonization or spread of exotics.

These methods will be more expensive than standard timber harvest operations and compensation will be small due to the small diameter of extracted trees. Agee et al. (2000:1-12) observed, "...fuel fragmentation does not have to be associated with structural fragmentation or overstory removal, but must be associated with reduction of surface fuels and increases in height to live crowns." It should be noted that costs endured today in the name of forest health are the cost of yesterday's and tomorrow's profits.

At the landscape level "anchor habitats" (Naugle 2002) should be identified, preserved, and incorporated into a landscape based forest restoration goal. "Anchor habitats" may consist of intact old-growth stands, watersheds, or riparian areas. Treatments focused on surrounding areas could increase ecological integrity and identify "critical thresholds" potentially connecting a system of healthy forests.

Nested within the benefits of limiting selected treatment areas to the WUI lies--the opportunity for adaptive management ecologically and sociologically. Adaptive management and risk assessments are both fundamental principals of the current ecosystem management paradigm, which currently guides land management agencies. The call for a better understanding, increased use, and the development of tools for risk assessments and adaptive management principals has been sounded by scientists for some time (e.g., Thomas et al. 1990, FEMAT 1993, Thomas 1997, Wear et al.1996, Fitzgerald 2002), GAO 1994, and Reynolds et al 1999). In addition to the described need for better tools to aid in land management decisions, risk assessments, and adaptive management, many models have been offered, attempting to capture the critical mechanisms of sustainable ecosystem management. These models include, but are not limited to, Mullner et al. (2001), Norton & Steinman (2001), and Hayes et al (1996). While differing slightly in prescribed mechanisms, there are commonalities among these models.

In addition to the disproportionate social/political/ecological benefits offered by focusing treatments on the WUI, there are a suite of reasons why other treatment areas should be avoided, at least initially. All high severity fire regime habitats and a large portion of mixed severity habitats have not yet missed a full fire return cycle and thus impacts of treatments may out-weigh the benefits of FHRA treatments. Concomitantly, these fire regimes produce complex spatial patterns across the landscape that are poorly understood and impossible to reproduce via thinning and prescribed fire (Agee 1996, 1998). These areas are at much higher risk from impacts resulting from treatments and these impacts may be more ecologically degrading than wildfire.

CONCLUSION

Perhaps the current situation related to wildfire and the forest health dilemma should be viewed in the broader sense of sustainability wherein ecologic, sociologic and economic factors converge, and where society identifies what forest outputs should be. The current management approach on federal lands is unlikely to be sustainable due to biomass accumulating at a rate faster than humans or nature can remove it. Without action forest health conditions can be expected to deteriorate, resulting in more and more high-severity wildfires. With associated damage to life, property, watersheds, wildlife habitat, timber, and other resources. The aftermath of this circumstance requires great and increasing expenditures for ecologic and sociologic rehabilitation. In contrast, active management undertaken with the objective of restoring forest health and reducing wildfire severity has a greater likelihood of effectively addressing problems and promoting sustainable forest management. Active management will not eliminate fire--nor should it. But ecosystems that are better able to survive fire will continue to produce the ecological, sociological and economic goods people have come to expect. Prevention of damage to ecosystem function through treatment is likely to incur less social, economic, and ecological cost than would rehabilitation. The question then, is, does the FHRA adequately address these needs in a socially and ecologically acceptable manner?

Forest "health" restoration on some level is widely accepted. Appropriate response is confounded by diverse expectations of forest outputs, varied definitions of what constitutes forest health, commercial factors, inter-agency and policy conflicts, budgetary limitations, public aesthetic preferences, and the entrenchment of opposing traditions—"wise use" versus preservation." In light of increasing numbers of threatened and endangered species, declining old-growth forests, the needs of local communities, and finite resources, an integrated strategic approach which limits unintended environmental consequences while considering the socio-economic needs of communities is needed.

There is much to be learned about forested ecosystems and the role that thinning and prescribed fire can play in restoring those systems. Regardless of approaches employed by managers all seem to be controversial with at least some portion of the public. That is why it will be critical not to limit citizens' voice in FHRA projects. With citizen involvement and thoughtful application of management tools, it will be important that FHRA treatments occur where success will be the greatest and chances for unintended sociologic and ecologic consequences the lowest. Basic guidelines for selecting FHRA projects should include:

- Focus on low-elevation, dry forest types;
- Concentrating initially, exclusively on the urban interface;
- Using techniques which will have minimal effects on soil;
- Use precautions to prevent infestation and spread of non-native species;
- Leaving most large trees and providing for future recruitment of old-growth;
- Protecting roadless areas minimizing construction of new roads;
- Having crews, equipment, and precautions in place when conducting controlled burns to minimize chances escape;
- Treating slash and other fuel generated by thinning to reduce threat of future surface fires.

- Learning from monitoring and employing adaptive management principles;

Given the breadth of the definition of eligible treatment areas and associated variation of ecological and sociological impacts proposed in the FHRA and the large amount of public scrutiny it has received, it is important to define the desired future conditions of treatment areas as well as providing a more limited definition of eligible treatment areas. In its current form there is likely to be much social backlash and litigation. Though the FHRA attempts to answer several pressing forest management questions, it needs to be further scrutinized and refined before becoming law.

There are no quick fixes to the "forest health crisis". Addressing the reality of failing governing systems, and incorporating new ecological and sociological insights gathered over a century will be arduous. Success is not guaranteed. The application of risk assessment, adaptive management, and an honest and complete response to information garnered, appears to be the best place to start. Alternatively, quick fixes, such as the FHRA may well lead to exacerbation of the problems at hand thereby setting off a vicious cycle of new problems and quick fixes.

This traditional, reactionary "quick fix mentality" has brought us to our current space-time location in federal land management with its inherent ecologic and sociologic paradoxes. We should no longer nor can we afford to suffer amnesia. A more honest approach would be to address the need to treat fuels in the WUI, identifying priority treatment areas through public involvement and adaptive management and, then to separately asses and address "forest health" problems in the general forest environment. The FHRA in its current form tries to do too much too fast, possibly at expense of ecological and sociological values.

This analysis identified a starting point for cognition and application relating to FHRA treatments to begin this evolution toward a socially and ecologically sustainable set of forest health restoration goals and mechanisms. It is critical that this evolution take place, as ecological and sociologic balance must be achieved for the long-term survival of our increasing population. The fate of forests, natural resources in general, and humankind a hundred years from now and forevermore, will depend on the intelligence, motivation, and caring of people alive today.

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