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Bridging the Worlds of Fire Managers and Researchers:

Lessons and Opportunities From the Wildland Fire Workshops

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Cover Photo: On the lookout for fires–Mount Siloox, Cabinet National Forest, 1909. (Photo by W.J. Lubkin.)

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ABSTRACT

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In March and April of 2003, over 250 managers, researchers, and other participants gathered for a series of workshops at Oregon State University, the University of Arizona, and Colorado State University, near the largest wildfires of 2002. In response to the need for better understanding of large fires, the Wildland Fire Workshops were designed to create an atmosphere for quality interactions between managers and researchers and to accomplish the following objectives: (1) create a prioritized list of recommendations for future wildland fire research; (2) identify the characteristics of effective partnerships; (3) identify types of effective information, tools, and processes; and (4) evaluate the workshops as a potential blueprint for similar workshops in other regions. Through a series of professionally facilitated workshops, participants worked toward speaking with one voice about many key issues. Although differences emerged among individuals, disciplines, and geographic locations, many common themes emerged. Participants suggested that research should be framed in the larger picture of fire ecology and ecosystem restoration, be interdisciplinary, be attentive to the effects of fire at different scales over the landscape and through time, and be focused on social issues. Effective partnerships occur when direct interaction takes place between people at multiple stages, adequate time is allowed for partnership building, partners are rewarded and held accountable for their roles, and when dedicated individuals are identified and cultivated. Participants identified effective information, tools, and processes as those that are adequately and consistently funded, user-friendly, interactive between people at multiple levels, and often championed by key, dedicated individuals. A survey of participants at the final meeting in Colorado revealed that the workshops did in fact create an atmosphere for positive interactions between managers and researchers, and that with some refinements, similar workshops could be carried out in other regions with productive results.

Keywords: Wildfire, fire, communication, technology transfer, applied research, management, information, partnerships.

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Bridging the Gap Between Managers and Researchers

Veteran firefighter and author Dan Robinson wants to be clear about one thing: his novel, After the Fire, *is not just about fire. The novel deals with larger issues–making tough decisions that put lives at risk on the fire line, for example, and establishing ties with a local community where fires are burning. If* After the Fire *is just a book about fire, then* Moby Dick *is just a book about a whale. In the same sense, the recent Wildland Fire Workshops in Oregon, Arizona, and Colorado were about fire, and much more.*

The Wildland Fire Workshops provided a forum to talk about the 2002 wildfires and to elicit priorities for research from managers; they also offered a place to discuss more comprehensive issues: the role of fire in maintaining ecological sustainability, the desired conditions of future landscapes in light of natural fire cycles and public attitudes, existing partnerships and how they can be improved, processes for delivering information and how to do it more efficiently, and issues of accountability–who will share in which tasks and what are the incentives? The workshops were essentially about wildfires, but discussions covered much more ground–they were not just about fire. As one participant put it: "Fire is the current vehicle in which we are talking about sustainability."

The driving force behind the workshops was the recognition of a trend of increasing land area burned by fires and the associated social, ecological, and fiscal costs. In 2002, more than 88,000 fires burned through forest and rangeland ecosystems in the United States. It was not the number of fires that set records; it was the amount of ground they covered–nearly 7 million acres, almost twice the 10-year average. Aided by a drought comparable in severity to the 1930s Dust Bowl and increasing buildup of flammable vegetation and dead wood (termed "fuels" in the world of fire managers and researchers), the fires of 2002 initiated a heightened awareness of large and politically complex fires, especially in the American West. Three fires in particular–the Biscuit Fire in southern Oregon and northern California, the Rodeo-Chedeski Fire in Arizona, and the Hayman Fire in Colorado–burned over 1 million acres combined and put firefighters, human communities, and ecosystems at risk.

Lessons from the 2002 wildfire season provided insight on the width of the chasm between managers and researchers. Cultural and political differences, the lack of incentives for developing partnerships, and the lack of a common language among groups have worked to create a disconnect between the needs of managers and the current direction of applied fire research–science that is directly applicable to on-the-ground management. Time constraints also have contributed to the width of the chasm, with managers and researchers responding to multiple demands and meeting multiple project goals, leaving little time for managers to keep abreast of current research and little time for researchers to synthesize existing research. In addition, financial support for fire research is modest compared to that of fire suppression, with only a small fraction (less than 2 percent) of the total fire budget allocated to research, creating a culture among agencies to literally and metaphorically put out fires rather than to find solutions to the long-term problem.

With more large fires probable in the future, the escalating impacts of wildfire on natural and human resources, and the need to reduce the element of surprise, the 2002 fire season was important for recognizing the need to bridge the worlds of managers and researchers. This bridge could potentially bring applied fire researchers into the management arena as full partners regarding the understanding of wildfires, the development of appropriate strategies to reduce the occurrence of large fires, the management of real-time incidents, and the mitigation of the effects of fire on ecological and human communities. Although intended for a broad audience in the fire management and research communities, this report is directed toward policymakers and those who make decisions about wildland fire research funding. The report synthesizes the key points of the workshop findings, with an emphasis on common themes among geographic locations.

THE WORKSHOP FORMAT

Participants gathered in the locations where wildfires were most severe and where managers, landowners, and communities had a heightened awareness and concern about the effects of wildfires. In March and April of 2003, more than 250 managers, researchers, and other participants gathered at Oregon State University, the University of Arizona, and Colorado State University. The workshops were sponsored by the Joint Fire Science Program (JFSP), National Fire Plan, and USDA Forest Service Pacific Southwest and Pacific Northwest Research Stations. To achieve a balanced representation of stakeholders, invitations were sent to a diverse array of people with expert knowledge of wildland fire, including managers, researchers, policymakers, educators, and community leaders. Workshop organizers and participants aspired to speak with one voice about wildland fire issues–not so that diverse perspectives were oversimplified, but so that different viewpoints were acknowledged and incorporated into discussions geared toward finding common ground.

Participants and workshop organizers aimed to accomplish the following objectives:

1. Develop a list of prioritized recommendations for future wildland fire research.
2. Identify characteristics of effective partnerships among managers, researchers, and other groups.
3. Identify the types of information, tools, and processes that are effective for practicing fire management and implementing wildland fire research.
4. Qualitatively evaluate the workshops as a potential blueprint for similar workshops in other regions.

With the help of note takers and a professional facilitation group, the workshop objectives were accomplished through a series of keynote presentations, small technical working groups, plenary discussions, and in the case of the Arizona workshop, a field trip to the site of the 2002 Bullock Fire, Coronado National Forest.

SUPPLEMENTARY MATERIALS

Workshop organizers provided participants with background information regarding existing wildland fire research: current projects with the Joint Fire Science Program and National Fire Plan, and highlights of current fire research from the USDA Forest Service Pacific Northwest, Pacific Southwest, and Rocky Mountain Research Stations. Joint Fire Science Program research was particularly relevant to the workshop goals because the program's funding requirements include the existence of researcher-manager partnerships and a component of technology transfer–the planned delivery of scientific information to intended users–in addition to the proposed research. Since its inception in 1998, JFSP has funded 178 projects (as of fiscal year 2002) related to fire effects and fuel treatment effects; planning and preparedness; air quality, smoke management, and climate; social and economic impacts; fire and invasive plants; remote sensing; demonstration-site projects; and administrative studies and local needs projects. The vast body of existing wildland fire research from JFSP and other programs continues to grow; the Wildland Fire Workshops provided an opportunity for researchers to touch base with managers about the direction of their research, a forum for managers to voice their needs regarding priorities for research, and a chance for each group to critically evaluate their existing toolkits.

KEYNOTE SPEAKERS

Over 30 keynote speakers helped set the tone for the workshops and engaged participants to think about wildfires from diverse perspectives (app. A). Speakers represented federal, state, and tribal foresters, political leaders, community activists, university professors and administrators, a veteran firefighter-novelist, and other respected leaders in research and management.

The major themes from keynote presentations were:

- The enormous effort and success of fire suppression

and research in 2002, including community and watershed recovery processes.

- The increased probability of large and politically complex fires owing to fuel buildup, changing vegetation, climate change, and the recognition that a growing human population at the edge of wildlands will increase the complexity of wildland fire management.
- The overwhelming and seemingly ever-increasing budget for fire suppression, juxtaposed with modest financial support for research.
- The importance of trust in building relationships–from individual to agency levels.
- Case studies of effective partnerships with communities at the edge of wildlands.
- Processes for delivering information–opportunities for moving existing tools to end users.
- The importance of tribal issues–from integrating traditional ecological knowledge into management plans to recognizing current tribal needs and partnership opportunities.
- The need for science to play an active role in improving predicting skills, understanding, and mitigation of the effects of large fires and complex interactions occurring at the landscape scale.

Speakers said all this and more. Most notably, the 2002 fire season was recognized as a season of crisis–but with crisis came opportunities to recognize gaps in our knowledge, in our predictive abilities, and in the cultures of management and research. According to keynote speaker Congressman Mark Udall, Colorado, the Chinese symbol for crisis is the combination of two other symbols–danger and opportunity. In their own way, each presenter at the Wildland Fire Workshops described the current wildfire crisis as having a dual meaning: the danger of increasing risk and the opportunity to improve upon current approaches to solving problems.

The American landscape harbors much potential for the communities of people, plants, and animals who live here. Figuring out how wildfire fits in will be a significant challenge in the short and long terms. (Photo by Bob Szaro.)

Sidebar 1. The Bullock Fire Field Trip—Lessons and Opportunities

On March 25, 2003, one day before the Wildland Fire Workshop in Tucson, Arizona, a tour bus departed from the University of Arizona. Winding up the sharp curves of Mount Lemmon Highway, a group of about 20 managers, researchers, and graduate students glanced out the window at Smokey Bear declaring today's fire danger as "moderate." Not so in May of 2002, when the Bullock Fire burned several hundred thousand acres and threatened local communities close to the outskirts of Tucson. Fortunately, communities near the fire were spared as a result of national attention, prior fuel treatments–projects designed to reduce the risk of ignition and potential damage from wildfires–and by the efforts of many dedicated firefighters. But what were the specific lessons learned from the Bullock Fire? What opportunities for research did managers identify during and after the fire? These were questions addressed at a number of sites during the Bullock Fire field trip.

Geology Vista–Looking out over the Coronado National Forest, site of the Bullock Fire, a team of managers and resource specialists related the events of the fire. It started small but spread rapidly because of dry conditions, wind, and difficulties with working on steep terrain. After an unsuccessful attempt to stop the fire at a major ridge, managers used the highway as a firebreak; the fire came dangerously close to permanent and summer homes. In early June, Forest Service officials declared the fire 100 percent contained but not without damages: 300,000 acres burned and $14 million in fire suppression costs. During the field trip, participants posed the following question to managers: How could such a large fire have been prevented, or at least reduced in severity? Managers suggested that more research is needed concerning when and where to place fuel treatments such as prescribed burning or mechanical thinning of trees. Intensive treatments applied before accidental fires start could reduce the risk of crown fires that spread across the tops of trees or shrubs; but treatments would only be cost effective if placed strategically on the landscape, using research as a guide. Watershed recovery efforts also became a topic of discussion: How effective were Bureau Area Emergency Rehabilitation (BAER) efforts, and for how long should monitoring of postfire watershed processes occur? Managers indicated that research could help BAER teams decide how to best allocate limited time and costly resources.

Mount Lemmon Fire Station, Arizona–a panel of community members relay their needs and concerns regarding reducing wildfire risk at their homes and in the nearby forest. (Photo by Seth White.)

San Pedro Vista–From this viewpoint, participants observed a strip of green forest adjacent to a charred, blackened landscape. Both areas were burned over by the Bullock Fire, but with very different consequences. The green forest was an area previously treated with a prescribed burn to reduce fuels. The charred landscape was forest where no prescribed burning occurred. Both sites were previously identified as having critical nesting habitat for Mexican spotted owls, a federally listed endangered species. Besides the obvious difference in how the two parts of the forest looked from this viewpoint, the sites differed in that Mexican spotted owls returned to nest in the previously treated forest but not in the untreated forest. Biologists in the Coronado National Forest would like to know more about the long-term, beneficial effects of prescribed fires and other

fuel treatments on Mexican spotted owls, and the Bullock Fire scenario presents a prime research opportunity.

Mount Lemmon Fire Station–Participants were greeted by a panel of citizens from the Mount Lemmon area, the communities most affected by the Bullock Fire. Community members shared their concerns about the fire risk and economic recovery associated with living at the edge of wildlands, an area known as the wildland-urban interface. Making communities fire safe involves attention to individual homes, surrounding vegetation, and the nearby forest before wildfires start. But other questions remain, like what can be done with flammable materials, such as pine needles and slash, left from forest thinning? Economic issues also came up: How can we better fund community fire planning, and what is the long-term economic impact of fires on communities that derive most of their income from tourism?

Aspen Vista–The discussion here was focused on public affairs. The public information office received over 5,000 calls from concerned citizens during the Bullock Fire, mostly from community members wanting to know when they could return to their homes. Many news reporters and citizens also wanted to know why the fire was not stopped when it was small. One potential avenue for social research is how to relay to the public, directly or through the media, current management objectives and messages such as "all fires start small." Also of interest is how to earn the public trust, a high priority for managers. Research could help to identify the best processes for facilitating these interactions with the public.

Palisades–A glance backward in time reveals that on a scale of centuries, the Bullock Fire was probably not unusually large. It was, however, unusually severe because of drought, overcrowding of small-diameter trees, and accumulated dead fuel. Managers from the Coronado National Forest suggested that in the future, preventing large fires like this one may require active management–thinning and restoration of forests, treating fuels immediately next to homes, and maintaining high levels of community awareness. Research projects similar to those at Palisades, where the effects of different forest thinning treatments are evaluated, will help managers focus their efforts where they will do the most good.

Lessons from the Bullock Fire spoke to many central themes from all three workshops, but the positions of individuals, technical groups, and geographic locations differed on each particular issue. For example, not everyone felt that active management of forests is always the best strategy–in some places and for certain management objectives, passive forest restoration, a more hands-off approach, may be more applicable. The diversity of perspectives did not come as a surprise to workshop organizers, and in fact workshop sessions were organized around identifying the variability between manager and researcher viewpoints to bring about common themes, or "transferable concepts," that span regions and disciplines.

Opportunities for research include evaluating the effects of previous prescribed fires on the severity of burn from the 2002 Bullock Fire. According to biologists in the Coronado National Forest, nesting pairs of Mexican spotted owls returned to the previously treated forest (right), but not to the untreated forest (left) after the Bullock Fire burned through both areas in 2002. (Photo by Seth White.)

Firefighters were up to the challenge of fighting the big fires of 2002. (Photo by Bob Nichols, U.S. Department of Agriculture.)

TECHNICAL GROUPS

Participants and workshop organizers recognized that productive conversations about wildland fire will be interdisciplinary in nature–crossing the boundaries of physical, ecological, and social disciplines. However, the need to focus discussions to produce relevant results called for the formation of technical groups.

In an attempt to balance the number of managers and researchers within work sessions and to secure a diversity of expertise and interests, participants were assigned to the following groups:

- Fire behavior and fuels
- Fire effects, insects, and diseases
- Soil erosion and water quality
- Climate and smoke patterns
- Threatened and endangered species, invasive species
- Social and economic concerns, decisionmaking

Using these categories as a framework, facilitators invited participants to brainstorm a list of questions and issues related to the technical group topics. Later, participants in the technical groups refined and prioritized these questions, condensing the list into the top six research questions or statements of research need. Participants in technical groups also discussed partnerships, information, tools, and processes for practicing fire management and implementing wildland fire research.

PLENARY SESSIONS

Following each small-group discussion, participants brought key points to the plenary session. Reporters presented summaries of discussions from the small groups, asked for additional input from other group members, and opened the floor to discussion within the larger group. In the final plenary sessions, reporters presented the top six research questions or research needs from their technical group. The 36 questions were displayed around the meeting room, and all participants were given 7 votes and asked to identify the questions they considered most important. Participants were allowed to place their votes anywhere–all votes on one question, one vote on seven questions, or anything in between. In this way, a prioritized set of recommendations for future research was arrived at in each of the three workshops.

BULLOCK FIRE FIELD TRIP, ARIZONA

Workshop hosts at the University of Arizona went above and beyond the traditional workshop format by arranging a field trip prior to the meeting in Tucson–a visit to the 2002 Bullock Fire site in the Coronado National Forest. The field trip started a conversation between managers and researchers about wildland fire research, a dialogue that was sustained and referred to throughout the subsequent workshop. The trip highlighted lessons learned and opportunities for research gathered from the Bullock Fire in particular, but the concepts extended across geographic regions and illustrated some of the fundamental needs for wildland fire research (see Bullock Fire sidebar).

Fire is a natural phenomenon that has helped shape structure and function of forests and other ecosystems that we know today. (Photo by Tom Iraci.)

Research on fuel treatments–projects designed to reduce the amount of flammable vegetation and dead wood–can provide managers with information about what kinds of treatments, if any, should be used to achieve management objectives. (Photo by Tom Iraci.)

OBJECTIVE 1: PRIORITIES FOR RESEARCH

In early June of 2002, a few raindrops fell on the Colorado Front Range near Denver and Colorado Springs. Fire managers, well aware of the long-standing drought caused in part by La Niña conditions, were probably hoping for more than this light spattering of rain–hoping at least that the dry ground and fuels would be quenched to reduce fire danger. On June 8, however, a dry air mass rolled in along with wind gusts, and that afternoon the Hayman Fire started. The initial response was a Herculean effort. People were ready with air tankers, helicopters, engines, and ground crews, but by the next morning, the fire was larger than 1,000 acres. Just over 1 week later, the wet monsoon weather arrived and halted substantial progress of the fire. But by June 18, almost 138,000 acres of the Front Range had burned land that provided recreation opportunities and clean water for communities, habitat for animals, and scenic areas for neighborhoods and businesses.

The 2002 Hayman Fire in Colorado drew immediate national attention, and Congress requested that the USDA Forest Service conduct a formal review of the fire, with emphasis on lessons learned and future needs. Efforts from the Wildland Fire Workshops were in some ways parallel to those in the Hayman Fire review, but with a larger geographic scope that included lessons and opportunities for research from several large fires in the American West.

Results from the three locations differed, but common themes emerged. The highest priority recommendations in each location were related to

the effects of fuel treatments–their efficacy, their effects on ecological and social values, their context in different ecosystems and weather regimes, and whether in some cases passive restoration techniques might be more appropriate. Social, economic, and decisionmaking issues came out as extremely important across all disciplines, and many of the technical groups focused on these questions. A call for support for adaptive management was heard in each location, including continued monitoring of existing projects and identifying barriers to getting new projects started. Research, according to participants, should also incorporate multiple spatial and temporal scales–from stands to landscapes and from seasons to centuries. Participants wanted to be clear that projects should be interdisciplinary in nature, taking an ecosystem-based approach, and framed within the larger picture of fire ecology and restoration.

The following questions are a synthesis of common research needs identified by participants from Oregon, Arizona, and Colorado in March and April of 2003–research needs that emerged from all three locations and whose utility spans the boundaries of the Pacific Northwest, Southwest, and interior West regions. For the complete list of research priorities by location, refer to appendix B.

FIRE BEHAVIOR AND FUELS

Much discussion focused on where, when, and what kinds of fuel treatments, such as forest thinning and prescribed fires, need to be done (if at all) in order to achieve desired landscape conditions. Not to mention, what **are** the desired landscape conditions? Participants recommended that research on this topic should describe fire behavior and the effectiveness of fuel treatments in the context of the following: departure from historical vegetation conditions, climate, weather, and smoke patterns, and the associated social and economic issues such as risk to human communities. Recommendations for research that were common to all three locations included:

- **Prediction of large fire behavior and occurrence:** How can we modify existing tools or create new tools that better predict the occurrence and behavior of wildland fires?
- **Management potential of fuel treatments:** Taking into account climate patterns; which fuel treatment strategies are most likely to have the most impact on fire behavior, natural resources, and social values; and how should we allocate management resources across the landscape to achieve desired conditions?
- **Existing fuel conditions:** Across landscapes and in different ecosystems, what are the existing fuel conditions and rates of fuel accumulation in the context of historical and current fire regimes?
- **Postfire fuel management activities:** After fires occur, what are the consequences of various restoration strategies related to fuel treatments?

FIRE EFFECTS, INSECTS, AND DISEASES

Participants acknowledged that there are positive and negative effects of fire on insects and diseases, and they indicated that more research is needed about those impacts and about how insects and diseases respond to fuel treatments. Also, participants asked, what are the thresholds of insect and disease populations that make ecosystems more susceptible to fires? What, for instance, are the fire-related ecological consequences of bark beetle treatment strategies? Answering these questions may involve the development of a historical database of interactions between climate, insects, and diseases. Recommendations for research that were common to all three locations included:

- **Insects, diseases, and other disturbance processes:** What are the interactions among insects, diseases, fire, and drought conditions from stand to landscape scales?
- **Managing insects and diseases:** What should be the scope of our vegetation/fuel management activities in order to mitigate the harmful effects and reap the beneficial effects of fire and other disturbance processes such as insects and diseases?

THREATENED AND ENDANGERED SPECIES, INVASIVE SPECIES

What are the effects of wildfires, prescribed fires, and other fuel treatments on threatened and endangered species? This tied into one of the most striking questions from the Bullock Fire site in Arizona: How is Mexican spotted owl (*Strix occidentalis lucida*) nesting activity affected by prescribed burning? These questions also have political implications–what are the impacts of endangered species regulations on meeting management objectives? In the realm of invasive species, what is the role of fire in spreading invasive species such as cheatgrass (*Bromus tectorum* L.) or sulfur cinquefoil (*Potentilla recta* L.), and what is the role of invasive species in spreading fire? Recommendations for research that were common to all three locations included:

- **Invasive species:** What are the interactions between invasive species and fire–how does fire spread or restrict invasive species, and how do invasive species spread or restrict fire?
- **Climate and invasive species:** How do drought conditions affect the propagation and spread of flammable invasive species?
- **Threatened and endangered species and fire:** What are the effects of wildland fire, hazardous fuel treatments, incident management tactics, and postfire rehabilitation on threatened and endangered species? How can these activities be implemented to minimize the harmful effects and maximize the positive effects of fire?

What is the desired look and condition of future landscapes? How do fires fit in? These are just some of the important questions that social scientists are addressing. (Photo by Tom Iraci.)

SOIL EROSION AND WATER QUALITY

What is the ecological role of fire on watershed processes such as flooding and soil erosion? How can managers minimize or avoid the harmful side effects of fire and recovery efforts in watersheds? In particular, participants felt that the burn area emergency rehabilitation (BAER) process presented many opportunities for research–including getting researchers on the ground to evaluate the long-term effectiveness of watershed recovery treatments. Recommendations for research that were common to all three locations included:

- **The ecological role of fire in watershed processes:** How do fires, fuel treatments, and base conditions affect watershed processes such as the cycling of nutrients, sediment transport, and streamflow?
- **Watershed rehabilitation and fire:** How do postfire watershed rehabilitation processes affect watersheds and other resources for short and long time scales? How effective are current rehabilitation techniques for the short and long terms?

CLIMATE AND SMOKE PATTERNS

Participants wanted to emphasize the difference between weather and climate: weather is short term, what actually occurs on a day-to-day basis, whereas climate refers to longer term conditions and trends. When do climate and weather effects override management activities such as fuel treatments, and how do climate and weather interact with fire danger and smoke

Mechanical treatment or prescribed fire? One avenue for research is determining which methods of fuel treatments in which circumstances are most effective for meeting management objectives. (Photo by Tom Iraci.)

emissions? How can smoke models be refined, improved, and evaluated to better predict and monitor regional haze and nuisance? The latter questions have implications for health standards relative to wildfires and prescribed fires. Recommendations for research that were common to all three locations included:

- **Modeling smoke emissions:** How can we improve models for predicting wildfire- and prescribed fire-generated smoke emissions, smoke movement, and impacts on human health and visibility?
- **Fire history and climate patterns:** To develop better prediction tools, what can be determined about the historical natural variation in the distribution of fuel loadings, stand structure, insect and disease cycles, and the interactions between these characteristics and historical drought?
- **Fire hazard and climate:** At what point do climate patterns override the effects of fuel treatments, and how does climate influence fire behavior?

After fires, watershed processes such as soil erosion and flooding can be in need of recovery. Integrating research with watershed recovery efforts was identified by workshop participants as an essential need. (Photo by Bob Nichols, U.S. Department of Agriculture.)

SOCIAL AND ECONOMIC CONCERNS, DECISIONMAKING

Because much of the discussion was focused on socioeconomic concerns and decisionmaking, in all technical groups and in plenary sessions, this topic could be considered the keystone topic of the

Sidebar 2. Historical Fire Regimes

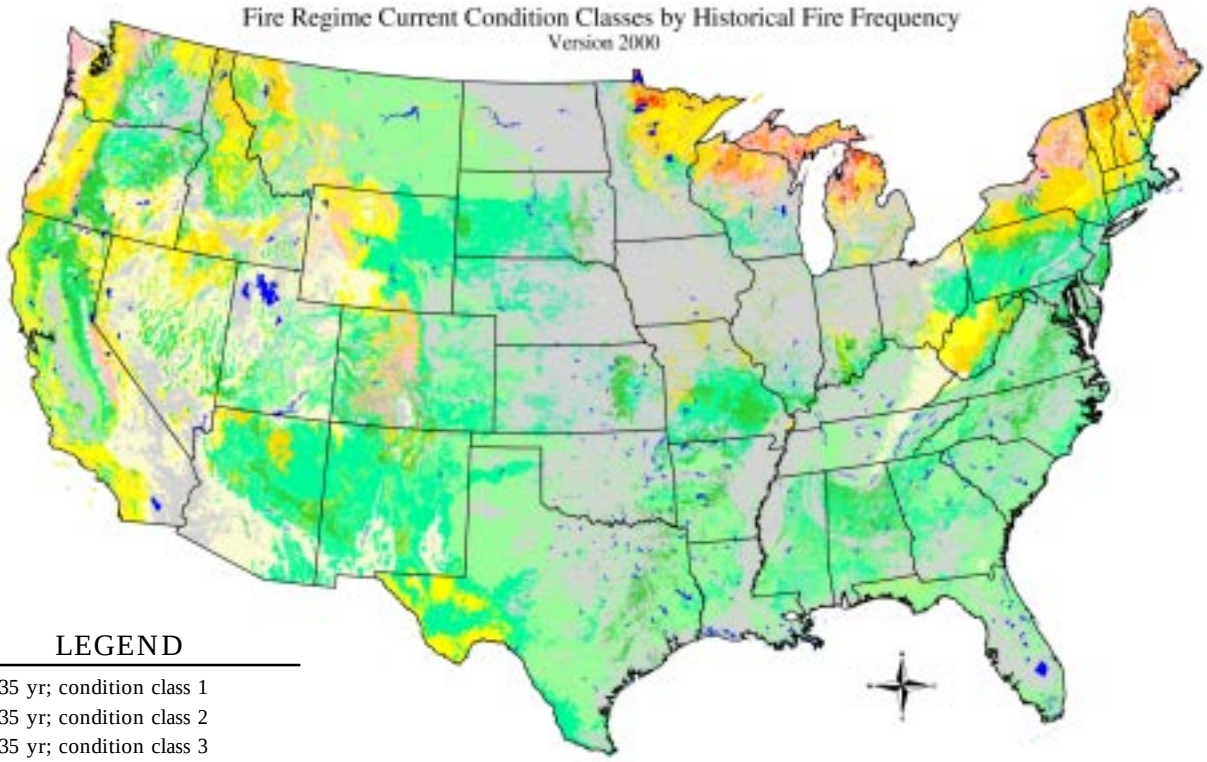
Wildfires are one of many natural disturbances that have helped shaped the forests, rangelands, and other ecosystems we know today. Disturbance need not imply negative consequences; a moderate level of disturbance is required to maintain high biodiversity in many systems, and many ecosystem processes such as the flows of energy and nutrients work most optimally under natural disturbance cycles. Historical fire regimes–the natural patterns of fire frequency and intensity–differ as a result of geographic location, climate, elevation, and

Fire histories are written into the trees; fire scars relate the frequency and intensity of past fires. (Photo by Tom Iraci.)

Departures from natural fire cycles, termed "condition classes," reveal when key ecosystem processes such as species composition have been altered from historical conditions. (Map courtesy of the Fire Modeling Institute, Fire Sciences Laboratory, Missoula, MT.)

many other factors. Plant and animal communities have adapted to these natural patterns of fire over the course of thousands of years, and some recent fire and fuel management strategies are designed to promote a fire regime that closely resembles historical conditions for the benefit of ecological communities.

The goal of managers is not always to mimic historical fire regimes, however. In human communities at the edge of wildlands where fires were historically severe, for instance, managers hope to reduce fire risk by using fuel treatments such as lighting prescribed fires, thereby increasing the frequency and decreasing the intensity of fires from their historical regime. Climate change may also impose constraints on managing forests and rangelands within their historical fire regime. Under future climate conditions (specifically global warming), it may not be feasible to achieve historical conditions, and so the public, managers, and decisionmakers will have to decide how fire fits into attaining the desired landscape conditions.



	Risk of Key Ecosystem			Vegetation Attributes
	Fire Regimes	*Component Loss*	*Fire Frequency*	*(Species composition and structure)*
Condition Class 1	Within or near historical range	Low	Departed from historical frequencies by no more than one return interval	Intact and functioning within historical range
Condition Class 2	Moderately altered from historical range	Moderate	Departed (+/-) from historical frequencies by more than one return interval, moderately changing: fire size, frequency, intensity, severity, and/or landscape patterns	Moderately altered from historical range
Condition Class 3	Significantly altered from historical range	High	Departed from historical frequencies by multiple return intervals, dramatically changing, fire size, frequency, intensity, severity, and/or landscape patterns	Significantly altered from historical range

workshops. Good science on the previous topics will provide a foundation for managers to make informed decisions, but that science must have proper focus in light of public needs. Also, the results, implications, and uncertainty of the science must be relayed clearly to managers and the public. Participants called for research on the best methods for delivering scientific information to managers and the public, especially concerning issues with human communities near the edge of wildlands. How can we improve technology transfer, and how can we best relay information to the public? Recommendations for research that were common to all three locations included:

- **Communication and partnership efforts:** How can we best improve communication and partnership efforts between the public, agencies, and other organizations in order to relay useful information, facilitate collaboration, and enhance the utility of scientific information for management application?
- **Optimizing decisionmaking:** What social tools are needed by institutions (e.g., legislative branches, land management agencies, universities, stakeholder organizations, etc.) in order to improve decisionmaking?
- **Wildland-urban interface issues:** How can we apply lessons from successful community fire planning efforts and social science to other communities in order to decrease the risk of fire to people, and what are the various policies that enhance or inhibit these efforts?
- **Costs, benefits, and risks of fire:** What are the social, economic, and ecological costs, benefits, and risks of fire and fire management strategies, and how can we use these analyses to make better decisions?
- **A vision for the future:** How do we as a society decide on the desired future conditions of the landscape? What methods are most appropriate for achieving those conditions?

INTEGRATION

Several high-priority needs went beyond the scope of the topic areas and therefore deserved their own category. The following research need was common to the three locations and addressed the interdisciplinary nature of wildland fire-related problems and opportunities by incorporating knowledge from several disciplines to implement long-term, landscape-scale projects:

- **An interdisciplinary perspective:** What are the effects of fires and postfire management activities on ecosystems and biological communities? Addressing this question may include the use of adaptive management strategies, a critical assessment of existing models, and the development of a comprehensive fire occurrence database.

Although the above research priorities do not represent the complete list of needs identified by participants, they do relay the common needs as identified by managers, researchers, and other groups from several regions in the American West. Workshop organizers felt that these common needs were particularly important because they represented research areas where joint efforts by many groups–state, federal, and tribal agencies, private industry, and community organizations, for example–in diverse locations could pool their resources to deliver products that are greater than the sum of the individual parts. This involves more than just making sure the pieces fit: collaboration is an active process that requires the identification of key partnerships and qualities that make them effective.

The wildland-urban interface–communities at the edge of wildlands–will require solid partnerships with state, federal, and tribal agencies to reduce the risk of wildfires. (Photo by Tom Iraci.)

OBJECTIVE 2: CHARACTERIZING EFFECTIVE PARTNERSHIPS

Dallas Massey, Chairman of the White Mountain Apache Tribe, Arizona, has a strong sense of what recovery means. After all, he and his people have recent experience-recovery from the 2002 Rodeo-Chedeski Fire that burned over 450,000 acres and affected the forests, rivers, lakes, streams, and animals that make their homes in "the most beautiful place on earth." The tribe and many other agencies spent precious time and resources fighting fire and evacuating communities–but the work did not stop there. The fire's impact extended beyond burned forests; people's homes, jobs, and economic resources were also affected and in need of recovery. According to Massey, the Apache language has one word for "our land" and "our mind," shii ne', and he argues that recovery of the land is strongly linked to recovery of the people, a process that depends on solid partnerships between partners–from individuals to agencies.

Fighting the Rodeo-Chedeski Fire, recovering from its impacts, and learning from the fire through management–driven research required strong partnerships between agencies and other organizations whose resources complemented their partners' strengths and weaknesses. In this report, partnerships are defined as

Table 1—Examples of key partnerships for wildland fire research and management

Partnerships with...	Examples	Effective when...
Communities	Town hall meetings; cooperative extension services; community forestry; Firewise; demonstration areas; Gateway Community Program; soil and water conservation districts; watershed councils	Manager/researcher/extension agent is knowledgeable and respected locally; researchers are rewarded for interactions; public is involved in fuels planning; public has input prior to management plan; extension agent is knowledgeable in fire ecology.
Resource specialists	Biologists; burn area emergency rehabilitation (BAER) teams	Input is solicited from researchers; knowledge from case studies is relayed to researchers.
Schools and universities	Research; Student Career Experience Program (SCEP); Junior Fire Program	Fire science is integrated into university curricula; students emerge with practical knowledge for on-the-ground application.
Tribes	Direct partnerships with tribal councils and tribal fire managers; Bureau of Indian Affairs (BIA)	Tribal governments are recognized as sovereign; each tribe is recognized as unique; input is solicited from tribal elders; electronic communication pathways are intact (i.e., BIA).
Policymakers and funding agencies	Intermediate organizations; Western Governors Association; other advisory councils; National Fire Plan; Joint Fire Science Program	Science is translated correctly; stakeholder goals are not contradictory; projects developed are applicable to managers; input occurs while writing forest plan; partnerships are a required element for grants.
Technologists	Incident meteorologists (IMETs); long-term fire analysts (LTANs); fire behavior analysts (FBANs)	Adequate support is provided; users and managers have trust in products being developed; technology transfer is a key component.

the relationships and associated sharing of resources–funding, personnel, or information systems, for example–within agencies and among external groups. Interagency partnerships include relationships between agency managers and researchers; external partnerships include relationships among agencies, universities, the public, and others. Workshop participants identified the qualities of partnerships that were essential to the recovery of communities such as those on the Fort Apache Reservation, and also for other processes: fireproofing communities at the edge of wildlands, practicing effective incident management during fires, restoring ecosystems, implementing applied fire research, and, more generally, developing comprehensive plans and implementing collaborative strategies.

According to participants, partnerships are most effective when:

- Direct interaction occurs between all partners at multiple stages, including the development of a vision for the future.
- Adequate time is allowed for partnership building.
- Partners are rewarded and held accountable for their roles.
- Key individuals are identified and cultivated, people who will "hang their hat on a project."

Participants felt the above characteristics were vital for maintaining manager-researcher partnerships at the local, state, federal, and tribal levels, but also identified partnerships beyond the manager and researcher interface. See table 1 for specific examples of key partnerships and characteristics that make them effective.

COMMUNITIES

Whether through an informal town hall meeting or through an intermediate organization such as the local watershed council, interactions with the public were identified as among the most essential partnerships for managers and researchers. Public partnerships work best when public liaisons are

Sidebar 3. Native Americans and Fire

Native Americans actively managed the landscape, and fire was a major tool. Traditional stories, the accounts of tribal elders, the journals of explorers and settlers, and the fire scar histories written into the trees all point toward the active use of fire by indigenous people. Fire was used to clear sites for villages and travel corridors, fireproof human settlements and medicinal crops, control pests, and maintain ecological conditions for hunting game and gathering plants.

In the Pacific Northwest, fire was used for cultivating big huckleberry (*Vaccinium membranaceum* Dougl. ex Torr.), a common staple in the diet of many tribes. By carefully regulating the location, timing, and intensity of burning, the tribes used fire to reestablish huckleberry patches that were known to be productive. Prescribed fires were typically started in fall after the huckleberry season ended and when cooler and wetter weather set in–reducing the risk of accidental fires. Within a few years after burning, the huckleberry patches yielded an abundant harvest of berries. An associated outcome of the frequent, human-caused burns was a reduced fuel load and decreased risk of large fires.

After European American settlement and the implementation of a nationwide fire suppression policy, the landscape changed. Places in the Northwest that were once meadowlike and open, promoting the growth of huckleberry patches, became crowded with willows, alder, and other deciduous trees, and were finally succeeded by conifers such as fir and pine. For Native Americans this meant losing touch with a way of life. Today, Native Americans and their partners in research and management are reconnecting with this wisdom from the past, known as traditional ecological knowledge, and making the public and decisionmakers aware that these techniques for ecosystem management and reducing wildfire risk can be incorporated into current management practices and scientific research.

Gathering huckleberries after the fire–long before European American settlement, Native Americans actively managed the landscape, and fire was a major tool. (Photo by K.D. Swann.)

knowledgeable and respected locally. What does not work, participants agreed, are "slick presentations," especially when not followed by true collaboration. Opportunities for collaborating with the public include community involvement with fuel-reduction projects and soliciting input concerning desired future conditions of nearby forests or other ecosystems. Most importantly, participants felt that effective community partnerships are based on trust. Trust takes time to build and requires sustained efforts from both sides but is well worth the effort.

RESOURCE SPECIALISTS

In many cases, resource specialists have the most up-to-date information regarding their field; biologists, BAER teams, and other specialists have access to many case studies and examples of the effects of wildfires, prescribed fires, and fuel treatments on plants, animals, and ecosystems. By soliciting researcher input, these case studies can be turned into statistically robust research projects, moving local knowledge into peer-reviewed scientific literature where it can be referenced and used by others.

SCHOOLS AND UNIVERSITIES

From junior high school to university graduate programs in science, opportunities for partnerships in education abound. University cooperative extension units, as well as less formal relationships between academic researchers and agency managers, provide research results that can be applied to on-the-ground management problems. Partnering with educators also allows for early integration of fire science so that students emerge from programs not only with instruction in scientific theory, but also with practical training. A fair amount of the background notes used in compiling this report, for example, came from volunteer undergraduate and graduate students. Many of the student note takers commented that they learned a lot about real-life issues related to fire and appreciated the chance to watch their professors engage with managers on a professional level. Important manager-researcher partnerships exist at the university level as well: universities have a wealth of knowledge and research capabilities that when properly matched with manager needs can result in a productive relationship.

TRIBES

Relationships with tribal governments represent some of the longest standing partnerships in the United States. Tribes often have a wealth of traditional ecological knowledge related to fire–oral histories that relate Native American use of fire as a tool for active ecosystem management long before European American settlement. Recognizing and incorporating this knowledge into management plans, soliciting input from tribal elders, and respecting the sovereignty of tribal governments are good first steps to maintaining partnerships with tribes, according

to participants. Sovereignty need not mean separateness, however. As in the case of the White Mountain Apaches, tribes can offer substantial resources for fire management, such as personnel, yet will require help in initiating and maintaining economic recovery from fires.

POLICYMAKERS AND FUNDING AGENCIES

Natural resource policy is not based on science alone. Rather, the policymaking process is the culmination of interactions among managers, researchers, and many stakeholders–community members, activist groups, tribes, and state and federal agencies, just to name a few. Good policy, according to participants, occurs when science is interpreted correctly and appropriately, and when various stakeholder goals are not contradictory. Funding agencies that solicit input from managers during the requests for proposals and make partnership building a required element will be rewarded with research results that are relevant to managers and that perpetuate collaborative efforts.

Effective partnerships can contribute to all levels of fire management and research, including the development of a vision of our future forests. (Photo by Tom Iraci.)

TECHNOLOGISTS

Delivering accessible, accurate information to managers who need quick access to the most current technology was identified as one of the greatest needs in the world of fire management today. For instance, weather and smoke models are continually created, refined, and improved to produce increasingly accurate predictions. Managers are often busy implementing projects on the ground and therefore cannot keep up with the technology. One role for technology transfer specialists, people who communicate information to users, will be to maintain partnerships between technologists, such as weather and smoke modelers, and managers who need information for making decisions while fires are burning. Participants relayed that managers must have trust in the products being delivered in order for this partnership to work.

Participants felt that although increasing the body of knowledge about wildland fire was important, it was only one part of the story. Establishing and maintaining quality partnerships will be essential to ensuring that research is heading in the right direction and that once the results are out, information gets delivered to the proper users. The delivery of this information is just one of the many processes that play into effective wildland fire research and management; the next step was for participants to identify types of information shared between partners, tools for implementing management and research, and processes for seeing them through–from idea generation to on-the-ground application.

Communication with the public was identified as one of the key processes for delivering timely fire danger information and informing the public about new research. (Photo by Tom Iraci.)

OBJECTIVE 3: EFFECTIVE INFORMATION, TOOLS, AND PROCESSES

On July 13, 2002, thunder and lightning storms drifted in from the Pacific Ocean and crossed the border of California into Oregon. That same afternoon, fire lookouts reported several lightning strikes in the Kalmiopsis Wilderness, Siskiyou National Forest. At 3:17 p.m., an observer in a reconnaissance aircraft reported a fire in the Biscuit Creek area, the first of several fires that would eventually merge and become one of Oregon's largest fires in recorded history. Resources used to contain the Biscuit Fire included 23 regional and national fire management teams and thousands of firefighters and support personnel. Nearly 2 months later, on the evening of September 5, the Biscuit Fire was declared contained. The final tally was nearly half a million acres burned, mostly in the heart of the Kalmiopsis Wilderness, and $150 million in fire suppression costs.

But still the work was not over with containment and eventual control of the fire–communities, managers, recovery teams, and researchers initiated economic and watershed recovery processes, continued monitoring of long-term projects, and deliberated on what kind of research was helpful–and what research was needed. The Biscuit Fire, as with large

fires in general, called for the interaction between many different agencies and groups of people, each with their own culture, language, and set of tools for practicing fire management and implementing research.

Using large fires as teachers, the Wildland Fire Workshop participants identified typical characteristics of effective information, tools, and processes. Those that are effective are:

- Adequately and consistently funded.
- Approached at multiple spatial and temporal scales.
- User-friendly–either for end users or for those who deliver to end users.
- Interactive between people at multiple levels.
- Often championed by a key, dedicated individual.

With these elements in place, participants described some qualities that make specific types of information, tools, and processes effective. These qualities and specific examples are also listed in table 2.

MODELS

Models were the tools most frequently discussed. Models are useful for making predictions for a wide range of outcomes in fire behavior, smoke movement, climate patterns, and risk assessment. Participants identified effective models as having results driven by manager needs. The models should be accessible and user-friendly for the intended user, whether

Fire managers–the people who implement on-the-ground projects–count on effective information, tools, and processes in order to do their job. (Photo by Tom Iraci.)

Table 2—Examples of key information, tools, and processes for wildland fire research and management

Information, tools, and processes	Examples	Effective when...
Models	First Order Fire Effects Model (FOFEM); Wildland Fire Situation Analysis (WFSA); BlueSky; Fire Area Simulator (FARSITE); Rare Event Risk Assessment Process (RERAP)	Driven by manager needs; accessible to all intended users; produces relevant results for clear decisions; interpreted correctly; uses up-to-date default values in addition to user input; landscape scale; includes a spatial component; interacts with other models.
Information clearinghouses	National Interagency Fire Center (NIFC) Web site; Fire Effects Information System (FEIS); National Fire Danger Rating System (NFDRS)	Regionally based; information is current, distilled; put into context of the "big picture;" local data are available; located centrally for easy access.
Funding	National Fire Plan (NFP) funding; Joint Fire Science Program (JFSP) announcement for proposal process	Managers are included in the process; funding is consistent and long term; cost sharing exists; local districts have input regarding how dollars are spent.
Education	University curricula; training seminars; short courses; cooperative extension service; The *Wildland Fire Primer*	Integrated with other resources; adequate time for learning exists; learning is hands-on; fire science and National Environmental Policy Act (NEPA) training are integrated into university curricula.
Direct communication	Workshops; meetings; conferences; field trips; communication during fire events	Networking occurs; cultural barriers are removed (organizational, racial, and gender); incentives for communication are in place.
Scientific publications	Scientific journals; general technical reports (GTRs)	Peer reviewed; provides synthesis of existing information; authors are given credit for syntheses; abstracts are searchable; jargon is minimal.
Research	Original, synthesis, meta-analysis: research on physical, ecological, and social processes related to fire	Collaboration with end user occurs at all phases (including hypothesis generation); design is statistically robust; results are reported with statement of uncertainty; researchers interact with one another and with managers; research is interdisciplinary.
Monitoring and reporting	Fire Effects Monitoring (FIREMON); National Fire Plan Operating and Reporting System (NFPORS); data ram cache; Remote Automated Weather stations (RAWS); Long-Term Ecological Research (LTER) stations; adaptive management projects	Occurs long term; protocols are consistent across large spatial and temporal scales; maps of fire severity and fuel condition class are generated.
Mass media	Radio; newspapers; television broadcasts; community bulletins; Web sites; flyers	Information is timely and has correct context

Table 2—Examples of key information, tools, and processes for wildland fire research and management (continued)

Information, tools, and processes	Examples	Effective when...
Demonstration areas and case studies	Blue Ridge Demonstration Project, AZ; Hayman Fire case study, CO; Blue Mountains Demonstration Project, OR	Comparative analysis is used; is run by a respected official.
Postfire recovery efforts	Burn Area Emergency Rehabilitation (BAER); Emergency Stabilization and Rehabilitation (ESR)	Standard protocols exist; long-term effectiveness monitoring occurs; monitoring is integrated with research; assembly of teams is evaluated.
Incident management	Community evacuations; implementation of fire management plan (FMP)	Planning occurs; wildland-urban interface communities have community fire plan in place (e.g., Firewise); standard safety protocols exist; other information, tools, and processes are effective and in place.

Firefighter safety is a major concern of fire managers. Flame exposure, smoke inhalation, and fatigue are a few of the many safety issues involved in wildland firefighting. (Photo by Tom Iraci.)

manager, resource specialist, or a technology transfer specialist–a person dedicated to interpreting and delivering information and tools to users. In some cases, participants said, models should use up-to-date default information in addition to user input so that new, timely information can be incorporated, and should also include a spatial component, bringing together information at relevant scales–especially the landscape scale.

INFORMATION CLEARINGHOUSES

One participant had this to say about the amount and quality of available information: "We get a fire hose of information, and it's often delivered with the fog-nozzle on." Many participants related that although there is no shortage of information, it is often difficult to access and its meaning is often unclear. The need for regionally based information clearinghouses with distilled information, incorporating local data, and having a central location for easy access was regularly called for during the workshops.

FUNDING

According to participants, the lack of consistent and long-term funding can be the greatest obstacle to implementing management and research partnerships. Funding for long-term projects is often pulled before the results are out, which diminishes the productivity of the management-research partnership. Some projects are effective within short-term funding cycles, but participants identified that funding should reflect the increasing need to view wildfires as large-scale, long-term events. Participants indicated that including managers in the research funding process and holding partners accountable for their roles in producing manager-driven research will ensure that research is relevant and applicable to real-life scenarios.

EDUCATION

Participants identified university curricula, and also continuing education for professionals, as important for managers and researchers. Effective education, like effective research, is interdisciplinary in nature.

Sidebar 4. Fire and Society—A Changing Target

Society's current relationship with fire is linked to events that occurred around the turn of the last century. Two large wildfires in particular–the Peshtigo Fire in Wisconsin and Michigan, 1871, and the Hinckley, Minnesota, fire of 1894–caused many casualties of human life, property, and public land and alerted the public to the risks of wildfires. Later, the Great Idaho fires in northern Idaho and Montana in 1910, along with the 6-year jinx–a series of fires near Tillamook, Oregon, that occurred every 6 years from 1933 to 1951–helped instigate an aggressive approach toward fire suppression that

Forest policy has changed since 1941 when this public relations advertisement was released. Early policy focused on aggressive fire suppression, whereas decisionmakers today are incorporating the idea that fire is a natural process. (Poster by James Montgomery Flagg; image courtesy of the U.S. Forest Service.)

Forest harvest was a major focus on public lands in the past. In recent decades, other management goals are coming to the forefront such as ecosystem restoration; creating and maintaining habitat for fish, wildlife, and noncommercial plant species; restoring ecosystem functions such as nutrient cycling and woody debris input into streams; and providing recreation opportunities. (Oregon Historical Society)

became known as the "10 a.m. policy." Fires reported on any particular day were to be put out by 10 a.m. the next morning. This policy may have helped save countless lives, structures, and resources for the short term, but it left unintended consequences in some areas: the accumulation of flammable dead wood and vegetation that would otherwise have burned naturally and with less intensity.

Recent forest policy is striving toward an understanding of wildfires and prescribed fires in reducing fire risk and recognizes that fire suppression alone will not solve the long-term problem. One of the major goals of the National Fire Plan is to reduce hazardous fuel near human communities at the edge of wildlands so that large fires will not start in the first place, precluding the need for aggressive suppression. According to participants at the Wildland Fire Workshops, earning the public's trust regarding fire and fuel treatments will be essential for implementing effective policy.

Incident management–the act of fighting fires–is a process that relies on a fair amount of preparedness regarding information, tools, and processes. (Photo by Bob Nichols, U.S. Department of Agriculture.)

Quality learning is hands-on, involves fire science and training in related policies–particularly National Environmental Policy Act (NEPA) training–and in the case of training seminars, allows adequate time for students to absorb information.

DIRECT COMMUNICATION

Workshops, meetings, conferences, and field trips were all identified as events that helped facilitate quality, direct communication between managers, researchers, and other groups. These events are most effective when networking occurs (often best accomplished in hallway conversations according to some participants) and when incentives for communication are in place—that is, reasons for people to attend. During incident management, having channels open for direct communication between managers and the public was identified as important for keeping communities informed and maintaining public trust.

SCIENTIFIC PUBLICATIONS

Perhaps the best example illustrating the disparate cultures of management and research was the discussion of scientific publications. Managers often have too little time or expertise to read papers and assimilate information from publications. At the same time, managers depend on having quality, peer-reviewed research results for making informed decisions. Researchers are rewarded for writing peer-reviewed publications rather than for developing partnerships and interacting with managers. At the workshops, managers asked for publications that contained little jargon–language specific to a specialized discipline–and for papers that synthesize existing information. Having incentives in place for researchers to write informative, accessible, and relevant papers that managers can use was one possible solution to crossing this barrier.

RESEARCH

Physical, ecological, and social research on wildfires can take the form of original research, where new information is collected and analyzed, or synthesis and meta-analysis, where conclusions are strengthened or new conclusions are drawn from the results of several existing studies. Effective, management-driven research occurs when researchers and managers collaborate during all phases, including the hypothesis generation phase when ideas and

questions for research are developed. Participants identified that researchers must also collaborate with one another so that existing information is not ignored and results dovetail into one another. Participants also relayed that research design must be statistically robust and results must be reported with a statement of uncertainty, or the variability associated with a prediction or statement. The most effective research, according to participants, will occur when researchers think outside the box, spanning the boundaries of traditional disciplines.

MONITORING AND REPORTING

Flooding and soil erosion, postfire recovery of local economies, and climatic patterns are just a few of the processes that require monitoring and reporting. Participants stressed that monitoring and reporting should have standard protocols among agencies and occur over periods long enough to allow for relevant observations. Monitoring also ties in well with adaptive management–the act of managing while simultaneously learning from prior actions, and applying those lessons to the landscape. Adaptive management was identified as a key process that should continue receiving support from funding agencies.

Printing a fire map–managers rely on having ready access to current and dependable technology. (Photo by Bob Nichols, U.S. Department of Agriculture.)

POSTFIRE RECOVERY EFFORTS

Along with economic recovery of communities affected by wildfires, participants in all locations emphasized opportunities for improving BAER efforts. The BAER teams typically apply treatments for recovery and monitor watershed processes immediately after fires are contained. Participants felt these efforts could be improved through standardization of protocols and could be integrated with research to evaluate short- and long-term effectiveness of recovery treatments.

DEMONSTRATION AREAS AND CASE STUDIES

Sometimes messages can be most powerful when relayed onsite, with the audience experiencing the message with all of their senses. Demonstration areas showing results in the field can be a strong teaching tool, according to participants. Demonstration areas also bring people together to interact on a personal level, a handy way to build trust and develop partnerships. Case studies are also effective teaching tools because people often relate to stories–narratives that illustrate and clarify particular examples–better than they relate to data points. To be effective, participants said, demonstration areas should be run by locally respected officials, and comparative analysis should be used to synthesize lessons from individual case studies.

MASS MEDIA

Radio, newspapers, television broadcasts, community bulletins, Web sites, and flyers all can be used as tools for communicating with the public. One advantage to mass media is that timely information can be delivered to a large number of people. An associated disadvantage is that science can be misinterpreted or put into improper context. Participants felt that further developing these pathways of communication will be important not only for relaying immediate fire danger information, but also for informing the public about new thinking in research and management.

INCIDENT MANAGEMENT

The act of fire suppression, termed "incident management," is a process that depends on having access to effective information and tools. Incident management can mean implementing a fire management plan during the fire or evacuating communities at risk. This process is effective when all other information, tools, and processes are effective, so managing a burning fire can represent the focal point of efforts initiated before the fire. Therefore, participants said, a fair amount of planning, community awareness, and in some cases the prior treatment of fuels need to be in place before fires start. Participants also identified that during and after the fire, safety protocols for communities and firefighters need to be communicated clearly and be readily available.

The big fires across the American West tested the efficacy of many types of information, tools, and processes. Rather than merely tallying the damage done, workshop participants discussed those lessons and presented ways in which they could redirect intentions and improve actions. One avenue for bringing managers and researchers together was mentioned in several discussions in Oregon, Arizona, and Colorado: the use of workshops such as this one as a tool for delivering information and as a process for establishing partnerships among important players. These kinds of workshops have the potential for facilitating one-on-one interactions while simultaneously communicating a substantial amount of information to a larger group. With that in mind, and with the need for ongoing communication between managers and researchers, the workshop organizers were willing to take a critical look at the effectiveness of the 2003 Wildland Fire Workshops.

Catastrophe or natural process? Media coverage and public attitudes about wildfires are often centered on fire as a catastrophe, and in some cases those impressions may be well-founded. However, even some large fires are natural, scientists argue, and in the past have periodically burned through areas with low-frequency, high-intensity fire regimes. (Photo by Tom Iraci.)

OBJECTIVE 4: THE WORKSHOPS AS A BLUEPRINT

After the final workshop, participants at Colorado State University were asked to complete an evaluation of the workshop. The last question on the survey was: "Should this workshop be conducted in other regions?" Invariably, the response was "Yes." In addition, the majority of participants who responded to the questionnaire supported the final workshop product–the list of prioritized recommendations for research. Participants felt the workshops provided a good atmosphere for managers to convey research needs, and the workshops were a vital first step for developing partnerships between managers and researchers. More difficult to quantify yet nonetheless important, according to participants, were the numerous hallway conversations that occurred during the meeting, the informal conversations that happen between organized sessions. The importance of providing a setting where researchers and managers can interact one-on-one through direct communication was mentioned frequently in the small group and plenary sessions of all locations (in addition to the Colorado survey) as an essential means for creating partnerships and exchanging information.

From the Colorado survey, the most frequent criticism was that the number of researchers outweighed the number of managers in some technical groups. A few participants also suggested that little attention was paid to existing research, which possibly caused some "reinvention of the wheel" regarding the lists of research needs. But other participants suggested that the problem is more fundamental–we need better ways to communicate. Whether this takes place through previously identified technology transfer pathways, through good science writing, from professionally produced videos, or any other mechanism of storytelling, communication pathways need to be opened, maintained, and continuously improved.

Although the survey was conducted only at Colorado State University, similar comments were voiced

Workshop facilitators engage participants in a discussion about wildland fire. (Photo by Seth White.)

Table 3—Summary of participants' evaluation of the Colorado workshop

Participant occupation	What worked	Suggested improvements
Manager	One-on-one conversations were helpful for conveying research needs; technical groups were a good format; workshops will translate well to managers in other regions.	Translation of needs into "researchable questions" was challenging; more focus on prescribed fire and other fuels treatments needed; more focus on technology transfer; concerned whether research will be applicable to users; encourage thinking across topics; more coverage of current/previous research.
Researcher	This was a "real working meeting"; good working relationships developed; clarified high-priority research topics; facilitators did an admirable job; brainstorming session worked well; people were committed to the final product vs. their own agenda.	Separate technical group needed for harvesting/wood products and fire ecology; need more managers present in some groups; encourage thinking across topics; more background information on existing research needed; concerned about how prioritized recommendations will be handled across locations.
Other (educator, student, partner, etc.)	Workshops tracked well with current information and were interesting; "time well spent, overall a positive investment."	Technical sessions could be longer and more free-form; priority-setting exercise may not have been completely objective; historical fire effects not covered well; more "hall time" needed for informal discussions; some manager concerns are policy oriented and cannot be captured by research.

by participants in other locations, indicating the Colorado survey at least partially represented the concerns in Oregon and Arizona as well. For a summary of Colorado participant comments by their role in the management-research arena, see table 3.

After the final workshop, the steering committee met and discussed what they thought worked and what did not work in terms of meeting the workshop objectives in all three locations. Overall, the committee agreed that the workshops were very productive, and that thoughtful recommendations for research were developed. The committee also felt the workshops created a favorable atmosphere for managers and researchers to identify concerns, share ideas, and solve problems concerning partnership building and the development and improvement of information, tools, and processes. Suggestions for improvement from the workshop organizers included putting incentives in place for more managers to attend the workshops, and adding incentives for participants to attend the entire workshop rather than just the first 1 or 2 days. The original intent of the workshops was to provide a forum for discussion and evaluation of issues relative to managers' goals. Although researchers were to be involved in these initial discussions–as they were during the workshops–the presence and participation of managers during the research planning stage was valued as an equally essential part of coordinating research and management. Several workshop organizers and many participants felt that managers were underrepresented in the workshops even though a special emphasis was put on achieving a balance when sending invitations. In future workshops, a more balanced representation from research and management may help facilitate more productive interactions between the two groups.

CONCLUDING REMARKS

Tom Harbour, Deputy Director of the Forest Service's Fire and Aviation Management unit, has been through the ranks. This year his focus is on fire suppression, but throughout his career he has worked in almost every fire position there is, and in the most unlikely places–from the wildest forests to the wildest urban centers in the country. In short, he has seen it all. In his keynote address to the Oregon participants of the Wildland Fire Workshops, Harbour indicated that more once-in-a-lifetime fires are in our future, meaning that wildfires once considered off the scale in terms of size and intensity are likely to become more common. With this in mind, participants at the Wildland Fire Workshops aspired not to list damages from the 2002 fires, but to find new directions for research and management.

Participants from the three locations relayed diverse opinions about the future of wildland fire research, yet many common viewpoints surfaced in the plenary and small-group discussions. According to participants, future wildland fire research should consider a long-term, landscape perspective of fire ecology and be integrated across disciplines, especially in the social sciences with attention to manager needs on the ground, the public's desired future conditions of the landscape, and the direction of future research. Research that builds on existing studies and integrates the large volume of information that is currently available (but in forms that are difficult to access) will prove rewarding to both the management and research communities because of the benefits in increasing both the quantity and quality of our knowledge about wildland fire.

Implementing these research priorities and other manager-researcher projects will require the establishment and maintenance of strong partnerships. These partnerships are defined as both interagency and external collaborative efforts where the roles of partners are clearly understood and partners are both rewarded and held accountable for their parts. Again, building on existing partnerships that have already proved successful and can act as models for joint efforts will greatly facilitate the creation and maintenance of partnerships. Quality partnerships are often championed by key individuals, but will be further improved when the process is institutionalized, when direct interaction occurs between partners at all stages, and when adequate time and resources are available.

Information, tools, and processes that are successfully used to carry out wildland fire research, management, and to aid in partnership building were described as adequately and consistently funded, approached at multiple spatial and temporal scales, user-friendly, and interactive. Many important processes such as direct communication or establishment of demonstration areas are often championed by dedicated people (who should be identified and rewarded, according to participants), but these processes should also be institutionalized to better facilitate the movement of relevant research results into the management and public arenas.

With some refinements–chiefly a greater balance of researchers and managers and a more thorough review of existing research–participants and workshop organizers felt that the Wildland Fire Workshops could be used in other regions to effectively bring managers and researchers together about pertinent wildland fire issues. This process of sharing information, forming partnerships, and starting discussions about wildland fire research from the initial stages of planning was recognized as a continuing process that deserves revisiting on a regular basis. Allowing frequent opportunities for all partners and stakeholders to touch base about wildland fire issues will ensure that the direction of management and research remains focused on the correct questions.

As of the writing of this report, the 2003 fire season is underway. On July 16, 2003, the National Interagency Fire Center in Boise, Idaho, reported 352 large fires already contained this season and 126,000 acres burning from 32 large fires across the American West. Cy learly, large fires are part of the past and current conditions of our Nation's forests and rangelands, and more than likely part of our future as

Many dedicated individuals helped organize, facilitate, and record the dialogue that emerged from the Wildland Fire Workshops, and without them the workshops would have been far less productive and far less interesting. (Photo by Seth White.)

well. As for the present: this may prove to be a crucial time when stakeholders, decisionmakers, managers, researchers, and other groups have the chance to evaluate and redirect our actions to better address the needs of the American public and the people who serve them.

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METRIC EQUIVALENT

When you know:	Multiply by:	To find:
Acres	0.405	Hectares

SELECTED PUBLICATIONS

Agee, J.K. 1994. Fire and weather disturbances in terrestrial ecosystems of the eastern Cascades. Gen. Tech. Rep. PNW-GTR-320. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 52 p.

Balice, R.; Miller, J.D.; Oswald, B.P. [et al.] 2000. Forest surveys and wildfire assessment in the Los Alamos region: 1898-1999. LA-13714-MS. Los Alamos, NM: Los Alamos National Laboratory. 86 p.

Blackburn, T.C.; Anderson, K., eds. 1993. Before the wilderness: environmental management by native Californians. Menlo Park, CA: Ballena Press. 476 p.

Brady, J.A.; Robichaud, P.R.; Pierson, F.B., Jr. 2001. Infiltration rates after wildfire in the Bitterroot Valley. Society for Engineering in Agricultural, Food, and Biological Systems Paper No. 01-8003. St. Joseph, MI: American Society of Agricultural Engineers. 11 p.

Breininger, D.L. 1999. Florida scrub-jay demography and dispersal in a fragmented landscape. Auk. 116: 520-527.

Breininger, D.R.; Burgman, M.A.; Stith, B.M. 1999. Influence of habitat, catastrophes, and population size on extinction risk of Florida scrub-jay populations. Wildlife Society Bulletin. 27: 810-822.

Brooks, M.L.; Catchett, J.R. 2001. Plant community patterns in unburned and burned blackbrush (*Coleogyne ramosissima*) shrublands in the Mojave Desert. 17 p. Unpublished report. On file with: National Park Service, 1111 Jackson St., Suite 700, Oakland, CA 94607.

Brose, P.H.; Wade, D. 2001. Understory herbicide as a treatment for reducing hazardous fuels and extreme fire behavior in slash pine plantations. In: Proceedings of the 11th biennial southern silviculture research conference. Gen. Tech. Rep. SRS-GTR-48. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station: 109-113.

Brose, P.H.; Wade, D. 2002. Potential fire behavior in pine flatwood forests following three different fuel reduction techniques. Forest Ecology and Management. 163(1): 71-84.

Brown, J.K.; Smith, J.K., eds. 2000. Wildland fire in ecosystems: effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 257 p. Vol. 2.

Butry, D.T.; Mercer, D.E.; Prestemon, J.P. [et al.]. 2001. What is the price of catastrophic wildfire? Journal of Forestry. 99(11): 9-17.

Carroll, M.S.; Findley, A.J.; Blatner, K.A. [et al.]. 2000. Social assessment for the Wenatchee National Forest wildfires of 1994: targeted analysis for the Leavenworth, Entiat, and Chelan Ranger Districts. Gen. Tech. Rep. PNW-GTR-479. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 114 p.

Daniel, T.C.; Meitner, M.M. 2001. Representational validity of landscape visualizations: the effects of graphical realism on perceived scenic beauty of forest vistas. Journal of Environmental Psychology. 21: 61-72.

Edminster, C.B.; Weatherspoon, C.P.; Neary, D.G. 2000. The fire and fire surrogates study: providing guidelines for fire in future watershed management decisions. In: Proceedings of land stewardship in the 21st century: the contributions of watershed management. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 312-315.

Elliot, W.J.; Robichaud, P.R.; Pannkuk, C.D. 2001. A probabilistic approach to modeling erosion for spatially-varied conditions. In: Proceedings of the 7th federal interagency sedimentation conference. Reston, VA: U.S. Geological Survey: VI-33-VI-40.

Ferguson, S.A. 2000. Climatology of biomass smoke in wildland areas of the United States. In: Proceedings, Third symposium, fire and forest meteorology. Boston, MA: American Meteorological Society: 43-48.

Ferguson, S.A.; Sandberg, D.V.; Ottmar, R. 2000. Modeling the effects of land use changes on global biomass emissions. In: Innes, J.; Beniston, M.; Verstraete, M., eds. Biomass burning and its inter-relationships with the climate system. Dordrecht, The Netherlands: Kluwer: 33-50.

Flannigan, M.D.; Wotton, B.M. 2001. Climate, weather, and area burned. In: Johnson, E.A.; Myanishi, K., eds. Forest fires: behavior and ecological effects. San Diego, CA: Academic Press: 351-373. Chapter 10.

Grace, S.; Wade, D. 2001. Ecological and economic consequences of the 1998 Florida wildfires. In: Proceedings of the 3rd Longleaf Alliance conference. Auburn, AL: Longleaf Alliance: 70-74.

Graham, R.T.; Harvey, A.E.; Jain, T.B.; Tonn, J.R. 1999. The effects of thinning and similar stand treatments on fire behavior in Western forests. Gen. Tech. Rep. PNW-GTR-463. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 27 p.

Hanula, J.L.; Meeker, J.R.; Miller, D.R.; Barnard, E.L. 2002. Association of wildfire with tree health and numbers of pine bark beetles, reproduction weevils and their associates in Florida. Forest Ecology and Management. 170(1): 233-247.

Hof, J.; Omi, P.N.; Bevers, M.; Laven, R.D. 2000. A timing oriented approach to spatial allocation of fire management effort. Forest Science. 46: 442-451.

Loomis, J.B.; Bair, L.S.; Gonazles-Caban, A. 2001. Prescribed fire and public support: knowledge gained, attitudes changed in Florida. Journal of Forestry. 99(11): 18-22.

McIver, J.D.; Starr, L. 2000. Environmental effects of postfire logging: literature review and annotated bibliography. Gen. Tech. Rep. PNW-GTR-486. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 72 p.

Omi, P.N.; Joyce, L.A., eds. 2003. Fire, fuel treatments, and ecological restoration: conference proceedings. Proc. RMRS-P-29. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 475 p.

Ottmar, R.D.; Vihnanek, R.E. 2000. Stereo photo series for quantifying natural fuels. Vol. VI: longleaf pine, pocosin, and marshgrass in the Southeast United States. PMS 835. Boise, ID: National Wildfire Coordination Group. 85 p.

Ottmar, R.D.; Vihnanek, R.E.; Regelbrugge, J.C. 2000. Stereo photo series for quantifying natural fuels. Vol. IV: pinyon-juniper, sagebrush, and chaparral types in the Southwestern United States. PMS 833. Boise, ID: National Wildfire Coordination Group. 97 p.

Ottmar, R.D.; Vihnanek, R.E.; Wright, C.S. 1998. Stereo photo series for quantifying natural fuels. Vol. I: mixed-conifer with mortality, western juniper, sagebrush, and grassland types in the interior Pacific Northwest. PMS 830, NFES 2580. Boise, ID: National Wildfire Coordination Group. 73 p.

Ottmar, R.D.; Vihnanek, R.E.; Wright, C.S. 2000. Stereo photo series for quantifying natural fuels. Vol. III: lodgepole pine, quaking aspen, and gambel oak types in the Rocky Mountains. PMS 832. Boise, ID: National Wildfire Coordination Group. 85 p.

Outcalt, K.W.; Wade, D. 2000. The value of fuel management in reducing wildfire damage. In: Neuenschwander, L.F.; Ryan, K.C., eds. Proceedings of the Joint Fire Science Program conference on crossing the millennium: integrating spatial technologies and ecological principles for a new age in fire management. Boise, ID: University of Idaho and International Association for Wildland Fire: 271-264.

Pierson, F.B.; Robichaud, P.R.; Spaeth, K.E. 2001. Spatial and temporal effects of wildfire on the hydrology of a steep rangeland watershed. Hydrological Processes. 15: 2905-2916.

Prestemon, J.P.; Pye, J.M.; Butry, D.T. [et al.]. 2002. Understanding broad scale wildfire risks in human-dominated landscapes. Forest Science. 48(4): 685-693.

Reinhardt, T.E.; Ottmar, R.D. 2000. Smoke exposure at Western wildfires. Res. Pap. PNW-RP-525. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 72 p.

Reinhardt, T.E.; Ottmar, R.D.; Hanneman, A.J.S. 2000. Smoke exposure among firefighters at prescribed burns in the Pacific Northwest. Res. Pap. PNW-RP-526. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 45 p.

Rorig, M.L.; Ferguson, S.A. 1999. Characteristics of lightning and wildland fire ignition in the Pacific Northwest. Northwest Journal of Applied Meteorology. 38(11): 1565-1575.

Sandberg, D.V.; Ottmar, R.D.; Cushon, G.H. 2001. Characterizing fuels in the 21st century. International Journal of Wildland Fire. 10: 381-387.

Sandberg, D.V.; Ottmar, R.D.; Peterson, J.L.; Core, J. 2002. Wildland fire in ecosystems: effects of fire on air. Gen. Tech. Rep. RMRS-GTR-42. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 79 p. Vol. 5.

Schmoldt, D.L.; Peterson, D.L.; Keane, R.E. [et al.]. 1999. Assessing the effects of fire disturbance on ecosystems: a scientific agenda for research and management. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 104 p.

Smith, J.K., ed. 2000. Wildland fire in ecosystems: effects of fire on fauna. Gen. Tech. Rep. RMRS-GTR-42. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 83 p. Vol. 1.

Swetnam, T.W.; Betancourt, J.L. 1990. Fire–Southern Oscillation relations in the Southwestern United States. Science. 249: 1017-1020.

Welch, N.T.; Waldrop, T.A. 2001. Restoring Table Mountain pine (*Pinus pungens* Lamb.) communities with prescribed fire: an overview of current research. Castanea. 66(1-2): 42-49.

Welch, N.T.; Waldrop, T.A.; Buckner, E.R. 2002. Response of southern Appalachian Table Mountain pine (*Pinus pungens*) and pitch pine (*P. rigida*) stands to prescribed burning. Forest Ecology and Management. 136: 185-197.

Winter, G.J.; Vogt, C.; Fried, J.S. 2002. Fuel treatments at the wildland-urban interface: common concerns in diverse regions. Journal of Forestry. 100(1): 15-21.

Wohlgemuth, P.M.; Hubbert, K.R.; Robichaud, P.R. 2001. The effects of log erosion barriers on postfire hydrologic response and sediment yield in small forested watersheds, southern California. Hydrological Processes. 15: 3053-3066.

SELECTED WEB SITES

Arizona Board of Regents. 2001. WALTER: exploring wildfire alternatives. http://walter.arizona.edu. (23 July 2003).

Arizona Board of Regents. 2002. CLIMAS: climate assessment for the Southwest. http://www.ispe.arizona.edu/climas/learn/fire/index.html. (23 July 2003).

National Fire Plan. 2003. National Fire Plan: managing the impacts of wildfires on communities and the environment. http://www.fireplan.gov/content/home. (23 July).

National Interagency Fire Center. 2003. National Interagency Fire Center. http://www.nifc.gov. (23 July).

National Interagency Fire Center. 2003. The communicator's guide: wildland fire. http://www.nifc.gov/preved/comm_guide/wildfire/TOC.html. (23 July).

U.S. Department of Agriculture. 2003. Online photography center photo research: fire. http://www.usda.gov/oc/photo/opc-fire.htm. (23 July).

U.S. Department of Agriculture, Forest Service. 2003. Fuels planning: science synthesis and integration. http://www.fs.fed.us/fire/tech_transfer/synthesis/synthesis_index. (28 August).

U.S. Department of Agriculture, Forest Service. 2003. Rocky Mountain Research Station online fire publications. http://www.fs.fed.us/rm/main/fire_res/fire_pubs.html. (23 July).

U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 2003. Hayman Fire case study analysis. http://www.fs.fed.us/rm/hayman_fire/. (23 July).

U.S. Department of Agriculture, Forest Service; U.S. Department of the Interior; Oregon Department of Forestry. 2003. Biscuit Fire recovery 2003. http://www.biscuitfire.com/index.htm. (23 July).

U.S. Department of the Interior; U.S. Department of Agriculture, Forest Service. 2003. Joint Fire Science Program. http://jfsp.nifc.gov/. (23 July).

U.S. Department of the Interior; U.S. Department of Agriculture, Forest Service; National Aeronautics and Space Administration. 2003. FRAMES: Fire Research and Management Exchange System. http://www.frames.gov/. (23 July).

Wildlandfire.com. 2003. Wildlandfire.com: the home of the wildland firefighter. http://www.wildlandfire.com/index.html. (23 July).

APPENDIX A:

KEYNOTE SPEAKERS

Oregon State University, March 18-19, 2003

Welcome and introductions
- Bruce Shindler, Professor of Forest Resources, Oregon State University
- Jamie Barbour, Program Manager, Focused Science Delivery Program, USDA Forest Service, PNW Research Station
- Hal Salwasser, Dean, College of Forestry, Oregon State University
- Barb Beck, Lead Facilitator, Wildland Fire Associates

Bridging the world of fire managers and applied fire researchers
- Tom Harbour, Deputy Director, USDA Forest Service, Fire and Aviation
- David Sandberg, Supervisory Research Biologist, USDA Forest Service, PNW Research Station

A trio of workshops and the Joint Fire Science-National Fire Plan research connection
- Bob Clark, Program Manager, Joint Fire Science Program, National Interagency Fire Center

An update on the postfire assessment
- Tom Link, Biscuit Fire Recovery Manager, Rogue River-Siskiyou National Forest

Interdisciplinary panel discussion: Wildfire 2002: the effectiveness of information systems and processes for managing large wildfires
- Bruce Shindler for Steve Fitzgerald, Extension Forester, Oregon State University
- Vicky Sturtevant, Sociology Department, Southern Oregon University
- Jeff Borchers, USDA Forest Service, PSW Research Station

Panel discussion: taking advantage of local opportunities
- Jim Doran, Colville Coalition
- Ike Cawston, Colville Indian Agency, USDI Bureau of Indian Affairs Forestry
- Nils Christoffersen, Wallowa Resources

Reinstating traditional Native American practices—what does it mean for fire managers today?
- Frank Lake, Department of Environmental Sciences, Oregon State University

University of Arizona, March 25-27, 2003

Welcoming remarks
- Tom Swetnam, University of Arizona
- Bob Clark, Joint Fire Science Program, National Interagency Fire Center
- John Szymoniak, USDA Forest Service, PSW Research Station, National Interagency Fire Center
- Barbara Morehouse, University of Arizona

Photographic essays: Rodeo-Chedeski and Cerro Grande Fires
- John Philbin, Regional Forester, USDI Bureau of Indian Affairs, Fort Apache Agency
- Craig Allen, USGS, Jemez Mountains Field Station

The Rodeo-Chedeski Fire and the White Mountain Apaches
- Dallas Massey, Chairman, White Mountain Apache Tribe

Collaborative fire research among universities and agencies
- Patrick Reid, Director, School of Renewable and Natural Resources, University of Arizona

WALTER: Exploring Wildfire Alternatives Dissemination and Assimilation of Fire Information Science and Technology
- Steve Yool, Acting Head of Geography, University of Arizona

Colorado State University, April 16-17, 2003

Welcome and purpose
- Phil Omi, Colorado State University

Agenda review and logistics
- Bob Clark, Joint Fire Science Program, National Interagency Fire Center
- John Szymoniak, USDA Forest Service, PSW Research Station, National Interagency Fire Center
- Barb Beck, Wildland Fire Associates

Hayman Fire review and general Colorado situation
- Bill Romme, Colorado State University

Political perspective
- Mark Udall, Member of Congress, 2nd District, Colorado

Manager/line officer perspective
- Mark Stiles, Department of Forestry, San Juan Field Office, USDI Bureau of Land Management

Tribal perspective
- John Waconda, USDI Bureau of Indian Affairs, Southwest Region

Creative writings on fire
- Dan Robinson, Colorado State University

APPENDIX B:

PRIORITIZED RESEARCH RECOMMENDATIONS BY GEOGRAPHIC LOCATION

The following recommendations were identified as high priority by the Wildland Fire Workshop participants in Oregon, Arizona, and Colorado in March and April of 2003. A few recommendations were essentially the same and were therefore collapsed into a single statement or question by this author, and minor edits were required in order to put them into a common format. Otherwise, the lists reflect an accurate representation of the research needs identified by participants. Tier 1 for each list represents the top 10 priorities from each location, and tiers 2 and 3 represent intermediate and lower priority, respectively. Although these prioritized needs reflect the scope of priorities identified by managers and researchers from diverse fields and geographic locations, research priorities should also be considered in light of particular management needs.

Oregon State University, March 18-19, 2003

Tier 1

- How effective are passive and active rehabilitation/restoration treatments on (a) reducing undesirable consequences of fire and (b) accelerating the recovery processes? What are the likely outcomes for associated ecological attributes and social values?
- What are the consequences of passive and active fuel management strategies/treatments on fire risk (e.g., behavior and severity) at multiple temporal and spatial scales? Determine the likely outcomes on ecological and social values (e.g., native species, invasive species, threatened and endangered species, and economic values).
- Determine which techniques and processes are most effective for moving research results and information more quickly into application. How can researchers package and deliver usable, useful knowledge and products?
- Develop prediction tools (and the requisite information base) for risk assessment. Develop protocols and models for addressing uncertainty and risk of undesirable consequences on important resources (e.g., threatened and endangered species, invasive species, watershed and aquatic ecosystem function).
- Establish consistent, durable, flexible, and scalable monitoring protocols to measure success and support adaptive management processes.
- Determine the effects of postfire management activities (e.g., BAER activities and salvage harvests) on hill slope processes, future fire behavior, vegetation succession, aquatic ecosystems, and wildlife habitat. Are these activities and effects consistent with long-term goals and objectives?
- From a landscape perspective, what spatial and temporal patterns of fuel conditions reduce the potential for the occurrence of severe wildfires? What are the implications for different resources (e.g., wildlife, water, soil, etc.)?
- Design a decision-support system that effectively integrates ecological, economic, and social dimensions (i.e., a model that brings together disparate values for decisionmaking in uncertain environments).
- Determine the ecological role of fire on hill slope processes and aquatic ecosystems.
- Develop an optimization process to allocate funds and other resources to address the use of prescribed fire and the suppression of wildfires; consider the costs/benefits to social and cultural values.

Tier 2

- What adjustments are needed in existing institutional structures, processes, and policies to make organizations more effective in fire planning and management?
- What can be learned from communities that have been successful at fire planning and fire-based programs, and how can we apply these lessons to other communities?

- How does postfire logging influence future fire behavior and ecological conditions?
- Improve fuel consumption modeling to better predict fire size and the effects of climate and weather.
- How can we use climate and weather to predict fire hazard, risks, and consequences?
- Determine postfire fuel accumulation rates and relationships across different ecosystems.
- Develop methods to determine desired future conditions for forest and rangeland ecosystems. Design engagement processes to identify/quantify social priorities. What is the role of fire in achieving these conditions?

Tier 3

- Develop methods to quantify smoke and the tradeoffs of its effects.
- Determine the effects of smoke exposure on human health.
- Determine the ecological effects and social/economic dimensions of gaining a postfire community from burned ecosystems.
- What is the role of historical management practices on fire severity and subsequent effects, and what are the likely consequences of continued fire suppression policies?
- What are the long-term consequences to site nutrient capital given a fire cycle of increasing frequency and intensity?
- Develop methods to determine the probability of a catastrophic fire event, both preseason and at the time of the event.
- Assess existing models for analyzing landscape conditions and determine the best framework for integrating these tools. What information is lacking, and how do we obtain it?
- Determine which fuel types and over what timeframes our management actions should be directed to influence the disturbance processes of fire, insects, and diseases.

University of Arizona, March 25-27, 2003

Tier 1

- How effective are different fuel treatments within the context of weather, climate, smoke emissions, multiple spatial and temporal scales, different vegetation types, condition classes, cost efficiency of treatments, and human values at risk? Answering this question may include the use of simulation models.
- What are the variables influencing effective communication with the public?
- What political, institutional, and economic factors affect the utilization of small-diameter trees and slash in the Southwest?
- What are the most effective methods for determining if we are focusing fire management efforts in places with the highest values at risk (i.e., social, economic, cultural, and ecological values)?
- On a system-by-system basis, what is the role of invasive species in spreading fire, and what is the role of fire in spreading invasive species?
- What are the impacts of planned and unplanned fire and fire regimes on threatened and endangered species relative to managing fire intensity, fire frequency, and season of burn?
- Identify and describe thresholds that cause drastic change in fire behavior in terms of fuel type, terrain, weather, size of fire, crown fire initiation and disruption, and firefighter safety.
- Develop a consistent and coherent fire occurrence database, including (but not limited to) the development of standards to define fire severity and the relationship to aquatic and territorial ecosystems for arid and semiarid regions.
- Create regional maps of fuel characteristics that are not currently represented in existing models for the Southwest. This approach takes into account fire behavior thresholds and variable stand characteristics and will involve remote sensing.
- Are BAER treatments and other erosion-control strategies effective in mitigating and restoring fire-affected watersheds in arid or semiarid geographic areas?

Tier 2

- What are the fire regime characteristics, effects, behavior, and predisposing factors related to fire in Southwest ecosystems (i.e., ponderosa pine, chaparral, mixed conifer, pinion-juniper,

and oak woodlands)? The development of a hazard rating system could be one application of this research.
- How do we model short- and long-term interactions among socioeconomic and biophysical factors to assess prefire and postfire vulnerability and risk?
- What relationships between agencies and other groups are important under different circumstances, and what will foster the best collaboration among the players?
- What were the effects of historical drought (e.g., the 1950s drought in the Southeast and Southwest) on insect and disease populations and fire? Addressing this question would involve identifying spatial and temporal patterns, developing ecoregional approaches to outbreak mitigation, and evaluating the interaction between fire behavior, risk, and vegetation mortality.
- What is the impact of fire on the episodic movement of sediments, nutrients, and metals in intermittent streams?
- How does climate affect the role of fire on the spread of flammable invasive species, and how are fire cycles related to climate and its effects on flammable invasive species?
- What economic models can be developed to aid in decisionmaking before, during, and after fire events?
- With the involvement of research, development, and monitoring, create and test short- and long-term soil erosion and water quality monitoring protocols.
- Synthesize information for common locations (and in a common language) that is available to managers, researchers, and others, as relevant to current and future needs.
- Which rehabilitation techniques are most appropriate for preventing the spread of invasive species, and what are the effects of seeding with exotic species?

Tier 3

- In order to improve prescriptive fire, fuel, and smoke programs at wildland-urban interface areas, model the interactions between climate, fuel treatments, restoration and rehabilitation, and smoke emission inventories.
- At the stand and landscape scales, what are the interactions between fire behavior, drought, insects, diseases, and affected vegetation, including the effects of fire on different vegetation seral stages?
- What is the role of fire in maintaining mosaics of communities to maintain threatened and endangered species across the landscape?
- Develop and refine models for regional use that are interactive, efficient, user-friendly, and that will analyze input data and provide treatment options.
- What are the implications of the Endangered Species Act on the achievement of National Fire Plan objectives?
- Identify existing systems that are relatively "natural" for comparison with "altered" systems in order to evaluate the effects of insects and diseases on fire.
- Define desired fuel conditions across the Southwest based on current fuel conditions, their departure from historical conditions, and the feasibility of sustaining desired conditions.
- Implement research and monitoring to verify smoke dispersion and transport models for improved future use (i.e., Do the models actually do what they say they will do?).
- Identify key elements that establish parameters for smoke management, regional haze, wildland-urban interface areas, nuisance, and health standards as related to wildfire and prescriptive fire.

Colorado State University, April 16-17, 2003

Tier 1

- How do fuel, stand structure, and fire history differ currently and historically within and across vegetation association types, and what are the appropriate methods for mapping this information across the landscape and making predictions given various climatic and management scenarios?
- Characterize the responses of invasive nonnative species (or threatened and endangered species) to wildland fire, prescribed fire, fire exclusion, fuel

treatments, and herbicides. This implies experimental testing under a range of environmental conditions (e.g., fire intensity, vegetation type, and stand characteristics).
- Evaluate the effectiveness of fuel treatments and ecological restoration in the context of landscape-scale events–how does treatment effectiveness differ across climate and weather gradients?
- For all stakeholders, what are the positive and negative effects of insects and diseases on fire behavior from stand to landscape scales, and can these patterns be used to predict the occurrence of large fires?
- Refine and improve existing fire behavior prediction and management tools.
- What are the costs, benefits, values, products, markets, and employment opportunities assignable to ecological restoration, fuel reduction, and wildland fire?
- How can we improve the transfer and integration of common research results, including usable operational products, into management decisionmaking?
- Evaluate the current efforts for ecological restoration, fuel reduction, and fire mitigation in light of the interactions between changing demographics and public values, attitudes, and perceptions toward wildland fire and forest health.
- Develop a database with historical information on fire distribution and interactions with climate, insects, and diseases.
- What are the factors that impede adoption of adaptive management practices, and how do we overcome barriers to better implementation?

Tier 2

- How effective are the various treatments and rehabilitation measures in mimicking natural disturbance processes necessary for the maintenance of threatened and endangered species habitats?
- Evaluate the effectiveness of and recommend improvements for various statutes, codes, regulations, and policies as they affect the wildland-urban interface.
- Identify an array of assessment and monitoring protocols that can be used to identify high-priority areas for prefire and postfire treatments, and for assessing the effects of treatments.
- From a landscape perspective, determine the relationship between fire and important biological communities (e.g., riparian, aquatic, and rare communities).
- Develop landscape models and strategies that span administrative boundaries to assess risk, acceptable conditions, economic values, and multiple programmatic goals.
- Assess the effects of prefire and postfire vegetation treatments on insect and disease dynamics relative to seasonality, drought, mechanical treatments, salvage operations, and BAER.
- Synthesize fire behavior, fuel, and smoke information from case studies of prescribed fires and wildfires to create foundations and validation for models.
- How do we characterize and enhance the effectiveness of ecological restoration, fuel reduction, and wildland fire mitigation at various scales of policy, administration, and operations?
- Develop and enhance competencies and capabilities for sustaining collaboration within and among communities and agencies.
- Develop models to predict (a) the response of invasive nonnative species to wildfire, prescribed fire, fuel treatments, and (b) the effectiveness of various mitigation strategies. These models would allow managers to evaluate tradeoffs, select alternatives, and develop management plans.
- Evaluate the multiple-scale effects of fires on patch dynamics, movement corridors, and other unique components of habitat matrices important to threatened and endangered species (e.g., lynx).

Tier 3

- How are different base conditions, prefire treatments, direct fire effects during and after fire, fire suppression activities, and postfire activities related to peak flows and erosion rates? This

question could be addressed in different geographic areas and under different magnitudes of spatially variable storm events.

- How do changes in sedimentation, water chemistry, and the amount and timing of stream-flow affect municipal water supplies and aquatic ecosystems, and how do we develop appropriate assessment and predictive procedures?
- Who are the target users for new models and technologies being developed? This includes characterizing potential users in terms of their capability of using the tools, identifying their administrative level, and assessing the information environment in which they operate.
- Given epidemic insect and disease conditions, what types and intensities of prefire and postfire vegetation management should we apply, when should we apply them, and to which geographic locations?
- Using modeling and monitoring strategies, characterize endemic to epidemic insect and disease dynamics under prefire and postfire conditions.
- Clearly define the national fire emissions inventory and develop tools to improve its utility for meeting federal, regional, state, and tribal needs.

Several research and management activities depend on consistent and effective protocols, including mitigating and evaluating the harmful effects of fire in watersheds. (Photo by Tom Iraci.)

The **Forest Service** of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives—as directed by Congress—to provide increasingly greater service to a growing Nation.

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