DEPARTMENT OF AGRICULTURE

Forest Service

Protecting People and Sustaining Resources in Fire-Adapted Ecosystems—A Cohesive Strategy

AGENCY: Forest Service, USDA.

ACTION: Notice.

SUMMARY: The Forest Service is adopting a cohesive strategy for fire management and forest health programs. The full text of the report, *Protecting People and Sustaining Resources in Fire-Adapted Ecosystems—A Cohesive Strategy*, is set out at the end of this notice. This report responds to direction from Congress and the President to provide a strategic plan to reduce wildland fire risk, protect communities, and restore and maintain forest ecosystem health in the interior West. The report also responds to findings and recommendations in a recent General Acounting Office report, and it provides a strategic framework for reducing hazardous fuels buildup as addressed in the September 8 report to the President by the Secretaries of Agriculture and the Interior, *Managing the Impacts of Wildfires on Communities and the Environment.*

ADDRESSES: Copies of the cohesive strategy report and related materials are available electronically from the Forest Service World Wide Web/Internet home page at *http://www.fs.fed.us/.* Paper copies of the report also may be obtained by writing to Director, Fire and Aviation Management Staff, 2nd Floor-SW, Sidney R. Yates Federal Building (Mail Stop 1107), Forest Service, USDA, P.O. Box 96090, Washington, D.C. 20090–6090.

FOR FURTHER INFORMATION CONTACT: Mark Beighley, Fire and Aviation Management Staff, (202) 205–0888.

SUPPLEMENTARY INFORMATION: During the 2000 fire season more than 6.8 million acres of public and private lands had burned as of early October—more than twice the 10-year national average. The magnitude of these fires is the result of two primary factors: a severe drought, accompanied by a series of storms that produced thousands of lightning strikes followed by windy conditions; and the long-term effects of almost a century of suppressing all wildfires that has led to a buildup of brush and small trees in the nation's forests and rangelands.

On August 8, 2000, the President directed the Secretaries of Agriculture and the Interior to prepare a report recommending how best to respond to this year's severe fires, reduce the impacts of those fires on rural communities, and ensure sufficient firefighting resources in the future. On September 8, 2000, the President accepted their report, *Managing Impacts of Wildfires on Communities and the Environment*, which provides an overall framework for forest health and fire management.

Subsequently, the Forest Service issued the report entitled, *Protecting People and Sustaining Resources in Fire-Adapted Ecosystems—A Cohesive Strategy*, which is set out in its entirety, with the exception of certain illustrations which could not be printed in the **Federal Register**, in this notice. This report provides the strategic framework for reducing hazardous fuels buildup within wildland—urban interface communities, readily accessible municipal watersheds, threatened and endangered species habitat, and other impotant local features. The Chief of the Forest Service signed the cohesive strategy report on October 13, and it was released to agency managers on October 17.

The report responds to Congressional direction to provide a strategic plan to reduce wildland fire risk and restore forest ecosystem health in the interior West. The report is set out at the end of this notice as directed by Title IV of the fiscal year 2001 appropriations act for Interior and related agencies (Public Law 106–291). As further directed by the act, the agency also has reviewed other policies and rulemakings currently in development for consistency with the cohesive strategy, including proposed rules and policies for the National Forest System road management and transportation system (65 FR 11675, March 3, 2000) and roadless area conservation (65 FR 30276, May 10, 2000); and the Interior Columbia Basin Supplemental Draft Environmental Impact Statement and the Sierra Nevada Framework/Sierra Nevada Forest Plan Draft Environmental Impact Statement. This report also responds to the General Acounting Office report, *Western National Forests: A Cohesive Stratgey Is Needed To Address Catastrophic Wildfire Threats* (GAO/RCED–99–65).

This cohesive strategy addresses the restoration and maintenance of ecosystem health in fire-adapted ecosystems for priority areas, with emphasis on the interior West. The focus of the strategy is on protecting communities at risk and restoring ecosytems that evolved with frequently occurring, low-intensity fire. Many of these forests and rangelands have grown out of balance due in part to past management practices and decades of fire suppression. The strategy identifies restoration priorities in fire dependent ecosystems for urban-wildland interface areas, threatened and endangered species habitat, and readily accessible municipal watersheds.

Dated: November 1, 2000.

Mike Dombeck,

Chief.

Protecting People and Sustaining Resources in Fire-Adapted Ecosystems—A Cohesive Strategy

The Forest Service Management Response to the General Accounting Office Report, GAO/RCED–99–65,

October 13, 2000.

Submitted by: Lyle Laverty, Report Team Leader, Rocky Mountain Region Regional Forester; and Jerry Williams, Report Team Co-Leader, Northern Region Director Fire Management

Approved by: Mike Dombeck, Chief of the Forest Service

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Resilience and the Effects of Restoration Treatments in Fire-Prone Forests

Note: The photograph mentioned below is not printed in the **Federal Register**. It is available as indicated in the **ADDRESSES** section at the beginning of this notice.

This photograph illustrates how a treated forest—the green strip running toward the crest of the ridge in the photo's center—can survive a severe wildland fire. It also shows the differences in resilience between treated and untreated forests. The untreated forest—the blackened areas located on either side of this green strip—burned in the Wenatchee National Forest's 1994 Tyee Fire.

In this example, treatment was in the form of a ''shaded fuel break'' (area of green trees in above photo) established several years before. The purpose of these shaded fuel breaks—located in tactically important areas—is to provide firefighters an anchor from which to safely fight fire. The shaded fuel break (pictured) left older-age trees overhead and thinned out the smaller trees beneath them—removing surface fuels to reduce potential fire intensities.

On the Tyee Fire, extreme conditions that included high winds and rapid fire growth, precluded safe attack. No suppression actions were therefore taken in this area. Nevertheless, because the fuels had been reduced and fire intensities did not burn hot enough to kill all of the older trees, much of the treated forest survived the fire—even without the efforts of firefighters.

The cohesive strategy described in this report attempts to achieve improved forest and grassland resilience—as illustrated in this Tyee Fire photo. The strategy provides an approach to reduce fuel loadings in fire-prone forests to protect people and sustain resources.

Executive Summary

Premise

This strategy is based on the premise that sustainable resources are predicated on healthy, resilient ecosystems. In fire-adapted ecosystems, some measure of fire use—at appropriate intensity, frequency, and time of year—should be included in management strategies intended to protect and sustain watersheds, species, and other natural resources over the long term.

The strategy is also based on the premise that, within fire-adapted ecosystems, fire-maintained forests and grasslands are inherently safer for firefighters and the public than ecosystems in which fire is excluded.

Purpose

The strategy establishes a framework that restores and maintains ecosystem health in fire-adapted ecosystems for priority areas across the interior West. In accomplishing this, it is intended to:

- Improve the resilience and sustainability of forests and grasslands at risk,
- Conserve priority watersheds, species and biodiversity,
- Reduce wildland fire costs, losses, and damages, and
- Better ensure public and firefighter safety.

Priorities

Wildland-urban interface. Wildland-urban interface areas include those areas where flammable wildland fuels are adjacent to homes and communities.

Readily accessible municipal watersheds. Water is the most critical resource in many western states. Watersheds impacted by uncharacteristic wildfire effects are less resilient to disturbance and unable to recover as quickly as those that remain within the range of ecological conditions characteristic of the fire regime under which they developed.

Threatened and endangered species habitat. The extent of recent fires demonstrates that in fire-adapted ecosystems few areas are isolated from wildfire. Dwindling habitat for many threatened and endangered species will eventually be impacted by wildland fire. The severity and extent of fire could eventually push declining populations beyond recovery.

Maintenance of existing low risk Condition Class 1 areas. This is especially important in the southern and eastern states where high rates of vegetation growth can eliminate the effects of treatment in 5–10 years. Recent droughts have caused severe wildland fire problems in Florida and Texas.

Elements

For the purposes of this report, the following are used as the elements of a cohesive strategy:

- Institutional Objectives and Priorities
- Program Management Budgets and Authorities
- Social Awareness and Support

The strategy is based on the alignment of these institutional, program management, and constituency elements. The cohesion of this strategy stands on the collective strength of these three core elements.

Within the Forest Service, ecosystem management concepts continue to evolve into practice. This report describes a cohesive set of actions from which the Forest Service may choose to initiate restoration and maintenance objectives within fire-adapted ecosystems.

I. Purpose and Intent of a Cohesive Strategy

''The most extensive and serious problem related to the health of national forests in the interior West is the over-accumulation of vegetation.''—General Accounting Office Report (99–65)

Preface

The 2000 fire season was undoubtedly one of the most challenging on record. As of early October, more than 6.8 million acres of public and private lands burned—more than twice the 10-year national average. The magnitude of these fires is the result of two primary factors: A severe drought, accompanied by a series of storms that produced thousands of lightning strikes followed by windy conditions; and the long-term effects of almost a century of aggressively suppressing all wildfires that has led to an unnatural buildup of brush and small trees in our forests and rangelands.

On August 8, 2000, President Clinton asked Secretaries Babbitt and Glickman to prepare a report that recommends how best to respond to this year's severe fires, reduce the impacts of those fires on rural communities, and ensure sufficient firefighting resources in the future. On September 8, 2000, President Clinton accepted their report *Managing Impacts of Wildfires on Communities and the Environment.*

Operating principles directed by The Chief of the Forest Service in implementing this report include:

Firefighting Readiness. Increase firefighting capability and capacity for initial attack, extended attack, and large fire support that will reduce the number of small fires becoming large, to better protect natural resources, to reduce the threat to adjacent communities, and reduce the cost of large fire suppression.

Prevention Through Education. Assist state and local partners to take actions to reduce fire risk to homes and private property through programs such as FIREWISE.

Rehabilitation. Focus rehabilitation efforts on restoring watershed function, including the protection of basic soil, water resources, biological communities, and prevention of invasive species.

Hazardous Fuel Reduction. Assign highest priority for hazardous fuels reduction to communities at risk, readily accessible municipal watersheds, threatened and endangered species habitat, and other important local features, where conditions favor uncharacteristically intense fires.

Restoration. Restore healthy, diverse, and resilient ecological systems to minimize uncharacteristically intense fires on a priority watershed basis. Methods will include removal of excessive vegetation and dead fuels through thinning, prescribed fire, and other treatment methods.

Collaborative Stewardship. Focus on achieving the desired future condition on the land in collaboration with communities, interest groups, and state and federal agencies. Streamline process, maximize effectiveness, use an ecologically conservative approach, and minimize controversy in accomplishing restoration projects.

Monitoring. Monitor to evaluate the effectiveness of various treatments to reduce unnaturally intense fires while restoring forest ecosystem health and watershed function.

Jobs. Encourage new stewardship industries and collaborate with local people, volunteers, Youth Conservation Corps members, service organizations, and Forest Service work crews, as appropriate.

Applied Research and Technology Transfer. Focus research on the long-term effectiveness of different restoration and rehabilitation methods to determine those methods most effective in protecting and restoring watershed function and forest health. Seek new uses and markets for byproducts of restoration.

Managing Impacts of Wildfires on Communities and the Environment provides an overall framework for implementing fire management and forest health programs. This report provides the strategic framework for reducing hazardous fuels buildup within wildland-urban interface communities, readily accessible municipal watersheds, threatened and endangered species habitat, and other important local features. The objective of this strategy is to describe actions that could restore healthy, diverse, and resilient ecological systems to minimize the potential for uncharacteristically intense fires on a priority basis. Methods will include removal of excessive vegetation and dead fuels through thinning, prescribed fire, and other treatment methods.

This report is based on Forest Service experience and analysis. It also responds to Congressional direction to provide a strategic plan to reduce wildland fire risk and restore forest ecosystem health in the interior West. It reflects the findings of the U.S. General Accounting Office (GAO) Report, *Western National Forests: A Cohesive Strategy is Needed to Address Catastrophic Wildland fire Threats* (GAO/RCED–99–65).

The General Accounting Office report concludes, ''The most extensive and serious problem related to the health of national forests in the interior West is the over-accumulation of vegetation.'' The General Accounting Office estimated that the over-accumulation of fuels problem affects approximately 39 million acres in the interior West.

The Chief of the Forest Service chartered the strategy outlined in this report. The National Association of State Foresters and the U.S. Department of the Interior participated with the Forest Service in developing this report.

It is important to note that this is an iterative strategy. It will be refined by: further programmatic and manual direction; ongoing roadless, roads, and planning rulemakings; and environmental impact statements and decision documents for the national grasslands and ongoing regional initiatives.

At the national level the strategy articulates:

- Agency-wide objectives and milestones.
- Geographic priorities, broad management guidance, and performance measures for accountability.
- Alternative schedules to accomplish restoration and maintenance objectives over various timeframes.

Separate action plans, consistent with the strategy and regional assessments and direction, and ongoing national rulemakings, will outline implementation steps at the organization's regional, forest, and ranger district levels.

The acreage and cost estimate numbers used in this report are preliminary and derived from coarse-scale assessments. Further refinement and analysis will initiate appropriate adjustment in the strategy and will occur as more site-specific assessments are completed.

Focus

The focus of this strategy is on restoring ecosystems that evolved with frequently occurring, low intensity fires. These fires typically occurred at intervals of between 1 to 35 years and served to reduce growth of brush and other understory vegetation while generally leaving larger, older trees intact.

Fire suppression activities and some past management practices over the past 100 years have excluded fire from many of these fire-adapted ecosystems. In the absence of fire, many of these lands have become subject to an over-accumulation of shrubs and small trees, diminishing ecosystem diversity, health, and resiliency and fueling conditions for unnaturally intense fires that threaten communities, air, soil, water quality, and plant and animal species.

Premise

This strategy outlines approaches to protect communities and restore and maintain land health in fire-adapted ecosystems across the interior West. The report is based on the premise that sustainable resources depend on healthy, properly functioning, resilient ecosystems.

Within fire-adapted ecosystems, fire-maintained forests and grasslands are inherently safer for firefighters and the public than ecosystems in which fire is excluded.

In fire-adapted ecosystems, some measure of fire use—at the appropriate intensity, frequency, and time of year—should be an essential component of management strategies intended to protect and sustain watersheds, species, and other natural resources over the long term.

Purpose

The strategy outlines approaches to restore and maintain land health in fire-adapted ecosystems across the interior West. In accomplishing this, it is intended to:

- Improve the resilience and sustainability of forests and grasslands at risk,
- Conserve priority watersheds, species and biodiversity,
- Reduce wildland fire costs, losses, and damages, and
- Better ensure public and firefighter safety.

Priorities

• Wildland-urban interface. Wildland-urban interface areas include those areas where flammable wildland fuels are adjacent to homes and communities.

• Readily accessible municipal watersheds. Water is the most critical resource in many western states. Watersheds impacted by uncharacteristic wildfire effects are less resilient to disturbance and unable to recover as quickly as those that remain within the range of ecological conditions characteristic of the fire regime under which they developed.

• Threatened and endangered species habitat. The extent of recent fires demonstrates that in fire-adapted ecosystems few areas are isolated from wildfire. Dwindling habitat for many threatened and endangered species will eventually be impacted by wildland fire. The severity and extent of fire could eventually push declining populations beyond recovery.

• Maintenance of existing low risk Condition Class 1 areas. This is especially important in the southern and eastern states where high rates of vegetation growth can eliminate the effects of treatment in 5–10 years. Recent droughts have caused severe wildland fire problems in Florida and Texas.

Present Situation

Most forests and grasslands in the interior West and their associated species are fire-adapted. Some, known as ''short interval'' fire-adapted ecosystems, evolved from frequent, low-intensity fires that burned surface fuels. These fires recycled nutrients, checked encroachment of competing vegetation, and maintained healthy conditions (see below in top picture).

Generally, the prolonged absence of low-intensity burning in these ecosystems creates a surface fuel buildup and an over-accumulation of small trees and brush that makes forests more susceptible to insect infestations, disease outbreaks, and severe wildland fires.

Before the turn of the last century, livestock grazing, selective logging, and curtailment of burning by Native Americans began to alter the composition, structure, and function of these fire-adapted forest ecosystems. As a result of human influences, fire-intolerant species replaced fire-tolerant species. Forest stands that typically grew 50 larger fire-tolerant trees per acre became encroached with more than 600 mostly small, fire-intolerant trees per acre. Without recurring underburns, seedlings filled in beneath the older trees—transforming open park-like forests into dense forests.

Expanded human development, changes in climate, and fire suppression have contributed to substantial accumulations of understory vegetation. This over-accumulated vegetation predisposes some areas to severe wildland fires, potentially leaving watersheds, species, and people at risk.

Today, primarily as a result of prolonged fire exclusion, many of the most serious wildland fire threats and forest ecosystem health issues are concentrated within fire-adapted ecosystems that evolved with frequent, low-intensity fires.

The Strategy

This report outlines a strategy to reduce wildland fire threats and restore forest ecosystem health in the interior West. The strategy builds on the premise that within fire-adapted ecosystems, reducing fuel levels and using fire at appropriate intensities, frequencies, and time of year are key to: Restoring healthy, resilient conditions; sustaining natural resources; and protecting people.

The strategy introduces institutional objectives, establishes program management priorities and cost estimates, and confirms the importance of expanding constituency support. The strategy's success stands on the cohesion and collective strength of these elements.

The strategy places a high priority on treating areas where human communities, watersheds, or species are at risk from severe wildfire. It relies on a variety of treatment options to achieve restoration objectives in wildland-urban interface areas, readily accessible municipal watersheds, and habitats of threatened and endangered species. Immediate treatment efforts would be concentrated in the shorter interval fire-adapted ecosystems. These priority ecosystems are farthest outside the historic range of variability and are in close proximity to human communities.

Strategy—Ties to Ongoing Planning and Rulemaking Efforts

First, the strategy meets the requirements of the Forest Service Government Performance and Results Act (GPRA) Strategic Plan (2000 revision) by establishing objectives, milestones, and performance elements for ecosystem restoration and maintenance, and conservation education.

Second, few wildland-urban interface areas are adjacent to inventoried roadless areas making roadless areas a lower priority for treatment. More over, all of the alternatives currently under consideration in the roadless initiative allow for the construction of roads to suppress fire where public health and safety are at risk.

Third, the ongoing roads policy will ensure that operational decisions relative to implementation—such as which roads should be left open or maintained to enhance firefighting or other fire management activities—are made locally through cooperative planning.

Finally, efforts to revise management plans governing the national forests and grasslands and the Columbia River Basin and Sierra Nevada ecosystems will integrate fire management with other agency multiple-use objectives. This strategy will be refined and adapted to ensure consistency with the outcomes of these regional conservation efforts.

Strategy—How Much Treatment Is Needed?

The strategy does not require that every high, medium or low risk acre be treated, nor does it eliminate all risks. By strategically identifying fuel treatment areas to protect values associated with human communities, municipal watersheds and critical species habitat, the damaging effects of wildland fire can be effectively minimized.

Due to other agency priorities and funding constraints, historic efforts to reduce fire risk often focused treatment efforts on areas that posed the least risk to communities. The result: areas where treatments could be implemented at the least cost often took priority over other areas with higher costs.

The purpose of this report is to establish priorities for treatment. The strategy will be refined as hazardous fuels reduction and restoration priorities are considered in local, regional and national planning efforts.

Strategy—Focus on High-Risk Areas

The strategy focuses treatment on high-risk areas, rather than least-cost acres. Existing roads will be used to access high-risk areas. Where roads are scheduled for closure, consideration will be given to accomplishing ecosystem restoration objectives prior to closure.

While emphasizing *restoration* in the interior West, the strategy also supports ongoing efforts to *maintain* healthy ecosystems where they currently exist. For example, in the South, fuels can rapidly accumulate to dangerous levels in the absence of treatment. The Forest

Service must therefore continue treating these areas.

Fuel reduction treatment techniques will range from maintenance prescribed burning, where fire is used to maintain forest conditions in lower-risk acres, to restoration treatments in higher-risk areas where mechanical thinning is followed by prescribed burning. Forest planning and collaboration with states, local governments, tribes and the public will determine the number of acres to be treated and where and how the treatment will occur.

The first priority for restoration will be the millions of acres of already roaded and managed landscapes that are in close proximity to communities. Extensive use of service contracts will provide local jobs and accomplish land management objectives while helping to protect people and property.

In order to maximize effectiveness and minimize controversy, mechanical treatments will be prioritized toward wildland-urban interface areas within already roaded and managed portions of the landscape. Under this strategy, ecologically sensitive areas, such as old growth and late successional forests, will be avoided. In some areas, where old growth characteristics are threatened by the risk of uncharacteristic wildfire effects, the agency may conduct fuel treatments designed to protect older, larger trees while reducing unnatural buildups of understory vegetation.

Better integration of existing program budgets could reduce the amount of money requested. In most cases, any receipts associated with treatments will not be significant due to the need to reduce the disproportionately large number of small, non-merchantable trees, brush, and shrubs that dominate short interval fire-adapted ecosystems and leave standing the larger, fire-tolerant trees.

Strategy—Complements Other Efforts

The strategy complements other work, including efforts to protect roadless areas and to better manage the existing road system. For example, in most places roadless areas are often less affected by past management practices and found at higher elevations with vegetation that evolved with longer fire return intervals. Furthermore, roadless areas are typically removed from human communities. Thus, fires in these areas may pose less of a threat to lives and property. The proposed road policy would require that issues such as the need for hazardous fuels treatments be considered prior to making decisions about road decommissioning, upgrading, or new construction.

The strategy also builds on the Joint Fire Sciences Program. It relies on adaptive management, monitoring, research, and the further integration of social sciences. It encourages development of procedures that bring together and overlay agency objectives for watershed protection, species conservation, ecosystem resilience, and public safety.

Research is needed to support restoration. The need for assertive action must be coupled with prudence and caution to minimize unintended consequences. Additional research is needed to support managers in prescribing land management treatments to improve forest ecosystem health, as well as to find ways to increase utilization of small diameter material.

The Consequences of Deferral

The costs of implementing the restoration and maintenance approaches outlined under this strategy are high. Yet, fire suppression costs, public resource losses, private property losses, and environmental damages accruing without treatment are expected to be significantly greater over time.

Successful Restoration and Maintenance Efforts

The optimum method to ensure success in restoring ecosystems is collaborating with the local public in planning efforts. Regional planning, including stakeholders in identifying and assessing values at risk, is an important component of the strategy. The Sierra Nevada Ecosystem Management Project and the Interior Columbia River Basin Management Project are examples of regional-scale planning that address resources at risk and establish priorities for broad geographic areas.

More localized planning processes, including Land and Resource Management Plan (forest plan) revisions and amendments, will integrate specific concerns and priorities at a watershed or landscape scale within the context of regional plans and the Forest Service GPRA Strategic Plan.

Across the nation, awareness is growing about the fire-related consequences that occur in untreated forests and grasslands prone to wildland fire. The following are two examples of citizen-based efforts that have been developed to reduce risks within the interior West's urban interface:

- The Grand Canyon Forests Partnership (joining Arizona Game and Fish, U.S. Fish and Wildlife Service, Arizona State Land Department, Coconino County, City of Flagstaff, Northern Arizona University, Grand Canyon Trust and the Nature Conservancy);
- The Priest-Pend Oreille Stewardship Project that focuses on 7,200 acres of wildland-urban interface lands in the Idaho Panhandle National Forest (joining two community project teams with the Forest Service).

To improve forest ecosystem health and reduce wildland fire risks at larger scales, action needs to be expanded over broader areas and coordinated among Forest Service research, state and private forestry, and National Forest System programs. Restoration and maintenance of fire-adapted ecosystems depends on:

- Understanding and valuing ecological processes as the means to sustain ecosystem health.
- An ability to evaluate options and weigh decisions for long-term outcomes.
- An understanding and acceptance of the tools needed to accomplish restoration goals.
- A commitment to monitoring, evaluation, and research as the basis for adaptive management.
- Working collaboratively with communities and interested parties to build project plans with broad-based local ownership.

Successful implementation of the approach outlined in this strategy requires strong support from Congress and constituents. It must also be recognized that success will depend on applying a combination of traditional and newly developed methods and knowledge.

II. Background, Land Use History and Ecological Change

Background

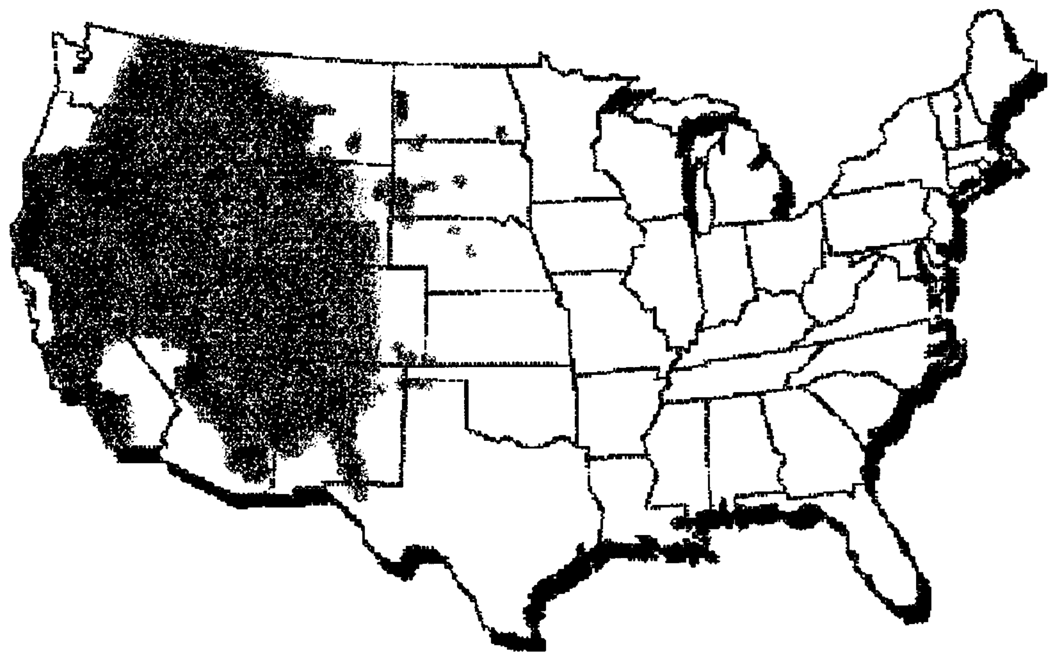

Figure 1—General Affected Area Within the Western United States

Approximately 134 million acres, or about 70 percent of National Forest System lands are in the western U.S. The area is a fire-influenced environment. For thousands of years, the magnitude of burning that occurred in this area was much greater than today. In the upper Columbia River Basin alone—a small portion of the interior West—scientific assessments indicate that prior to European settlement, more than six million acres per year burned. Today, fewer than one-half million acres burn per year in this same area.

Nearly all forests and grasslands in this region evolved and adapted as a result of widespread fire from lightning and burning by Native Americans. These adaptations enabled plant species to survive and regenerate in the presence of fire. Some interior West ecosystems depend on frequently recurring, low-intensity surface burns to cycle nutrients, control pathogens, and maintain healthy, resilient conditions.

These are called ''short interval'' fire-adapted ecosystems. Before the turn of the century, these forested ecosystems were often described as open and savannah or ''park-like,'' with well-spaced, older-aged trees. Grasses and forbs dominated the understories of these forest communities. They were kept in this condition by frequent, low-intensity fires that swept the forest floor.

Land Use History

Many of the wildland fire threats and forest ecosystem health issues that confront us today were triggered more than 100 years ago. In the late 1800s and early 1900s, ''high grade'' logging selectively removed the largest, most valuable trees—often the fire-tolerant ponderosa and other long-needle pine species.

Slash and other brush left behind from logging practices of this era posed tremendous fire risks and contributed to devastating fires in the Great Lakes states and elsewhere. In later years, fire exclusion from plantations of uniform trees of the same age class created conditions conducive to insect and disease infestation and subsequent fires. In later years, logging and other management practices may have further compromised land health by removing overstory trees while leaving smaller trees, slash, and other highly flammable fine fuels behind.

Across open landscapes, early livestock grazing also reduced grass cover and scarified the soil. In forested areas, the bare soil seedbeds that resulted from logging and intensive grazing allowed hundreds of trees to establish on each acre. Without grass fuels to carry surface fires, the number of trees (including fire-intolerant species) multiplied rapidly. These became dense tree stands that foresters termed ''dog-hair'' thickets. Elsewhere, grasslands often converted to brushlands and woodlands.

In the West, the notion of forest protection has historically been equated with fire exclusion. Thus, a primary function of the Forest Service's overall mission became forest fire suppression.

Ecological Change

The unintended consequences of logging, livestock grazing, and fire control resulted in significant changes to species composition and structure—especially in short interval fire-adapted ecosystems. These changes, in turn, predisposed extensive areas to many of today's wildland fire and forest ecosystem health problems in the interior West.

The following photos (figures 2–3), from the Bitterroot National Forest in western Montana, illustrate the changes that have occurred in species composition and forest structure over a 111-year period in a short interval fire-adapted ponderosa pine forest ecosystem. Each photo was taken from the same place, looking at the same forest, at different periods in time. The photos capture the differences that have developed in species composition and forest structure in the prolonged absence of periodic surface burning. Within these ecosystems, these changes become indicators of potential risk.

Changes in Species Composition and Forest Structure

Note: Figures 2 and 3 are not printed in the **Federal Register**. They are available as indicated in the ADDRESSES section at the beginning of this notice.

Figure 2—Bitterroot National Forest 1871 Photo

1871 Photo

This serves as the baseline reference of forest stand conditions that evolved from regularly occurring, low-intensity surface burning. The forest was open and dominated by fire-tolerant, fire-adapted ponderosa pine.

Figure 3—Bitterroot National Forest 1982 Photo

1982 Photo

By 1982, the forest has changed dramatically from the one that existed here in 1871. Over this 111-year period, small trees have established in dense thickets and fire-intolerant tree species now crowd the forest. During drought periods the overabundance of vegetation stresses the site, predisposing the forest to insect infestations, disease outbreaks, and severe wildland fire.

In the prolonged absence of periodic surface burning, vegetative growth compounds and dead fuels accumulate. Within the forest, this biomass—in the form of multi-layered tree canopies—can carry flames from the surface where dead branchwood burns up into the tree crowns. In drought years, when vegetation dries, these ''ladder fuels'' contribute to severe, high-intensity wildland fires.

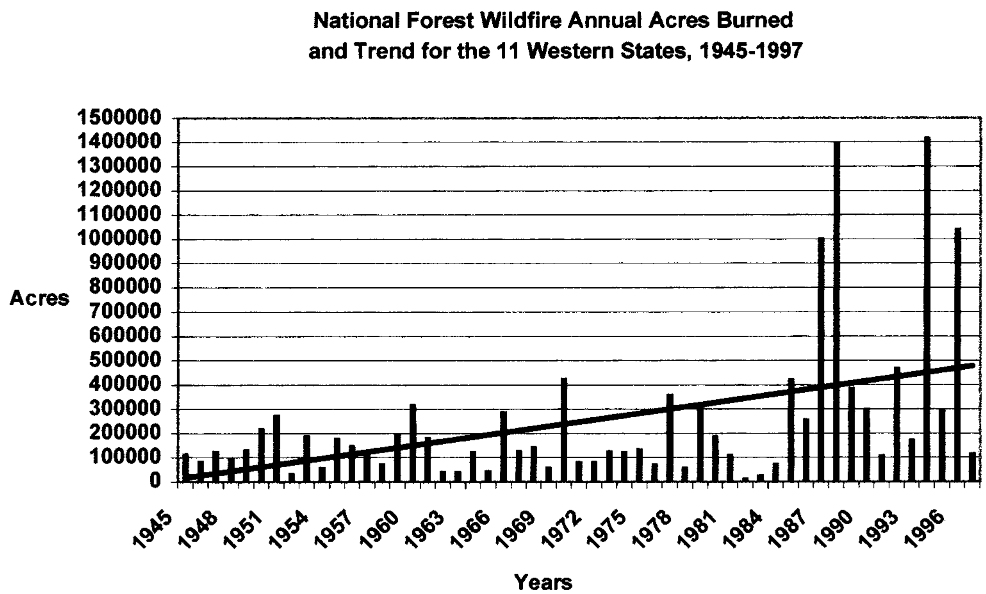

Figure 4—National Forest Wildland Fire Acres Burned Trend in 11 Western States

Under these conditions, wildland fires exceed nearly all control efforts and often result in long-lasting damage to the soil and to the watershed.

In 1871, practically all of the short interval fire-adapted ecosystems in the interior West were considered to be relatively low risk. They were typically open and because of frequent fire had little fuel accumulation. By 1982, the situation had reversed. This elevated risk is apparent when evaluated in the context of Western wildland fire trends (Figure 4). Since approximately 1987—despite better firefighting capabilities—the change in fuel conditions has resulted in an increase in wildland fire acres burned.

For the purpose of this strategy, risk conditions are assigned ''condition class'' descriptors. In short interval fire-adapted ecosystems, Condition Class 1 [for a complete definition, see Appendix *A The Coarse-Scale Assessment and Definition of Fire Regimes and Fire Classes]* (which corresponds to the 1871 Bitterroot N.F. photo) represents low relative risk. As Figure 2 indicates, the Condition Class 1 trend has few small trees and little ground fuel. The scarcity of fuel tends to limit the intensity of wildland fires. At low intensities, wildland fires typically do not kill the larger fire-tolerant trees but often consume small encroaching trees, other vegetation, and dead fuels.

At low intensities, fire is ecologically beneficial because nutrients are cycled. In addition, the soil's organic layer is not consumed at these low fire intensities. The remaining organic material stabilizes the soil surface and helps prevent erosion.

Because fires in Condition Class 1 areas are low-intensity within these ecosystems, they leave the soil intact and functioning normally. These fires generally pose little risk and have positive effects to biodiversity, soil productivity, and water quality.

Note: Figures 5 through 7 are not printed in the **Federal Register**. They are available as indicated in the ADDRESSES section at the beginning of this notice.

Figure 5—Increased Density of Smaller Trees Provides Fuel for Vertical Fire Spread

Condition Class 2 situations develop as one or more fire return intervals are missed, primarily due to well-intentioned suppression efforts, while understory vegetation continues to grow, becoming denser. If this accumulating vegetation is not treated, fires begin to burn more intense—making them more difficult to suppress. The impact of fires to biodiversity, soil productivity and water quality become more pronounced.

In Condition Class 3 areas within these same ecosystems, fires are relatively high risk. As Figure 5 indicates, the forest is littered with considerable amounts of dead material and is choked with hundreds of small trees that reach into the crowns of the larger, older-age forest above. During drought years, small trees and other vegetation dry out and burn along with the dead material—fueling severe, high intensity wildland fires. At these intensities, wildland fires kill all of the trees—even the large ones that, at lower fire intensities, would normally survive.

Within Condition Class 3 in these short interval fire-adapted ecosystems, wildland fires usually damage key ecosystem components, including the soil. High-intensity fires consume the soil's organic layer and burn off or volatilize nutrients. When small twigs, pine needles, and other litter are consumed, water runs unimpeded over the surface. Under these circumstances, the soil becomes more susceptible to erosion (Figure 6).

Figure 6—Buffalo Creek Fire, Colorado

These photos, of Colorado's Buffalo Creek Fire aftermath, illustrate soil severity burned and left exposed to rain and runoff. This produced the subsequent 1996 flash flood that claimed two lives. The ensuing erosion also washed topsoil off hillsides, clogging downstream watercourses. This erosion reduced future storage capacity of reservoirs and silted-over the river's gravel beds—significantly reducing spawning habitat.

At extreme fire intensities, the soil's capacity to absorb water is often lost. The fine, powder-like ash that follows a severe wildland fire on these sites makes water bead on the surface. These so-called ''hydrophobic conditions'' result in highly erodable soils.

Condition Class 3 is classified as high risk because of the danger it poses to people and the severe, long-lasting damage likely to result to species and watersheds when a fire burns—particularly in drought years. Firefighters are especially cognizant of hazards in Condition Class 3 situations. In a national survey (Tri-data, 1995), nearly 80% of all firefighters identified fuel reduction as the single-most important factor for improving their margin of safety on wildland fires.

In Condition Class 3, fires become more costly when homes are involved. Throughout much of the interior West, short interval fire-adapted ecosystems are typically located in valley-bottoms where homes and human development are most concentrated. Just as building homes in floodplains exposes homeowners to risk of floods, if hazardous fuels accumulations persist, development in fire-adapted ecosystems may pose a tangible risk to communities.

An example from the 2000 fire season demonstrates the increased costs of fighting fire near people and homes. The Skalkaho Fire on the Bitterroot National Forest covered 64,000 acres of forest interspersed with homes. It employed 755 firefighting personnel at a cost of $7.2 million dollars. Meanwhile, on the same forest within the Selway-Bitterroot Wilderness Area, a fire that burned about the same acreage (63,0000 acres) only required 25 firefighters at a cost of approximately $709,999.

Efforts to reduce hazardous fuels on federal lands must be coupled with efforts to assist private landowners to take preventative action in their own communities. Creating defensible perimeters around homes, improving building codes, and employing fire resistant landscaping will help reduce fire risk to communities. These and other such actions can help prevent wildland fires from burning homes, reduce insurance premiums, and reduce suppression cost.

Figure 7—Homes Burning in the Dude Fire, Arizona, 1990

The Dude Fire burned in central Arizona in Condition Class 3 stand conditions. Although the fire only burned a few days, it resulted in the death of six firefighters and cost $7.5 million to control. It destroyed 75 homes, resulting in property loss of $12 million. No estimate is available on the resource losses involved.

III. Ensuring Clean Air, Clean Water, and Biodiversity in Fire-Adapted Ecosystems

Sustainability: ''Meeting the needs of the current generation without compromising the ability of future generations to meet their needs. Ecological sustainability entails maintaining the composition, structure and processes of a system, as well as species diversity and ecological productivity. The core element of sustainability is that it is future oriented.'' Committee of Scientists Report, 1999.

The Legal Basis for Sustainability

A suite of federal laws and regulations guide management of National Forest System lands and fire-related activities on those lands. These include the Organic Act, Clean Air Act, Clean Water Act, Endangered Species Act, National Environmental Policy Act, and National Forest Management Act. Long-term sustainability is a consistent theme embodied within these laws.

Sustaining natural resources in short interval fire-adapted ecosystems is a basis of the cohesive strategy outlined in this report.

Legal Basis for Sustainability

Endangered Species Act

''The purposes of this Act are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved * * * ''

Clean Water Act

''(a) Restoration and maintenance of chemical, physical and biological integrity of the nation's waters * * * The objective of this chapter is to restore and maintain the chemical, physical, and biological integrity of the nation's waters.''

Clean Air Act

''(1) to protect and enhance the quality of the nation's air resources so as to promote the public health and welfare and the productive capacity of its population.''

National Forest Management Act (NFMA)

''(6) the Forest Service * * * has both a responsibility and an opportunity to be a leader in assuring that the nation maintains a natural resource conservation posture that will meet the requirements of our people in perpetuity.''

National Environmental Protection Act (NEPA)

''(a) Creation and maintenance of conditions under which man and nature can exist in productive harmony.''

The Forest Service Government Performance and Results Act (GPRA) Strategic Plan (2000 revision) bridges law and Forest Service activities. This report's cohesive strategy anchors to the following GPRA Strategic Plan's specific objectives:

- Improve watershed conditions and restore hydrological processes;
- Improve habitat quality; and conserve fish, wildlife and plant populations;
- Improve ecosystem resiliency associated with fire adapted ecosystems; and
- Reduce the relative risk of damage to human communities associated with wildland fire.

The overarching purpose of the GPRA Strategic Plan, consistent with these laws, is to maintain healthy, diverse ecosystems that meet human needs on a long-term basis. Sustaining healthy, diverse conditions requires consideration of entire landscapes in the context of specific ecosystems and their ecological dynamics.

The Need for Adaptive Management

Increased human population growth, expanded land-use development, and changes in natural ecosystems affect ecosystem dynamics and processes. In the short interval fire-adapted systems, over-accumulated fuels indicate that more wildland fires in the future may burn with uncharacteristic fire effects. This trend may result in higher corresponding threats to human life and property, as well as potentially more degraded ecosystems.

Planning in fire-adapted ecosystems requires an integration and understanding of: fire history, potential fire behavior, past management actions, land-use change, watershed needs, species viability, and relative risk to human communities. Uncertainties associated with these considerations are addressed through monitoring, research, and adaptive management. During planning and implementation of restoration activities, the best available science and frequent monitoring must be used to reduce uncertainty and to facilitate learning. In addition, public outreach and collaboration will be critical components to successful ecosystem restoration.

While some ecosystems are adapted to infrequent high-intensity burning, the short interval fire-adapted ecosystems are not. The primary emphasis of the strategy is ensuring protection of human values and the sustainability of natural resources in the context of short interval fire-adapted ecosystems

Active Management Improves Habitat

Most research involving relationships between fire and wildlife has focused on mammals and birds, with an emphasis on habitat, rather than populations (Smith, 2000). The cause and effect relationships between fire and wildlife are only correctly understood in the context of specific ecosystems.

Research reveals that active management can improve habitat quality for some species dependent on fire-adapted ecosystems, such as Kirtland's warbler (Probst and Weinrich, 1993) and the red cockaded woodpecker. For example, the relationship between fire and bobwhite quail populations served as an important factor in initiating the prescribed burning program in the South's fire-adapted forests.

The effectiveness of ecosystem restoration in contributing to species conservation is dependent on the extent to which landscape patterns and processes support population persistence over the long term (Wilcove, 1999). For example, sage grouse population dynamics are dependent on landscape patterns (Knick, 1999); yet many factors affect the integrity of sagebrush ecosystems across landscapes following fire (such as the expansion of cheat grass).

Considering the extent of habitat alteration that has occurred over the past century, management for species conservation in fire-adapted ecosystems is complicated. In many areas, habitat is currently at risk of long-term loss from severe wildland fires. In some cases, further reduction of habitat due to severe wildland fires may threaten species viability.

Integrating ecosystem restoration goals with species conservation priorities will require coordinated effort between planned land uses to improve the quantity and quality of potentially suitable, but presently unoccupied habitat. This must occur prior to treating any areas that serve as refugia for remnant populations (Noss *et al.* 1997).

Using Adaptive Management to Evaluate Results

The type, intensity and frequency of management activity in fire-adapted ecosystems will influence the ability to provide for clean air, clean water, and biodiversity over the long term. A considerable amount of science supports an understanding of fire-adapted ecosystems. Some uncertainty, however, surrounds management treatments. It is therefore essential that an adaptive management framework involving the public be used in designing, monitoring, and evaluating activities. Assumptions associated with management approaches across broad landscapes need to be clearly identified and articulated as a part of the adaptive management process.

In developing manual direction and regional and local level plans for implementing the strategy, it is essential that monitoring be conducted to validate assumptions, reduce uncertainties, and measure progress. Upon completion of these actions, the agency will determine whether to continue pursuing ongoing management, modified management approaches, or to propose new actions in response to what was learned through monitoring. The strategy will evolve as planning decisions are made on the ground and results are evaluated. While some uncertainties exist, implementing this strategy may help to avoid serious consequences that are certain to occur if fuel reduction treatments are deferred.

IV. A Cohesive Strategy to Protect People and Sustain Resources in Fire-Adapted Ecosystems

This cohesive strategy provides a broad national framework for aligning the social, program management, and institutional elements that will be required to restore fire-adapted ecosystems. These three elements underpin this strategy.

Implementation will be based on regional assessments, integrated planning processes, public input, and collaboration with other agencies. Environmental documentation for on-the-ground projects will contain many of the ''how to'' actions necessary to move the strategy forward in a manner that is consistent with law, regulations, and Forest Service policy.

Priorities for Restoration

Specific areas of emphasis in the strategy include reducing risk within the wildland-urban interface, readily accessible municipal watersheds, and threatened and endangered species habitat. However, it is equally important to maintain existing low risk areas from developing into moderate or high-risk. To this end, the following priorities will apply when designating areas for treatment.

- *Wildland-urban interface.* Wildland-urban interface areas include those areas where flammable wildland fuels are adjacent to homes and communities.
- *Readily accessible municipal watersheds.* Clean water is the most critical resource in many western states. Watersheds impacted by uncharacteristic wildfire effects are less resilient to disturbance and unable to recover as quickly as those that remain within the range of ecological conditions characteristic of the fire regime under which they developed.
- *Threatened and endangered species habitat.* The extent of recent fires demonstrates that in fire-adapted ecosystems few areas are isolated from wildfire. Dwindling habitat for many threatened and endangered species will eventually be impacted by wildland fire. The severity and extent of fire could eventually push declining populations beyond recovery.
- *Maintenance of existing low risk Condition Class 1 areas.* This is especially important in the southern and eastern states where high rates of vegetation growth can eliminate the effects of treatment in 5–10 years. Recent droughts have caused severe wildland fire problems in Florida and Texas.

Supporting Scientific Evidence

Considerable scientific evidence supports use of prescribed fire and other management treatments in fire-adapted ecosystems to reduce risk of catastrophic wildland fire, improve ecosystem resilience, and restore plant community composition, structure, and landscape patterns.

Several examples of small-scale watershed improvement projects exist in national forests in fire-adapted systems. Virtually all use prescribed fire and mechanical treatments to improve watershed conditions. Fuel reduction work can reduce potential fire severity, which, in turn, can reduce potential erosion. Conditions that favor low intensity burning on these sites help prevent erosion and leave more organic material that filters water and improves water quality characteristics.

At landscape scales, the effectiveness of treatments in improving watershed conditions has not been well documented. Many scientists, however, agree that careful application of treatments across larger scales can restore water quality.

Degraded air quality associated with long-duration wildland fires has been widely experienced in the West. Because wildland fires tend to occur at the driest time of year when dead fuels and vegetation is also driest, they are more completely consumed and typically produce three to five times more emissions than early or late-season prescribed fires.

In Condition Class 3 and some Condition Class 2 situations, the strategy advocates mechanical thinning of small trees, brush and shrubs to reduce fire intensities and particulate emissions during prescribed burning. This practice, although expensive, opens prescription windows of opportunity—enabling managers to capitalize on better weather conditions for smoke ventilation and dispersal.

The extent to which management for ecosystem resilience can improve air quality over the long term is not completely known. Present regulatory policies measure prescribed fire emissions, but not wildland fire emissions. The emissions policy tends to constrain treatments and—in short interval fire systems—may act to inadvertently compound wildland fire risks. A growing body of scientific evidence suggests that mechanical treatments followed by prescribed fire can reduce the overall adverse impacts to air quality by reducing the amount of fuel that would otherwise be available during the wildland fire season.

The Three Cohesive Elements

Social

- Establish an objective for conservation awareness in the Forest Service Government Performance and Results Act (GPRA) Strategic Plan (2000 revision). Emphasize the need to increase public awareness of the role of ecological processes in ecosystem sustainability (Appendix B).
- Initiate collaborative planning with stakeholders to identify and evaluate ecosystem restoration and maintenance needs and opportunities. Utilize science-based assessments of present and projected ecosystem conditions as a basis for determining restoration needs.
- To promote fire-safe local planning, zoning, and building requirements, establish partnerships with other federal agencies, states, communities, and the insurance industry.

Encourage and assist communities to take responsibility for sharing in risk reduction and fire prevention efforts.

Institutional

Long-Term Policy Assessment

- Establish objectives, strategies, and milestones for restoration and maintenance of fire-adapted ecosystems in the Forest Service GPRA Strategic Plan. Emphasize integration in objectives for public safety, watershed protection, species conservation, and ecosystem resilience. (Appendix B.)
- Establish ecosystem restoration as a performance element in the Forest Service Annual Performance Plan. Use changes in condition class as one of the measures for annual performance and accountability. (Appendix B.)
- Establish assessment procedures that integrate considerations of current ecosystem condition (status), probability of degradation from disturbance events (risk), and alternatives to reduce risk or improve conditions (opportunity). Include objectives at the national, regional and local scales for: watershed protection, species conservation, ecosystem resilience, and public safety. Coordinate information across all program areas.

Program Management

At the National Level

- Concentrate projects in the shorter interval fire-adapted ecosystems (Fire Regimes I and II), with emphasis in Condition Classes 2 and 3. (GPRA 1c.)
- Establish the interior West as a priority for restoration. (GPRA 1c.)
- Direct funds—in an integrated fashion—to highest values to be protected, especially for: watersheds (GPRA 1a), species (GPRA 1b), ecosystems (GPRA 1c), and human communities (GPRA 4b).
- Explore innovative use of existing authorities for grants, agreements, and contracts for project execution such as service contracts to hire local people.
- Emphasize long-term training and community development opportunities through restoration activities.
- Establish program reviews at regular intervals to determine if adjustments are needed. Take into account: budget, the findings of regional assessments, finer-scaled risk and hazard mapping, and other planning efforts.

At the Regional Level

- Conduct regional assessments, establishing restoration and maintenance priorities consistent with values to be protected (watersheds, species, human communities) in collaboration with other federal agencies, tribes, state and local government, and constituents.

At the National Forest and Grassland Level

- In Land and Resource Management Plan amendments and revisions: identify land by condition class categories, discuss the resources to be protected from catastrophic wildland fire including human communities, watersheds, threatened and endangered species habitats, and establish landscape goals to achieve sustainable ecosystems. Goals should be included to reduce acres at risk.
- Establish monitoring and evaluation programs and measures in Land and Resource Management Plan revisions for restoration activities in fire-adapted ecosystems.
- Consistent with Land and Resource Management Plans, develop fire management plans that provide for suppressing fires that would threaten public safety, communities, species habitat, or degrade ecosystems. Increase the management of natural ignitions for resource benefits where values and resources will be increased or improved.

State and Private Forestry

- Expand efforts such as the Firewise Communities Program to assist communities and homeowners in the urban wildland interface to take preventative and corrective actions to protect lives and property from fire. Provide assistance in conducting risk and hazard assessments in developing community disaster plans, and in educating the public about measures they can take to protect their property.

Research and Development

- Strengthen Forest Service research programs to evaluate ecological, social, and economic tradeoffs and other issues; develop more effective prediction systems; and quantify disturbance effects and ecological interactions in fire regimes. Continue funding the Joint Fire Sciences Program.
- Study, document and monitor examples of various treatments and their effectiveness in restoring ecological processes, protecting communities, and protecting key ecosystem components.
- Research the long-term results of rehabilitation techniques and help determine those most effective at restoring ecological processes and habitats.

Funding

- Establish an integrated budget structure that facilitates an accomplishment of the GPRA Strategic Plan elements: Watershed Restoration, Species Conservation, Ecosystem Processes, and the Protection of Human Communities.
- Wildland fire preparedness funding requests should be made at the most efficient level, as defined by the National Fire Management Analysis System.

Actions Requiring External Collaboration

Long-Term Policy Assessment

Collaborate with the Environmental Protection Agency, National Marine Fisheries Service, and the U.S. Fish and Wildlife Service in addressing long-term impacts, tradeoffs, and issues to air quality, watershed resilience, species conservation, ecosystem integrity, and public safety as a result of each agency's respective policy in the context of fire-adapted ecosystems. Identify opportunities for improved coordination between regulatory and land management agencies in achieving restoration and maintenance objectives to protect people and sustain resources in fire-adapted ecosystems.

Economic Feasibility Assessment for Fuel Utilization

Because understory biomass has little or no value, disposing of it becomes problematic. Small diameter material, however, may become more economically feasible if assessments for its utilization more comprehensively evaluate tradeoffs and risks to watershed and species values, public health and safety, and other factors that may benefit from reducing fuels in fire-adapted ecosystems. Projected wildland fire costs, resource losses, and environmental damage, all suggest that developing and supporting markets for utilization of over-accumulated biomass may be desirable.

Consistent with Executive Order 13134 "Developing and Promoting Biobased Products and Bioenergy", collaborate with other agencies and organizations to conduct economic feasibility analyses of increased biomass utilization.

The FY 2001 budget includes a Presidential bio-based products and bio-energy initiative. This initiative supports research and development, demonstration and commercialization, and outreach and education activities. The Forest Service will take a leadership role in this effort.

Projected Treatment Schedule at Full Program Implementation

Different treatment schedules are displayed below. The strategy does not include a treatment target of a fixed number of acres within a set period of time. The number of acres actually treated will depend on different circumstances, including available funding. The treatment schedule displayed below illustrates potential costs over varying time frames. Actual treatment costs and rates will depend on a variety of circumstances.

The purpose of the report is to establish priorities and a rationale for restoration. Local Land and Resource Management Plans and community involvement will help to guide the types and locations of treatment actions. Enhancing forest ecosystem health is best accomplished at the local level with on-site examination and experience.

Tables 1a, 1b, and 1c provide estimates of a potential annual program to achieve restoration goals within 10, 15, and 20-year time periods.

This information was developed using regional input based on Land and Resource Management Plan and other assessments. Strategy implementation will be consistent with forest plan direction and other ongoing initiatives. Acreage estimates give consideration to regulatory obligations for clean air, clean water, and threatened or endangered species habitat. These goals are expected to change as the Forest Service refines these data. More accurate regional and sub-regional assessments, integrated planning processes, and public collaboration may refine these figures.

10-YEAR TREATMENT SCHEDULE

Regions 1-6 Treatment Schedule (acres)

	Year 1	Year 2	Year 3	Year 4-10
CC1	200,000	400,000	600,000	800,000
CC2	500,000	850,000	1,400,000	2,500,000
CC3	300,000	700,000	1,100,000	1,650,000
Total	1,000,000	1,950,000	3,100,000	4,950,000

Regions 8-9 Treatment Schedule (acres)

	Year 1	Year 2	Year 3	Year 4-10
CC1	770,000	1,000,000	1,150,000	1,250,000
CC2	220,000	350,000	470,000	640,000
CC3	50,000	60,000	60,000	60,000
Total	1,040,000	1,410,000	1,680,000	1,950,000

Table 1a—10-Year Schedule To Increase the Annual Hazardous Fuels Treatment Program.

15-YEAR TREATMENT SCHEDULE

Regions 1-6 Treatment Schedule (acres)				
	Year 1	Year 2	Year 3	Year 4-15
CC1	150,000	250,000	400,000	500,000
CC2	450,000	700,000	1,100,000	1,500,000
CC3	200,000	500,000	750,000	1,000,000
Total	800,000	1,450,000	2,250,000	3,000,000

Regions 8-9 Treatment Schedule (acres)				
	Year 1	Year 2	Year 3	Year 4-15
CC1	750,000	780,000	780,000	780,000
CC2	200,000	380,000	380,000	380,000
CC3	300,000	400,000	400,000	400,000
Total	980,000	1,200,000	1,200,000	1,200,000

Table 1b—15-Year Schedule To Increase the Annual Hazardous Fuels Treatment Program

20-YEAR TREATMENT SCHEDULE

Regions 1-6 Treatment Schedule (acres)					
	Year 1	Year 2	Year 3	Year 4	Year 5-20
CC1	100,000	150,000	225,000	325,000	375,000
CC2	400,000	600,000	750,000	900,000	1,100,000
CC3	200,000	300,000	400,000	550,000	750,000
Total	700,000	1,050,000	1,375,000	1,775,000	2,000,000

Regions 8-9 Treatment Schedule (acres)					
	Year 1	Year 2	Year 3	Year 4	Year 5-20
CC1	400,000	400,000	450,000	500,000	620,000
CC2	120,000	150,000	200,000	250,000	300,000
CC3	25,000	25,000	30,000	30,000	30,000
Total	545,000	575,000	680,000	780,000	950,000

Table 1c—20-Year Schedule To Increase the Annual Hazardous Fuels Treatment Program

V. Consequences of Deferral

"* * * in many of the interior West forests, the costs and risks of inaction are greater than the costs and risks of remedial action."

Concluding comments from academic and agency scientists. Assessing Forest Ecosystem Health in the Inland West Workshop (November, 1993).

This chapter projects suppression costs, natural resource and private property losses, and environmental damages expected under present treatment schedules and compares them with the costs, losses and damages anticipated for the mid-range treatment schedule shown on Table 1c. If treatment schedules are accelerated, objectives may be met sooner. If treatment schedules are extended, results may be deferred. Three alternative treatment timeframes are presented in the strategy. For demonstrative purposes, changes over time are projected using the 15-year treatment schedule (figures 8,10, 11, and 12).

Commodity values are well established. Non-commodity values, however, are more difficult to determine. Economic research is ongoing to better describe and quantify amenity values including ecosystem components, natural resources, and safety considerations involved in tradeoff analysis. Tradeoff analysis measures the costs, benefits, and risks under different protection strategies. It is one way to compare the expected outcomes of different management scenarios.

Fire-adapted ecosystems are dynamic. With any treatment schedule, live vegetation will continue to grow and dead wood will continue to accumulate. Risk conditions will continue to increase as some forests and grasslands areas migrate from lower-risk conditions to higher-risk conditions. During this same time period, severe wildland fires will continue to occur—reducing high-risk acres, but also potentially damaging ecosystem components and natural resources.

Areas at Risk

As human populations continue to expand, threats to species viability, watershed health, and ecosystem integrity will grow. The situation will be exacerbated as forest fuels accumulate and fire risks increase. Even at current levels of treatment, risks to species, watersheds, forest health, and human communities throughout the interior West are escalating due to increasing fuels buildups (vegetation) in fire-prone environments. The answer is not in bigger and better firefighting apparatus. At very high fuel loadings, fire behavior overwhelms even the best fire suppression efforts. Under extreme conditions, control of fire becomes dependent on relief in weather or a break in fuels.

Reducing fuels and restoring fire's ecological role in fire-adapted ecosystems can reverse many adverse trends that serve as important indicators of ecosystem sustainability. To demonstrate the strategy's benefits, graphs from a recent assessment of several indicators for the Western states were developed to illustrate trends (figures 8, 10, 11, 12). These graphs reflect assessments from a recently completed national-scale evaluation (see Appendix D). They are based on coarse-scale data that model averages for the area under study. They cannot be directly applied to areas smaller in scale than the analysis area. The data are not directly applicable to fine-scale analysis; they serve to evaluate relative risk trends among different management options.

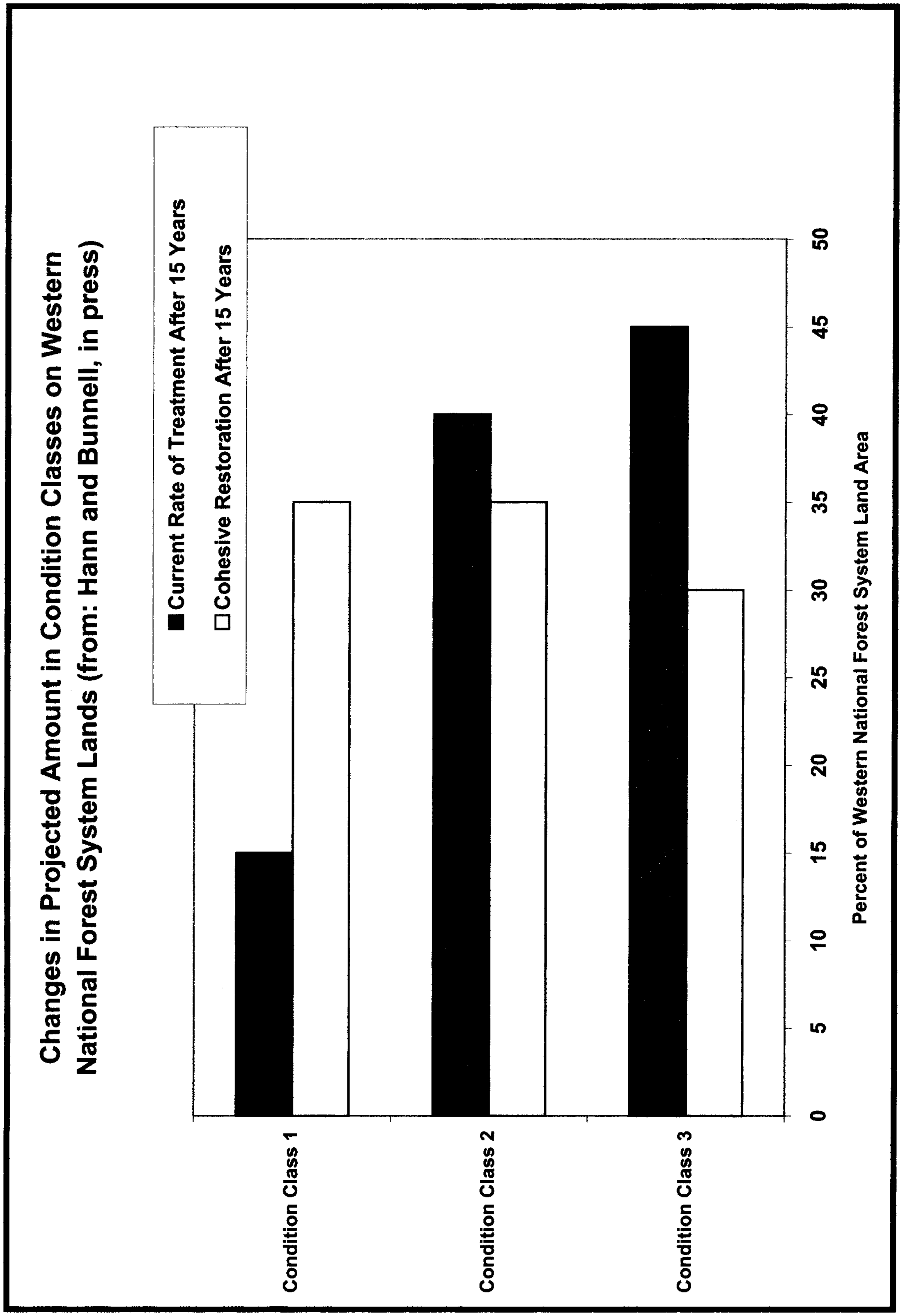
Changes in Projected Amount in Condition Classes on Western National Forest System Lands (from: Hann and Bunnell, in press)
Current Rate of Treatment After 15 Years
Cohesive Restoration After 15 Years
Condition Class 1
Condition Class 2
Condition Class 3
0
5
10
15
20
25
30
35
40
45
50
Percent of Western National Forest System Land Area

Figure 8

The assessment was based on a projection using the 15-year treatment schedule. Results for the 10 and 20-year treatment schedules will vary from this only in the time required to achieve the same level of results. At 100 years, the social, economic, and ecological benefits of restoration treatments become exponentially greater. And, as treatments shift from restoration to maintenance, treatment costs will go down.

At the current rate of treatment (0.75 million acres/year), the acres at high risk in the interior West will increase over the next 15 years. Implementing the approaches outlined in this strategy can increase levels of treatment and decrease moderate and high-risk categories (Condition Classes 2 and 3). It will restore proportionately more low-risk areas (Condition Class 1). The strategy therefore substantially reduces risk over the current rate of fuel reduction treatment.

Without increased restoration treatments in these ecosystems, wildland fire suppression costs, natural resource losses, private property losses, and environmental damage are certain to escalate as fuels continue to accumulate and more acres become high-risk.

Suppression Costs

Suppression strategies (and their associated costs) are determined using the Wildland Fire Situation Analysis (WFSA), a required assessment process on federal lands. Under this system, suppression costs are calculated from an array of alternatives prior to selecting a fire suppression strategy. The analysis weighs values to be protected. Firefighter and public safety always serves as the first criteria. As a general rule, depending on the circumstances surrounding a particular wildland fire, resource or private values to be protected are typically two to five times greater than the expected suppression costs, as calculated using the WFSA.

The Line Officer selects the most appropriate strategy and, in doing so, approves the expected suppression costs. If the strategy fails or if costs exceed the expected level, the Line Officer must reevaluate alternatives and approve any changes.

Suppression costs and wildland fire acres burned (Figure 9) have increased due to over-accumulation of fuels and a corresponding increase in high-risk acreage and drought conditions. In recent years, large fires have become more damaging and more costly. *Unless the rate of restoration is increased, larger burned acreages and higher wildland fire suppression costs should be expected.*

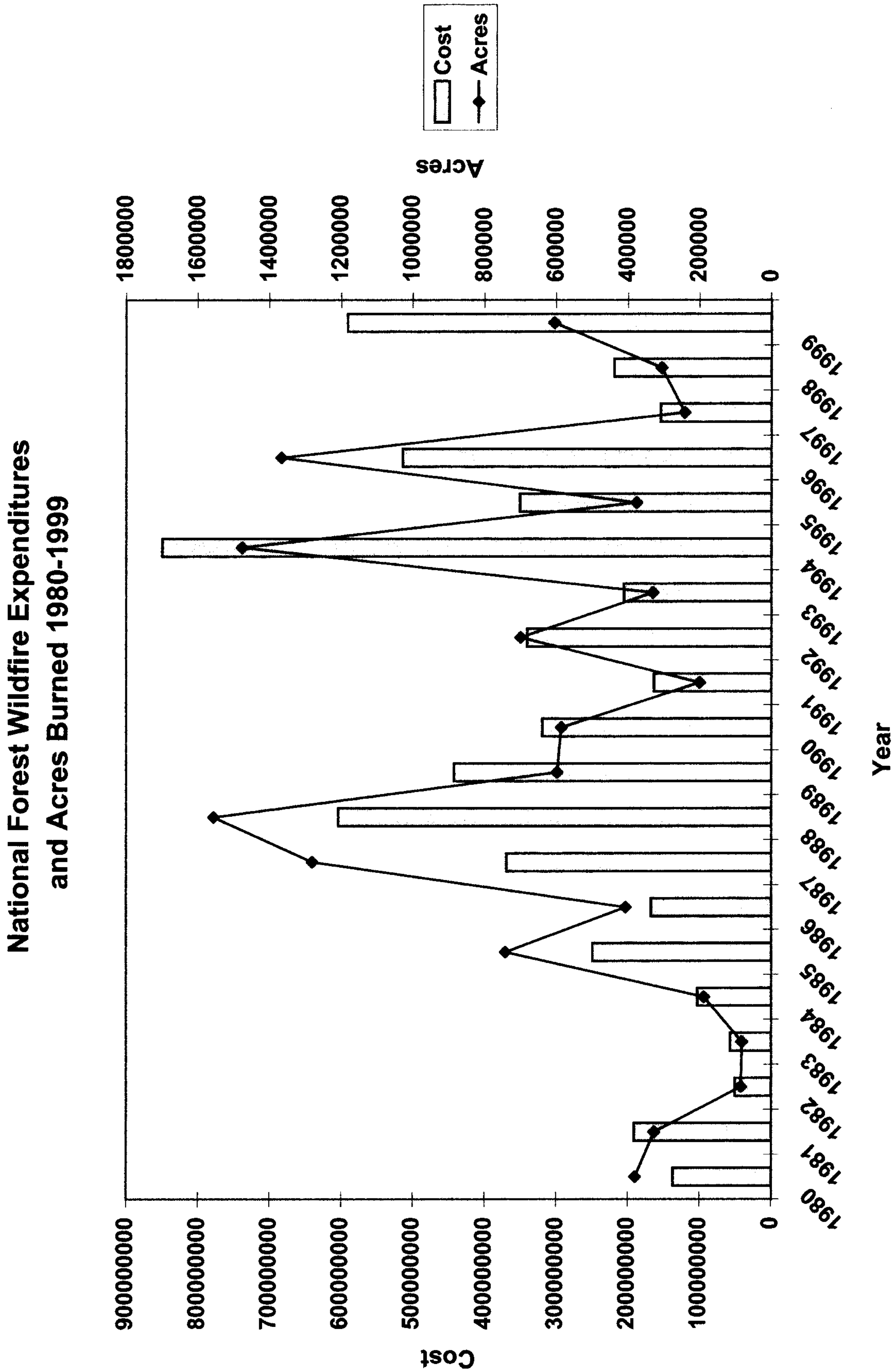
National Forest Wildfire Expenditures
and Acres Burned 1980-1999
Cost
Acres
Year
Cost
Acres
0
100000000
200000000
300000000
400000000
500000000
600000000
700000000
800000000
900000000
0
200000
400000
600000
800000
1000000
1200000
1400000
1600000
1800000
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999

Figure 9

Loss to Private Property and Resource-Based Commodities

As human populations grow and shifting demographics concentrate more people in or adjacent to wildlands, more private property will be at risk to catastrophic wildland fires.

According to the National Fire Protection Association, wildland-urban interface fires from 1985 to 1994 destroyed 8,925 homes. During dry years or under adverse weather conditions, because they occur in high-risk fuels, many wildland-urban interface fires exceed firefighting capabilities.

No forest can be made fireproof. As homes and communities are built in the wildland interface, they face added risk of fire. Efforts to reduce hazardous fuels on federal lands must be coupled with efforts to assist private landowners to take preventative action in their own communities.

Research suggests that the most effective way to reduce risk of fire to homes in the wildland-urban interface is through fuels treatment carried out within 200 feet of building structures (Cohen, 1999). Homes with high ignitibility factors, such as pine needle accumulation on roofs and in yards and firewood piles next to houses, frequently suffer more severe fire damage than other areas.

When fuel loadings are reduced, protection of life and property is significantly improved (Fischer, 1988).

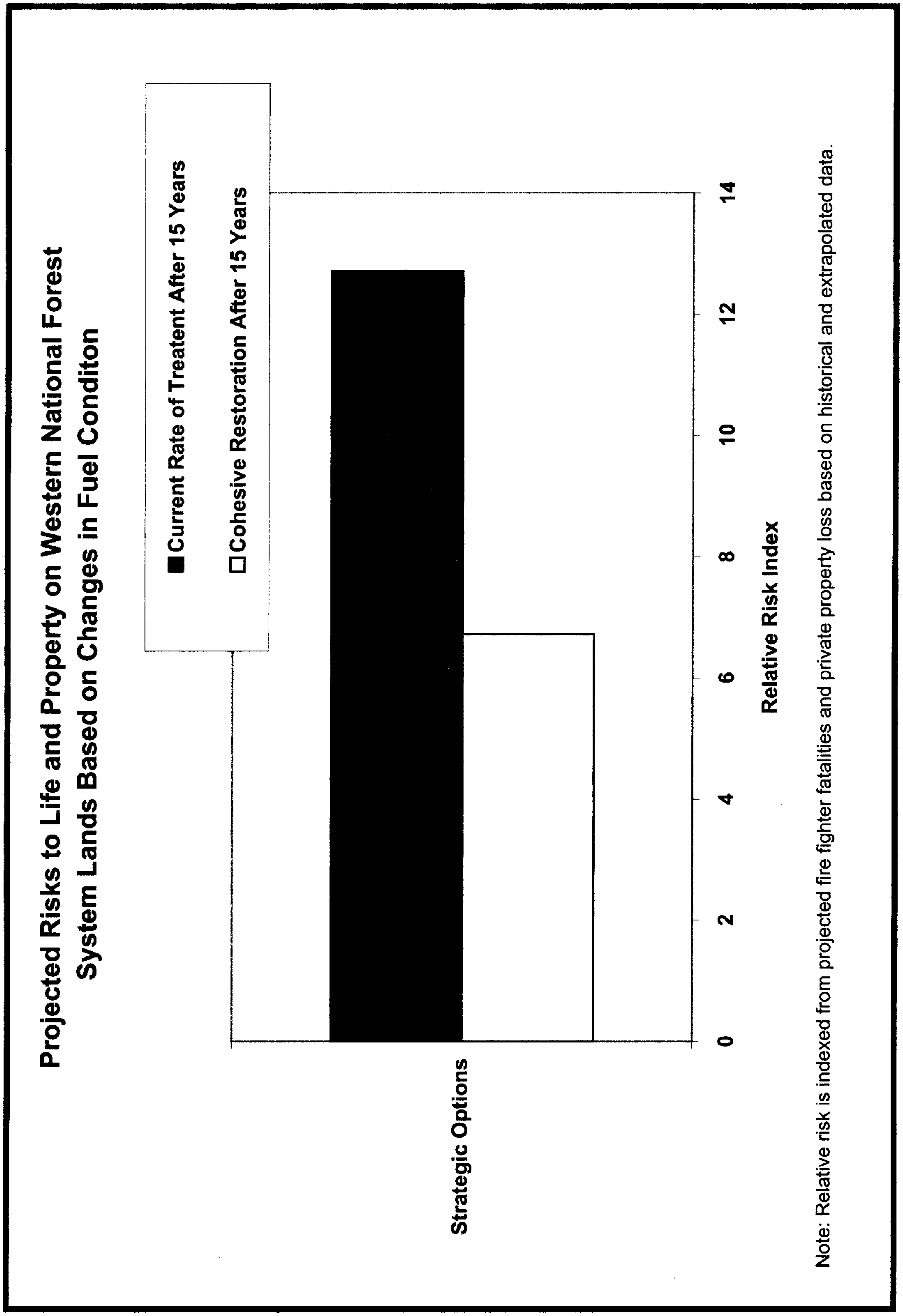
Projected Risks to Life and Property on Western National Forest System Lands Based on Changes in Fuel Conditon
Current Rate of Treatent After 15 Years
Cohesive Restoration After 15 Years
Strategic Options
0
2
4
6
8
10
12
14
Relative Risk Index
Note: Relative risk is indexed from projected fire fighter fatalities and private property loss based on historical and extrapolated data.

Figure 10

The National Research Council and the Federal Emergency Management Agency (FEMA) recognized wildland fires in California (1993) and Florida (1998) as among the defining natural disasters of the 1990s. In terms of damage, the magnitude of these catastrophic fires were compared with the Northridge earthquake, Hurricane Andrew, and flooding of the Mississippi and Red rivers.

The 1991 Oakland, California fire was ranked by insurance claims as one of the ten most costly all-time natural catastrophes. More wildland fire disasters of this scale can be expected in the absence of a mitigation strategy. FEMA is emphasizing mitigation and prevention to state and local governments to address the growing losses from natural disasters such as hurricanes and flooding. The strategy outlined in this report complements the efforts to forestall disaster-related costs and losses.

Damage to commodity resources such as wood fiber and watersheds often result from severe wildland fire. These losses can be significant. For example, the Big Bar Fire Complex, consisting of five fires that burned during the late summer of 1999 in northern California. The Complex burned 141,000 acres on and adjacent to the Six Rivers National Forest. The Big Bar Complex cost $81 million to suppress and $6 million for burned-area rehabilitation. It resulted in a preliminary estimate of $122 million in resource losses, including loss of marketable timber.

Environmental Damage

Any restoration strategy should be evaluated in the context of the ecosystem under consideration. Wildland fires occurring in the shorter interval fire-adapted ecosystems where fuels have accumulated over several missed fire cycles often burn with uncharacteristic wildfire effects. Consequently, habitats, soils, and watersheds are burned beyond their adaptive limits. The severity of these fires pose threats to species persistence and watershed integrity. The damage from these fires is often long-lasting and, within some ecosystems, may be irretrievable.

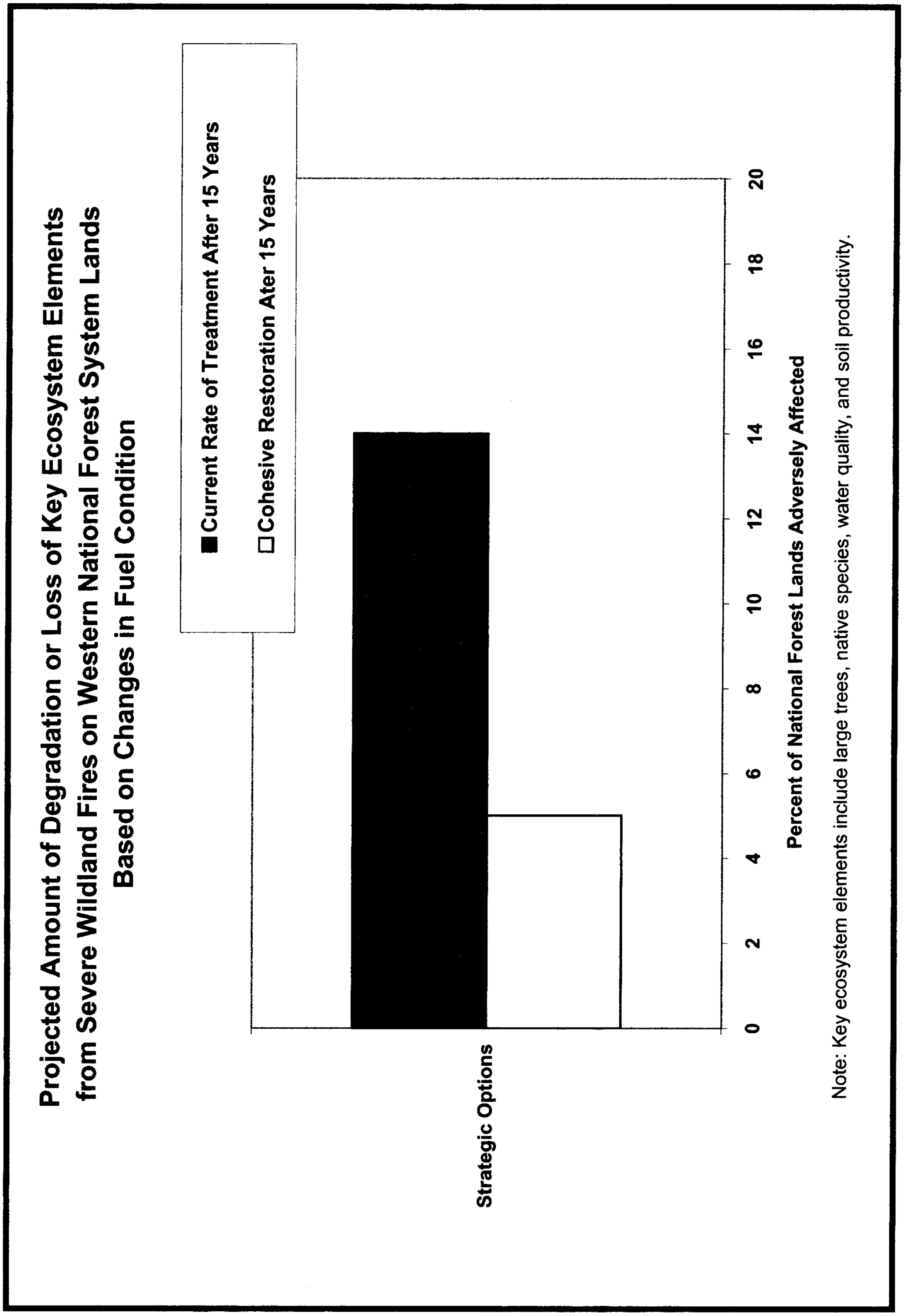
Projected Amount of Degradation or Loss of Key Ecosystem Elements
from Severe Wildland Fires on Western National Forest System Lands
Based on Changes in Fuel Condition
Current Rate of Treatment After 15 Years
Cohesive Restoration Ater 15 Years
Strategic Options
0
2
4
6
8
10
12
14
16
18
20
Percent of National Forest Lands Adversely Affected
Note: Key ecosystem elements include large trees, native species, water quality, and soil productivity.

Figure 11

With an increasing number of large, uncharacteristically damaging wildland fires in short interval fire systems, we can eventually expect:

- Loss of critical habitat for fish, wildlife, and plant species at risk.
- Soil erosion and loss of site stability and productivity.
- Changes in temperatures and moisture regimes on certain sites.
- Increased spread of invasive weeds or non-native plants.

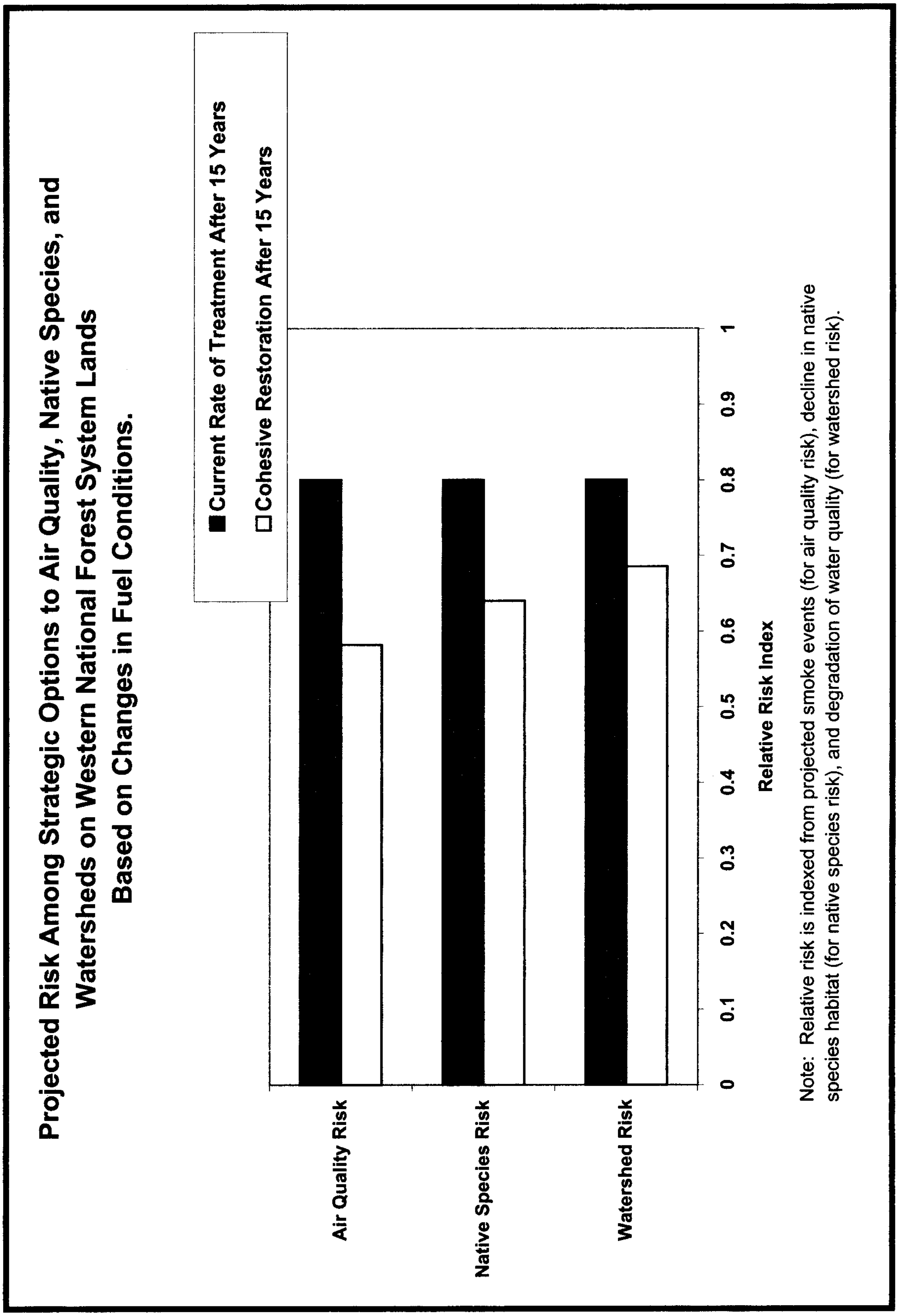
Projected Risk Among Strategic Options to Air Quality, Native Species, and Watersheds on Western National Forest System Lands Based on Changes in Fuel Conditions.
Current Rate of Treatment After 15 Years
Cohesive Restoration After 15 Years
Air Quality Risk
Native Species Risk
Watershed Risk
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Relative Risk Index
Note: Relative risk is indexed from projected smoke events (for air quality risk), decline in native species habitat (for native species risk), and degradation of water quality (for watershed risk).

Figure 12

On the 1999 Big Bar Complex, adverse effects were most commonly found where the fires burned at higher intensities. Impacts from the fires included:

- Prolonged exposure of local communities to unhealthy smoke concentrations.
- Increased soil erosion and stream course sedimentation.
- Loss of old-growth trees that provide significant wildlife habitat.
- Degradation and loss of fish habitat, especially in the New River's tributaries.

Public and Firefighter Safety

In fire-adapted forests adjacent to human communities, concerns for public health often compete with concerns for public and firefighter safety. Treatments that use prescribed burning raise health issues related to smoke. Although this strategy would employ mechanical thinning prior to prescribed burning in some areas to reduce particulate emissions, air quality will remain an important concern.

Current regulatory policies ''count'' prescribed fire emissions in measuring air quality, but do not include wildland fire emissions. Constraining prescribed fire use in fire-adapted ecosystems to ensure public health may inadvertently increase risks to human safety.

Stagnant atmospheric conditions during the late summer and early fall often inhibit smoke dispersal from wildland fires. Although these episodes are exempt from regulatory control, they exceed public health standards. In 1977 and 1987, southern Oregon and northern California experienced long-term, unhealthy smoke concentrations. The 1999 Big Bar Fire Complex in northern California and the 1994 Wenatchee, Washington wildland fires also caused prolonged exposure of local communities to unhealthy smoke levels.

In recent years, several tragedies have occurred as firefighters tried to control wildland fires threatening human developments. In 1991, the Dude wildland fire near Payson, Arizona killed six firefighters as they attempted to protect a rural subdivision. The South Canyon fire in 1994 resulted in the death of 14 firefighters who were suppressing a wildland fire that was approaching homes near Glenwood Springs, Colorado.

Among the general public, loss of life due to wildland fire is rare but not unknown. In 1991, 25 lives were lost, 150 people injured, and more than 3,000 structures were destroyed in a wildland fire in the hills near Oakland, California. On March 8, 2000, three motorists lost their lives and many more were injured in a multi-car pileup in Florida—the result of wildland fire smoke obscuring visibility on a highway.

While fuel treatments across the interior West have increased in the last few years, further increases are needed to protect communities, watershed health, species viability, and ecosystem resilience.

VI. Conclusions and Next Steps

''Moving toward sustainability is a two-part process. First, revising the uses of the ecosystem so that environmental values take an economically relevant place in policy and practice; second, incorporating the well-being of the ecosystem into the way management is conceived and implemented.''—Kai N. Lee, Compass and Gyroscope, 1993

The cohesive strategy outlined in this report is based on the premise that, within fire-adapted ecosystems, fire—at the right intensities, frequency, and season—is fundamentally essential for healthy, sustainable resources and the protection of nearby human communities. The strategy clarifies agency goals and objectives, establishes milestones and performance measures, and outlines an approach for setting restoration priorities.

The strategy directs treatments to high-risk areas, specifically, the wildland-urban interface, readily accessible municipal watersheds, and threatened and endangered species habitat. Implementing it will reduce the area in the interior West considered at highest risk of loss or damage. It prioritizes treatment of additional acres to prevent them from developing into high-risk conditions. It relies on a variety of treatments—including thinning, some harvest, other mechanical treatments and prescribed burning—to reduce fuels and the consequent risks of loss or long-lasting damage resulting from wildland fire.

The strategy provides an iterative approach, based on adaptive management and incremental steps. Actual treatment schedules will be developed using regional input based on Land and Resource Management Plans and other more recent assessments.

The strategy is responsive to regulatory responsibilities for clean air, clean water, and threatened and endangered species. Over the long term, the agency believes strategy implementation will better ensure ecosystem integrity for the benefit of future generations. The strategy does not attempt to treat all acres, nor does it eliminate all risks. While it does not aim to return forests and grasslands to pre-European settlement conditions—it does reduce risks by reducing over-accumulated fuels (Figure 13). The strategy will continue to evolve as the agency works with states, tribes, local communities and others.

The strategy also maintains that constituency support and collaboration with tribal, other federal, state, local agencies, and the public is an essential cornerstone for restoration work. It is consistent with the guiding principles of the Federal Wildland Fire Management Policy (approved by the Secretaries of Interior and Agriculture in 1995). In addition, it supports federal and state initiatives aimed at improving forest ecosystem health on public lands.

This strategy effectively reduces risk on a scale that makes a difference, but is potentially expensive and will take time and collaborative planning to implement. The costs, losses, and damages that will occur without this strategy are not always quantifiable or precisely known. When evaluated against recent trends and projections, however, wildland fire costs, loses, and damages, are expected to compound and exceed treatment costs—unless the rate of treatment is accelerated.

Large wildland fires will continue to occur. This cohesive strategy aims to reduce losses and damages from these wildland fires by concentrating treatments where human communities, watersheds, and species are at risk. Until restoration efforts are significantly expanded in fire-adapted ecosystems, the risks to watersheds, species, and people will continue to increase.

Note: Figure 13 is not printed in the **Federal Register**. It is available as indicated in the **ADDRESSES** section at the beginning of this notice.

Figure 13—The cohesive strategy outlined in this report aims to reduce severe insect, disease, and wildland fire risk.

Next Steps

This report provides a broad iterative approach to restore fire-adapted ecosystems and protect human values.

The coarse-scale assessments that establish the basis for the strategy will be refined as finer scale data become available to conduct forest-level planning. Implementation will occur consistent with Land and Resource Management Plan direction and other ongoing initiatives. More accurate assessments, integrated planning processes, public input, and collaboration with other agencies are all included in the work ahead.

Strategy actions to be addressed immediately:

- Refine coarse-scale assessments for wildland fuel risks.
- Develop regional implementation plans, integrating the status and risk

information included in the Western Watershed Initiative, Human Population Density Maps, and Species at Risk Analysis into forest planning efforts at national, regional, and local levels as applicable.

• Incorporate recommended adjustments to the Forest Service Government Performance and Results Act (GPRA) Strategic Plan (2000 revision).

• Identify funding for priority projects.

• Frame a research program to strengthen monitoring and evaluation during the strategy's implementation.

• Coordinate with states, tribes, and local communities for work in the urban-wildland interface to help in risk reduction and hazard mitigation.

• Continue efforts to develop markets and ideas for small-diameter material utilization.

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IX. Glossary

Uncharacteristic Wildfire Effects

An increase in wildfire size, severity and resistance to control, and the associated impact to people and property, compared to that which occurred in the native system.

Ecosystem Process

The actions or events that link organisms and their environment, such as predation, mutualism, successional development, nutrient cycling, carbon sequestration, primary productivity, and decay. Natural disturbance processes often occur with some periodicity (From Webster's dictionary, adapted to ecology.)

Ecosystem

The complex of a community of organisms and its environment functioning as an ecological unit in nature. (Webster's dictionary.)

Ecosystem Integrity

The completeness of an ecosystem that, at multiple geographic and temporal scales, maintains its characteristic diversity of biological and physical components, spatial patterns, structure, and functional processes within its approximate range of historic variability. These processes include: disturbance regimes, nutrient cycling, hydrologic functions, vegetation succession, and species adaptation and evolution. Ecosystems with integrity are resilient and capable of self-renewal in the presence of the cumulative effects of human and natural disturbances. (Proposed Rule, Section 219.36, 1999.)

Ecosystem Management u

The careful and skillful use of ecological, economic, social, and managerial principles in managing ecosystem integrity and desired conditions, uses, products, and services over the long term.

Fire-Adapted Ecosystem

An ecosystem with the ability to survive and regenerate in a fire-prone environment.

Fire Regime

A generalized description of the role fire plays in an ecosystem. It is characterized by fire frequency, seasonality, intensity, duration and scale (patch size), as well as regularity or variability. (Agee, as modified by Sexton.)

Fire Frequency (Fire Return Interval)

How often fire burns a given area; often expressed in terms of fire return intervals (*e.g.*, fire returns to a site every 5–15 years).

Interagency Wildland Fire Policy

The Federal Wildland Fire Management Policy and Program Review was chartered by the secretaries of the Interior and Agriculture to ensure that federal policies are uniform and programs are cooperative and cohesive. For the first time, one set of federal fire policies will enhance effective and efficient operations across administrative boundaries to improve the capability to meet challenges posed by current wildland fire conditions.

The policy review team reexamined the role of fire in ecological processes and the costs associated with fighting fire. An interagency product has resulted in changes in terminology, funding, agency policy, and analysis of ecological processes.

Landscape

An area composed of interacting and inter-connected patterns of habitats (ecosystems) that are repeated because of the geology, landform, soils, climate, biota, and human influences throughout the area. Landscape structure is formed by patches (tree stands or sites), connections (corridors and linkages), and the matrix. Landscape function is based on disturbance events, successional development of landscape structure, and flows of energy and nutrients through the structure of the landscape. A landscape is composed of watersheds and smaller ecosystems. It is the building block of biotic provinces and regions.

Restoration

In the context of this report's cohesive strategy, restoration means the return of an ecosystem or habitat toward: its original structure, natural complement of species, and natural functions or ecological processes.

Sustainability

Meeting the needs of the current generation without compromising the ability of future generations to meet their needs. Ecological sustainability entails maintaining the composition, structure and processes of a system, as well as species diversity and ecological productivity. The core element of sustainability is that it is future-oriented. (Committee of Scientists Report, 1999.)

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XI. Appendices

Appendix A—The Coarse-Scale Assessment and Definition of Fire Regimes and Condition Classes

Fire Regime Descriptors

Five combinations of fire frequency, expressed as fire return interval and fire severity, are defined (Table 2) to create the map of Historic Natural Fire Regimes (Figure 14). Groups I and II include fire return intervals in the 0–35 year range. Group I includes ponderosa pine, other long-needle pine species, and dry-site Douglas fir. Group II includes the drier grassland types, tall grass prairie, and some chaparral ecosystems. Groups III and IV include fire return intervals in the 35–100+ year range; and Group V is the long-interval (infrequent), stand replacement fire regime.

TABLE 2.—THE FIVE HISTORIC NATURAL FIRE REGIME GROUPS

Fire Regime Group	Frequency (fire return interval)	Severity
I	0–35 years	Low severity.
II	0–35 years	Stand replacement severity.
III	35–100+ year	Mixed severity.
IV	35–100+ year	Stand replacement severity.
V	>200 years	Stand replacement severity.

Fire Regime Groups I and II

These first two fire regime groups occupy nearly all the lower elevation zones across the U.S. They have been most affected by the presence of human intervention and our analysis shows that these types demonstrate the most significant departure from historical levels. The departures are affected largely by housing development, agriculture, grazing, and logging. These areas are at greatest risk to loss of highly valued resources, commodity interests, and human health and safety. It is expected that these areas will receive primary focus of wildland management agencies in the future.

Current Condition Class Attributes

Three Condition Classes have been developed to categorize the *current* condition with respect to each of the five historic Fire Regime Groups. Current condition is defined in terms of departure from the historic fire regime, as determined by the number of missed fire return intervals—with respect to the historic fire return interval—and the current structure and composition of the system resulting from alterations to the disturbance regime. The relative risk of fire-caused losses of key components that define the system increases for each respectively higher numbered condition class, with little or no risk at the Class 1 level.

CONDITION CLASS [1] DESCRIPTIONS

Condition class	Fire regime	Example management options
Condition Class 1	Fire regimes are within an historical range and the risk of losing key ecosystem components is low. Vegetation attributes (species composition and structure) are intact and functioning within an historical range.	Where appropriate, these areas can be maintained within the historical fire regime by treatments such as fire use.
Condition Class 2	Fire regimes have been moderately altered from their historical range. The risk of losing key ecosystem components is moderate. Fire frequencies have departed from historical frequencies by one or more return intervals (either increased or decreased). This results in moderate changes to one or more of the following: fire size, intensity and severity, and landscape patterns. Vegetation attributes have been moderately altered from their historical range.	Where appropriate, these areas may need moderate levels of restoration treatments, such as fire use and hand or mechanical treatments, to be restored to the historical fire regime.

CONDITION CLASS[1] DESCRIPTIONS—Continued

Condition class	Fire regime	Example management options
Condition Class 3	Fire regimes have been significantly altered from their historical range. The risk of losing key ecosystem components is high. Fire frequencies have departed from historical frequencies by multiple return intervals This results in dramatic changes to one or more of the following: fire size, intensity, severity, and landscape patterns. Vegetation attributes have been significantly altered from their historical range.	Where appropriate, these areas may need high levels of restoration treatments, such as hand or mechanical treatments, before fire can be used to restore the historical fire regime.

[1] Current conditions are a function of the degree of departure from historical fire regimes resulting in alterations of key ecosystem components such as species composition, structural stage, stand age, and canopy closure. One or more of the following activities may have caused this departure: fire suppression, timber harvesting, grazing, introduction and establishment of exotic plant species, insects or disease (introduced or native), or other past management activities.

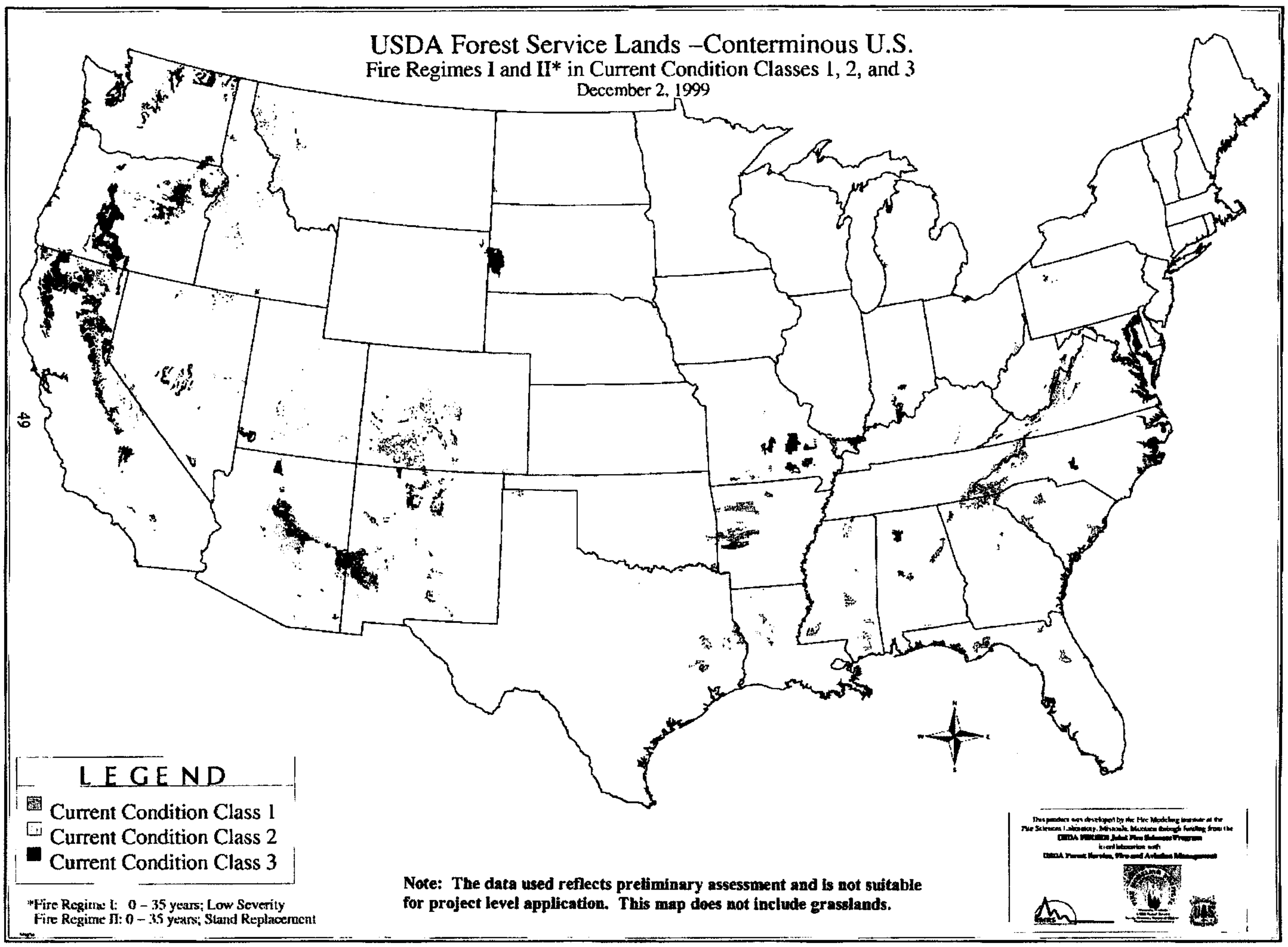

Figure 14—Forest Service Lands, Fire Regime Groups I and II

Appendix B—Recommended Adjustments to the Forest Service GPRA Strategic Plan

Objective 1.c—RESTORE ECOSYSTEM HEALTH AND RESILIENCE WITHIN THE CONTEXT OF NATURAL DISTURBANCE PROCESSES.

Strategies to Achieve the Objective

We will . . .

- Identify priority health restoration needs through national and regional environmental monitoring and ecological risk assessments. Including:
- social and economic factors and
- sensitive species habitats at risk.
- In regional, Land and Resource Management Plan, and landscape scale assessments, clearly identify values to be protected, relative risks, benefits, and costs of all treatment options for restoring fire-adapted ecosystems.
- Research ecosystems (composition, structure, and process), social and economic values at risk, and the role of disturbance process.
- Assess what fel treatment works most effectively to protect communities and restore fire-adaped ecosystems.
- Design and implement systematic methods for broad-scale and landscape scale assessments of the history, status, and trajectory of ecosystem conditions; values at risk; and management opportunities for maintaining and restoring ecosystem integrity.
- Apply the latest knowledge to develop and implement landscape scale protection and restoration projects that achieve landscape goals established in Forest Plans.

Measure

Trends in acres at extreme risk from fire, insects, diseases, and invasive species.

FY 2006 Milestones

- A 5% decrease in acres at extreme risk from insects and diseases.
- Restore and maintain fire-adapted ecosystems in fire regimes I and II. Reduce high risk areas by 25 percent.
- Acres infested with targeted invasive species remains unchanged or is diminished.

Key External Factors

Baseline data on acres at risk was collected in an inconsistent manner in the past. Well-defined methods of data collection and storage are being developed. Fires, insect and disease epidemics and other unplanned large natural disturbances can radically alter the landscape and rapidly change management strategies, priorities, and budget allocations.

Local jurisdictions regulate homebuilding. As development extends into wildlands, areas can experience higher intensity fires that increase risks to human life and property and contribute to the spread of invasive species.

Objective 3.e

Increase awareness among employees and constituents about the need for restoration and management for ecosystem sustainability.

Educate homeowners about FIREWISE programs and principles.

Strategies to Achieve the Objective

We will . . .

Develop corporate training module for conservation awareness, and ensure all employees participate in this training module.

Strengthen interagency conservation education efforts to emphasize the importance of watershed protection, species conservation, and management for long-term ecosystem integrity and resilience.

Design and implement conservation awareness products that facilitate understanding about natural disturbance processes, particularly fire, and the potential values at risk when fire regimes are altered.

Conduct FIREWISE workshops in all high-risk urban-interface communities adjacent to National Forests. Assist states in implementing the FIREWISE program nation-wide.

Measure

Increasing trend in employee and public awareness of relationships among natural disturbance processes, ecosystem integrity and social values.

All communities in high-risk urban-interface areas understand FIREWISE principles.

FY 2006 Milestone

- Complete corporate training module for conservation awareness and require all employees to participate in this training, by 2002.
- Develop an MOU with the Department of Interior to strengthen interagency conservation education to focus on the importance of watershed protection, species conservation, and management for ecosystem integrity and resilience, by 2002.
- Conduct FIREWISE workshops in all high-risk urban-interface areas adjacent to National Forest System lands.

Key External Factors

Cooperate with state, tribal, county, municipal, and local governments.

Appendix C—Reconciling Stewardship Objectives—Assessing Values at Risk

Considerable progress can be made in reconciling stewardship objectives by assessing values at risk at national, regional, and local scales. Emphasizing the agency's strategic objectives, a framework for assessing values at risk can be developed. Specifically, agency objectives for ecosystem health and public safety define national priorities for values to be protected. These objectives and their associated values are:

- Public safety (GPRA SP Objective 4b)
- Watershed protection (GPRA SP Objective 1a)
- Species conservation (GPRA SP Objective 1b)
- Ecosystem resilience (GPRA SP Objective 1c)

At a national level, we are working to integrate information on human development, watershed condition, species and ecosystems of concern, noxious weeds, insects and disease, roadless areas, and plant community/ecosystem conditions by fire regimes. This requires compilation of information on historic disturbance regimes, watershed condition information, and development of a watershed-at-risk map, and completion of the species-at-risk map. An integrated map of relative risk to these values will provide broad-scale context of the challenges for protecting people and sustaining ecosystems at the national level. A standard process for integrating and interpreting this information needs to be developed. National leadership will use this information to refine priorities for annual and long-term performance and accountability.

In assessing risk at the regional level, we need to integrate information including, but not limited to: human development, historic disturbance regimes, watershed condition, species and ecosystems of concern, invasive weeds, insects and disease, roadless areas, plant community/ecosystem conditions by fire regimes. This will require compilation of appropriate information at finer scales of resolution than that compiled for the national risk assessments. Based on regional assessments, priorities for landscape scale analyses and management action can be developed. On-the-ground treatment priorities are then identified by the goals, objectives, and strategies that are linked up through the agency to GPRA strategic goal for restoring and maintaining ecosystem health.

Appendix D—Brief Summary for Future Projections of Condition Classes and Risks

Introduction

The methods, results, and confidence in the future projections of Condition Classes and associated risks in section VI, ''Consequences of Deferral,'' are discussed in detail in a paper by Hann and Hilbruner (2000) titled ''Protecting People and Sustaining Resources—Assessment of Management Options for the Western U.S.'' This paper can be found on the www web site ''fs.fed.us/fire/fuelman.'' Methods for this analysis were based on adjustment and re-calibration for Forest Service lands in the Western U.S. of a vegetation and disturbance dynamics model developed by Hann and Bunnell (In Press) for the contiguous Lower 48 States.

This appendix provides a brief overview of methods and limitations of the modeling projections.

Methods

A landscape succession and disturbance network model was developed for the assessment of the cohesive strategy options in the Western U.S. (Hann and Hilbruner 2000) using the Vegetation Dynamics Development Tool (VDDT) (Beukema and Kurz 2000). The model that was developed used Condition Classes as states and incorporated probabilities for succession, unplanned disturbances (such as fire), and planned disturbances (such as mechanical and prescribed fire restoration).

The concepts of this type of model of multiple succession and disturbance pathways were first developed by Egler

(1954). These concepts were incorporated with other information into the development of conceptual succession and disturbance models by Noble and Slatyer (1977). Conceptual succession and disturbance models were combined with ecosystem specific information into computer models by Kessell and Fischer (1981) and Keane *et al.* (1989 to predict response over time of the interactions of vegetation succession and disturbance dynamics. As space and time pattern and process concepts developed in the field of landscape ecology, these models were further advanced (Forman and Godrun 1986, Turner *et al.* 1989). State and transition model concepts were further expanded with findings on multiple pathways and steady states in rangelands by Tausch *et al.* (1993).

The accumulation of this long history and wide variety of kinds of spatial and temporal landscape modeling were fully implemented to support an assessment of management implications that included characterization of the historical range and variation, as well as future outcomes of management option for the Interior Columbia Basin Ecosystem Management Project (ICBEMP) by Keane *et al.* (1996) and Hann *et al.* (1997 and 1998).

Dynamic relationships of basic landscape vegetation, disturbance, and hydrologic regimes were then linked with aquatic and terrestrial habitat and species population characteristics to characterize basic relationships and project future outcomes (Lee *et al.* 1997, Raphael *et al.* 1998, Wisdom *et al.* 2000). Similar linkages were developed with social and economic variables to characterize basic relationships and project future outcomes (Haynes and Horne 1997). Further developments have resulted in development of the Tool for Exploratory Landscape Scenario Analyses (TELSA) (Kurz *et al.* In Press) and the LAND and fire planning model which have been designed to support assessment of ecosystem status and risk variables, and prioritization of restoration opportunities to improve status and reduce risk (Hann and Caratti 2000).

Much of the understanding developed from the comprehensive scientific assessment and evaluation of management alternatives for the ICBEMP (Quigley *et al.* 1996, 1997, 1999) became the foundation for the modeling effort described briefly in this appendix and by Hann and Bunnell (In Press) for the Lower 48 states and Hann and Hilbruner (2000) for the western U.S. The modeling effort used the description of the present conditions for the western U.S. from Hardy *et al.* 2000.

Succession and disturbance probabilities were developed by determining average rates for the Fire Regimes and between each Condition Class. The model was calibrated for the historical range and variation (HRV) by repeating 10 runs per simulation (to get average, maximum, and minimum) until succession and disturbance probability combinations were found that could represent the fire regimes. The model was then calibrated from the late 1800s to the present by activating disturbances associated with post-Euro-American settlement, fire suppression, and management activities. The methods for this calibration were similar to those for calibration of HRV in that 10 runs per simulations were conducted until the projected conditions at the year 2000 and the trends of Condition Class and wildland fire graphs were similar to those of the published literature (Agee 1993, Hardy *et al.* 2000).

Two future options were calibrated using the combined understanding gained from the HRV and post-settlement calibration, with adjustments for future management option projections. The two future management options were: (1) Continuation of current management using the current levels of prescribed fire and fuel management combined with current levels of other activities (such as timber management, range improvement, wildlife habitat restoration, watershed restoration); and (2) implementation of the cohesive restoration strategy. In comparison to the HRV and post-settlement calibrations, these were relatively simple to calibrate, since the current levels of activities and the cohesive strategy level of activities were known entities.

Attributes for projections of loss of life and property, severe event degraded ecosystems, and relative risks of smoke/air quality, native species endangerment, and stream/watershed were developed using correlation of trends in landscape Condition Classes and assumptions similar to relationships found within ICBEMP (Quigley *et al.* 1999), but adjusted for conditions in the western U.S. (Elmore *et al.* 1994, Flatherer *et al.* 1994 and 1998, Hann and Caratti 2000, Hardy *et al.* 2000, Leenhouts 1998, Mangan 1999).

Loss of life and property was based on the relationship between firefighter fatalities and property losses correlated with amount of uncharacteristic wildland fire events. The amount of severe event degraded ecosystems was projected based on the correlation of uncharacteristic wildland fire events with high risk conditions. Relative risk of smoke/air quality was correlated with tons of particulates produced for both wildland fire and prescribed fire events. Native species endangerment patterns were correlated with the number of species of concern in the western U.S. and cumulative effect patterns of association with loss of habitat quality. Stream and watershed risk was correlated with effects of uncharacteristic wildland fires in cumulation with other effects. Many of the risks (such as land use or human disturbance on adjacent lands) that cause cumulative negative effects to native species, air quality, and streams and watersheds are not reduced by restoration on Forest Service lands. This was factored in to the model relationships.

Three key assumptions served as a basis for the Condition Class, disturbance, and associated attribute modeling:

Assumption 1—based on the landscape pattern and causes of fragmentation findings from ICBEMP, it was assumed that a step-down prioritization would occur that would identify priority watersheds to be restored. The watersheds would be selected based on high composition of Fire Regimes I and II and opportunities for maintenance of low risk or reduction of high risk conditions. However, once a priority watershed was selected, restoration activities would be designed to restore habitats and regimes across all Forest Service lands within the watershed, irrespective of the Condition Class and Fire Regime. This would achieve a landscape approach to restoration. This would avoid a fragmented outcome associated with the fragmented landscape pattern of Fire Regimes I and II that often occur in association with variation in elevation, terrain, road access, or history of land use within the watershed. In turn this would restore wildlife and fish habitats, and hydrologic and air regimes at a watershed scale, thus providing a positive outcome to those resources.

Assumption 2—based on aquatic native species strongholds and vulnerability of wildlife species, air quality and hydrologic regimes to the combination of land use, human activities, and proposed restoration; the step-down prioritization would result in an integrated design as described by Reiman *et al.* (2000). This would assure that vulnerable native species or ecosystems would not be selected for restoration activities that could cause a decline in these resources. This would also assure that watersheds selected for restoration would be restored in an integrated fashion, such that vegetation and fuel restoration activities would be paralleled with the necessary road, stream, and watershed restoration activities that would cumulatively result in a healthy watershed.

Assumption 3—the future projections assumed a minor level of continuation of increasing drought and warming temperatures in both management options. However, for the future projections of the cohesive strategy it was assumed that a landscape approach to restoration would occur. This would result in a re-patterning of the fuels and vegetation such that the present contiguous high risk fuel bodies would be restored to a pattern somewhat similar to that of HRV, thus resulting in lower risk of uncharacteristic wildland fire event continuity or continuation of uncharacteristic succession/disturbance momentum. For the cohesive strategy, this assumption resulted in the slowing of succession rates to higher risk Condition Classes and lowering of probabilities of large uncharacteristic wildland fire events.

Limitations of Modeling

There are considerable limitations to this type of general modeling at a scale that accounts for all Forest Service lands in the western U.S. Modeling could be much more precise with more detailed pixel modeling using refined stratification of succession, disturbance, and attribute parameters, such as accomplished by Keane *et al.* (1996) with the Columbia River Basin Succession Model. However, given experience with validation of this and other detailed spatial and temporal geographic information systems, it is unlikely that the relative differences between the outcomes of the two options would change substantially with more detailed modeling. This appears to be particularly true at the broad scale of Forest Service lands in the western U.S.

One key caution is emphasized relative to use of the projected outcomes:

Caution—the strength of this type of modeling is in reliance on relative differences and not on the absolute. The absolute value of the area for a Condition Class, disturbance effect, or associated attribute class does not have high confidence at this scale. However, the relative difference (percent difference) between management options for the Condition Class, disturbance effect, or associated attribute class has fairly high confidence. This is because the confidence in relative differences between management options for the same attribute class increases with increasing size of summary area, while the confidence in the absolute area of an attribute class decreases with increasing size of summary area (Hann *et al.* 1997).

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