FIRES IN THE WILDLAND URBAN INTERFACE: DILEMMAS OF DUALITY and the ROLE OF NATIONAL SCIENCE LEADERSHIP

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Summary

Wildland fires are inevitable natural events. Fire is a major force in shaping ecosystems. But fires can inflict great damage and suffering when they occur in environments heavily inhabited by humans and their structures. This inherent duality - ecological agent and destructive force - creates many dilemmas in fire policy formulation and management. These dilemmas have been exacerbated by the explosive growth of the wildland urban interface and the rapid accumulation of vegetation.

To better inform policy and fire management debates and better prepare citizens to live in fire-adapted ecosystems, the science community must continue to provide analytical judgment and ask hard questions in the face of volatile political agendas and narrow representations of the wildland urban interface problem. The role of science is help us avoid taking the systems that create the urban interface problem for granted. Emerging science can emphasize the couplings in integrated human/biophysical systems, find new ways to quantify the variability and uncertainties in these systems, more reliably forecast the occurrence of damaging fire events, and characterize the possible consequences of policy options.

National leadership in science can better describe the national wildland urban interface problem and how its intersects with large scale processes such as global climate change; encourage integration of knowledge about natural and technological hazards; develop and advocate a national vision and agenda for hazards research; mobilize the science community to use natural disasters as "knowledge creation" opportunities; and develop a common, results-oriented model for planning research, development, and application in wildland fire and other natural hazards.

Wildland Fire as a National Natural Hazard

The extreme fire season of 2000 focused national attention on the destructiveness and the costs of wildland fire. More fires burned than in any other year in the last 50 years - 89,740 fires burned 7.2 million acres. More than 850 structures were destroyed. Communities in New Mexico, Colorado, Montana, and Idaho were besieged by fire and smoke, and valuable economic and social infrastructure was destroyed or threatened, including the Los Alamos National Laboratory.

The fire season started in January in Florida and ended almost full circle back in Tennessee and in Virginia's Shenandoah National Park in November. At its peak, August 20 and 21, 69 separate fires each greater than 1,000 acres were burning at once. There were so many fires burning that the national supply of firefighting resources was completely exhausted. Some fires were left to burn in the absence of adequate resources. The largest acreage burned in one day was 168,929 acres on August 21. The three largest fires were averaged a quarter million acres apiece. At one time (August 29th) there were 28,462 people fighting fire, including federal agency, civilian, state, military (National Guard, Army and Marines), rural fire departments, and international firefighters from Australia, New Zealand, Mexico, and Canada.

But the 2000 fire season was only a part of an ongoing trend in wildfire activity. On the average, about 67,000 fires annually burn about 2.7 million acres. This average has been increasing since 1980, punctuated more frequently by extreme fire years. Fuels accumulation, suburban sprawl, and weather extremes have led to increased fire hazard and risk of damages. At the same time, fire suppression efforts are becoming more complex and unpredictable. Consequently, wildfire costs and damages have been rising. Wildland fire management and suppression cost federal and state agencies more than two billion dollars a year. According to the National Fire Protection Association, wildland-urban interface fires from 1985 to 1994 destroyed 8,925 structures. Additional billions are spent by state and local agencies, and lost in property, resource, and economic impacts.

In 1994, wildfires raged across the country and burned more than 1.5 million acres, killing 34 firefighters from federal, state, and local agencies. The Florida wildfires of 1998, 1999, and 2000 resulted in billions of dollars of damage to human structures, infrastructure, loss in value of timber and other resources, and disruptions in social and business patterns. The 1998 fires burned 500,000 acres and destroyed 337 homes; in 1999, 360,000 acres burned and 64 homes were destroyed. The estimated impact of the 1998 fires was $800 million incurred by local communities, timber owners, the tourism industry, and taxpayers who footed the $100 million suppression bill. In 1999, two large fire complexes (Kirk and Big Bar) in California cost $178 million to suppress and resulted in hundreds of millions in damages, loss of structures, and ecological rehabilitation.

Public concern about wildfire losses has grown to national proportions. The National Research Council and the Federal Emergency Management Agency (FEMA) recognized wildland fires in Oakland, California (1993) and Florida (1998) as among the defining natural disasters of the 1990s. Damages from these catastrophic fires have been compared to 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. This fire destroyed 454 structures, although it only burned 1,600 acres in a densely populated area.

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.

Loss of civilian life due to wildland fire is rare but not unknown. In 1991, 25 lives were lost, 150 people injured in the Oakland fire. 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. History holds a reminder of what is possible, however. In 1871, the Peshtigo Fire in Wisconsin took 1500 lives, the 1894 Hinckley Fire in Minnesota claimed 418, and the 1881 Michigan Fire resulted in 169 deaths.

Budget increases signal a growing emphasis in the federal and state sectors on wildfire protection, especially in the wildland urban interface. In response to the fires of 2000, President Clinton asked Secretary of Interior Babbitt and Secretary of Agriculture Glickman to recommend how to respond to the year's severe fires, reduce the impacts of fires on rural communities, and ensure sufficient firefighting resources for the future. This report has since been developed into a multi-billion dollar, multiple agency National Fire Plan. The plan attacks the fire problem on five fronts: firefighting capacity; restoring landscapes and rebuilding communities; reducing fire risk through fuels treatment; and working with communities to reduce fire hazards.

The Wildland Urban Interface - Nexus of the Dual Roles of Wildland Fire

Wildland fires are inevitable natural events. Fire is a major force in shaping ecosystems. But fires can inflict great damage and suffering when they occur in environments heavily inhabited by humans and their structures. This inherent duality - ecological agent and destructive force - creates many dilemmas and complexities in policy formulation and management.

These dilemmas have been exacerbated by the explosive growth of the wildland urban interface and the rapid accumulation of vegetation. As human populations expand out to be adjacent or mixed into the wildland, more private property is exposed to losses from catastrophic wildland fires. Recent geographic analyses estimated that 7.2 per cent of the land area of the conterminous U.S. and 14.4 per cent on the population (38.6 million people) live in fire-impacted urban interface areas (Sampson 2000). This includes the true interfaces, where subdivisions are adjacent to wildland vegetation as well as intermix areas where structures are scattered more widely through the landscape.

Fire, and the absence of fire, has been major forces in shaping the ecosystems in which wildfires burn today. Compared with preindustrial times, wildland fire incidence has decreased ten fold in response to aggressive fire suppression and land use changes. The unintended consequences of these changes, in combination with logging and livestock grazing have been significant changes to vegetation composition and structure - especially in short interval fire-adapted ecosystems in the Interior West.

While representing protection for economic development, the decrease in wildland fire has destabilized many forested ecosystems that depended on periodic fires to maintain healthy functions and processes. Understory vegetation has become so dense that wildland fires that do occur are larger and more severe than the historical fires. These extreme fires can have catastrophic effects on ecosystems and the human communities that depend on them. The severity of these fires poses threats to species persistence, watershed integrity, and community resilience. Extreme fire behavior can result in loss in soil productivity and site stability, increase sedimentation in streams and water supplies, degrade or destroy critical habitat for fish, wildlife, and plant species, including those at risk of extinction, and increase the spread of invasive weeds or non-native plants. Such fires also emit millions of tons of gases and particulate matter into the air, with serious consequences for human health and carbon balances that contribute to global climate change.

The ecological prescription for this situation is to return fire, on the proper terms, to these fire-adapted ecosystems. It is not simply a matter of letting wildfires burn, because many of these systems are already primed to support severe fire behavior and are festooned with human values at risk. Frequent, controlled fires - so called prescribed burning - can be an antidote for sporadic, catastrophic fires. However, many of these systems have missed so many natural fire intervals that mechanical thinning may be necessary to safely restart natural processes. Fire managers are rapidly increasing the use of prescribed fire and thinning, but these efforts pose their own risks and controversies, illustrated vividly in the unfortunate case of the Cerro Grande prescribed fire escape.

The principal dilemma is that these fire-adapted ecosystems are also home to an expanding wildland urban interface. To protect the interface by reintroducing the very agent it's being protected from is a tricky proposition. While in the long run, a well-functioning fire-adapted system will have fewer catastrophic fires, the side effects such as smoke and prescribed fire escapes may be unacceptable to the human communities in the short run. A number of critical tradeoffs emerge. For example, constraining prescribed fire use to ensure public health or minimize the chances of prescribed fire escapes may inadvertently increase risks to human safety. In an indirect way, these land management practices will also influence the decisions of future residents to live in fire-adapted ecosystems. Assurances of protection through aggressive fire suppression and fuels management can create a "moral hazard" that encourages residents to build in areas, further exacerbating the problem.

The wildland urban interface deserves a place on the national agenda. Protecting structures and lives in the wildland urban interface imposes costs and impacts on the entire country. This mixing of the wild and urban worlds create many hidden costs, including:

- Higher levels of firefighting preparedness in anticipation of wildland urban interface fires
- Higher suppression costs to protect structures
- Firefighter safety jeopardized under strategies to aggressively protect structures
- Contribution to critical resource shortages during "peak loads" from multiple fires.
- Complex fuels reduction efforts to minimize side effects
- Litigation and administrative appeals from controversial treatments
- Ecosystem restoration work foregone
- Payoffs by insurance companies (their policyholders) for fire protection

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.

The federal role goes beyond firefighting. Most of the long-term changes in the fuel bed, at least in the West, are influenced by federal land management practices. Fire, like recreation and timber harvesting is one of the major activities on a landscape. The federal government manages about 415 million acres of fire-adapted land in the conterminous United States. More than 71 million acres of this land is considered to be high risk to human and natural resource values because of the over accumulation of fuels and the increasing potential of high-severity fires. These lands will require extensive restoration and mitigation through prescribed burning and mechanical fuel removal. Another 141 million acres pose a moderate public safety and ecological risk and need attention lest they rapidly degrade to a high-risk condition.

The Interface - An Interaction of Ecological and Human Systems

The wildland urban interface is the interaction of two major systems - one biophysical, the other human. Successful management of this condition must be based on knowledge about both of these systems. The likelihood of high-severity fires in important ecosystems and vulnerable wildland-urban interface areas is increasing rapidly (physical process). The severity of these fires is potentially rising because of fuels accumulation (biological and human fire exclusion policies). The rising costs and losses from these fires are being driven by urban intermix proliferation, fire suppression policies, and losses in availability of technically qualified fire fighters (human processes). The most effective strategies for reducing losses while maintaining the beneficial effects of fire can only be developed if we understand how these different processes interact in different settings.

No forest can be made fireproof. Efforts to reduce hazardous fuels and restore fire-adapted ecosystems must be coupled with efforts to encourage and assist citizens to take preventative actions in their own communities and to accept the ecosystem management activities required in restore the fire-adapted system that they inhabit. For example, research and practical experience suggest that the most effective way to reduce risk of fire to homes is through fuels treatment carried out within 200 feet of building structures (Cohen 2000). Many homes can survive wildland fires if the homeowner gives proper attention to fire-safe construction and landscaping. Homes with high ignitability factors, such as wood roofs, pine needle accumulation on roofs and in yards, and firewood piles next to houses frequently suffer more severe fire damage. Yet many homeowners fail to take preventative action. Policy and the science that informs it must deal with these human motivations and decisions just as they deal with the ecological processes.

The Roles of Science in the Wildland Urban Fire Problem

Science cannot solve the urban interface fire problem, but there are several roles science can play in helping policymakers and others deal with it more effectively and efficiently.

Many policy questions surround the wildland urban interface problem. Whose responsibility is it to assure fire-safe construction and landscaping? How much discretion should be given to managers to let ongoing fires burn? How can we justify harvesting trees to reduce the fire risk to human communities? These policy questions are confusing and often come disguised as science questions. If it is science's role to inform these questions without advocating an outcome or policy solution, there are several areas where we could contribute.

* Understand the interactions of biophysical and human systems that comprise the urban interface. Characterize the driving forces for fuels accumulation and urban sprawl better, show where they are likely to intersect, and suggest, "leverage points" for modification of these trends.

For example, remote sensing has opened up tremendous opportunities to understand both ecological and human processes at a variety of scales. These capabilities hold great potential for tracking landscape development patterns, vegetation changes and fuel buildups in urban interface areas, fire behavior and smoke dispersion of prescribed fires and wildfires. But these data must be analyzed against relevant conceptual models of the urban interface system if they are to be useful in policy and management.

* Find new ways to quantify variability and uncertainty in human-hazard systems. Apply the emerging perspectives of complex and chaotic systems to the fire problem. Use these to describe the

range of possible consequences of policy actions. Remind managers about the extent of the variability and the status of the knowledge base for their actions.

Wildland fire as a system has some unique elements of uncertainty. Fires are certainly more numerous than most other hazard events, they occur quite dispersed over the landscape and almost simultaneously once threshold conditions are met. The implications for fire management are severe; a large control force must be available to handle the peak loads. We have little knowledge about what these systems would do in the absence of control; since at least the 1930's we have always had an active suppression force. A perplexing complication is that human structures are part of the burning medium, so that the values at risk are actually part of physical propagation of the fire. The juxtaposition of a home and its ignitability can therefore impact the risk of adjacent homes, so the spatial configuration of the urban interface becomes important in characterizing the fire risk. Within the fire event, there is great spatial and temporal variability in the fire's intensity and consequently its effects. The implication is that not all fires are all destructive, and the heterogeneity in fire effects can create variety that is ecologically beneficial.

* <u>Predict with greater lead-time and/or with greater accuracy the occurrence of damaging events</u>.

A large part of fire costs and damages are caused by a small number of large and intense fires, often occurring simultaneously. Wildfires undergo rapid and unpredictable transitions to these high levels of severity. Much damage, human injury, and loss of control occur because of the speed and force of these changes.

Scientific understanding about large fire behavior is not mature enough to support reliable predictive models. Greater knowledge is needed to quantify the characteristics of large, catastrophic fires and multiple fire patterns if we are to effectively locate and move firefighting forces and protect firefighters from volatile situations. Poor prediction can mean the difference between life and death to a fire crew, between a successful prescribed fire and escaped fire debacle.

* <u>Ask hard questions about the role of fire and the basis for management strategies.</u> Explore different frames of the wildland urban fire problem and provide analytical and comprehensive judgments about the potential consequences of policy options without judging the goodness or badness of the policies.

The Role of National Science Leadership

What should leadership at the national level be doing to legitimize and realize the roles of science in the wildland urban fire problem? Here are a few suggestions.

* <u>Characterize the long-term, big-picture perspectives of the problem</u>. Maintain the course for deeper scientific understanding of ecological and urbanizing systems, even if the public and agencies are transfixed on individual events and urgencies of emergency response.

Part of this responsibility is in describing how patterns in wildland fire and other hazards interact with vegetation condition and land fragmentation, demographic trends and large scale processes such global climate change, invasive species movements, and airborne transport of air pollutants. This requires a continual trading of results and ideas among the among the scientific disciplines in the natural hazards fields. National leadership can create opportunities for this exchange and develop incentives for interdisciplinary work.

* Encourage a blending of knowledge about natural and technological hazards. Much of the thinking about how to deal with technological risk has begun to take hold in the public psyche. A common risk management terminology and framework applied to all hazards would facilitate communication and help citizens and managers make more informed tradeoffs. Wildland fire in the interface involves hazards from natural processes and those either influenced or introduced by the technology of fire fighting and fuels treatment. In addition, because fire easily spreads from one environment to another - structures, industrial facilities, wild lands, and others - more coordination between research efforts in wildland and structural fire would be beneficial.

* Advocate a national agenda for hazards research and development. This would incorporate wildland fire in a national vision of hazard-resilient communities. This vision would demonstrate why science-based hazard management makes sense and would be the basis for a political constituency for hazard research. It would require closer coordination at high levels in the planning and funding of research on wildland fire and other hazards.

* Organize and mobilize the science community to use natural disasters as "knowledge creation" opportunities. Provide systematic approaches for learning from the events and in integrating the lessons into management and policy. Develop protocols and support scientists to study these human and biophysical systems as events unfold.

This rapid response capability would allow scientists to (a) initiate research quickly to preserve perishable data and insights (b) identify research and technology transfer needs (c) better understand the implications of response and rehabilitation measures, (d) advise managers on the state of the science and the implications of their decisions.

* Develop a universal, results-oriented model of research, development, and application in wildland fire and other natural hazards. This R&D framework that would be used by all agencies, and would proscribe a systematic approach for determining user needs and science gaps and translating these into research and development programs with minimal duplication of effort. It would also contain incentives for joint efforts to effectively and efficiently solve natural hazards problems.

Research Needs Specific to Wildland Urban Fire

Following is a summary of research needs identified in a research review sponsored in 1999 by the Subcommittee on Natural Disaster Reduction (SNDR) of the Committee on Environment and Natural Resources (CENR) of the National Science and Technology Council. The SNDR is made up of representatives from Federal agencies that address natural hazards. Research needs are expressed as key questions in six major categories.

Problem Extent

- What is the extent, nationally, of the wildland urban interface fire situation? Is the situation getting worse?
- What are the most important factors in assessing and predicting the status of this situation?

- Why do some areas have heavy vegetative fuels and suffer relatively little structural loss, while others incur heavy losses even in more moderate fuels conditions?

- How do the locations of buildings and other attributes contribute to vulnerability?

- What is the total cost of fire losses in the wildland urban interface? How does the economic impact of these losses and the mitigation and fire control employed to reduce them compare with other natural disaster losses?

<u>Management of Fire Events in the Interface</u>

- What are the primary judgments and decisions required in managing fires in urban interface areas?

- What are the information needs most important in improving the quality of those decisions?

- How do these judgments and their information needs differ from those required in wildland fire situations?

- What are the possible scenarios that fire managers might face in an urban interface fire and what options are available for responding to these contingencies? How do these scenarios unfold under varying levels of fire fighting force intervention, fire behavior, fuels, infrastructure, and other variables?

- What is the best method of representing wildland urban interface fire risks for resource allocation and strategy formation?

<u>Social, Political, and Institutional Dimensions</u>

- How can social cultures change to more effectively live in fire-adapted ecosystems?

- What beliefs and attitudes determine whether wildland urban interface residents will take responsibility for reducing the vulnerability of their homes?

- What methods are most effective in educating the public about fire-safe options and making crucial tradeoffs in the development of building and land-use codes?

- What policies will encourage fire-safe behavior by residents and communities? What are the expected consequences of blending homeowner responsibility, community-level planning and preparation, building and fire code compliance, fire department preparation, and vegetative fuel management into overall programs to reduce wildland fire losses?

- Who gains and who loses under different institutional approaches (command-and-control, incentive, and information-based) to reduce wildland urban fire losses?

- What legal liability issues might discourage prescribed burning, mechanical fuels reduction, and other forms of mitigation?

<u>Hazard Behavior</u>

- What dimensions of fire propagation behavior at what spatial resolutions will provide the most useful information for fire effects, emissions management, and fire control, and other purposes in wildland urban interface areas?

- How can non-vegetation fuels such as structures be incorporated in models of wildland fire behavior?
- How does the spatial arrangement and pattern of mixed vegetation/structural fuels influence the propagation of fire?

- How can we determine whether available data is accurate enough to minimize costly mistakes in fire resource allocation?

- How can we better predict and monitor smoke plume development and dispersion in prescribed fires and wildfires?

Exposure Modification

- What are the reasons for structural involvement in wildland urban interface fires (e.g. vegetation proximity, roof construction, litter) and how much of this ignitability is preventable under different wildland fire scenarios?

- How can we quantify the ignitability of different structures and settings and incorporate this characterization into risk rating systems?

- What elements (building types, construction materials, contents, spacing, etc.) of the wildland urban interface community need to be quantified to accurately assess the relative riskiness of different interface communities?

- What are the most important structural setting modifications in managing wildland urban interface risk and what is the risk reduction return to investments in these modifications?

Prediction and Warning Systems

- What weather factors need to be tracked diagnosed and predicted to enhance fire management success in wildland urban interface areas? At what spatial and temporal resolution? In what forms?

- What are the modeling and data requirements for integrating meteorological data and forecasts into products and services to assist fire decisions in wildland urban interface areas?

- What predictions are needed to improve decisions to preposition fire and emergency management resources, activate concentrated prevention programs, and evacuate residents?

- What is the cost-effectiveness of investments in alternative forecasting techniques?

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Appendix A: Federal Fire Management

The six main agencies that have provided the biggest part of the fire protection program include: U.S. Department of Agriculture Forest Service, and the Bureau of Land Management, Bureau of Indian Affairs, U.S. Fish and Wildlife Service, and the National Park Service in the U.S. the Department of the Interior, and the Department of Defense. These agencies provide the primary fire protection for federal land area in the U.S. State forestry agencies in cooperation with volunteer fire departments protect state and privately owned wildlands. These agencies maintain protection organizations consisting of aerial and lookout detection networks, prevention and law enforcement patrols, engines, crews, helicopters and fixed wing aircraft, and large caches of firefighting equipment. In addition to firefighting, the Forest Service provides fire protection services and training in areas such as fire behavior, smoke management, prescribed burning and fuels management, prevention, and other functions to the states.

National Wildfire Coordination Group (NWCG)

Much of the cooperation among these and other fire management agencies occurs under the auspices of the National Wildfire Coordination Group (NWCG), an interagency confederation chartered in 1976 to provide leadership in establishing and maintaining consistent nationwide policies, standards, and procedures for wildland fire management. The purpose of the NWCG is to coordinate the programs of the participating agencies so as to avoid wasteful duplication and to provide a means of constructively working together.

The NWCG is comprised of one representative each from the 5 federal agencies, including one from Forest Service Fire Research, the National Association of State Foresters, the Intertribal Time Council, and FEMA (U.S. Fire Administration). Plans are for the DOD to also become a member. Associate members include the National Fire Protection Association and the Fire Control Officers Group of

Australia and New Zealand. The NWCG meets three times a year to work through issues of standardization, coordination of efforts, and cooperation in solving common problems. The NWCG has 13 working teams that develop training, qualification, and communication programs, which are implemented by the member agencies.

The NWCG is the keeper of the National Interagency Incident Management System (NIIMS) that is now used by many domestic and international agencies in pre-planning and implementing interagency responses in a wide range of natural and technological disasters. Some of the major accomplishments of the NWCG include: implementation and refinement of NIIMS; development with the National Fire Protection Association of the FIREWISE concept for educating residents and communities planners; standardized job qualifications for incident operations and a supporting training program; uniform procedures for record keeping and other fire business practices; in depth analysis of fire line safety issues and implementation of improved safety practices; improvements in the interagency network of fire weather stations and the national fire danger rating system; automated systems for tracking the availability of national firefighting resources; consistent sets of fire use and fire education messages; and standards for fire chemical use, air tanker and helicopter operations, fire cache and safety equipment and radio communication frequencies.

Federal Wildland Fire Management Policy

The need for interagency cooperation and coordination is especially critical in wildland fire protection. This need was articulated in the 1995 Federal Wildland Fire Management Policy and Program Review (USDA and USDI 1995) and was strengthened in the recent 2000 Review of the 1995 Federal Fire Policy (USDA and USDI 2000) and its implementation. These reports set down and amplify guiding principles for fire management, including the role of fire as an essential ecological process that should be incorporated into planning for sustainability, sound risk management, safety, and cost-effectiveness as bases for making and documenting fire decisions, and the premier importance of interagency coordination and standardization of policies and procedures among federal agencies.

The 1995 Report was the first comprehensive statement of wildfire coordination between the Departments of Interior and Agriculture. The 2000 report, soon to be published, will expand beyond the land management agencies those with supporting programs in science, information, technology, and regulatory activates that affect fire management. Such federal agencies and departments include DOD, DOE, NWS (NOAA), Bureau of Reclamation (DOI), USGS (DOI), US Fish and Wildlife Service (DOI), National Marine Fisheries Service (Commerce) and EPA. Expanded coordination with state, tribal, and local organizations is also being called for. The report will bear down on the need for better interagency coordination and interdisciplinary problem solving as the only ways to fully implement the 1995 Federal Fire Policy. The report recommends a senior-level interagency mechanism to ensure that the Federal Fire Policy is implemented and adds important provisions to more fully incorporate ecosystem sustainability, sound science, education, communication, and program evaluation.

The Cohesive Fuels Strategy

The Cohesive Strategy for catastrophic fire reduction was developed by the USDA Forest Service for National Forest lands (USDA Forest Service 2000). The strategy outlines a plan for reducing wildland fire threats and restoring 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 timing are key to restoring healthy, resilient conditions; sustaining natural resources; and protecting people. The strategy introduces institutional objectives tied directly to GPRA goals, establishes program management priorities and cost estimates, and confirms the importance of expanding constituency support. The strategy also outlines a supporting research and development effort (see below).

The strategy outlines an ambitious 15-year program of treatment at 3 million acres per year in the Interior West, with additional efforts to maintain the relatively safe fuels conditions in the South and elsewhere. The strategy concentrates treatment on areas where human communities, watersheds, or species are at risk from severe wildfire. It relies on a variety of treatment options to achieve objectives in wildland-urban interface areas, municipal watersheds, and habitats of threatened and endangered species. Immediate treatment efforts are concentrated in the shorter interval fire-adapted ecosystems that depart the farthest from the historic range of variability and are in close proximity to human communities.

The Forest Service has already embarked on the strategy and is seeking progressive increases in funding to support it. The strategy has become the basis for the fuels component of the National Fire Plan (see below). The Department of the Interior is also developing a strategy. Plans are to meld the two departments' strategies into a comprehensive strategy for fuels management on federal lands.

<u>The National Fire Plan</u>

In response to the fires of 2000, President Clinton asked Secretary of Interior Babbitt and Secretary of Agriculture Glickman to prepare a report that recommended how to best respond to the year's severe fires, reduce the impacts of fires rural communities, and ensure sufficient firefighting resources for the future (USDA and USDI 2000). This report has since been developed into a multi-billion dollar, multiple agency National Fire Plan for dealing with the wildfire problem. The report recommended a FY 2001 budget, which was approved by the Congress, for the wildland fire programs of the Departments of Agriculture and the Interior of $2.8 billion, an increase of nearly $1.8 billion above the President's original FY 2001 budget request. This includes additional funding for fire preparedness resources, cooperative programs in support of states and local communities, and fuels treatment and burned area restoration.

The plan also included a substantial increase in the research activities of the federal agencies for the development of science and technology to support firefighting, rehabilitation and recovery efforts, fuels management and risk assessment, and the social and economic impacts of fire and fuels management. These increases are expected to continue in future budget cycles, and signal a growing emphasis in the federal and state sectors on wildfire protection in the wildland urban interface.

The plan was funded to attack the fire problem on five fronts:

<u>Making All Necessary Firefighting Resources Available</u>. The Departments will continue to provide all necessary resources to ensure that fire suppression efforts are at maximum efficiency in order to protect life and property. The increased funding would provide the Departments' fire management organizations with the capability to prevent, detect, and take prompt, effective action to control wildfires. These funds also would support the personnel, equipment, and technology necessary to conduct proper planning, prevention, detection, information, education, and training.

<u>Restoring Landscapes and Rebuilding Communities</u>. This includes assessing the economic needs of communities and committing financial resources to assist individuals and communities in rebuilding their homes, businesses, and neighborhoods. It also includes investing in landscape restoration efforts to protect public health and safety, unique natural and cultural resources, and lands susceptible to non-native invasive species.

Investing in Projects to Reduce Fire Risk. Reducing the brush, small trees, and downed material that have accumulated in many forests through significant investments to treat landscapes through prescribed fire and thinning. A locally led, interagency effort of integrated fuels treatment teams will prioritize projects targeted at communities most at risk, coordinate environmental reviews and consultations, facilitate and encourage public participation, and monitor and evaluate project implementation. Included would be efforts to develop markets for traditionally underutilized small diameter wood and other biomass.

Working Directly with Communities. This will include expanding community participation in efforts to reduce fire hazards, improving local fire protection capabilities, and expanding outreach and education to homeowners and communities about fire prevention through use of programs such as FIREWISE.

Being Accountable. The plan established a Cabinet-level coordinating team to ensure that the actions recommended receive the highest priority and would be evaluated based on consistent performance measures.

Appendix B. Federal Wildland Fire Research

Responsibility for developing new knowledge about wildland fire belongs solidly with the federal government. The USDA Forest Service and the US Geological Service are the principal research organizations for the interagency fire community, although there are many associated research activities in the DOE (national labs), NASA, NOAA, EPA, and others. Several universities and private consulting groups also provide do fire research and development.

The Forest Service has a core of researchers specializing in fire with a history of close cooperation with fire management in both the Forest Service and Interior. Fire operations today benefit from wise investments made in USFS fire research in previous years, but improvements to meet the future demands in fire management will require aggressive investment in R&D. Up until 2001's infusion of funding from the National Fire Plan , the USFS R&D fire research capacity had been severely constrained. While fuel and fire management budgets had increased in FS and DOI agencies, the FS R&D budget for fire research had remained level. Since 1985, FS staffing for fire research has gone from 60 scientists to 23, and the budget from 16% of total fire expenditures to less than 2%. The need for more fire research has been widely recognized. Further increases expected over the next 10 years under the National Fire Plan.

The first year's (FY 2001) funding from the Fire Plan allowed the Forest Service to invest an additional $26 million in research capacity to improve firefighting capacity, evaluate the effectiveness of rehabilitation treatments, develop new strategies to manage fuels, and better understand the human dimensions of the fire problem.

The Cohesive Fuels Strategy (see above) contains a proposed program of research and technology development in three major areas.

Quantifying the tradeoffs of fire and fuels management options. This includes (a) evaluating the ecological, environmental, and economic consequences of alternatives for treating fuels, (b)characterizing how fire interacts with other disturbance processes such as windstorms, invasive plants, insects, and disease and (c) developing guidelines for incorporating these tradeoffs into planning processes for land and fire management.

Developing and delivering more effective prediction. This includes (a) improving risk assessment, expert judgment and decision processes for prescribed fire planning and fire suppression, validating and improving fire weather and fire behavior prediction models, and improving the ability to predict and monitor smoke emissions from prescribed and wildfires.

Quantifying fire effects and interactions. This includes (a) developing tools for monitoring and predicting fuels, fire hazards, and vegetation recovery, (b) developing remote sensing tools to estimate fire severity, area burned, and smoke emissions, and (c) evaluating factors that affect the vulnerability of wildland interface communities to fire impacts.

The Joint Fire Science Program

The Joint Fire Science program (JFSP) was established by Congress in 1998 to provide support for the development of information and tools for fuels management. The goal of JFSP to develop consistent and scientifically sound interagency approaches in four primary areas: fuels inventory and mapping, evaluation of fuels treatments, scheduling of fuels treatments, and monitoring of treatment effects and effectiveness. This interagency research and development program does not support permanent salaries or long-term research, but provides funds for competitively selected proposals that are consistent with program goals.

The JFSP is a partnership of six Federal land management and research agencies: USDA Forest Service, and the Bureau of Indian Affairs, Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service, and U.S. Geological Service in the Department of the Interior. The program encourages collaborative research among agencies, universities, and other non-federal cooperators. The program for FY 98, 99, and 2000 issued requests for proposals and funded research, development, and applications work at $ 8 million a year (split evenly between USFS and DOI). Beginning in FY2001, with additional funds provided through the National Fire Plan, the Joint Fire Science program will be funded at $16 million a year.

Biographical Sketch

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Dave's specialty is decision science and risk analysis, about which he has authored numerous papers and done extensive consultation. He was formerly the national decision science specialist in the Forest Service where he developed methods and tools for improving environmental analysis and decision processes and advised policymakers on the human factors and decision behavior implications of policy initiatives. Dave was formerly a Forest Service research project leader in fire economics and management and a professor of forest economics at Oregon State University. Dave has a B.S. and M.S. from Michigan State University and a Ph.D. in economics from Texas A&M University.